UiT
THE ARCTIC UNIVERSITY OF NORWAY

Faculty of Health Sciences

# Systematic reporting of pre-hospital major incident medical management

*Identifying needs, a suggested solution and assessing implementation*

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**Sabina Fattah**

*A dissertation for the degree of Philosophiae Doctor – March 2017*


UNIVERSITY OF TROMSØ

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## Identifying needs, a suggested solution and assessing implementation

A dissertation for the degree of Philosophiae Doctor (PhD)

Sabina Fattah, cand.med

Tromsø, March 2017

The Arctic University of Norway and Norwegian Air Ambulance Foundation

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# Acknowledgements and Preface

Thinking of my great grandmother, who had to teach herself to read and write, I feel privileged to have had the possibility of an education. I am thankful for being born in a part of the world with free and equal rights to education, and for being raised in a family who valued such rights. I hope this thesis can contribute, even if only in a minor way, to addressing the inequalities that still exist in our world and help diminish them.

"Let us pick up our books and our pens. They are our most powerful weapons. One child, one teacher, one book, and one pen can change the world…Education is neither Eastern nor Western, it is human."

Malala Yousafzai, Nobel Peace Prize winner 2014.

In particular, my supervisors Torben Wisborg and Marius Rehn deserve acknowledgment for supervising this work and supporting my development as a researcher. I am very grateful for having had the chance to work with you and to know you as professionals and individuals.

My sincere gratitude to the Major Incident Reporting Collaborators and the HEMS Major Incident Reporting Collaborators for bringing to life both templates in this thesis. A heartfelt and humble thanks to the Major Incident Reporting Steering Group: Sophie Elizabeth Jap Hardy, Lasse Raatiniemi, Stephen Sollid, Marius Rehn, Trine Staff, Anne Siri Johnsen, Simo Ekman, Kristi Cecilie Grønvold Bache, Julian Thompson, and David Lockey. Without your voluntary work, it would not be possible to keep the project alive and developing. Thank you to our colleagues in Finland and Chile who have helped us implement the project in their countries. Thanks to Tormod Lunde Idsø, who created the Major Incident Reporting Database and contributes greatly to its continuous improvement. Thank you to Erik Reierth for being an excellent librarian and a good colleague with supportive words in times of academic despair. I am grateful to Kari Milch Agledahl for guiding me in learning grounded theory and bearing with me during the process. I would also like to thank all of those who have given their moral support to the project and to those who have submitted reports to the database in an altruistic manner.

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To all my teachers, students, and friends, who I will not mention individually, I am lucky to know you. Finally, and most importantly, I thank my family for always being there for me and for being the most important part of my life.

## Conflict of interest

The Norwegian Air Ambulance Foundation has employed me and covered all expenses related to this research. They financed the consensus meeting, development of www.majorincidentreporting.net, and currently finance the hosting and management of the website. Other than where they contributed as co-authors, no employees of the foundation have played a role in the design, implementation, interpretation, or publication of the studies in this research.

# List of papers

**Paper I**

Fattah S, Rehn M, Reierth E, Wisborg T. Systematic literature review of templates for reporting pre-hospital major incident medical management. BMJ Open 2013;3:e002658.

**Paper II**

Fattah S, Rehn M, Lockey D, Thompson J, Lossius HM, Wisborg T; Major Incident Reporting Collaborators. A consensus-based template for reporting of pre-hospital major incident medical management. Scand J Trauma Resusc Emerg Med 2014;22:5.

**Paper III**

Fattah S, Agledahl KM, Rehn M, Wisborg T. Experience with a Novel, Global, Open-Access Template for Major Incidents: Qualitative Feasibility Study. Disaster Med Public Health Prep 2016. DOI: https://doi.org/10.1017/dmp.2016.156.

**Paper IV**

Fattah S, Johnsen S, Sollid SJM, Wisborg T, Rehn M; HEMS Major Incident Reporting Collaborators. Reporting Helicopter Emergency Medical Services in major incidents: Delphi study. Air Med J 2016;35:348-351.

# Selected abbreviations

CRED - Centre for Research on the Epidemiology of Disasters

COREQ - Consolidated Criteria for Reporting Qualitative Research

EM-DAT – The International Disaster Database

EMDM - European Master in Disaster Medicine

EMS - Emergency Medical Services

EQUATOR - Enhancing the Quality and Transparency of Health Research

HEMS - Helicopter Emergency Medical Service

KAMEDO - Organising Committee for Disaster Medicine in Sweden

LMIC - Low-Middle Income Economy

MIMMS - Major Incident Medical Management and Support

MRMI - Medical Response to Major Incidents

NAAF - Norwegian Air Ambulance Foundation

NGT - Nominal Group Technique

NSD - Norwegian Centre for Research Data

PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PRISMA-P - Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols

SQUIRE - Standards of Quality Improvement Reporting Excellence

UNISDR - United Nations International Strategy on Disaster Reduction

WADEM - World Association on Disaster and Emergency Medicine

WHO - World Health Organisation

# Norsk sammendrag

Storulykker er krevende for prehospitale medisinske tjenester over hele verden. Vi vet at de samme problemene viser seg gang på gang. Hvordan kan de prehospitale tjenestene lære av tidligere erfaringer?

På grunn av storulykkers (engelsk: major incidents) omfattende betydning for menneskeliv og samfunn er det nødvendig å standardisere rapporteringen fra hendelsene. Dette kan muliggjøre analyser som sammenlikner hendelsene og identifiserer læringsmomenter. Tilsvarende innsats for å standardisere helseregistre på andre områder har tilrettelagt for sammenligningsstudier, samt gjort det mulig å identifisere forbedringspunkter. Vi antar at det samme vil gjelde for storulykker. Målet med denne avhandlingen var å tilrettelegge for systematisk innsamling av standardiserte data fra den prehospitale medisinske håndteringen av storulykker. Dette vil kunne øke kvaliteten på forskning og erfaringsformidling vedrørende prehospital innsats ved storulykker og potensielt forbedre kvaliteten på redningsarbeidet. Ved å standardisere data og tilrettelegge for analyser kan man redusere skadevirkningene av fremtidige hendelser, og den prehospitale medisinske responsen kan forbedres. Fire studier inngår i avhandlingen.

Vi gjennomført en systematisk litteraturgjennomgang for å identifisere innhold i eksisterende rapporteringsmaler for storulykker. Fordi det ikke fantes en egnet rapporteringsmal gjennomførte vi en konsensusprosess for å konstruere en slik mal. Etter implementering av denne, gjennomførte vi en pilotstudie for å undersøke hvor anvendelig malen var til å registrere de ønskede data. Malen ble så revidert på bakgrunn av funnene. En egen mal for rapporting av luftambulanserespons i storulykker ble senere utviklet ved hjelp av konsensusmetodologi. Begge rapporteringsmal er fritt tilgjengelig på www.majorincidentreporting.net.

Avhandlingen viser hvordan systematisk litteraturgjennomgang kan være nyttig for å identifisere eksisterende kunnskap og vurdere behovet for et nytt forskningsprosjekt. Avhandlingen fant at det var nødvendig å lage en konsensusbasert mal for å rapportere den

prehospitale medisinske responsen ved en storulykke. Det var mulig å oppnå konsensus, lage en rapporteringsdatabase og å få fagfolk til å bruke rapporteringsmalen.

Hovedutfordringene har vært at et lavt antall fagpersoner foreløpig har rapportert fra hendelser, og derfor deltok få respondenter i studien som så på anvendbarheten. Det lave antallet rapporter er også en utfordring når det skal gjøres analyser som sammenlikner data fra hendelsene. Gitt den relativt korte tiden som rapporteringsmalene har vært tilgjengelig, er det likevel grunn til optimisme med hensyn til mulighetene for å få gjennomført slike studier i fremtiden.

# Summary

Major incidents put Emergency Medical Services (EMS) to the test daily across the globe. Despite the same problems re-occurring, we fail to learn from them. How can EMS learn from these incidents?

Given the impact of major incidents on human lives and society, reporting should be standardised so that comparative analyses can be performed and learned lessons identified. Previous efforts aiming to standardise reporting, such as the creation of health registries, have been useful for generating research data and investigating associations. One might assume that the same applies for data from major incident medical responses. The aim of this thesis was to contribute to the systematic collection of standardised data from the pre-hospital medical management of major incidents and to enable identification of what could have been improved and what worked well in the response phase to a major incident. Four studies conducted along this aim are presented in this thesis.

We performed a systematic review to identify the content of existing major incident reporting templates. Due to the lack of a suitable template a consensus process was utilised to create a general template for reporting pre-hospital medical management of major incidents. Following implementation, a pilot feasibility study was conducted to identify users' experiences. The template was revised accordingly. Later a template for reporting Helicopter Emergency Medical Services response to major incidents was developed using consensus methodology. Both templates are freely available on www.majorincidentreporting.net.

This thesis shows how systematic literature review can be useful in identifying current knowledge and assessing the need for a new research project. We demonstrate a need for new consensus-based, open access templates for reporting the pre-hospital medical response to major incidents. We show that it was possible to achieve consensus, create a database, and have people submit reports using the template.

The main challenges have been recruiting reports, resulting in a low number of respondents in the study aiming to identify feasibility. Low rates of submitted reports also present a challenge in conducting comparative analyses of incidents. However, given the relatively

short timeframe in which the template has been available, there is reason to remain optimistic about the chances of conducting such studies in the future.

# Introduction

This thesis concerns major incidents, which can range from road traffic incidents and violence to natural disasters. Such incidents affect individuals, society and Emergency Medical Services (EMS) globally.

## Nomenclature

Nomenclature is essential for assuring understanding and agreement of what is being researched.

> *"Without a standard nomenclature, we will continue to be restrained to anecdotal descriptions of these unfortunate and very stressful situations, the ability to grow from each experience will be limited, and Disaster Medicine will remain a series of "notions" and will not develop as a science." - Birnbaum* (1)

The Major Incident Medical Management and Support (MIMMS) manual states that a major incident has occurred "when the number of persons involved, the type of incident, and the location of the incident require extraordinary rescue efforts" (2). Similarly, the Medical Response to Major Incidents (MRMI) manual defines a major incident as an "incident in which available resources are insufficient for the immediate need for medical care" (3).

The definition used in this thesis is based on the consensus presented in paper III. A major incident is "an incident that requires the mobilisation of extraordinary EMS resources and is identified as a major incident in that system." This definition purposefully includes the aspect of the local EMS system recognising the circumstances as a major incident.

No single agreed upon definition exists for disasters (4). The United Nations International Strategy for Disaster Reduction (UNISDR) defines a disaster as "a serious disruption of the functioning of a community or society involving widespread human, material, economic or environmental losses and impacts that exceed the ability of the affected community or society to cope using its own resources" (5). The Centre for Research on the Epidemiology of Disasters (CRED) defines a disaster as a "situation or event that overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering" (6).

The terms “multi-casualty event” or “mass casualty incident” are sometimes used in the literature. Mass casualty incidents have been defined as “events that overwhelm the resources of local hospitals and health care providers. They are likely to impose a sustained demand for health services rather than the short, intense peak customary with smaller scale disasters” (7). The World Association for Disaster and Emergency Medicine’s Task Force on Quality Control of Disaster Management, has defined multi-casualty event as “an event that produces many casualties but is managed completely with the resources available within the area in which the event occurred” (8).

All mass casualty incidents and disasters can, per our definition, be major incidents. However, the opposite is not necessarily the case. A major incident may be an incident in which extraordinary resources are put into place and the EMS overwhelmed without a particularly great number of persons being involved or the situation being a disaster.

## Major incident epidemiology

Major incidents are a recurring and significant health problem. High-profile terrorist attacks against civilians across the globe, such as the ones in Paris, Bagdad, and Istanbul, dominated the news in 2016. Most of us will not forget historical events such as the South-East Asian tsunami of 2004 and the massive earthquakes in Haiti in 2010 and Nepal in 2015. Many more major incidents occur daily. In the first half of 2016, a total of 175 disasters were registered in the International Disaster Database (EM-DAT) (9), ranging from road traffic incidents and industrial accidents to natural disasters. Regardless of the media coverage, all major incidents have humanitarian and personal impacts in common, and they put the local EMS to the test. Given the impact of major incidents on society, it would seem to be a natural consequence that we do our utmost to extract and convey learning from incidents to identify potential areas of improvement.

### Major incidents in Norway

The independent Norwegian research organisation Sintef published a report in 2003 summarising a total of 103 major accidents in Norway between 1970 and 2001 (10). In this report, the definition of major incident was five or more persons killed with extensive material or environmental damage. The report focuses on transportation accidents (air, sea, railway, and road), but also describes industrial accidents, including off-shore incidents.

In July 2011, we witnessed a terrorist bombing of the Oslo government district and the Utøya shootings in Norway, the worst incident to affect Norway since World War II. A government enquiry of the response to the incidents was initiated (11). The report of the July 22nd commission described resources available within a short timeframe in the Oslo government district and patients being transported to secondary care within a reasonable timeframe. However, due to the nature of the second incident at Utøya with an armed perpetrator and uncertainty regarding safety at the scene, access to patients was delayed. The incident illustrates differences in the response to an urban vs. a more remote location and the challenges faced in the presence of ongoing violence.

## Global challenges and inequalities

The CRED reported that half of the top 10 countries with the highest natural disaster mortality in 2013 were Low-Middle Income Economies (LMICs) (6). However, when it comes to road traffic injuries, the numbers are much higher, with more than 90% of deaths occurring in LMICs (12). The same type of trauma results in higher mortality rates in trauma systems with lower economic levels, most of which is attributed to pre-hospital mortality (13). This is illustrated by the following numbers from three earthquakes with the same strength: Armenia in 1989, 25 000 people killed and 35 000 injured; California in 1993, 61 killed and 8000 injured; and Bam in 2003, 30 000 killed and 50 000 injured (14). In addition, the maps from Worldmapper (Figures 1 and 2) (15) show the striking association between poverty and injury deaths.

These inequalities have led to the criticism of "low prioritisation of and relative inaction around injuries in LMICs on the global public health agenda" (16) and calls for building local competence and strengthening local resilience (14). These factors are an important backdrop for this thesis, as they illustrate why improving pre-hospital major incident medical management is important and why information on how this can be achieved needs to be freely accessible.

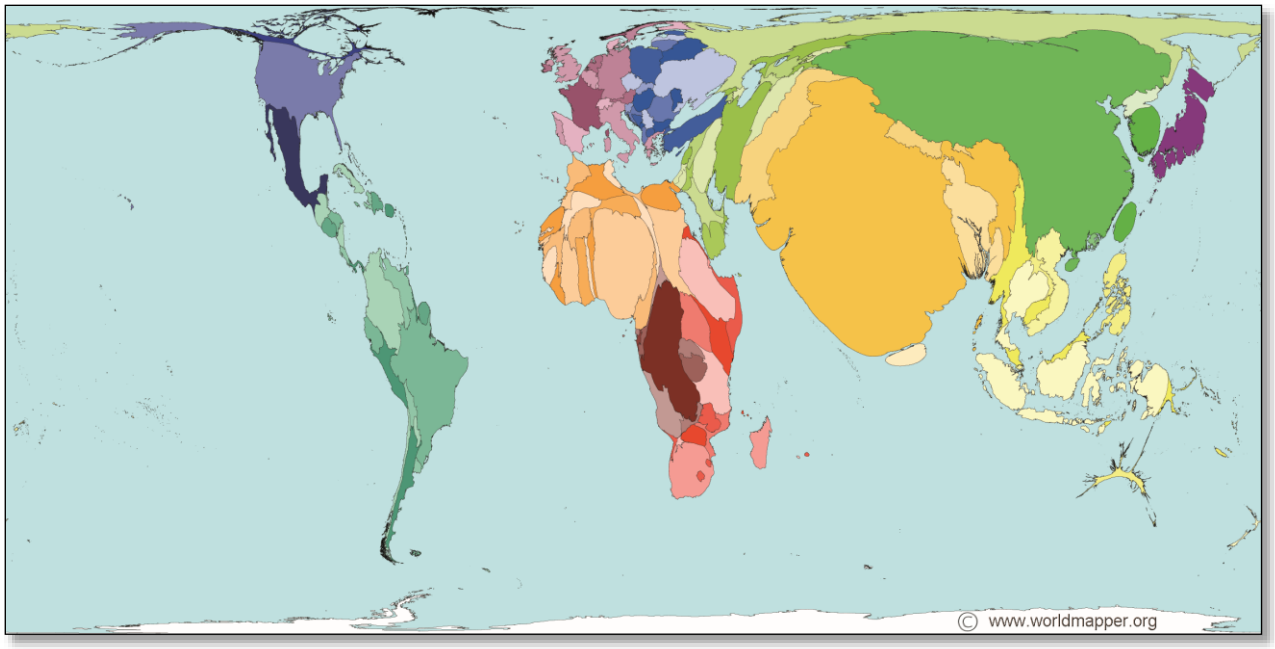



**Figure 1. Map of all injury deaths. Territories are sized in proportion to the absolute number of people who died from injuries in 1 year.**

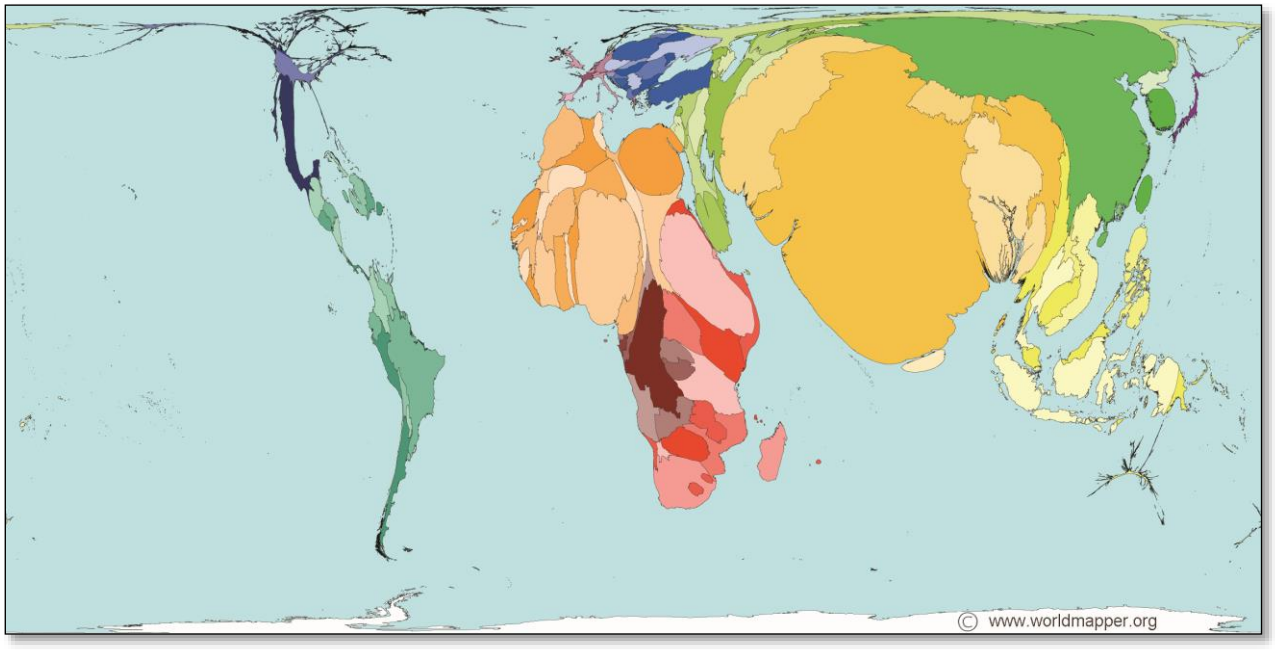



**Figure 2. Map of human poverty. Territory size shows the proportion of the world population living in poverty.**

## Global burden of injury

The World Health Organisation (WHO) publication Prehospital Trauma Care Systems described the essential and desired components of a trauma care system (17) and how basic trauma care can be provided in an affordable way. Globally establishing basic trauma care is an important step in minimising the burden of injury (18). This becomes perhaps especially important in major incident where the EMS is overloaded.

