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N.B.: When citing this work, cite the original article.

This is the English version of the original publication:

Anders Rüter and Tore Vikström, Indicateurs de performance: De la théorie à la pratique. Approche scientifique à propos de la médecine de catastrophe, 2009, Urgence Pratique, (93), 41-44.

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<http://www.urgence-pratique.com/>

Postprint available at: Linköping University Electronic Press

<http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-51565>

# **Performance indicators - from theory to implementation; one method of scientific approach to disaster medicine**

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## Abstract

The objective of this paper is to demonstrate a possible tool for the use of a quantitative research method that can be applied in disaster medicine.

Method: Stepwise, using the technique of concept and process modelling, key processes in forms of performance indicators for command and control at disaster and major incidents were identified. A standard was linked to each indicator. Based in these indicators, an educational program was developed. In this program results from examinations were expressed in numbers and can thereby allow statistical methods to be applied.

Results: Application of this model on prehospital command and control demonstrated weak and strong points. The method has been implemented in 13 out 21 regions and is used as a quality control tool.

Conclusions: The use of performance indicators developed by using results from modelling processes could possibly serve as a tool for conducting quantitative research in disaster medicine.

Key words: Disaster medicine, science, performance indicators, process modelling, concept modelling, implementation, prehospital command and control, standards, quality control.

## Introduction

The science of disaster medicine is a young area within the field of disaster medicine [1,2,3]. Researchers in disaster medicine have to deal with the difficulty of finding scientific methods that are suitable to apply on available data. Randomised controlled studies, which are highest ranked methods for testing hypothesis in medical research, cannot be performed and retrospective studies often have limited value. Methods for this way of conducting quantitative research have mainly addressed issues where different methods of treatment applicable in disasters situations have been studied [4]. Qualitative research methods can be applied, but the question on how to test hypothesis is still under debate.

One question that also needs to be addressed is the setting of standards. If there was a general agreement on what is to be considered as good standard or not, this could probably contribute to the process of finding scientific methods in disaster medicine. This is an issue that previously has been brought to attention by different expert groups [5]. Furthermore there is a need to develop protocols that in a specific way indicates what is important to study, i.e. what should we be looking for? These identified areas could be considered as measurable objectives, or performance indicators.

Analysis of variance, ANOVA, is a statistical method with the purpose to test if there are significant differences between observed mean values in large series [6]. Under the null hypothesis (that there are no mean differences between groups or treatments in the population), the variance estimated from the within-group variability should be about the same as the variance estimated from between-groups variability. ANOVA is thereby possible to use to compare different performances if observations results are expressed in numbers.

The aim of this paper is to contribute to the debate on methods in disaster medicine research by presenting the development and implementation of measurable performance indicators that allow results to be studied with quantitative methods.

## Method

The ten different steps for this method are listed in Table I. Firstly; the area of study is defined. The next step is listing all involved terminology and deciding on the definitions. This process, where also the relations between the different terms are indicated, is called concept modelling. Different roles and functions are defined in the concept modelling as well as how many persons that can hold the different roles, figure 1. The next step is making flowcharts of all involved processes, process modelling [7]. Result from this step will demonstrate the sequences and dependencies of the different processes. It will also indicated if, and what processes that are of continuous nature, or have a specified start and stop point, figure 2.

*Table I: Structure and sequence of the different steps in the development process*

1. Identify area that is to be studied
2. Concept modelling
3. Process modelling
4. The identification of key- processes
5. The setting of standard for the most important process
6. The setting of standards for the rest of the identified key-processes
7. Education and training#
8. Studying results from exercises\*
9. Implementation
10. Studying results from real incidents\*