Among the top 10 leading causes of death in the world, road traffic incidents were ninth in 2012, with an increase from 1 million deaths in 2000 to 1.3 million in 2012 (19). The global status of road safety in 2013 (20) confirmed that road traffic injuries are a global public health problem. Road traffic incidents can be of such a magnitude that they are identified as major incidents. Among the reports submitted to the Major Incident Reporting Database, two were road traffic incidents: the Sheppey Crossing Bridge Road Traffic Accident in the UK and the bus rollover in Skaidi, Norway (21). Both incidents occurred in countries with well-equipped EMS systems and had relatively good outcomes. However, globally most road traffic incidents happen in middle-income countries, with the African region having the highest fatality rate (20).

*"Only 28 countries, representing 449 million people (7% of the world's population), have adequate laws that address all five risk factors (speed, drink-driving, helmets, seat-belts, and child restraints)." – WHO Global Status on Road Safety 2013 (20)*

Public health measures such as the ones mentioned abover are important to both prevent and mitigate the outcomes of major incidents. We hypothesise that major incident reporting in the format proposed in this thesis will prove useful for identifying preventive measures and improving the response of the EMS. In addition, it may empower people to take corrective measures to improve their own EMS systems.

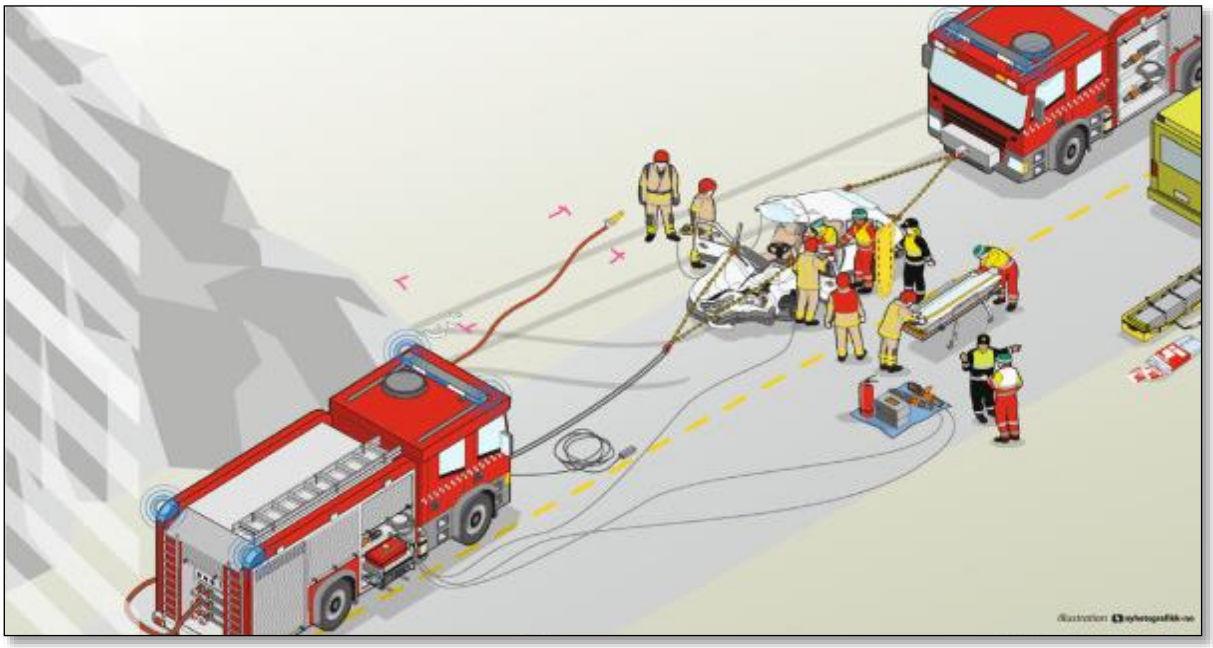


**Figure 3. What accident response may look like in a well-equipped rescue service (23). © Norwegian Air Ambulance Foundation**

**Figure 4. What accident response may look like in a less-equipped rescue service. © Trauma Care Foundation, Norway**

## Meeting the challenges of pre-hospital major incident medical management

The EMS plays a central role in the response phase, being responsible for important tasks such as dispatch, incident command, collecting information, triage, and communication (4). Communication, correct triage, treatment and transport of patients, and on-scene coordination have been described as recurring challenges in the major incident literature (22-27). Improving these areas of the EMS response demands a knowledge of factors that contribute to the challenges, as well as proper training to improve the skills of EMS providers.

The Utstein formula of survival is used in emergency medicine to describe factors that are important for the improved survival of patients (28).

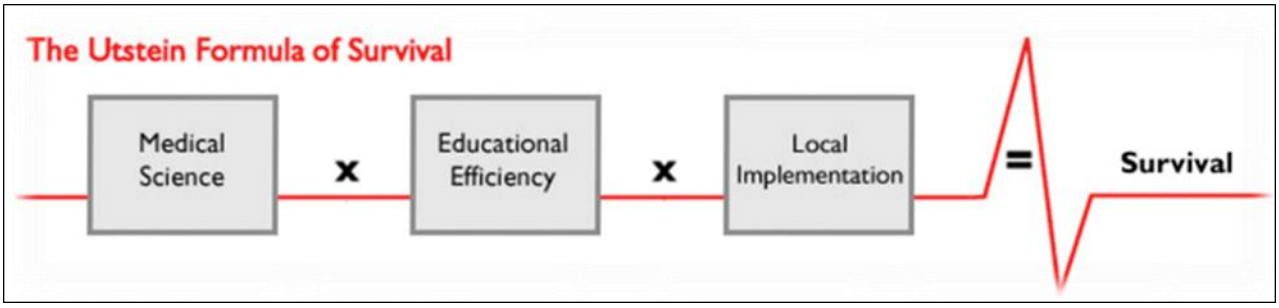



**Figure 5. Utstein formula of survival illustrating the components that increase survival. Used with permission from The Laerdal Foundation.**

With regards to educational efficiency, global initiatives have attempted to develop a curriculum and elevate knowledge within disaster medicine. A national survey in the US regarding education in emergency medicine residency programmes found that disaster preparedness training is the most commonly desired addition (29).

The MIMMS course teaches pre-hospital personnel a systematic approach to the management of multiple casualties on the scene of a major incident (30), including communication and major incident triage (2). The MRMI course trains the whole chain of medical major incident response, from the EMS coordinating centre to the incident scene and the hospital in real time using realistic amounts of resources (3). Coordination, triage, and deciding on treatment are core skills in the training. In Norway, the interdisciplinary emergency service cooperation (TAS) course is offered for fire services, police, vehicle salvagers, EMS personnel and community doctors. They train together and learn disaster triage, structured patient evacuation and rapid extrication of victims from vehicles (31-34).

Koenig and colleagues in the US have designed a disaster medical science fellowship programme (35) in which both clinical and academic skills are emphasised. The European Master in Disaster Medicine (EMDM) was established in 2000 and, thus far, almost 4000 professionals have participated. The EMDM community has been particularly concerned with promoting and developing disaster medicine as an academic discipline (36).

### The role of the Helicopter Emergency Medical Service in major incidents

A systematic review from 2010 noted that the majority of literature shows an effect of the Helicopter Emergency Medical Service (HEMS) on the mortality of trauma patients (37). However, the literature was not unanimous and the authors attribute the differences to three main factors:

1) some papers being published in the 1980s when the HEMS was different from current services;

2) papers being from seven different countries, where the geography, HEMS, and trauma systems vary;

3) different methodologies used in the papers.

A recent systematic review of 37 case reports from use of the HEMS in major incidents reported that this resource-demanding service is used mainly for patient treatment and to transport patients, personnel, and equipment in immediate response to a major incident (38). Yet, little is known about the optimal use of HEMS during a major incident response. In most high-income countries, HEMS plays a major role in the major incident response. Therefore, reporting the role of HEMS in major incidents is important for establishing a scientific basis for this part of the response phase. As not all countries or major incidents involve HEMS, the HEMS reporting template was developed as a separate process (paper IV), functioning as a stand-alone template that complements the Major Incident Reporting Template.

## Global initiatives to mitigate the impact of incidents

Mitigating the impact of an incident is important and saves individuals and society from unnecessary loss (39). The disaster management cycle was designed to illustrate how society plans for, responds to and recovers after a disaster (40). The cycle consists of three phases:

1) pre-disaster (prevention, mitigation, preparedness);
2) disaster (impact);
3) post-disaster (rehabilitation, recovery, response).

Actions suggested for managing these phases are rapid needs assessment, health surveillance, tracking systems, epidemiological investigations and studies, and registries (41). Planning, training, evaluating, and taking corrective actions in the pre- and post-disaster phases can improve preparedness for and response during disasters.

Disaster risk reduction has been a focus of the United Nations through the Hyogo Framework for Action 2005-2015 (42). This plan had five priority actions pertaining to disaster risk reduction as national and local priorities; identifying, assessing, and monitoring the risk of disaster; building a culture of safety; reducing the underlying risk factors; and strengthening disaster preparedness, thereby ensuring effective responses at all levels.

The Hyogo Framework is now being followed up by the Sendai Framework for Disaster Risk Reduction 2015-2030 (43), which seeks to ensure continuity with the previous framework, focusing on seven global targets:

1) reducing global disaster mortality
2) reducing the number of people affected globally
3) reducing direct economic loss
4) reducing damage to critical infrastructure and developing their resilience
5) increasing the number of countries with national and local disaster risk reduction strategies
6) enhancing international cooperation with developing countries
7) increasing the availability of and access to multi-hazard early warning systems and disaster risk information and assessments

Reducing disaster risk is a cost-effective investment in preventing future losses (43). To mitigate risks, emergency response systems must identify areas that can be improved. We

hypothesise that standardised major incident data and their analysis would contribute to reducing the burden of major incidents and disasters on society.

## Need for standardised reporting from major incidents

Experiencing several major incidents does not necessarily mean that lessons will be learned from them. A Dutch study from 2010 looked at reports from five consecutive national disasters and observed that, despite changes in protocol, legislation, organisation, and funding, the same mistakes were made each time (44).

The need for standardised reporting has been a theme in several areas of medical research. In the field of traumatology, uniform data collection has been initiated for establishing standardised reporting of patient injury, care, and outcome (45). The data collection was initiated at several trauma centres on three different continents and shown to be a feasible way of gathering comparable data (46). Similarly, a working group in the Netherlands set out to define a national core dataset for pre-operative assessment (47). The authors stated uniformity as a prerequisite for allowing the exchange of data between care providers. Epidemiological research health registries, which are a form of uniform data collection, have been valuable sources of research data (48-52) on several topics ranging from birth defects to cardiological interventions.

The Task Force on Quality Control of Disaster Management of the World Association for Disaster and Emergency Medicine (WADEM) has published guidelines for evaluation and research (53). These guidelines state that disaster management research is anecdotal and that data is reported with little external validity due to a lack of common factors being identified. Several editorials and commentaries have since advocated the same message for standardised reporting of disasters and major incidents to improve the scientific level (54-59).

## Rationale for developing a new template

The motivation behind the present research project was to facilitate systematic collection of data from pre-hospital major incident medical management. This may contribute to improve the evidence base in disaster medicine. The rationale behind the systematic review was that it would be unreasonable to pursue the development of a new template if an optimal template was already available and implemented. The systematic review (paper I) identified ten standardised methods for reporting.

We hypothesised that a valuable template should:

- contain pre-defined data to be used in reporting from real-life incidents
- have a pre-hospital focus
- have been tested in real-life incidents
- be available as an open access template to allow widespread use
- be developed using a scientific method

No one template meeting these aspects was found (Table 1). Therefore, the findings in the systematic review justified the development of a new template.

| Template | Description & original purpose | Explains method for developing template? | Open access? | Focuses on pre-hospital data? | Tested in real-life incidents? |
|---|---|---|---|---|---|
| Anderson (60) | A comparative retrospective analysis applying a systematic method to eight airliner crashes. No template used. | × | × | × | √ |
| Debacker et al (61) | Utstein-style template for reporting pre-defined uniform data from the acute medical responses in a disaster. | √ Utstein style consensus process | √ | √ | × |
| DISAST-CIR (62-69) | A template for uniform reporting from mass casualty incidents. | × | × | √ | √ |
| Juffermans et al (44) | A comparative retrospective analysis applying a systematic method to five disasters. No template used. | √ opinion of expert group at one meeting | × | √ | √ |
| Kulling et al (70) | Guidelines for structured reporting of health crises and critical health events. | √ expert opinion in several rounds and based on previous guidelines | × | × | √ |
| Lennquist (71) | Guideline for systematic reporting from real incidents. | × | √ | √ | √ |
| Ricci et al (72) | Guidelines for systematic reporting from real incidents. No actual template used. | × | × | × | × |
| Green et al (73) | Evaluation methods for reporting from disaster field exercises in developing countries. | √ opinion of the authors | × | √ | N/A |
| Ingrassia et al (74) | Systematic method for reporting medical management during mass casualty incident field exercises. | × | × | √ | N/A |
| Performance indicators (75, 76) | Systematic method for reporting from disaster field exercises. | × | √ | √ | N/A |

**Table 1. Templates identified in the systematic review and rating of aspects considered important. N/A = not applicable.**

## Aims of the thesis

The aim of this thesis was to enable open, accessible, systematic collection and dissemination of data and experiences from the pre-hospital medical management of major incidents. This was to be achieved by assessing whether existing templates for such reporting fulfil a set of criteria considered to be critical. Further, to develop a consensus-based template using appropriate methodology and to assess template feasibility.

From a broader perspective, the aims of the thesis were to:

- Mitigate the impact of future incidents by allowing responders, managers, and decision-makers to organise their response based on prior experiences
- Allow aggregated and comparative analysis of data to generate knowledge of possible associations between actions and outcomes in the EMS response to major incidents
- Provide free access to the collected data as a means of decreasing the global inequalities that already exist

# Methodological considerations

For each study we applied the method we best considered would meet the study aims. Systematic reviews are suitable for synthesis of knowledge. Consensus processes are useful methods when there is a lack of pre-existing knowledge. Qualitative methods are useful when identifying informants opionions on a subject. The systematic literature review (paper I) aimed to collect information on existing templates and their content and to identify whether there is a need for a new reporting template. Based on the findings in paper I, we identified such a need, leading to the development of a major incident reporting template based on expert opinions (paper II). In the consensus paper (paper II), we aimed to create an open access template and website for submitting standardised data meeting the following criteria: contain pre-defined data to be used in reporting from real-life incidents, have a pre-hospital focus, be available as an open access template to allow widespread use, be developed using a scientific method and be tested in real-life incidents. The feasibility study (paper III) aimed at investigating users' experiences with the template to identify areas of improvement thereby facilitating revisions of the template. During the thesis work, a knowledge gap was identified regarding the tasks of the HEMS in the response to a major incident (77). We therefore conducted another consensus process with the aim of creating a template for reporting the HEMS response to major incidents (paper IV).

Existing knowledge was collected and synthesised using systematic literature review methodology (paper I) (77). Expert opinion was gathered in a systematic and qualitative manner using a modified nominal group technique (paper II) and the Delphi method (paper IV). Grounded theory was used as the basis to survey the opinions of experts on the Major Incident Reporting Template and identify factors that may prevent its use (paper III). The work of this thesis was supplemented by writing commentaries (78-83) and using social media to disseminate knowledge of the Major Incident Reporting Database. Figure 6 provides an overview of the thesis, illustrating the line of argument.

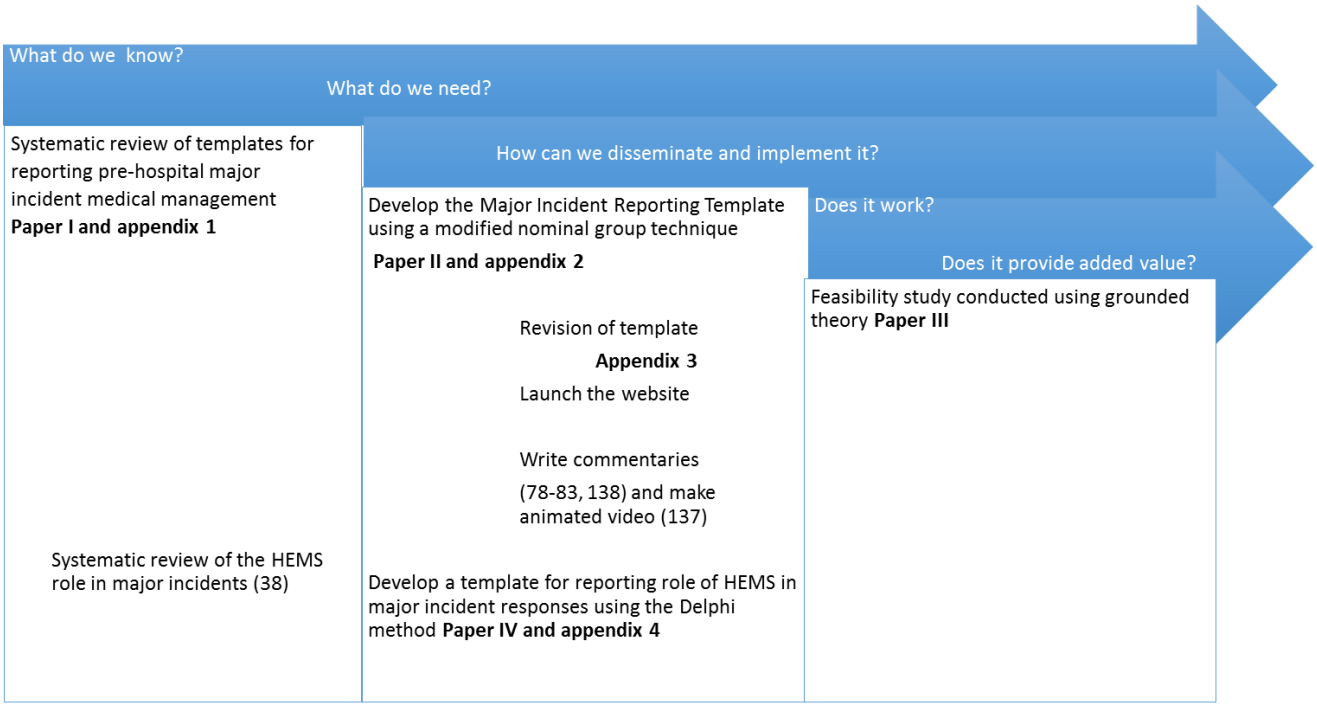



**Figure 6. Overview of the thesis line of argument and associated studies and publications.**

## Paper I

A systematic literature review was conducted to identify existing templates, sets of standardised data, or guidelines for reporting pre-hospital medical management of major incidents. Further, to describe what data the included manuscripts reported. We did not seek to evaluate whether data variables were useful or not in the identified templates.

According to expert recommendations (84-87), the systematic review was pre-registered in the International Prospective Registry of Systematic Reviews (PROSPERO) (88) and the protocol published (89) to ensure full transparency and avoid data driven decisions. After the protocol was submitted and published, guidelines were established in 2015 to encourage all authors of systematic reviews to publish protocols (90, 91). The main purpose of the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA-P) 2015 statement was to improve the quality of systematic review protocols. Both PROSPERO and PRISMA-P allow transparency in the performance of a systematic review and increase the reliability of published reviews.

The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (92, 93) were followed when conducting the systematic review, and the PRISMA checklist and flow chart were used in preparation of the final manuscript. The Cochrane Handbook for Systematic Reviews of Interventions (94) was consulted.

We chose a broad set of search terms to avoid missing any relevant literature (Appendix 1 – complete search strategy). Included studies were subject to data extraction to describe the content of the templates and quality appraisal to evaluate their internal and external validity. The extracted data was not considered suitable for meta-analysis.

## Paper II

The aim of this study was to identify which data a panel of experts considered the most important to report from pre-hospital major incident medical management. We sought not to influence expert opinion by presenting existing templates. However, we aimed to transfer experience from previous template work by inviting authors of these templates into the expert panel. The Major Incident Reporting Template was developed using a modified Nominal Group Technique (NGT). The modified NGT is a structed four step process used for gathering expert opinion to acheive consensus, in our case by establishing a template (95) (Figure 7). The process was moderated by method and clinical experts who had applied it in recent consensus processes (45, 96-98).

European experts identified in the systematic review (paper I) as previous guideline authors were invited to participate in the process to ensure that current consensus was also based on previous work. The reason for not inviting non-European experts was solely economical. The remaining experts were identified by each of the organising committee members suggesting two experts each.

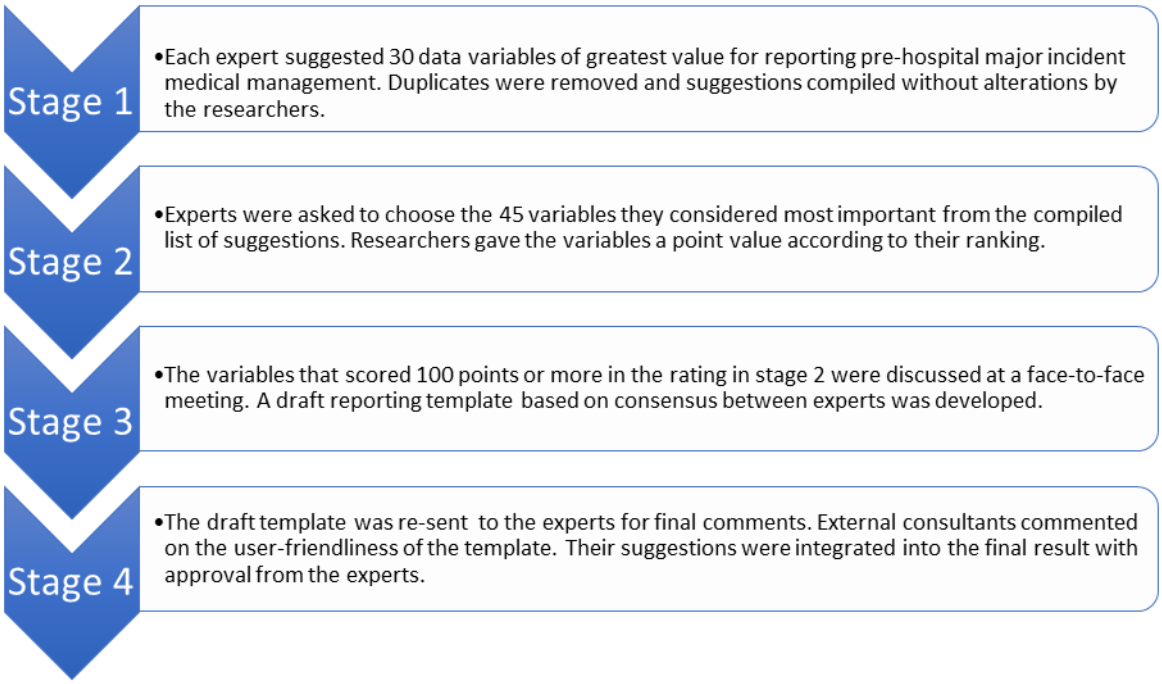



**Figure 7. Overview of the modified Nominal Group Technique used in paper II.**

The consensus process was initiated by a brainstorming phase (stage 1) to generate variables for further discussion. Stages 1, 2, and 4 of the modified NGT process were carried out via e-

mail correspondence and stage 3 was a 2-day meeting in Torpomoen, Norway. The meeting began with an introduction of the background of the modified NGT to the expert panel and a brief repetition of the steps performed up until that time. The list of the 41 data variables scoring ≥100 points were presented to the experts again with instructions that they would form the basis for discussions, but that the experts may come up with new ideas during the meeting if they wished. The 41 variables were structured into six main categories as suggested by the moderators: pre-incident data, EMS background, incident characteristics, EMS response data, patient characteristics and key lessons. The meeting continued with a plenary discussion of data to include in the pre-incident data category before the experts were divided into two groups. Each group was moderated by one methods expert and minutes taken by two researchers. One group discussed and suggested a draft for the demographic data to be included in the pre-incident data in addition to the EMS background and patient characteristics. The second group discussed and suggested a draft for the incident characteristics and EMS response data. The experts reconvened for a plenary discussion of the suggestions from each group and the contents of the key lessons section. Later, the expert panel recessed and the researchers who had taken minutes during the day made a first draft of the complete Major Incident Reporting Template. The following day, the draft template was presented to the expert panel, who could comment upon it and discuss if all elements previously touched upon were present. The meeting was concluded by applying the draft template to a real incident (Utøya) as a way of "pilot testing" its usefulness for reporting from a real incident. It was discussed that the template would primarily be intended to be used by persons who had responded to major incidents or taken part in the management of them.

## The online template

A parallel process was creation of the online, open access version of the template. The website was created through a collaboration between the Norwegian Air Ambulance Foundation (NAAF), an external consultant at Promarketing.no, and the Major Incident Reporting Steering Group. The website enables downloading of data from all submitted reports.

## Paper III

This feasibility study sought to identify whether those who had used or considered to use the template found it feasible and what they found useful and less useful. We performed semi-structured interviews with individuals who had been asked to use the template. We analysed the transcribed interviews using the central elements in grounded theory methodology (99) as a basis: constant comparative method, substantial coding, and theoretical coding (100).

One researcher collected data that were audio recorded and transcribed verbatim. All transcribed interviews were analysed by two coders, initially on an individual basis. The codes were then compared and assessed by the two other authors and consensus on the theoretical construct reached between all authors.

First, the transcripts were coded with open codes to get an impression of "what was going on" (i.e substantial coding). Next, memos, transcripts and substantial codes were sorted into minor categories. This back-and-forth assessment of the codes, memos and transcripts (i.e., constant comparative method) resulted in a main category/major theme being identified. The minor categories were then sorted and developed in relation to the major theme (i.e theoretical coding). Figure 8 illustrates the process.

In preparation of the manuscript, Consolidated Criteria for Reporting Qualitative Research (COREQ) (101) and Standards of Quality Improvement Reporting Excellence (SQUIRE) guidelines (102) were consulted and followed where applicable.

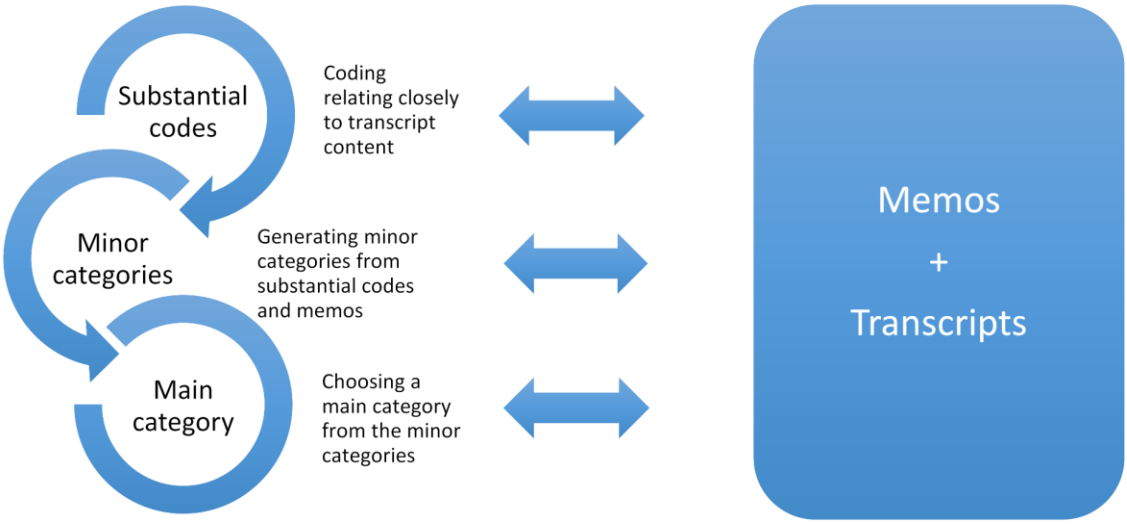



**Figure 8. The constant comparative methodology used in Grounded Theory. Category = a group of codes of similar content. Memos = notes, thoughts and observations made during interviews or data analysis.**

Grounded theory was originally described by Glaser and Strauss (99), but has subsequently developed into different "schools", all characterized by generating theory grounded in the data. Data analysis and data acquisition are performed simultaneously, and data analysis conducted in a systematic and step-wise manner. The steps are occasionally differently named, but principally alike. Because the method used is firmly based on grounded theory we found it most useful to describe it in terms of this methodology. Since we did not generate a full-blown theory, it may however be most accurately described as an inductive approach based on grounded theory.

## Paper IV

The aim was to identify which data would be most important to report from a HEMS response to a major incident. We used the Delphi method to develop a template for such reporting. The Delphi method is a systematic qualitative method used to gain information in the absence of sufficient research on a topic (103). The method involves administering questionnaires to a group of experts in repeated rounds (103-105) until consensus is reached. The experts were current or former HEMS physicians selected from the European Pre-hospital Research Alliance (EUPHOREA). All rounds (Figure 9) were performed by e-mail.

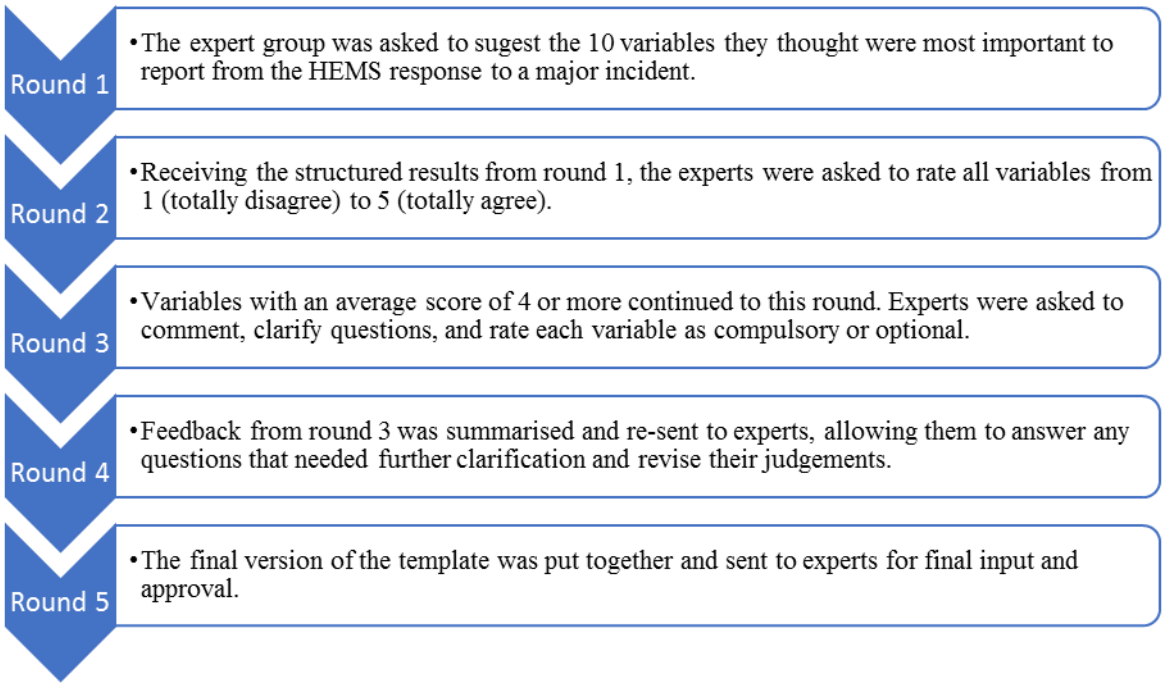



**Figure 9. The Delphi method as applied in paper IV.**

## Ethical and legal considerations

In Norway, Regional Committees for Medical and Health Research Ethics (RECs) are the main regulatory bodies for ethical approval of medical and health research (106). Some research projects do not require approval from RECs, such as quality improvement studies or observational research containing anonymous information. For research not requiring approval from RECs, but in which data that can be linked back to a person will be collected, recorded, or stored using a computer, the Norwegian Centre for Research Data (NSD) (107) must be notified.

Paper I was a literature study and required neither ethical approval nor approval from the NSD. In papers II and IV, no data stored on a computer could be linked to the participants in the consensus group. After the participants' feedback was received by e-mail on excel sheets (containing no personal information), these documents were saved on the computer hard drive and the e-mail deleted. Furthermore, as no personal or sensitive information was collected, no ethics approval was required according to Norwegian legislation. For the feasibility study (paper III), we did not apply for approval from RECs because this was not considered a health research project (108). However, we applied for approval from the NSD (reference number: 36565/2/LMR) due to personal information being stored in the form of audio recordings.

Legal approval for registering data on the website was granted by the Norwegian Data Protection Authority (written confirmation of legality 28.05.14). All reports used in the analysis have been guaranteed by the author of each report to comply with local ethical regulations prior to submission to the database.

# Summary of results

This section provides a short summary of the results of each of the four papers. Detailed results are depicted in the respective papers.

## Paper I

The systematic review identified 18 articles that met inclusion criteria. A total of 10 different templates were described in these studies. We conducted data extraction and a quality appraisal according to checklists published in the protocol for the systematic review (89). In the absence of a standard on what should be reported from a major incident, we pre-defined 34 data points (Table 2) divided into four main categories: pre-event information, information about the incident, system characteristics, and patient characteristics.

| **Data variable** | **Number of times reported** |
|---|---|
| Other system characteristics reported[1] | 9 |
| How medical illness was classified | 7 |
| Other incident information reported[2] | 7 |
| Other pre-event information reported[3] | 6 |
| Other descriptors of patient characteristics[4] | 6 |
| Number of deceased | 6 |
| Number of slightly injured | 6 |
| Description of damage caused by MI | 6 |
| Time and date of MI | 5 |
| Number of severely injured | 5 |
| Number of moderately injured | 5 |
| Number of uninjured | 5 |
| Available pre-hospital resources | 5 |
| Pre-hospital resources lacking | 5 |
| Situation of pre-hospital telecommunications system | 5 |

**Table 2 continues on next page**

| | |
|---|---|
| Time from alarm to arrival at scene | 4 |
| Communication between rescue workers/aid organisations | 4 |
| Coordination of rescue/relief work | 4 |
| Time required for moving casualties from site to next level of care | 4 |
| Basic information on affected area | 3 |
| Characteristics and number of affected prior to MI | 3 |
| Information received by ADC | 3 |
| Safety situation at and around incident site | 3 |
| Pre-hospital triage systems used | 3 |
| Scaling-up and scaling-down of response | 3 |
| Children, adults, senior citizens, or all age groups involved | 3 |
| The most frequent medical injuries/illnesses | 3 |
| Information provided by ADC to responder | 2 |
| Accessibility of the incident site | 2 |
| Triage at first evaluation on scene | 2 |
| Injury models used | 2 |
| Median/mean injury score reported | 2 |
| Triage classification of patients received through ADC | 0 |
| Triage before transport to next level of care | 0 |

**Table 2. Data variables in the extraction form and the number of times they were reported in the included literature.** ADC = ambulance dispatch centre, MI = major incident. [1]Other system characteristics reported were on-site medical care, distribution of casualties, independent action by medical disaster response personnel, continuation of day-to-day care, decision flow, and information management. [2]Other incident information reported was a description of the incident. [3]Other pre-event information reported were climate, child mortality rate, and descriptions of hazards. [4]Other descriptors of patient characteristics reported were different triage systems used, description of psychological reactions, and morbidity using hospital data.