# Educational models may have to be developed

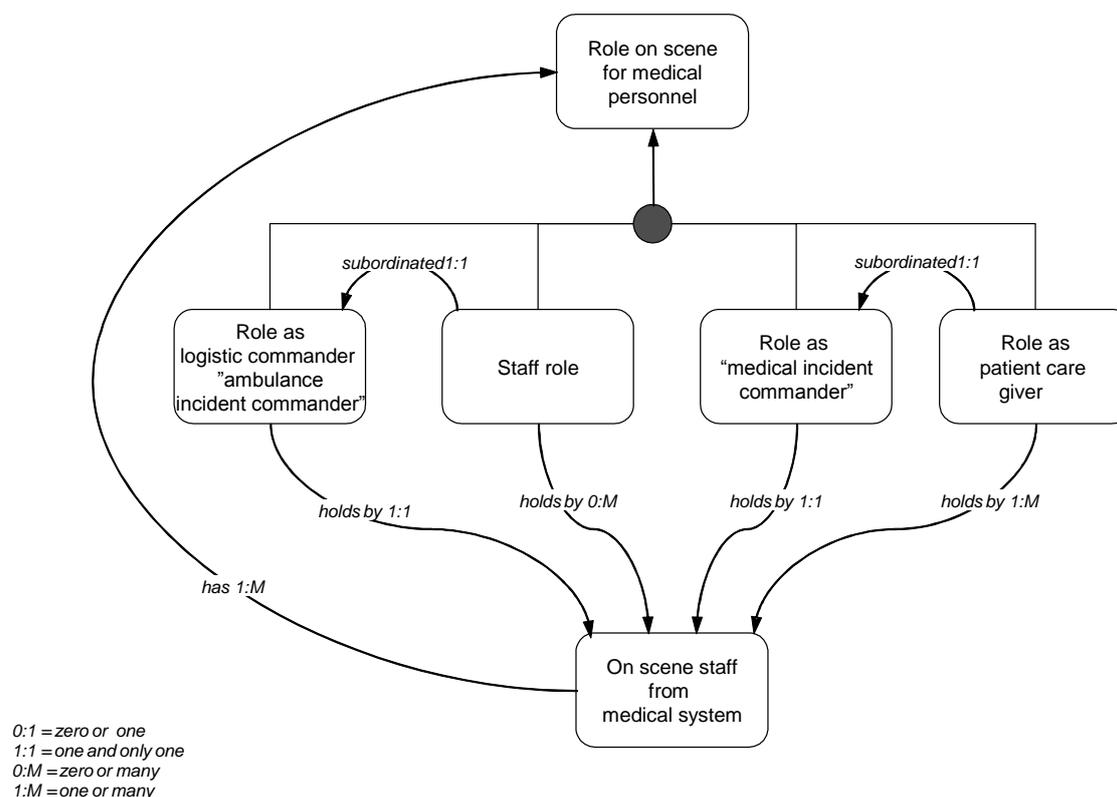
\* Results that can be analysed using ANOVA (analysis of variance)

Knowing all involved processes and there relation to each other makes it possible to decide on what processes that are most important, the key-processes. These key processes are called performance indicators.

Deciding on standards is the next step. If possible, this is done by first selecting the single one most important performance indicator, and with regards to current evidence or scientific

knowledge, decide what could be considered as the desirable level of achievements, the gold standard. In the field of disaster medicine this is preferably directly related to favourable outcome for the patients, see result-paragraph. If no performance indicator is considered the most important, this step is omitted. Selecting the standards is crucial for later evaluations. The standard for the rest of the performance indicators than are set. Both timeframes in which the indicators should be performed as well as the content (for example content in a report) can be used.

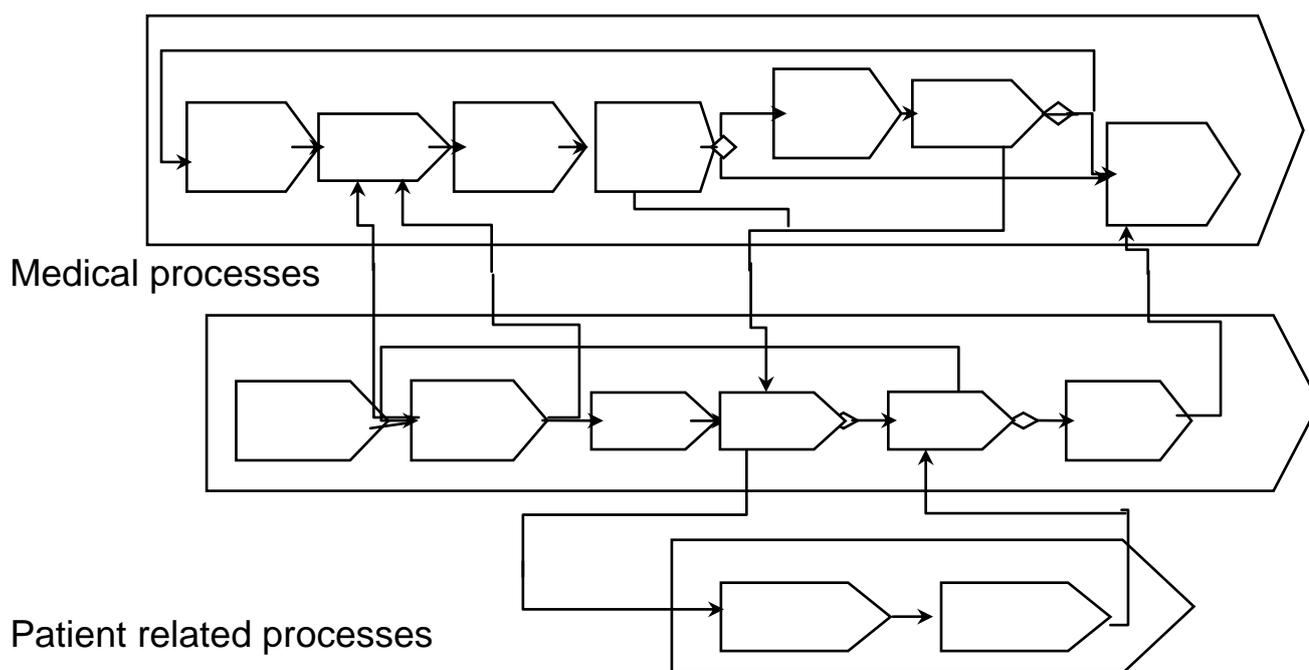
*Figure 1: Example of result from concept modelling. Figure submitted with the permission of Scandinavian Journal of Trauma Resuscitation and Emergency Medicine.*