The templates had shortcomings in regards to both internal and external validity (Figure 10).

| | Anderson (23) | Debacker (13) | DISAST-CIR (24-30, 35) | Green (36) | Ingrassia (31) | Juffermans (32) | Kulling (37) | Lennquist (33) | Performance indicators (34,39) | Ricci (38) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Was the methodology for developing the template clearly explained? | x | ✔ | x | ✔ | x | ✔ | ✔ | x | x | x | Internal validity |
| 2. Are the data variables listed in the template clearly defined? | x | ✔ | ✔ | ✔ | x | x | ✔ | ✔ | ✔ | x | |
| 3. Is the rationale for the data variables described? | x | ✔ | x | ✔ | ✔ | ✔ | ✔ | x | x | x | |
| 4. Is handling of missing data described? | x | ✔ | x | ✔ | x | x | ✔ | x | x | x | |
| 5. Has an ethics committee approved the template? | x | x | x | ✔ | x | ✔ | x | x | x | x | |
| 6a. Does the literature state who developed the template? | x | ✔ | ✔ | ✔ | x | x | ✔ | x | ✔ | x | External validity |
| b. How the process was funded | x | ✔ | ✔ | ✔ | x | x | ✔ | x | x | x | |
| 7a. Which continent/country/organization was the template developed in? | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | |
| b. Where (specific region) it is intended to be used? | x | ✔ | ✔ | ✔ | x | x | x | x | x | x | |
| 8. Are the data variables transferable to other countries or major incident management systems? | x | ✔ | ✔ | ✔ | x | x | ✔ | ✔ | ✔ | x | |
| 9. Is it possible to report the incident timeline? | x | ✔ | ✔ | ✔ | x | ✔ | ✔ | ✔ | x | x | |
| 10. Is a valid discussion included about possible sources of bias? | x | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | x | ✔ | x | |
| 11. Do the authors discuss using the template as a tool for evaluation? | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | |
| 12. Has the clinical credibility of the tool been evaluated? | x | x | x | x | x | x | x | x | x | x | |
| 13. Has the feasibility of the template been evaluated? | x | x | x | x | x | x | x | x | x | x | |
| 14. Has the template been used in other publications? | ? | * | ✔ | ? | ✔ | x | ✔ | ✔ | ✔ | ? | |

**Figure 10. Internal and external validity of literature included in paper I. √ = yes, x = no, ? = unknown *= not applicable due to recent publication. Reference numbers not applicable in reference list of thesis as the figure is from paper I.**

## Paper II

A total of 13 experts from 10 different European countries participated in the consensus process. They all had experience as major incident practitioners, planners, or both. Use of the modified NGT resulted in a template consisting of 48 data variables in six different categories (Appendix 2):

- Pre-incident data
- EMS background information
- Incident characteristics
- EMS response data
- Patient characteristics
- Key lessons

To comply with our own "standards" for internal and external validity as mentioned in paper I, we sought to be clear on the method used to develop the template and describe the data variables and rationale for them in a scientific paper (paper II). To handle missing data, we allowed for "unknown" to be an option in most answers and allowed free-text fields to facilitate elaboration and explanation of findings.

## The online template

The template was made freely available online parallel with the publication of paper II. The process for submitting reports to the database consists of the following steps:

- Registering for a username and password on the website
- Log on with the username and password and begin reporting. The report can be saved throughout the submission process. Submit when completed
- Once the report is submitted it is evaluated by two members of the Major Incident Reporting steering group and/or external peer reviewers
- The reports that are approved after feedback from peer review are made freely available for everyone to access on the website

The authors are free to submit case reports to scientific journals using the template before or after submitting to the database.

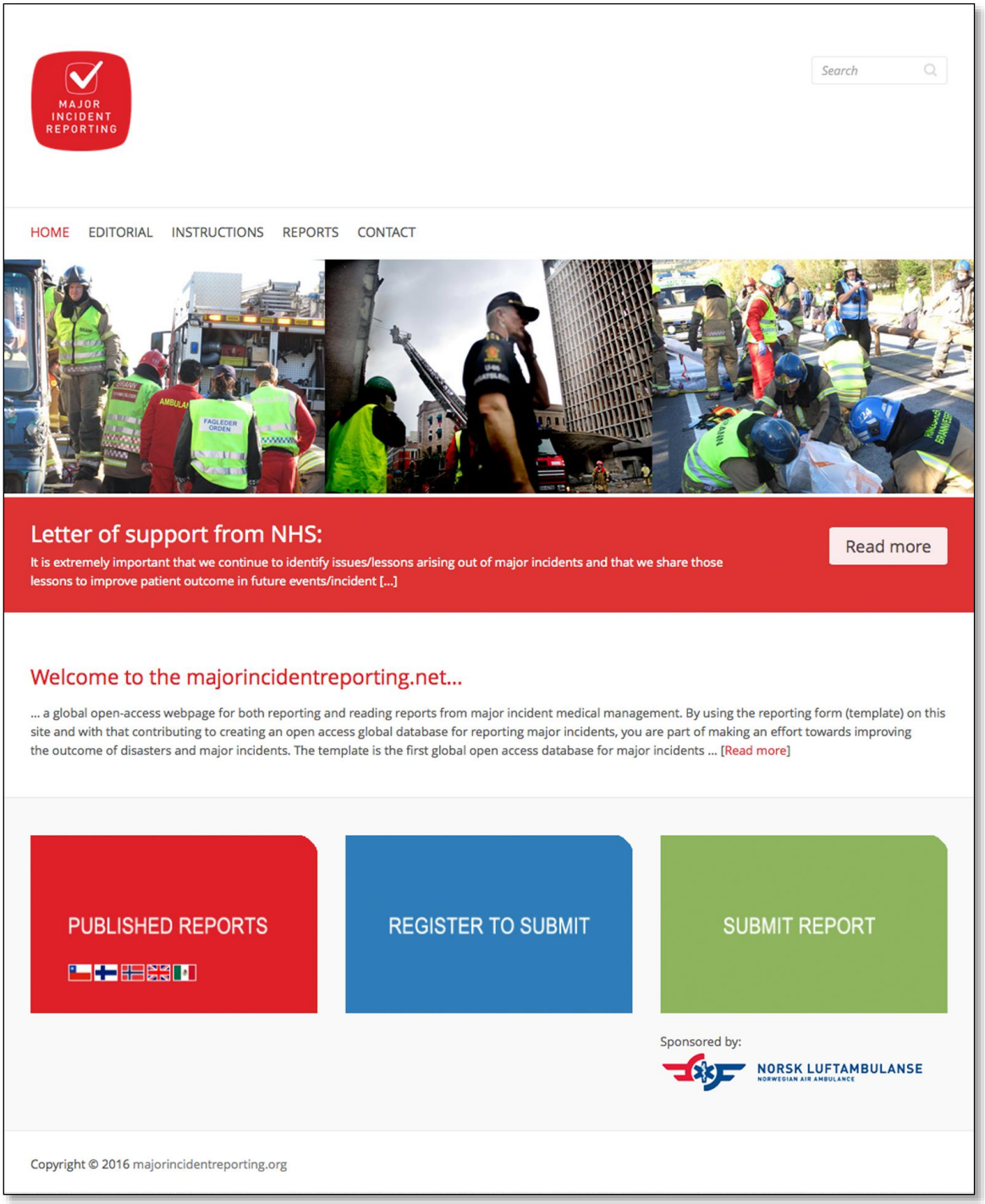



**Figure 11. Front page of the Major Incident Reporting Website.**

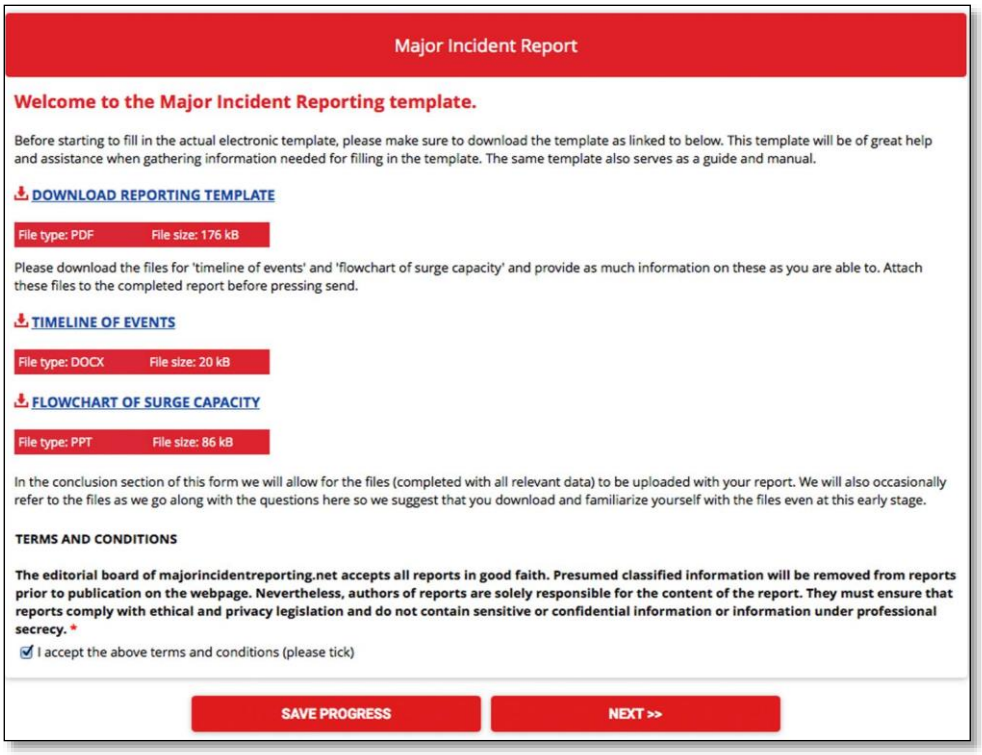



**Figure 12. The online submission form for the Major Incident Reporting Template.**

The eight reports from real-life incidents currently available on the website are from a gas explosion in Mexico, prison fire in Chile, school shooting in Finland, road traffic accident in the United Kingdom, and four incidents in Norway (bus rollover, truck and tunnel fire, mass shooting and train collision). Since the template was made available for reporting from field exercises, two reports from plane crash exercises in Finland have been made available.

All reports are made available as PDFs to facilitate downloading. In addition, each report contains a location map and printable summary (Figure 13).

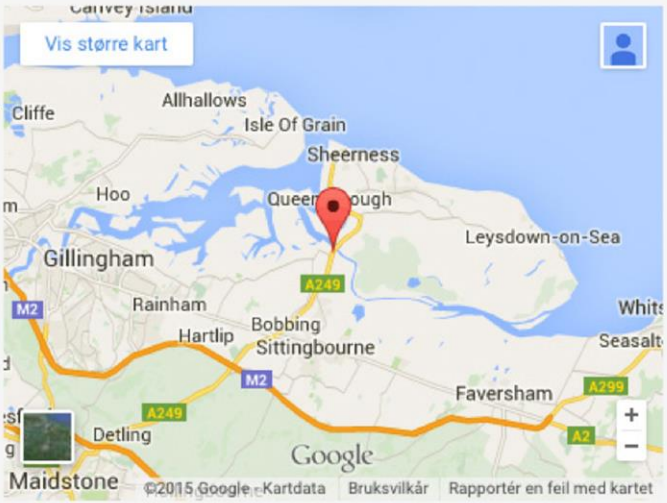
# Incident title: Sheppey Crossing Bridge

## Reporter

**Dr. Sophie Elizabeth Hardy**
A&E core trainee
Medway Maritime Hospital, Medway nhs trust

**Role in incident:** Junior Doctor on duty in A&E at time of Major incident

## Incident location




## Summary

Country: United Kingdom

On 5th September 2013, a road traffic accident involving 150 cars and 200 people occurred on the Sheppey Crossing bridge in Kent. It occured at 7:15 am under thick fog where visibility was reduced to 25 yards. Cars continued to impact each other for a further 10 minutes following the first collision and as the fog lifted, it was evident that the pile up involved cars extending across most of the 1270 metre long bridge. There were 69 casualties: 37 were taken to surrounding hospitals, 8 of them with serious injuries but no fatalities. 32 were directed to minor injuries by critical care paramedics on scene.
The crash was one of the worst seen on British roads and it has been hailed as a miracle that there were no deaths and very few serious injuries. Although declared a major incident, there was minimal disruption to the routine emergency and healthcare services. This was in a large part due to the effective triage by paramedic practitioners and critical care paramedics on scene and to appropriate use of ambulances and the patient distribution to various receiving hospitals.

**Figure 13. Report with summary and incident location map.**

A summary of the successes and failures described in the reports submitted from real-life incidents is illustrated in Figure 14.

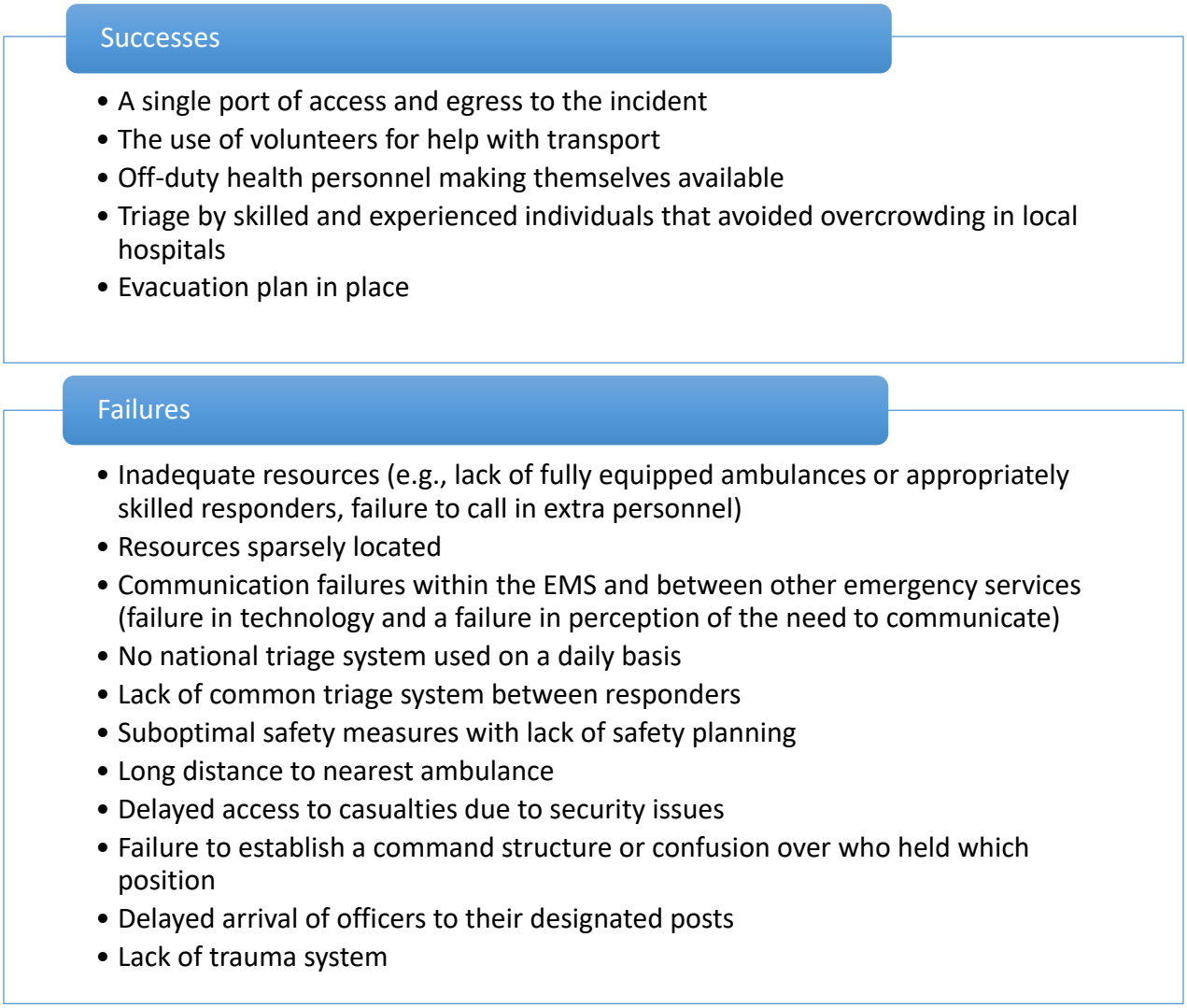



**Figure 14. Overview of the successes and failures mentioned in reports from real-life incidents submitted to majorincidentreporting.net. Courtesy of Sophie Elizabeth Jap Hardy.**

## Paper III

The feasibility study was performed the year following initial implementation of the template and consisted of seven interviews with individuals who had submitted reports using the template or were in the process of considering submission. Despite few respondents, saturation on the major theme was achieved (99). “Defining purpose” was identified as the main category/major theme, meaning that the informants were uncertain of the purpose of the template. This was further explained by four minor categories: “relevance”, “scope”, “resources”, and “usefulness”. Specifically, the relevance of questions needs to be explained more clearly in order to motivate people to fill in reports and the scope of the reporting (i.e., main purpose of the data gathering and who the report represents) needs to be explained. The resources, time and access (i.e., time needed to fill in the template and lack of registration or access to data) were mentioned as challenges. However, despite the potential for improvement, informants found the template to be useful. This study suggests that more successful implementation may be achieved if the purpose of the template and rationale for the questions asked are more clearly defined (“defining purpose”) and sufficient resources allocated for filling it in.

**Key issues as addressed by the informants:**

- Template is too comprehensive
- The relevance of the questions included in the template needs to be explained
- The aim of reporting needs to be more clearly stated (e.g., is the information collected for scientific value or for sharing experiences)
- The reporting process should be made clearer, including the time needed to complete a report

Based on these findings, the template has undergone preliminary revisions, resulting in a template consisting of 28 questions instead of 48. In addition, several data points have been made optional instead of compulsory (Appendix 3 – revised Major Incident Reporting Template). The revised template was approved by the Major Incident Reporting Collaborators and changes were implemented in the online version.

## Paper IV

A total of 17 experts from nine different European countries participated in the Delphi study. The experts were all active HEMS physicians with research experience. Application of the Delphi method resulted in a consensus-based template for reporting data on the use of HEMS in the immediate pre-hospital medical response to a major incident (Appendix 4 – HEMS Major Incident Reporting Template). The template consists of 21 data variables in four main categories:

- HEMS background
- Major incident characteristics relevant for HEMS
- HEMS response to the major incident
- Key lessons learned

The online version of the HEMS Major Incident Reporting Template (Figure 15) was made available at the same time as publication of paper IV and integrated into the existing database.

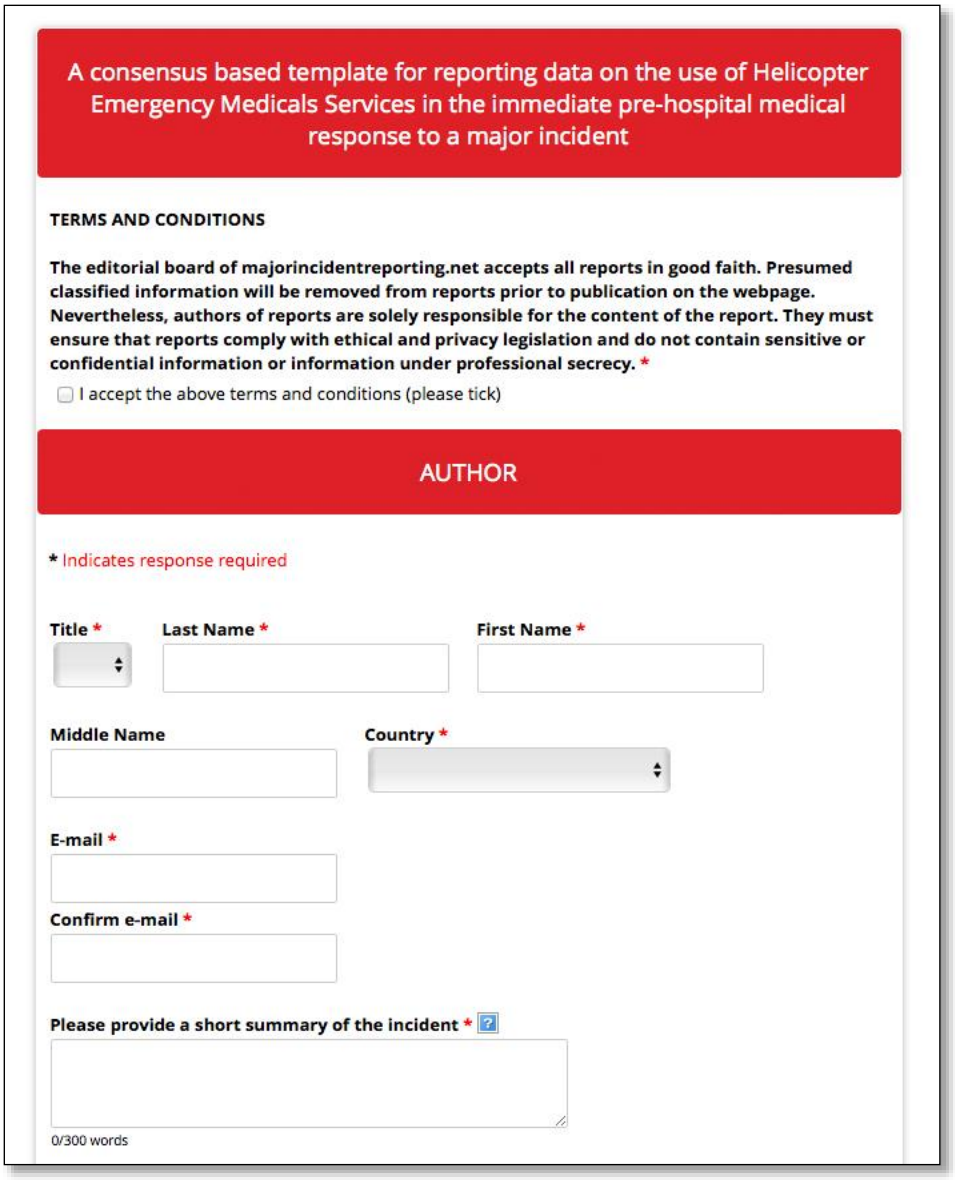



**Figure 15. Online submission form for the HEMS Major Incident Reporting Template.**

# Discussion

The work presented in this thesis is based on the need for more structured reporting from major incidents as voiced in the disaster medical community for several years (54-59). We systematically reviewed the existing literature to design templates for reporting from major incidents using expert opinion. The initial feasibility study of the Major Incident Reporting Template is also presented. Further, both templates have been implemented open access in scientific journals and on a website. This adds to the current knowledge in that the EMS community and policy makers now have a platform which they can freely access to read submitted reports and in which they themselves can report from incidents. It provides students, researchers and decision makers with a number of standardized reports which they can use for hypothesis generation and future research projects.

In relation to the hierarchical views of classifying evidence (109), we have applied methods of "excellent quality" (systematic reviews), "low quality" (expert opinions), and "fair quality" (focus group). Although randomised controlled trials are considered the highest level of evidence (109), it would be difficult to implement such a design during real-life major incident responses. Therefore, our work seeks to generate data and hypotheses for further studies, such as comparative analysis, case series, and feasibility studies. Similarly, the 6S hierarchy of pre-appraised evidence pyramid used to guide clinical decision-making (110) places individual studies at the bottom, followed by synopses of studies and syntheses, such as systematic reviews, higher up. The highest levels are synopses of syntheses, summaries (e.g., evidence-based clinical practice guidelines) and systems (e.g., decision support systems). Our work attempts to generate more solid evidence at the bottom of the pyramid to enable better quality studies higher up. In our opinion the already added knowledge and potential for future improvement of evidence warrants the making of the new Major Incident Reporting Templates.

## Thesis work related to previous research and implementation

The findings in this thesis have shown that it is possible to achieve consensus on essential data to report from the medical management of major incidents. This conclusion is in accordance with previous research in emergency and disaster medicine (45, 96-98, 111). The results also illustrate the challenges in performing feasibility testing of a template with a low number of respondents. Follow-up studies are made difficult by the low number of reports being submitted. Quantitative comparative analyses of reports are not feasible until several reports exist. The work of other researchers in the field of major incident reporting has also been met with the challenges of limited implementation (61, 70, 71). Similarly, the implementation of hypothermia-registry.org is limited due to few reports being submitted. The organiser commented that, "Compulsory registration is the best answer but this can only be insurance or government driven" (Dr. Beat Walpoth, hypothermia-registry.org, personal communication). The uniform reporting of data in trauma registries (45) has been implemented successfully, feasibility testing completed (46), and data used for research on clinical outcomes (112). This was achieved due to wide implementation of the reporting tool in health care institutions across several continents. An equally broad implementation of the templates presented in this thesis is expected in the coming years. The need for revision of the Major Incident Reporting Template may indicate a shortcoming with regards to the results of the modified NGT process. One factor might be that the expert panel did not take into large enough consideration the environment for data collection in health care services. There is today a great demand for documentation and reporting in health care services in addition to the clinical workload. As the Major Incident Reporting Template is voluntary to use it is plausible that it will be given less priority that other tasks. Factors such as compulsory reporting with trauma registries (45, 113) and allocation of staff with the specific task of reporting, as with the Organising Committee for Disaster Medicine in Sweden (KAMEDO) (114-116), has been a solution for increased reporting in similar settings. We suggest similar approaches in the future for major incident reporting.

### The ethics of conducting yet another series of studies

Over 50% of studies are designed without reference to systematic reviews of existing evidence. Combined with other factors, such as bias in study design and under-reporting of negative results lead to research waste (117). The ethical implication of designing future studies without knowledge of existing evidence may, in the worst case, be unnecessary

suffering of patients and the wasting of health care resources. The Lancet series "increasing value, reducing waste" has addressed many issues related to research ethics, such as setting priorities (118); the design, conduct, and analysis of studies (119); and access to research results (120). Although this thesis does not consider direct interventions on populations, we have attempted to address such ethical issues by performing a systematic review, assuring transparency in the research process, following research guidelines, and publishing open access.

### Research guidelines in medicine

Reporting guidelines provide structured advice on the minimum information to be included in an article reporting medical research (121, 122). They are an important means of ensuring transparency in the research process (123, 124) and ethically responsible publications (125). The Enhancing the Quality and Transparency of Health Research (EQUATOR) network (121), an international initiative, provides an overview of key reporting guidelines for different research methodologies. In all of the studies included in this research process, relevant guidelines were used whenever applicable.

### Open access

All papers in this thesis have been published open access due to the ethics of knowledge being freely available (126). A challenge with open access publishing is the number of "predatory journals", which increased from 18 to 477 between 2011 and 2014 (127). These journals add to the risk of poor quality research being published and, perhaps, decisions being made based on misguiding evidence. It is the responsibility of the authors to check the background of the journals and ensure they are of proper scientific standard. To ensure publications of adequate quality, each of the journals chosen for papers I-IV provide an external peer review process, has PubMed indexing and is assigned with an impact factor.

## Value of major incident case reports

Expert opinions have been clear on the lack of scientific rigor in case reports and the need for more systematic reporting (54-59). This thesis advocates elevating the level of reporting by using standardised data in case reports. At the same time, it is important to acknowledge the

many good case reports that already exist (22-27, 128, 129) and that they have provided us with valuable information (130). Publications describing work in the aftermath of disaster (131, 132) shed light on the human stories behind the numbers and remind us of the importance of a sufficient and well-organised medical response in emergency situations. Since 1988, KAMEDO (114) has been a part of the Swedish National Board of Health and published almost 100 case reports on disasters worldwide (116). Even though the reporting is not uniform, they have also generated important knowledge (115).

In a 2016 editorial in *Prehospital Disaster Medicine*, the journal announced it would be accepting well-structured field reports from major incidents (133). The anticipated advantages are that such reports convey first-hand knowledge and are close to the actual occurrence, whereas limitations are subjectivity and possible lack of an overview. In our response to the editorial (83) we supported the need for well-structured case reports. The template presented in this thesis is compatible with publishing structured case reports with a standardised data set. An example is the case report from the major incident in Kent (134).

## Reporting from major incident field exercises

Field exercises are resource-intensive events, and it seems imperative that evaluations should be structured to ensure learning in the participating EMS services and the greater EMS community (78). Reporting from field exercises in a structured manner with pre-defined data should be considered compulsory in order to facilitate learning and to compare responses and outcomes between several exercises. Several researchers have advocated the importance of learning from such exercises and suggested reporting solutions (73-76, 135). Majorincidentreporting.net allows the submission of field exercise reports. Two such reports were made available in 2016 from airplane crash exercises in Finland. The advantage of the current template is that it offers the same template for real-life incidents and exercises and is open access to both those submitting reports and those wishing to read them. Reporting from field exercises is also a valuable experience for familiarising oneself with the Major Incident Reporting Template, possibly making it easier to report from real-life incidents in the future.

## Dissemination and implementation of the template

*"Dissemination: the active and planned efforts to persuade target groups to adopt an innovation. Implementation: active and planned efforts to mainstream an innovation within an organisation. Sustainability: making an innovation routine until it reaches obsolescence."*

*- Greenhalgh et al (136)*

Dissemination and implementation of the template have been challenging. Despite the template being freely available online for three years, no more than eight reports are available. Information on the template has been disseminated by the making of an animation video (137) using international and local medical journals (78-83, 138) and an entry in the BioMed Central blog. Social media has been used whenever possible. Efforts to spread information on the template are continually being made by the editorial board of the website, as well as collaborators. It has been estimated to take an average of 17 years for scientific findings to reach clinical practice (139). In that respect, one should remain optimistic about the future of the major incident reporting project. Finding stable funding and being anchored within an organisation will be critical future steps to ensure further implementation and sustainability of the template.

### Formal and legal regulations

In the beginning of the implementation phase, the question was raised of whether the template and website were to be considered health registries. The National Centre for Clinical Documentation and Evaluation (140) was consulted and concluded that the database is not a health registry, which is defined in Norway as:

*"A registry where health information is stored systematically so that information on the individual easily can be retrieved"* (141).

Another question that was raised was whether confidentiality would be upheld in high profile cases with few casualties for which information on patients could be available in the public domain. Due to the management and ownership of the database currently being situated in Norway, the Norwegian Data Protection Authority was consulted. Their decision was that, as long as no data on less than six persons is included in reports, it will not violate patient confidentiality regulations. The online template was updated to accommodate this decision.

However, even data on more than six patients may breach confidentiality if presented together with data that allows for identification of the individuals. Therefore, disclaimers to which both the authors and readers of reports must agree were developed to clarify responsibilities for report content (Figure 16). Further, the peer-review and editorial process that reports undergo prior to publication aim to reduce the risk of confidential data being published.

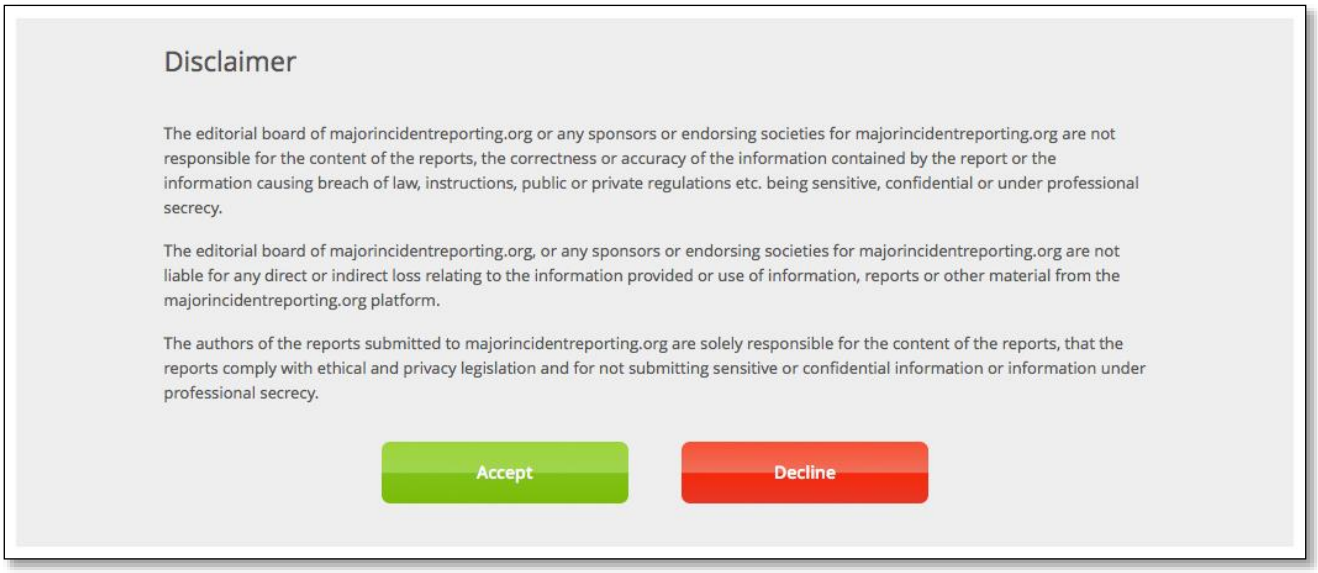



**Figure 16. Disclaimer to be accepted before accessing submitted reports. A similar disclaimer is mandatory upon submitting a report.**

The rule of not reporting data on less than six persons is challenging with respect to generating knowledge on the interventions and outcomes of treated patients. A future solution may be to couple the patient data in the template with trauma registries.

## Successful development and implementation of checklists

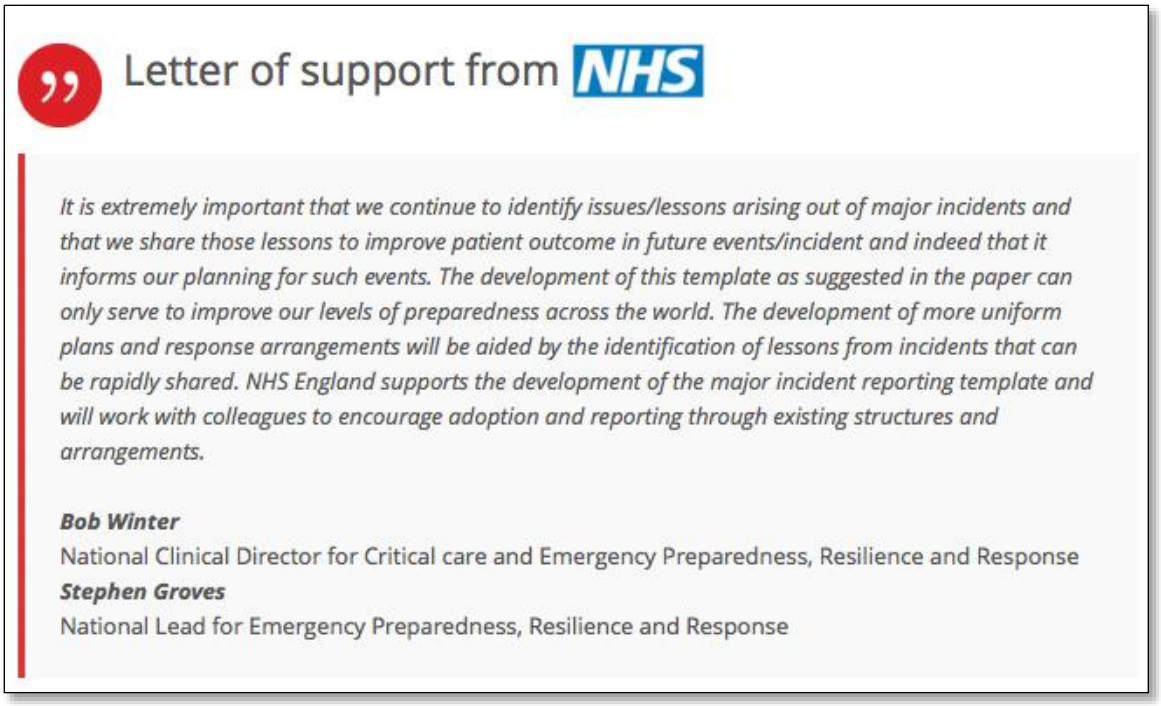
In research on checklists (142), successful development and implementation has been shown to be related to:

- the end users being involved in the development process
- the department head assuring the quality of the product
- any involved third parties being informed and consulted
- a well-recognised or leading person representing the implementation

These factors may also be relevant in the development and implementation of reporting templates. Table 3 shows which factors have been applied in our work so far and which still need to be addressed.

| Factors likely relevant in development and implementation | Status in the majorincidentreporting.net project |
|---|---|
| The end users must be involved in the development process. | The templates are intended to be of both clinical and academic value. Therefore, they were developed by individuals working clinically and those with an academic view of major incidents. Both the intended and actual users of the template have been those who were directly involved in the pre-hospital major incident medical management of either real-life incidents or field exercises. The template is also relevant for journal editors to implement standardised reporting of major incident case reports. |
| Head of department must assure the quality of the product. | In the case of the major incident reporting project, the department head would be the EMS heads and relevant authorities. So far these persons have not been asked to conduct quality assurance. |
| Any involved third parties must be informed and consulted. | Commentaries and social media have been used to inform the EMS community. One may conduct further studies investigating the EMS community's experiences with and opinion of the template. |
| A well-recognised or leading person must represent the implementation. | Early in the implementation phase the NHS wrote an endorsing letter for the template (Figure 17). Similar actions may be of value in the future. |

**Table 3. Status of the majorincidentreporting.net project with respect to elements claimed to increase successful implementation.**




**Figur 17. Letter of support for the Major Incident Reporting Template from the National Health Service (NHS), United Kingdom.**

### The Plan-Do-Study-Act cycle

The plan-do-study-act cycle (PDSA) is a series of repetitive steps used in the implementation of a procedure, intervention, or other planned inventions (143). The PDSA cycle in relation to the Major Incident Reporting project is presented in Table 4.

| PDSA cycle step | First round of cycle | Second round of cycle |
|---|---|---|
| **Plan** - identify goal or purpose. Formulate theory. | The goal was identified after a systematic literature review. A theory was formulated of what a useful template should contain. | The need to have a larger number of reports submitted has been identified. The theories on how this can be achieved: less demanding template to fill in, broader implementation, translation of template. |
| **Do** – implementation. | Templates have been made using expert opinions and thereafter implemented online.<br>Dissemination has been attempted by commentaries in scientific papers and social media. | The revised template has been implemented.<br>Reports from field exercises are possible to submit.<br>The steering group continues to disseminate knowledge of the project in journals and social media |
| **Study** the implementation and outcome. | A first study of feasibility has been conducted. | Future studies are needed (will be presented under the section "Implications of findings for future research"). |
| **Act** - modify according to outcome/findings. | The template has been revised based on user input in the feasibility study. | Actions will need to be taken according to findings in studies mentioned above. |

**Table 4. The Plan-Do-Study-Act (PDSA) cycle in relation to the Major Incident Reporting project.**

## Analysing data in published reports

Eight reports are currently available on majorincidentreporting.net. When a larger number of reports are available, data can be collated and investigated for trends and associations. Examples of hypotheses that may be generated are illustrated in the examples given below.