The indicators and standards are put into templates and are used, primarily in education and training. However, since not many educational programs are developed for this purpose, new program may have to be developed.

Figure 2: Example of a flow chart as a result from a process modelling. All areas represent a different process involved in prehospital medical command. The lines indicate the sequence of the processes and their dependencies. Each area represents a process for example “establish control”, “liaison with other agencies”, “transport of injured from scene” etc. The processes in this example are separated according to three different functions; logistic, medical and patient related

### Logistic processes



Results from exercises and training are recorded and evaluated against the developed template/s and when there is sufficient data it is possible to analyse results using ANOVA [6].

The same templates can also be used when evaluating the results from performance in daily activities and in real incidents. For this to happen there is a need the indicators that are considered good enough to have been implemented and used in daily activities and real incidents.

Using the same statistical method it is also possible to evaluate both the performance at incidents and also compare these to results from education and training.



## Application of method

The method per se can probably be applied on several areas in disaster medicine or even as a general method on areas other than disaster medicine. However, in this section results from applying this method for prehospital medical command is described.

Commissioned by the Swedish National Board of Health and Welfare a group of experts in medical command on scene and regional level was formed in 2000. The group was composed so that most areas within the field of medical command at incidents as well as in daily routines were covered. By daily routines it is in this context meant ambulance missions where a medical command on scene is established but without being classified as a major incident. The concept- and process modelling was performed during ten different occasions and took place during a time period over one year. The results of the concept and process modelling were presented in flowcharts and handed over to the national board of health and welfare in 2001 who used them as an important part in the development of national regulations for disaster management and preparedness that were imposed in 2005 [8,9].

The next step, the identification of the key processes, the performance indicators, was done as well as setting the standard for each indicator and the results were put into a template, Table I. The evacuation of the first (and correctly triaged) patient was considered as the most important indicator and the standard was set to 15 minutes after the arrival of the first ambulance. The rest of the standards were set according to this.

The template was used as backbone when developing an educational program in prehospital medical command [10]. Lectures and simulation exercises were designed with regard to this. The final examination of this two-day course was a functional test involving a head on car crash with eight victims. The students, all professional ambulance crew, were examined strictly according to the template and their performances were graded 0,1 or 2.

An instructor program was developed and the concept was spread nationally to 17 out of 21 regions in Sweden. Results from the examination, as described above, were collected and after the first 46 examinations a statistical analysis using ANOVA with Tukey post-hoc test was performed. [11].

The implementation process has after a time period of 2-4 years (depending on start time) lead to that some or all of the performance indicators have been implemented as a quality control tool in 13 regions.

Evaluation of the use of indicators in daily ambulance missions and incidents by comparing different regions is planned.

## Discussion

There is a general agreement that more research is needed in the field of disaster medicine. One important issue to consider is if disaster medicine strictly should be considered as a medical discipline or as part of the more general term crises management. From a scientific point of view these two overlapping fields apply, at least in our country, different research methods. In the medical field there is a tradition of using quantitative research methods while crises management research often is qualitative. It is the authors belief that both these methods are needed in disaster medicine, but so far quantitative research has been quite sparse. For ethical, or other reasons, conducting randomised trials in disaster medicine is impossible [12,13]. When a major incidents or disaster strikes, the response should always be what is considered as optimal and there is no room for conducting research on different methods. Nevertheless reports from incidents have a tendency to focus on the same problem areas over and over again [14,15]. It is then mandatory to ask ourselves: Do we learn from incidents? Or do we repeat the same mistakes again and again? As an example: after incidents reports, almost without exceptions, describe difficulties in command and control, communications and information. These are often the same areas that also have been demonstrated in previous studies. This suggests that mistakes, although not identical, are made over and over and it is justified to propose that lessons observed (and reported) ought to be replaced with lessons learned. There is also the issue of more exactly describing what the problems really consist of. An example of this is recognising that what is reported as communications failure often refers to one specific subcomponents of communication; coordination problems and not associated with failure technical equipment or its use [16].

The “Utstein template” directs attention to the need of developing methods for quantitative studies as well as setting standards indicating what is good and what is not [5]. However, there are no specific solutions described in this document. And, to our knowledge, there are no other prospective research methods described. This is one reason why the method

presented in this paper was introduced. Another reason is that the method, can serve, not only as a quality tool for disasters and incidents, but also as a quality tool for daily activities and for education and training [17].

One of the major issues in the described method is that “the experts” are involved in the first steps of this method, the modelling processes, can described how processes in a principal way take place both at incidents and disasters but also in daily activities. The management of incidents and disasters must be based on routines that are familiar to all personnel and are used in daily work [16]. If this is not done properly, that method will not lead to success and will probably not lead to implementation. In the example described in this paper we found that the developed performance indicators, and the standards have been implemented in 13 out of possible 17 regions. And this process has, for 11 regions taken less than three years. Once the processes involved are identified, the selecting of key processes is not difficult or controversial. Having a medical perspective on disaster management it was natural to have the most victim related performance indicator as the most important. However, setting the standard for this, and subsequently the rest of the performance indicators, requires subject matter knowledge. In the example presented, the key process was evacuation of patient from scene and the standard for this was within 15 minutes from arrival of first ambulance. It is well understood that this will not be possible in some settings and during certain circumstances such as some rural areas. Nevertheless, studying reports from incidents and other documentation did suggest that this could serve as a feasible goal. It must be emphasised that the standards suggested are not “carved in stone”, and can be adapted to areas of implementation. It must in this context be pointed out that changing (adapting) the standards will make results more difficult to analyse with quantitative methods.

Developing new educational programs require both experience in training and knowledge of how to start-up, conduct and administrated educational models. There are numerous successful

models that can be studied but the one that has served as a model at our centre was the ATLS® program [18]. As one of the most important building blocks in the ATLS® program, as well as in the training program developed for the use of performance indicators, was writing a manual that included subject matter material as well as evaluation technique.

The educational program that we built around the performance indicators was spread into the different regions by the forming of faculties (groups of trained instructors). Results from all examinations were collected in order for students to receive their certificate. A network of more than 100 instructors was thereby formed. All results were recorded, and the first statistical analysis was performed after 46 completed examinations [11].

The statistical method that was considered best was analysis of variance (ANOVA) where means of values are compared to each other. The results from the first study demonstrated what performance indicators significantly that differed from each other [11]. Given this, it was easy to single out the performance indicators where teaching, had to be improved.

Evaluation of the changes made is in progress.

The implementation is not the responsibility of our research and training centre. However, the fact that in 13 regions the developed indicators and standards have been implemented suggests that these have been accepted as a quality tool. By implementation it is meant that results from daily mission where specified criteria are met, are mandatory to record according to performance indicator template, and the ambulance provider will evaluate the results.

Different regions have different criteria when to use the indicators, but generally this is required when there is an incident where more than two ambulances are dispatched. Several regions have also declared interest in participating in studies and validation of the indicators. It is our belief that these studies will contribute to prehospital staff having a better knowledge in prehospital command and that the victims involved in incidents and disaster will benefit from this.

The crucial issue when applying performance indicators as described, is if they are valid. Do results really reflect what is important? This, and other similar questions, can probably not only be answered by using quantitative research methods. Qualitative research may give clues and should, in our opinion, also be used for studying whether the method described in this paper is contributing to making prehospital personnel more safe and secure when arriving as first responder. However, in future studies, quantitative or qualitative, should whenever possible also focus on the most important aspect of prehospital command, the patient outcome.

#### Conclusions.

The use of performance indicators developed by using results from modelling processes could possibly serve as an accepted way of conducting quantitative research in disaster medicine.

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Table II.

Developed performance indicators for prehospital command, each with a suggested standard.

| Process                                                                 | Standard or objective to be achieved                                              |
|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <u>all times are from when arriving on scene</u>                        |                                                                                   |
| 1. Putting on tabard indicating medical and ambulance incident officer. | Immediately                                                                       |
| 2. First report to dispatch centre                                      | Within 2 minutes                                                                  |
| 3. Correct content of first report METHANE*                             |                                                                                   |
| 4. Formulate guidelines for response                                    | Within 3 minutes                                                                  |
| 5. Establishing contact with strategic level of command and control     | Within 5 minutes                                                                  |
| 6. Liaison with fire and police incident officers on scene              | Within 5 minutes                                                                  |
| 7. Second report from scene (to strategic management)                   | Within 10 minutes                                                                 |
| 8. Correct content of report                                            | Verifying first report and indicating when first patient transport can take place |
| 9. Establishing level of medical ambition.                              | Within 10 minutes                                                                 |
| 10. First patient evacuated                                             | Within 15 minutes                                                                 |
| 11. Information to media on scene                                       | Within 30 minutes                                                                 |

\* Major Incident Medical Management and Support (10).