### Timelines

Timelines can be developed to provide overview of differences in incident and response events (Figure 17).

Using the timings, one may investigate possible associations. For example, the two fires (a tunnel fire in Norway and a prison fire in Chile) had the slowest times from occurrence to EMS arrival (49 min and 77 min, respectively). They also had the longest times from major incident occurred to major incident declared (66 min and 72 min, respectively). Thus, one may generate a hypothesis such as: incidents involving fires are initially under the control of the fire service and it is not until later that the EMS are dispatched. This could then lead to research projects considering this factor specifically.

Another example of a possible association could be: England and Finland had the shortest times between major incident occurred and arrival of the first EMS vehicles (11 min and 12 min, respectively). They also have the shortest time from major incident occurred to time of initial communication between different rescue organisations (25 min and 17 min, respectively). As England and Finland are the only two countries to have a single telephone number for all emergency services, a possible hypothesis is that short response times could be an indication that a single dialling number for all emergency services is efficient.


**Figure 18. Example of how timelines can be manually developed and compared using data in submitted reports.**

**Triage**

Graphs of the different triage categories in each incident can be presented to provide an overview of injury severity. This may indicate which incidents could be relevant to compare regarding the EMS response and patient care and outcomes.

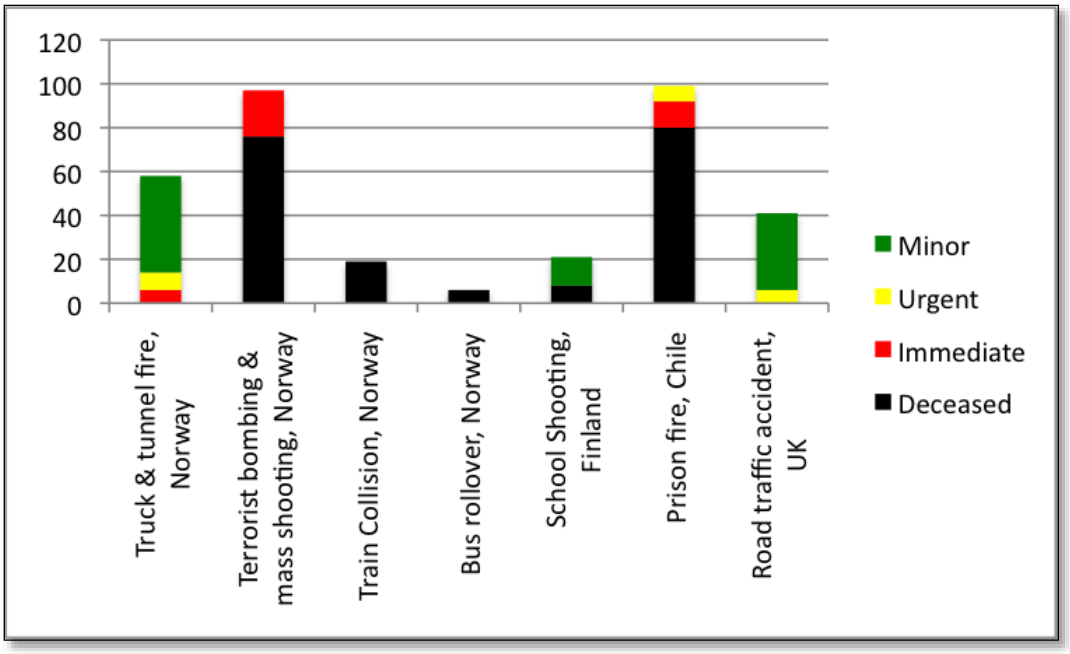



**Figure 19. Pre-hospital triage categories in each incident. In the report from the gas explosion in Mexico the triage categories were unknown. Courtesy of Sophie Elizabeth Jap Hardy.**

## Implementing lessons learned

Given that a standardised template for reporting major incident medical management is successfully implemented, some challenges may still be faced when implementing lessons learned.

Summarising the findings of previous studies, Drupsteen wrote in her thesis (144) that there are several hurdles to learning from incidents: too few incidents are reported, too little information is given about the incident, latent causes for the incident are not identified, and implementation of remedial actions is impeded. Furthermore, in the paper "Why do organisations not learn from incidents? Bottlenecks, causes, and conditions for a failure to effectively learn" (145), the authors studied which factors are failing when implementing

lessons learned from occupational accidents. Their study showed that reporting, selection, investigation, planning actions, and performing actions are considered bottlenecks. Factors mentioned are not knowing how and what to report, lack of time to do so, unwillingness to report in fear of negative consequences, systematic causes not being identified, limited employee involvement in planning interventions, and no sense of ownership to perform actions. In addition, a fear of extra work and lack of urgency due to not so serious incidents hinder interventions being implemented. Similar issues could be present in the EMS as well as other health care systems and should be investigated further.

This thesis does not seek to address these issues. However, it is important to keep in mind in future work that more is needed to learn lessons than solely providing a means of reporting.

## Strengths and limitations of methods applied in the thesis

### Paper I

In accordance with existing guidelines (90, 91), the study protocol for the systematic review was pre-registered and published (89) to assure full transparency in the research process and avoid data driven decisions. The systematic review was conducted according to PRISMA guidelines (92, 93). There was a deviation from the Cochrane Handbook for Systematic Reviews of Interventions (94), with only one author screening the initial findings rather than two. This was due to a lack of resources. As no further templates have been identified in the later work with this thesis, this indicates that all relevant templates were likely identified. Both the data extraction and quality appraisal items were a result of the authors' assumptions of what should be essential data to report with regards to internal and external validity. However, they do not represent a gold standard and are not a validated dataset. To the best of our knowledge, no such standards exist.

### Paper II and paper IV

In paper II, a modified NGT was used, whereas in paper IV the Delphi method was applied. Both methods were used previously in knowledge development in the field of emergency medicine (95, 111). These research methods have been used for programme planning in education, health, and social services (146). Both the Delphi and NGT consensus methods have been used for many years in medicine (147). The Delphi method is performed via e-mail only, allowing for a large number of participants and many rounds without geographic

restraints. This facilitates time- and cost-efficiency while allowing experts to voice their opinions in anonymity (104). The NGT traditionally consists of groups of less than 15 participants meeting face-to-face (146). This can be both a disadvantage, as the most dominant participants may be more easily heard, and an advantage, as it allows the group to discuss and comment on the ideas expressed. In the modified NGT (95), the bias of views not being expressed equally by all experts is reduced by allowing the first two stages (brainstorming and prioritising ideas) to be performed anonymously by e-mail. The structured results of the first stages are then discussed face-to-face at a 2-day meeting. In the case of paper II, such a meeting was necessary to allow ideas to be structured into a template. The disadvantage was that the costs of the meeting placed a geographic constraint that may present a challenge with regard to external validity in countries outside of northwestern Europe. In paper IV, we also chose European experts due to the EUPHOREA network being an available sample from which we could choose experts who fulfilled the inclusion criteria and for whom we had contact information.

*"Consensus participants should qualify for selection because they are representative of their profession, have power to implement the findings, or because they are not likely to be challenged as experts in the field."* - *Fink et al (147)*

The credibility of consensus studies is partly due to the participants (147). The Major Incident Reporting Collaborators (148) are a group representing both previous templates, clinical experience with pre-hospital major incident management, and academic work in the field. The HEMS Major Incident Reporting Collaborators were a group of HEMS physicians with clinical and research experience, as indicated by their involvement in the EUPHOREA network (paper IV). Had a different composition of experts been used one may have had different results. For this reason follow-up studies testing feasibility among those intended to use the templates are important.

With the modified NGT, moderators interact with the participants more actively and have more responsibility than with the Delphi method (147). In our case, they had moderated several consensus processes previously and were aware of their potential influence (46, 96-98). In both studies the researchers sought to not influence participants' ratings and opinions.

### Paper III

The main limitation of paper III is the low number of respondents and that informants who had used and were in the process of considering to use the template participated. The advantage of including the latter group is that persons who may have had objections to the template could also voice their opinions. Even with a low number of respondents, saturation was reached, i.e., the last informants did not provide new information (99). Due to the low number of published reports and the possibility of identifying an informant, gender, geographic location and detailed descriptions of their background could not be given. Despite its limitations, paper III provided valuable information for revising the template. The main author conducted the interviews and did not seek to influence answers. Despite this intention, the fact that revision was planned could have lead the informants to voice more clearly those aspects which could be improved with the template.

## Validity, reliability and accuracy

When developed, the templates were intended to be used by those who themselves had responded to a major incident or taken part in the management of them. Since the source of data collection will vary from one EMS system to another it is a relevant question to ask how data is validated and checked for error. A solution suggested in the first version of the major incident template was to supplement several of the questions with a follow-up question pertaining to the source of the data. Due to the feedback that the first version was too comprehensive, this was taken out of the revised version. One way to check data is to compare content of reports with other available data sources. This has not been done to date.

The Major Incident Reporting Database allows for several reports to be submitted by different authors from one incident. Reliability of data will be influences by perception of a situation according to a person's role and position on scene. Recently, a pilot inter-rater variability study was applied using the first version of the Major Incident Reporting Template (149). In this study several reporters applied the template to the same field-exercise. The analysis of the pilot data showed that the inter-rater variability for binary questions was fair (Cohen's kappa 0.21-0.40). A recommendation by the authors was to undertake a future study using reporters with non-clinical roles and a broader perception of the incident. Perhaps the most reliable data would be possible through collaboration between non-clinical reporters present at the scene and those who participated in the clinical response to the incident.

In incidents concerning national security data might be classified and made unavailable. The same might apply in EMS with less established reporting systems and in some categories of major incidents where infrastructure completely collapses. In the feasibility study (paper III), informants stated that the template contains data that are difficult to report due to the information not being collected accurately or not collected at all in the pre-hospital setting. Informants also stated that it could be difficult to understand which data were supposed to be reported in some questions.

All the abovementioned factors may be a source of low accuracy in the contents of reports. Standardising definitions, improving pre-hospital data collection and ensuring that those filling in the template have authorisation to access necessary data, could most likely improve accuracy.

## Transferability

*"Transferability is the range and limitations for application of the study findings, beyond the context in which the study was done." –Malterud (150)*

Only Western European experts have developed both templates. Therefore, investigating whether they are externally valid for non high-income EMS systems will be important.

# Conclusions

This thesis shows how systematic reviews can be useful for identifying current knowledge and assessing the need for a new research project. We describe the rationale for a new consensus-based, open access template for reporting pre-hospital major incident medical management. We also depict how it was possible to achieve consensus, create a database, and have people submit reports using the template. Users and potential users were interviewed and their feedback used to revise the Major Incident Reporting Template. The main challenge was the low numbers of respondents in the feasibility study. A lack of submitted reports also presents a challenge in comparatively analysing incidents. However, given the relatively short timeframe in which the template has been available, there is reason to remain optimistic regarding a larger number of studies and reports being published in the future.

The results of submitted reports are intended to provide data for research and share information so that the policy maker, managers, and medical personnel planning for and attending to major incidents can be better prepared for future incidents. The future of the template and website depend on funding and anchorage within an organisation that can provide the necessary resources to sustain the project. If we as a society wish to have this kind of information for future research and health care system improvements, it is necessary to allocate adequate resources. Ultimately, the goal should be to benefit the many persons affected by major incidents. No number of international frameworks or PhDs will make a difference unless lessons are learned and implemented in real-life and made freely accessible.

## Implications of findings for future research

This thesis provides the EMS community with a starting point for gathering standardised data from major incidents and making the results freely accessible to others. Deciding on a single template may be beneficial for uniform reporting from the immediate medical response to major incidents through collaboration with interested parties. For this purpose, a Delphi study may be beneficial to allow experts with a broad geographic representation to participate. Future research needs to address the feasibility, validity, and reliability of such a uniform template. A substantially greater number of submitted reports is needed to perform comparative analyses of responses and outcomes. In future research projects, the use of both qualitative and quantitative data could, through triangulation, shed new light on how the response to major incidents and patient outcomes can be optimised.

The HEMS Major Incident Reporting Template illustrates how other similar templates of interest may be developed to complement the Major Incident Reporting Template. Interesting topics may be the chemical-biological-radiation-nuclear (CBRN) response to major incidents, or specific templates for fire, police, and other rescue services. Such efforts should begin with gathering current knowledge through a systematic review.

In addition, studies are needed to identify reluctance to reporting in order to explain why so few reports are being submitted relative to the number of incidents occurring. Patient-specific data are difficult to report with the current solution. Such data may be gathered if the template data are successfully merged with existing trauma registries. Research on the external validity of the template outside of Europe is important given the impact incidents have on the most disadvantaged. With two reports from Latin America already available, there are prospects for increased global implementation.

| Need | Possible solution |
|---|---|
| Unite upon a single template | Delphi process |
| Comparative analysis of data in reports | More reports submitted |
| More reports submitted | Research on reluctance in reporting |
| Global implementation of template | • Include global experts in the Delphi process<br>• Feasibility study in non-European context<br>• Translation of template to several languages<br>• Increasing the number and geographic distribution of endorsing societies |
| Testing reliability of template | Inter-rater variability study |
| More detailed patient data | Coupling patient data in template to trauma registries |

**Table 5. Possible future research on the Major Incident Reporting project.**

# Errata

Paper I:

Sums in bottom row of Figure 3 are incorrect. The corrected sums are marked in red:

| | Basic info on affected area? | Characteristics and number of affected population prior to MI? | Other pre-event information reported? | Time and date of MI? | Description of damage caused by MI? | Number deceased? | Number severely injured? | Number moderately injured? | Number slightly injured? | Number uninjured? | Other incident information reported? | Information received by ambulance dispatch centre (ADC)? | Information provided by ADC to responder? | Accessibility of the incident site? | Time from alarm to arrival at scene? | Safety situation at and around incident site? | Available pre-hospital resources? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No. of √** | **3** | **3** | **6** | **5** | **6** | **6** | **5** | **5** | **6** | **5** | **7** | **3** | **2** | **2** | **4** | **3** | **5** |

| | Pre-hospital resources lacking? | Pre-hospital triage systems used? | Situation of pre-hospital telecommunications system? | Communication between rescue workers/aid organisations? | Coordination of rescue/relief work? | Time required for moving casualties from site to next level of care? | Scaling-up and -down of response? | Other system characteristics reported? | Children, adults, senior citizens, or all age groups involved? | Triage classification patients received through ADC? | Triage at first evaluation on scene? | Triage before transport to next level of care? | Injury models used? | Median/mean injury score reported? | The most frequent medical injuries/illnesses? | How medical illness was classified? | Other descriptors of patient characteristics? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No. of √** | **5** | **3** | **5** | **4** | **4** | **4** | **3** | **9** | **3** | **0** | **2** | **0** | **2** | **2** | **3** | **7** | **6** |

In Figures 3 and 4, Debacker (13) should be Debacker (12).

Paper II:

Erratum concerning correct creditation of the collaborating consensus group:

Fattah S, Rehn M, Lockey D, Thompson J, Lossius HM, Wisborg T, and The Major Incidence Reporting Collaborators. Erratum: A consensus-based template for reporting of pre-hospital major incident medical management. Scand J Trauma Resusc Emerg Med 2014, 22:42.

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## Appendix 1 – complete search strategy performed in Paper I

| | Searches |
|---|---|
| 1 | exp Disasters/ |
| 2 | exp Accidents/ |
| 3 | exp Terrorism/ |
| 4 | exp Mass Casualty Incidents/ |
| 5 | exp Emergencies/ |
| 6 | exp Geological Processes/ |
| 7 | exp Explosions/ |
| 8 | exp Fires/ |
| 9 | exp Warfare/ |
| 10 | exp Accidents, Aviation/ |
| 11 | exp Biohazard Release/ |
| 12 | exp Chemical Hazard Release/ |
| 13 | exp Radioactive Hazard Release/ |
| 14 | major accident*.ti,ab,kw. |
| 15 | major incident*.ti,ab,kw. |
| 16 | or/1-15 |
| 17 | exp "Outcome and Process Assessment (Health Care)"/ |
| 18 | exp Disaster Medicine/ |
| 19 | exp Data Collection/ |
| 20 | exp Evaluation Studies as Topic/ |
| 21 | exp "Surveys and Questionnaires"/ |
| 22 | exp Health Planning/ |
| 23 | exp Civil Defense/ |
| 24 | exp Medical Missions, Official/ |
| 25 | exp Disaster Planning/ |
| 26 | exp Qualitative Research/ |
| 27 | exp Learning/ |
| 28 | contingency plan*.ti,ab,kw. |
| 29 | emergency management*.ti,ab,kw. |
| 30 | template*.ti,ab,kw. |
| 31 | structured field report*.ti,ab,kw. |
| 32 | or/17-31 |
| 33 | report*.ti,ab,kw. |
| 34 | after-action report*.ti,ab,kw. |
| 35 | KAMEDO report*.ti,ab,kw. |
| 36 | disaster case report*.ti,ab,kw. |
| 37 | guideline*.ti,ab,kw. |
| 38 | lessons learned.ti,ab,kw. |
| 39 | lessons identified.ti,ab,kw. |
| 40 | lessons observed.ti,ab,kw. |
| 41 | or/33-40 |
| 42 | 16 and 32 and 41 |

# Appendix 2

# Template for reporting pre-hospital medical major incident management

MAJOR INCIDENT REPORTING

NORSK LUFTAMBULANSE
NORWEGIAN AIR AMBULANCE

LONDON'S AIR AMBULANCE

# Template for reporting pre-hospital medical major incident management

○ Indicates that only one option can be ticked.
□ Indicates that several options can be ticked.

## Pre-incident data

Free text. Maximum number of words: 500.
Please provide following minimum information: in which country/ies did the major incident occur. The population and population density (number of people living per unit of an area) in the affected area. Information on pre-existing infrastructure stating accessibility in the area (by road, train, boat, foot) and the telecommunications network. You should also describe any special conditions in the country and area.

## EMS background

| | |
|---|---|
| 1 | **Was an EMS coordinating centre (the centre responsible for dispatching and coordinating EMS units on-scene) available in the affected country/ies before the incident?**<br>○ Yes<br>○ No |
| 2 | **Does a dialling number to Emergency Services exist?**<br>○ Yes<br>○ No<br>*If yes: a single and unique dialling number to EMS or one common dialling number for all Emergency Services (fire, police and EMS)?*<br>*If no: please specify how EMS is alerted.* |
| 3 | **Can a major incident be declared directly by the person receiving an alert at the EMS coordinating centre?**<br>○ Yes<br>○ No<br>○ Unknown |
| 4 | **What is the background of staff in the every-day/normal staffing of EMS services? Please tick for all options that apply.**<br>☐ Basic Life Support by non-EMS professional<br>☐ Basic Life Support by EMS professionals, non-physician<br>☐ Advanced Life Support by EMS professional, non-physician<br>☐ Advanced Life Support on-scene by physician<br>☐ Other/unknown<br>*If other please specify.* |
| 5 | **What other resources are routinely available to assist the EMS service in a normal setting? Please tick for all options that apply.**<br>☐ Fire brigade<br>☐ Police<br>☐ Voluntary organizations.<br>☐ Coast guard<br>☐ Military<br>☐ Civil protection<br>☐ Other/unknown<br>*If other please specify.*<br>*If voluntary organizations are available please specify which and if these require authorisation from police or other authorities to participate in the response phase.* |

| | |
|---|---|
| 6 | **What other resources can be mobilized in a major incident? Please tick for all options that apply.**<br>☐ Fire brigade<br>☐ Police<br>☐ Voluntary organizations<br>☐ Coast guard<br>☐ Military<br>☐ Civil protection<br>☐ Other/unknown<br>*If other please specify.*<br>*If voluntary organizations are available please specify which and if these require authorisation from police or other authorities to participate in the response phase.* |
| 7 | **How many and what type of hospitals exist within the EMS catchment system that was affected by the major incident? Please tick for all options that apply.**<br>☐ Regional hospital with trauma specialty<br>☐ Regional hospital without trauma specialty<br>☐ Local hospital without trauma specialty<br>☐ Other types of hospitals. Please specify<br>*Please state whether the numbers are estimated or exact.* |
| 8 | **Is a pre-hospital on-scene triage system in use daily on a national level?**<br>○ Yes<br>○ No<br>○ Unknown<br>*If yes please specify which triage system/s.*<br>**Is a pre-hospital on-scene triage system in use daily on regional levels?**<br>○ Yes<br>○ Yes, but different triage systems exist in different regions<br>○ No<br>○ Unknown<br>*If yes please specify which triage system/s.* |
| 9 | **Is a pre-hospital on-scene triage system for major incidents in use on a national level?**<br>○ Yes<br>○ No<br>○ Unknown<br>*If yes please specify which triage system/s.*<br>**Is a pre-hospital on-scene triage system for major incidents in use on regional levels?**<br>○ Yes<br>○ Yes, but different triage systems exist in different regions<br>○ No<br>○ Unknown<br>*If yes please specify which triage system/s.* |
| 10 | **Does the pre-hospital on-scene triage system for major incidents include direct tagging/labelling of patients?**<br>○ Yes<br>○ No<br>○ Unknown<br>○ N/A |
| 11 | **For those employees within the pre-hospital EMS system who are intended to work on-scene: is major incident training mandatory?**<br>○ Yes<br>○ No<br>○ Unknown |

# Incident characteristics

| | |
|---|---|
| 12 | **What was the mechanism/external factor that caused the incident? Please tick for all options that apply.**<br>☐ Transport accident<br>☐ Extreme weather<br>☐ Seismic incident<br>☐ Fire<br>☐ Mass gathering<br>☐ Explosive<br>☐ Industrial accident<br>☐ Nuclear or radiological incident<br>☐ Biological incident<br>☐ Chemical incident<br>☐ Other. Please specify<br>*If extreme weather please choose one of the options below:*<br>☐ Avalanche<br>☐ Flooding<br>☐ Thunderstorm<br>☐ Hurricane<br>☐ Extreme heat<br>☐ Extreme cold<br>☐ Other. Please specify<br><br>**Is this incident coupled to another incident?**<br>○ Yes<br>○ No<br>*If yes, which incident?* |

| | |
|---|---|
| 13 | **What was the location of the incident scene? Please tick for all options that apply.**<br>☐ Urban area<br>☐ Rural/ countryside area<br>☐ Offshore/ maritime (ocean, river, lake)<br>☐ Mountain<br>☐ Road<br>☐ Airport<br>☐ Educational facility<br>☐ Public facility<br>☐ Health care facility<br>☐ Building<br>☐ Mass gathering<br>☐ Other/unknown<br>*If other please specify.* |
| 14 | **What was the EMS' mode of access to treat patients at incident scene? Please tick for all options that apply.**<br>☐ Wheeled vehicles<br>☐ Rail<br>☐ Air<br>☐ Boat<br>☐ Foot<br>☐ Other. Please specify<br>*For each ticked alternative please specify if there was a delay in accessing the patient in order to start evaluation/treatment and why this occured.*<br>*Reasons for delay could include reasons such as: security issues, congested roads due to traffic, weather conditions.* |
| 15 | **What was the EMS' mode of evacuating patients from the incident scene? Please tick for all options that apply.**<br>☐ Wheeled vehicles<br>☐ Rail<br>☐ Air<br>☐ Boat<br>☐ Foot<br>☐ Other. Please specify<br>*For each ticked alternative please specify if there was a delay in the evacuation of the patient/s and why this occured.*<br>*Reasons for delay could include reasons such as: entrapment, lack of transport capacity, weather conditions etc.* |
| 16 | **Was there damage to infrastructure that affected EMS response? Please tick for all options that apply.**<br>☐ Power<br>☐ Telecommunication<br>☐ Other modes of communication<br>☐ Road<br>☐ Rail<br>☐ Damage to the EMS or health structure<br>☐ Other damage. Please specify<br>*For each ticked alternative please state what the damage was and how it affected the EMS response.* |
| 17 | **How many sites required separate EMS infrastructure (such as on-scene leadership and casualty clearing stations) in the response phase?**<br>Please state whether the number is estimated or exact. |
| 18 | **Which hazards existed for rescuers on scene? Please tick for all options that apply.**<br>☐ On going violence or risk of further violence<br>☐ Fire<br>☐ Collapsing building/s<br>☐ Climate<br>☐ Lack of electricity<br>☐ Lack of water/food<br>☐ Other. Please specify<br>*For each ticked alternative please specify what the hazard was and how it affected the rescuers on-scene.* |
| 19 | **Which hazards existed for patients on scene? Please tick for all options that apply.**<br>☐ On going violence or risk of further violence<br>☐ Fire<br>☐ Collapsing building/s<br>☐ Climate<br>☐ Lack of electricity<br>☐ Lack of water/food<br>☐ Other. Please specify<br>*Fore each ticked alternative please specify what the hazard was and how it affected the patients on-scene.* |

# EMS response data

| | |
|---|---|
| 20 | The following questions are regarding on-scene initial actions by first medical team to arrive on-scene.<br><br>**Did the first medical team to arrive on-scene:**<br>☐ Assume the role of on-scene medical commander?<br>☐ Begin to make an assessment of scene safety?<br>☐ Communicate a situation report to EMS coordinating centre?<br>*If yes was this done according to a pre-existing system or mnemonic? (E.g. METHANE).*<br>☐ Request additional resources?<br>*If yes please specify what types of resources were requested.*<br>☐ Initiate any safety related actions?<br>*If yes please describe which.*<br>☐ Delegate responsibility for other tasks on scene?<br>*If yes please describe other tasks.*<br>For each ticked alternative the responder will be asked to provide time for each action (provided as date: year/month/day and time: hh:mm) and state whether the time provided is exact or estimated.<br><br>**What kind of medical personnel assumed the role of on-scene medical commander?** |
| 21 | The following questions are regarding system-level medical coordination.<br><br>**What time was summoning of additional medical staff to participate in the medical response initiated? (provided as date: year/month/day and time: hh:mm)**<br><br>**Were additional medical staff who responded to the major incident summoned by:**<br>☐ First medical team to arrive on-scene?<br>☐ On-scene medical commander?<br>☐ EMS coordinating centre?<br>☐ Other means? Please specify.<br><br>**Were medical pre-hospital resources used in the major incident response coordinated by:**<br>☐ First medical team to arrive on-scene?<br>☐ On-scene medical commander?<br>☐ EMS coordinating centre?<br>☐ Other means? Please specify.<br><br>**Who was responsible for briefing medical staff of the situation during the pre-hospital major incident medical response?**<br>☐ First medical team to arrive on-scene?<br>☐ On-scene medical commander?<br>☐ EMS coordinating centre?<br>☐ Other. Please specify. |
| 22 | The following questions are regarding medical communication<br><br>**Was communication achieved between medical personnel at the incident:**<br>○ Yes<br>○ No<br>○ Unknown<br><br>*If yes was this communication managed by:*<br>☐ First medical team to arrive on-scene?<br>☐ On-scene medical commander?<br>☐ EMS coordinating centre?<br>☐ Written reports?<br>☐ Other means? Please, specify.<br><br>*If yes, where possible please provide time for initiating the action (provided as date: year/month/day and time: hh:mm).*<br>*If no: why was communication not achieved?*<br><br>**Was communication achieved between the different task forces involved (police, fire fighters, health, political leaders etc)?**<br>○ Yes<br>○ No, between none of the task forces<br>○ Unknown<br><br>*If yes: was communication achieved between all of the task forces or only between some of the task forces?*<br>Follow up questions will be provided to specify between whom it was or was not achieved, and between whom it should have been achieved.<br><br>**Was communication achieved between the scene and the EMS coordinating centre:**<br>○ Yes<br>○ No<br>○ Unknown<br><br>If yes was communication managed by:<br>☐ First medical team to arrive on-scene?<br>☐ On-scene medical commander?<br>☐ EMS coordinating centre?<br>☐ Written reports?<br>☐ Other means? Please, specify.<br>*If yes, where possible please provide time for initiating the action (provided as date: year/month/day and time: hh:mm).*<br>*If no: why was communication not achived?* |

| | |
|---|---|
| | **Was communication achieved between the scene and receiving hospital/s:**<br>○ Yes<br>○ No<br>○ Unknown<br><br>If yes was communication managed by:<br>☐ First medical team to arrive on-scene?<br>☐ On-scene medical commander?<br>☐ EMS coordinating centre?<br>☐ Written reports?<br>☐ Other means? Please, specify.<br>*If yes, where possible please provide time for initiating the action (provided as date: year/month/day and time: hh:mm).*<br>*If no: why was communication not achived?*<br><br>**Was communication achieved between medical response personnel and the general public?**<br>○ Yes<br>○ No<br>○ Unknown<br><br>*If yes was this communication managed by:*<br>☐ First medical team to arrive on-scene?<br>☐ On-scene medical commander?<br>☐ EMS coordinating centre?<br>☐ Written reports?<br>☐ Other means? Please, specify.<br>*If yes, where possible please provide time for initiating the action (date and hh:mm).*<br>*If no: why was communication not achived?* |
| 23 | **Describe the structure of the medical incident command during the major incident (free text).** |
| 24 | The following questions are regarding modes of communication<br><br>**Which mode/s of communication were used during the major incident response? Please tick for all options that apply.**<br>☐ Radio, VHS<br>☐ Radio, tetra<br>☐ Other type of radio<br>☐ Mobile phone<br>☐ Land line telephone<br>☐ Communication to the public (such as television, social media)? Please specify mode of communication<br>☐ Other means of communication. Please specify<br>*For each ticked alternative please state if there were any failures to that mode of communication, specify what the failure was and how it affected the medical response.* |
| 25 | **Are the same communication systems mentioned above in use on a daily basis?**<br>☐ VHF radio<br>☐ Tetra radio<br>☐ Other type of radio<br>☐ Mobile phone<br>☐ Land line telephone<br>☐ Communication to the public (such as television, social media)? Please specify mode of communication<br>☐ Other means of communication. Please specify |
| 26 | **Please provide timings for the following (provided as date: year/month/day. Time: hh:mm):**<br>☐ Incident time<br>☐ Emergency Medical Service (EMS) notification<br>☐ First EMS arrival<br>☐ Major incident declared<br>☐ Medical command established<br>☐ Time of first meeting between police /fire / medical command<br>☐ 1st patient evacuated by EMS (time of leaving incident scene)<br>☐ Last patient evacuated by EMS (time of leaving incident scene)<br>☐ 1st patient arriving in hospital<br>☐ Last patient arriving in hospital<br>*Please state if the timings are estimated or exact.* |
| 27 | **Please describe any delays in the timings mentioned in question 26 (free-text).** |
| 28 | The following questions are regarding on-scene resources<br><br>**What was the number of persons in each category who were present at scene during the EMS response to the incident?**<br>☐ Lay person with no field care education<br>☐ Basic Life Support by non-EMS professional<br>☐ Basic Life Support by EMS professionals, non-physician<br>☐ Advanced Life Support by EMS professional, non-physician<br>☐ Advanced Life Support on-scene by physician<br>☐ Other personnel. Please specify.<br>☐ Unknown<br>*For each ticked option please state whether the number is estimated or exact.* |

| | |
|---|---|
| 29 | **What was the number of units in each transport category that responded to the major incident? Returning units are to be counted only once. Please tick for all options that apply.**<br>☐ EMS: vehicle.<br>☐ EMS: helicopter<br>☐ EMS: boat<br>☐ EMS: other. Please specify type<br>☐ Civilian: vehicle<br>☐ Civilian: helicopter<br>☐ Civilian: boat<br>☐ Civilian: other. Please specify type<br>☐ Other Emergency services: vehicle<br>☐ Other emergency services: helicopter<br>☐ Other emergency services: boat<br>☐ Other emergency services: other means of transport.<br>*If possible, please provide time of arrival for the first vehicle in each category.* |
| 30 | **What kind of equipment was available on-scene enabling EMS to do their job? Please tick for all options that apply:**<br>☐ Equipment to provide care for patients exposed to hazardous materials. Please specify<br>☐ Search and rescue equipment. Please specify<br>☐ Alpine/mountain rescue equipment<br>☐ Coast guard equipment<br>☐ Support vehicles. Please specify<br>☐ Other type of equipment. Please specify<br>*If possible please indicate the time when equipment was ready for use at the scene (provided as date: year/month/day and time: hh:mm).* |
| 31 | The following questions are regarding hospitals receiving patients<br><br>**How many hospitals received patients during the major incident?** |
| 32 | For each of the hospitals mentioned in question 31:<br>**What was the distance from incident scene? Distance measured as kilometers in air line.**<br><br>**Type of hospital**<br>☐ Regional hospital with trauma responsibility<br>☐ Regional hospital without trauma responsibility<br>☐ Local hospital<br>☐ Other types of hospitals. Please specify<br>☐ Unknown<br><br>**Number of patients conveyed to hospital:**<br>☐ By EMS<br>☐ By non-EMS<br>☐ In the first hour after the incident (<1 hour)<br>☐ Between 1 and 2 hours after the incident (≥1 hour <2hours)<br>☐ Between 2 and 3 hours after the incident (≥2 hours <3 hours)<br>☐ Between 3 and 4 hours after the incident (≥3 hours < 4 hours)<br>☐ After 4 hours or more following the incident (≥4 hours)<br><br>**Does a pre-existing patient distribution plan exist?**<br>○ Yes<br>○ No<br>○ Unknown<br><br>If yes, please explain any pre-existing patient distribution plan/s and give any comments on decision making, delays etc. |

# Patient characteristics

| | |
|---|---|
| 33 | **What was the estimated number of population at risk from the major incident? (e.g. number of passengers on a train / ship)**<br>Please explain how the above number of population at risk was reached? |
| 34 | **Gender**<br>☐ Males<br>☐ Females<br>☐ Unidentified/missing victims at the time of writing this report<br>*For each category please provide the number and if the numbers are estimated or exact.* |
| 35 | **Were there children requiring the attention of EMS?**<br>○ Yes<br>○ No<br>○ Unknown<br>*If yes number of:*<br>☐ Neonates (0-30 days)<br>☐ Infants (1 month-2 years)<br>☐ Young child (2-6 years)<br>☐ Adolescent (12-18 years)<br>*For each category please state if the number is estimated or exact.* |
| 36 | **What was the number of deaths on-scene before any medical care was provided?** |

| | |
|---|---|
| 37 | **What was the number of deaths after initial treatment, but before transport to hospital was started?** |
| 38 | **What was the number of deaths upon arrival at hospital, but for whom pre-hospital care and transport had been initiated?** |
| 39 | **If available: what was the 30-day mortality of those admitted to hospital?**<br>Please state whether figures are estimated or exact, and if data collection of 30-day mortality of those admitted to hospital is considered complete. |
| 40 | **Was a pre-hospital on- scene triage system used during the major incident response?**<br>○ Yes<br>○ No<br>○ Unknown<br><br>*If yes:*<br>**Who performed the on-scene pre-hospital triage?**<br>☐ Physician<br>☐ EMS personnel<br>☐ Other. Please specify.<br><br>**Which triage system was used?** |
| 41 | **Number of patients in each category upon first assessment on scene**<br>☐ Red = immediate<br>☐ Yellow = urgent<br>☐ Green = minor/delayed<br>☐ Black = deceased<br>☐ Other categories? Please specify.<br>*For each category please specify if the numbers are estimated or exact and please provide the data source from which these numbers originate.* |
| 42 | **Were any patients attended by EMS or medical staff at a primary health care facility and not admitted to hospital?**<br>○ Yes<br>○ No<br>○ Unknown<br>*If yes:*<br>*How many patients sustained minor injuries? Is the number given estimated or exact and from which data source do these numbers originate?* |
| 43 | **Was there any over-or undertriage?**<br>○ *Yes*<br>○ No<br>○ Unknown<br>*If yes: what was the % of overtriage, what was the % of undertriage. Please state any definition for triage precision calculations as well as the data source.* |
| 44 | **What was the total number of patients seeking care at a hospital?**<br><br>**What was the total number of patients admitted to hospital?**<br><br>**How many of the admitted patients were discharged within 24 hours?**<br>*Please state whether figures are estimated or exact and provide the data source (e.g.: hospital records).* |
| 45 | **Did any patients sustain the following types of injury?**<br>☐ Blunt trauma<br>☐ Penetrating trauma<br>☐ Burns<br>☐ Drowning<br>☐ Asphyxiation<br>☐ Hypothermia<br>☐ Intoxication/poisoning<br>☐ Infectious disease<br>☐ Acute psychiatric symptoms<br>☐ Nuclear or radiological injury<br>☐ Biological injury<br>☐ Chemical injury<br>☐ Other types of injury<br>*If possible: for each ticked alternative please specify the number, if the number is estimated or exact and please state the data source for which the numbers derive.* |
| 46 | **Were any patients admitted to critical care area?**<br>○ Yes<br>○ No<br>○ Unknown<br>*If yes:*<br>*Please state the number of patients admitted to critical care area, if the number is estimated or exact and state the data source.*<br>*Please explain how you define critical care.* |

# Key lessons

| | |
|---|---|
| 47 | **During the pre-hospital emergency medical response to this major incident, were there any particular problems that may be improved in future major incidents?**<br>○ Yes<br>○ No<br>*If yes: In what area/s did the problem/s occur?*<br>☐ Issues related to pre-incident situation in the country/region<br>☐ Issues related to EMS situation before the major incident<br>☐ Nature of the incident itself<br>☐ The EMS response<br>☐ Characteristics of the patients<br>☐ Other – please specify |
| 48 | **During the pre-hospital emergency medical response to this major incident, were there any particular successes that may enhance the response to future major incidents?**<br>○ Yes<br>○ No<br>*If yes: In what area/s did the problem/s occur?*<br>☐ Issues related to pre-incident situation in the country/region<br>☐ Issues related to EMS situation before the major incident<br>☐ Nature of the incident itself<br>☐ The EMS response<br>☐ Characteristics of the patients<br>☐ Other – please specify |

# Appendix 3

# Revised template for reporting pre-hospital medical major incident management


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# Template for reporting pre-hospital medical major incident management

Revised December 2015

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# Pre-incident data

* Indicates response required

**Country** *

**More than one country?** *

- ○ Yes
- ○ No

**Describe the area of the incident as much as possible (eg. GPS coordinates, population density, terrain)**

0/500 words

**Describe any special circumstances that were occurring in the area prior to or at the time of the incident that may have affected the situation ie.changes to the population or accessibility to the area that differed from normal (eg. did the major incident occur during a festival/rally/protest? Was there political unrest or upheaval or conflict in the area? Was accessibility to the area disrupted?)** *

0/500 words

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# Incident characteristics

* Indicates response required

**1.1. Date of incident** *

**1.1.2. Time (HH:MM) of incident**

**1.2. What was the mechanism/external factor that caused the incident? Please tick for all options that apply.** *

- [ ] Transport and industrial incident
- [ ] Extreme weather
- [ ] Seismic
- [ ] Fire
- [ ] Mass gathering
- [ ] Explosive
- [ ] Industrial accident
- [ ] Nuclear or radiological incident
- [ ] Biological
- [ ] Chemical
- [ ] Other / Unknown

**1.4. Is this incident coupled to another incident?** *

- ( ) Yes
- ( ) No

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# Incident characteristics

* Indicates response required

**1.5. What was the location of the incident scene? Please tick for all options that apply. ***

- [ ] Urban area
- [ ] Rural/countryside area
- [ ] Offshore/maritime (ocean, river, lake)
- [ ] Mountain
- [ ] Road
- [ ] Airport
- [ ] Education facility
- [ ] Public facility
- [ ] Health care facility
- [ ] Building
- [ ] Mass gathering
- [ ] Other / Unknown

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# Incident characteristics - continued

* Indicates response required

**2.1. What was the EMS' mode of access to treat patients at incident scene? Please tick for all options that apply. ***

- [ ] Wheeled vehicles
- [ ] Rail
- [ ] Air
- [ ] Boat
- [ ] Foot
- [ ] Other

**2.2. Please describe any delays of importance**

0/500 words

**3.1. What was the EMS' mode of evacuating patients from the incident scene? Please tick for all options that apply. ***

- [ ] Wheeled vehicles
- [ ] Rail
- [ ] Air
- [ ] Boat
- [ ] Foot
- [ ] Other

**3.2. Please describe any delays of importance**

0/500 words

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# Incident characteristics - continued

* Indicates response required

**4.1. Was there damage to infrastructure that affected EMS response? Please tick for all options that apply. ***

- [ ] Power
- [ ] Telecommunication
- [ ] Other modes of communication
- [ ] Road
- [ ] Rail
- [ ] Damage to the EMS or health structure
- [ ] Other damage
- [ ] No damage

**4.2. Please describe any delays of importance**

0/500 words

**4.3. How many sites required separate EMS infrastructure (such as on-scene leadership and casualty clearing stations) in the response phase? ***

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# Incident characteristics - continued

* Indicates response required

**5.1. Which hazards existed for rescuers on scene? Please tick for all options that apply. ***

- [ ] On going violence or risk of further violence
- [ ] Fire
- [ ] Collapsing building/s
- [ ] Climate
- [ ] Lack of electricity
- [ ] Lack of water/food
- [ ] Other
- [ ] No hazards existed

**5.2. If possible, please specify what the hazard was and how it affected the rescuers on-scene**

0/500 words

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# Incident characteristics - continued

* Indicates response required

**6.1. Which hazards existed for patients on scene? Please tick for all options that apply. ***

- [ ] On going violence or risk of further violence
- [ ] Fire
- [ ] Collapsing building/s
- [ ] Climate
- [ ] Lack of electricity
- [ ] Lack of water/food
- [ ] Other
- [ ] No hazards existed

**6.2. Please describe any delays of importance**

0/500 words

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# EMS response data

* Indicates response required

**7.1. Which (if any) of the following actions were implemented by the medical response ***

- [ ] Assume the role of on-scene medical commander
- [ ] Begin to make an assessment of scene safety
- [ ] Communicate a situation report to EMS coordinating centre
- [ ] Request additional resources
- [ ] Initiate any safety related actions
- [ ] Delegate responsibility for other tasks on scene

**7.1.1. Were these actions implemented by the first medical responder to arrive on scene? ***

- ( ) Yes
- ( ) No

**7.1.3. Do you have a dedicated on-scene medical commander in your EMS system? ***

- ( ) Yes
- ( ) No

**7.1.4. What kind of personnel assumed the role of on-scene medical commander in this incident?**

0/500 words

**7.2. Give details of which safety actions were initiated (eg. High visibility vests or personal protective equipment for responders)**

0/500 words

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# EMS response data - continued

**7.3. Give details of which tasks were delegated (eg. Ambulance parking officer, Primary triage officer)**

0/500 words

**7.4. If you have the times for these actions and the order they occurred please add them to the previously downloaded 'timeline of events' document. If there were reasons for tasks not performed, please elaborate**

0/500 words

**8.1. By whom were additional medical staff who responded to the major incident summoned? ***

- [ ] First medical team to arrive on-scene
- [ ] On-scene medical commander
- [ ] EMS coordinating centre
- [ ] Other means
- [ ] Unknown
- [ ] No additioal medical staff were summoned

**8.2. Please give details of which additional staff (eg. bronze, silver and gold officers, tactical advisors etc) were summoned, at what time they were summoned and at what time they arrived at their designated posts**

0/500 words

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# EMS response data - continued

* Indicates response required

**9.1. Were medical pre-hospital resources used in the major incident response coordinated by: ***

- [ ] First medical team to arrive on-scene?
- [ ] On-scene medical commander?
- [ ] EMS coordinating centre?
- [ ] Other means?

**9.2. If you have the times for these actions in the order they occurred please provide them here or in the downloaded Timeline of events document. If there were reasons for tasks not performed please elaborate.**

0/500 words

# Medical command structure

* Indicates response required

**10.1. Was there a pre-hospital major incident response plan in place? ***

- ( ) Yes
- ( ) No

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# Medical communication

* Indicates response required

**11.1. Was satisfactory communication achieved between those who needed to communicate during the incident?** *

- ◯ Yes
- ◯ No
- ◯ Unknown

**11.2. Who managed communication at the incident?** *

- ☐ First medical team to arrive on-scene
- ☐ On-scene medical commander
- ☐ EMS coordinating centre
- ☐ Other means

**11.3. If relevant, please describe any communication challenges**

0/500 words

**11.4. When available, please provide a timeline for central communication issues**

0/500 words

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# Mode of communications

* Indicates response required

**12.1. Which mode/s of communication were used during the major incident response? Please tick for all options that apply. ***

- [ ] Radio, VHS
- [ ] Radio, tetra
- [ ] Other type of radio
- [ ] Mobile phone
- [ ] Land line telephone
- [ ] Communication to the public (such as television, sms, social media)?
- [ ] Other means of communication

**12.2. Describe any failure to communication and how it affected the response**

0/500 words

**13.1. Which of the communication systems are in use on a daily basis? ***

- [ ] VHF radio
- [ ] Tetra radio
- [ ] Other type of radio
- [ ] Mobile phone
- [ ] Land line telephone
- [ ] Communication to the public (such as television, social media)?
- [ ] Other means of communication

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# EMS response data

* Indicates response required

**14.1. Please state number of lay persons with no field care education present at the incident scene ***

**14.2. Please state number of non-EMS personnel with basic life support (BLS) competency present at the incident scene ***

**14.3. Please state number of EMS professionals who were not physicians, but with BLS competency present at the incident scene ***

**14.4. Please state number of EMS professionals who were not physicians, but with Advanced Life Support (ALS) competency present at the incident scene ***

**14.5. Please state number of on-scene physicians with ALS competency present at the incident scene ***

**14.6. Please state number of other type of personnel/persons present at the incident scene ***

**14.6.1. Please specify other type of personnel/persons ***

0/300 words

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# Transport

* Indicates response required

**15.1.1. Number of EMS vehicles available at the incident scene ***

**15.1.2. Number of EMS helicopters available at the incident scene ***

**15.1.3. Number of EMS boats available at the incident scene ***

**15.1.4. Number of other type of EMS units available at the incident scene ***

**15.1.4.1. Please specify other type of EMS units ***

0/300 words

**15.2.1. Number of civilian vehicles available at the incident scene ***

**15.2.2. Number of civilian helicopters available at the incident scene ***

**15.2.3. Number of civilian boats available at the incident scene ***

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# Transport

* Indicates response required

**15.2.4. Number of other type of civilian units available at the incident scene ***

**15.2.4.1. Please specify other type of civilian units ***

0/300 words

**15.3.1. Number of other emergency services vehicles available at the incident scene ***

**15.3.2. Number of other emergency services helicopters available at the incident scene ***

**15.3.3. Number of other emergency services boats available at the incident scene ***

**15.3.4. Number of other units available at incident scene ***

**15.3.4.1. Please specify other type of units ***

0/300 words

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# Equipment

* Indicates response required

**16.1. What kind of equipment was available on-scene enabling EMS to do their job? Please tick for all options that apply** *

- [ ] Equipment to provide care for patients exposed to hazardous materials
- [ ] Search and rescue equipment
- [ ] Alpine/mountain rescue equipment
- [ ] Coast guard equipment
- [ ] Support vehicles
- [ ] Other type of equipment
- [ ] No equipment was available

**16.1.1. If any equipment was missing please describe**

0/300 words

# Patient surge data

* Indicates response required

**17.1. Number of receiving hospitals** *

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# Patient surge data

## Hospital I

**17.1.1. Distance from incident scene where pre-hospital medical response was initiated to hospital I by air line in kilometers** *

**17.1.2. Type of hospital I** *

**17.1.3. Date of first patient transported to hospital** *

**17.1.4. Time (HH:MM) of first patient transported to hospital**

**17.1.5. Date of last patient transported to hospital** *

**17.1.6. Time (HH:MM) of last patient transported to hospital**

If flow-chart data is available, download flow-chart template here > complete the template with your own data > upload the file below

**17.1.7. If available, upload a flow-chart**

Velg fil ingen fil er markert

Upload Delete

**17.1.8. If you have more details on the patient surge please provide them in the free-text field below**

0/300 words

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# Patient surge data (continued)

* Indicates response required

Note: If the number is 1-5 please check unknown. Due to patient confidentiality restrictions no data on less that 6 patients can be reported

**18.1. Number of patients with minor injuries** *

**18.2. Please provide the data source from which these numbers originate**

0/255 characters

**18.3. What was the total number of patients seeking care at a hospital** *

# Patient characteristics

* Indicates response required

Note: If the number is 1-5 please check unknown. Due to patient confidentiality restrictions no data on less that 6 patients can be reported

**19.1. What was the estimated number of people at risk from the major incident? (e.g. number of passengers on a train / ship)** *

**19.2. Please explain how the above number of population at risk was reached** *

0/300 words

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# Patient characteristics (continued)

* Indicates response required

Note: If the number is 1-5 please check unknown. Due to patient confidentiality restrictions no data on less that 6 patients can be reported

**20.1. Number of males injured** *

**20.2. Number of females injured** *

**20.3. Number of neonates injured** *

**20.4. Number of infants (1 month - 2 years) injured** *

**20.5. Number of young children (2-6 years) injured** *

**20.6. Number of children (6-12 years) injured** *

**20.7. Number of adolescent (12-18 years) injured** *

**20.8. Number of unidentified/missing victims** *

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# Patient characteristics (continued)

* Indicates response required

Note: If the number is 1-5 please check unknown. Due to patient confidentiality restrictions no data on less that 6 patients can be reported

**21.1. What was the number of dead on-scene/dead before any medical care was provided? ***

**21.2. What was the number of dead before arrival at hospital? ***

**21.3. What was the number of deaths of those admitted to the hospital within 30 days of the event? ***

**21.4. Is data collection of thirty day mortality of those admitted to hospital considered complete? ***

- ○ Yes
- ○ No
- ○ Unknown

**21.5. Was a pre-hospital triage system used? ***

- ○ Yes
- ○ No
- ○ Unknown

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# Triage

* Indicates response required

Note: If the number is 1-5 please check unknown. Due to patient confidentiality restrictions no data on less that 6 patients can be reported

**22.1. Number of patients in triage category red = immediate upon first assessment on scene** *

**22.2. Number of patients in triage category yellow = urgent upon first assessment on scene** *

**22.3. Number of patients in triage green = minor/delayed upon first assessment on scene** *

**22.4. Number of patients in triage category black = deceased upon first assessment on scene** *

**22.5. Number of patients who were triaged in another category than the previous upon first asesseement on scene** *

**22.5.1. Please describe the other triage categories** *

0/300 words

**22.6. Was there any over- or undertriage?** *

- ○ Yes
- ○ No
- ○ Unknown

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# Types of injury

* Indicates response required

Note: If the number is 1-5 please check unknown. Due to patient confidentiality restrictions no data on less that 6 patients can be reported

**23.1. Number of patients with blunt trauma** *

**23.2. Number of patients with penetrating trauma** *

**23.3. Number of patients with burns** *

**23.4. Number of patients drowned** *

**23.5. Number of patients with asphyxiation** *

**23.6. Number of patients with hypothermia** *

**23.7. Number of patients with intoxication/poisoning** *

**23.8. Number of patients with infectious disease** *

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# Types of injury

* Indicates response required

Note: If the number is 1-5 please check unknown. Due to patient confidentiality restrictions no data on less that 6 patients can be reported

**23.9. Number of patients with acute psychiatric symptoms requiring medical attention** *

**23.10. Number of patients with nuclear or radiological injury** *

**23.11. Number of patients with biological injury** *

**23.12. Number of patients with chemical injury** *

**23.13. Number of patients by other type of injury** *

**23.13.1. Please specify other types of injury sustained** *

0/300 words

**23.14. Number of patients admitted to critical care area** *

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# Key lessons

* Indicates response required

## Problems

**24.1. During the pre-hospital emergency medical response to this major incident, were there any particular problems that may be improved in future major incidents? ***

- ○ Yes
- ○ No

## Successes

**25.1. During the pre-hospital emergency medical response to this major incident, were there any particular successes that may enhance the response to future major incidents? ***

- ○ Yes
- ○ No

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# EMS background

* Indicates response required

**26.1. Was an EMS coordinating centre (the centre responsible for dispatching and coordinating EMS units to the scene) available in the affected country/ies at the time of the incident? ***

- ◯ Yes
- ◯ No

**26.2. Is there one common dialling number for all Emergency Services (fire, police, EMS) ***

- ◯ Yes
- ◯ No

**26.5. What is the background of staff in the every-day/normal staffing of EMS services? Please tick for all options that apply. ***

- ☐ Basic Life Support by non-EMS professional
- ☐ Basic Life Support by EMS professionals, non-physician
- ☐ Advanced Life Support by EMS professional, non-physician
- ☐ Advanced Life Support On-scene by Physician
- ☐ Other / Unknown

**26.6. What other resources are routinely available to assist the EMS service in a normal setting? Please tick for all options that apply. ***

- ☐ Fire brigade
- ☐ Police
- ☐ Voluntary organizations
- ☐ Coast guard
- ☐ Military
- ☐ Civil protection
- ☐ Other / Unknown

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# EMS background

* Indicates response required

**26.7. What other resources can be mobilized in a major incident? Please tick for all options that apply. ***

- [ ] Fire brigade
- [ ] Police
- [ ] Voluntary organizations
- [ ] Coast guard
- [ ] Military
- [ ] Civil protection
- [ ] Other resources / Unknown

**27.1. Does the country where the major incident took place have a trauma network? ***

- ( ) Yes
- ( ) No
- ( ) Unknown

**27.2. Are there any regional hospital/s with trauma specialty that exists within the EMS catchment system that was affected by the major incident? ***

- ( ) Yes
- ( ) No
- ( ) Unknown

**27.3. Are there any regional hospital/s without trauma specialty that exists within the EMS catchment system that was affected by the major incident? ***

- ( ) Yes
- ( ) No
- ( ) Unknown

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# EMS background

* Indicates response required

**27.4. Are there any local hospital/s without trauma specialty that exists within the EMS catchment system that was affected by the major incident? ***

- ◯ Yes
- ◯ No
- ◯ Unknown

**27.5. Are there any other type of hospital/s that exists within the EMS catchment system that was affected by the major incident? ***

- ◯ Yes
- ◯ No
- ◯ Unknown

**27.6. Is there a pre-hospital triage system in use on a daily basis on a national level? ***

- ◯ Yes
- ◯ No
- ◯ Unknown

**27.7. Is a pre-hospital triage system in use on a daily basis on regional levels? ***

- ◯ Yes
- ◯ Yes, but different triage systems exist in different regions
- ◯ No
- ◯ Unknown

**27.8. Is a pre-hospital triage system in use for major incidents on a national level? ***

- ◯ Yes
- ◯ No
- ◯ Unknown

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# EMS background

* Indicates response required

**27.9. Is a pre-hospital triage system in use for major incidents on regional levels? ***

- ◯ Yes
- ◯ Yes, but different triage systems exist in different regions
- ◯ No
- ◯ Unknown

**27.10. Does the pre-hospital on-scene triage system for major incidents include direct tagging/labelling of patients? ***

- ◯ Yes
- ◯ No
- ◯ Unknown
- ◯ N/A

**27.11. For those employees within the pre-hospital EMS system who are intended to work on-scene: is major incident training mandatory? ***

- ◯ Yes
- ◯ No
- ◯ Unknown

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# EMS background

* Indicates response required

**27.12. Does the region have a major incident plan? ***

- ◯ Yes
- ◯ No
- ◯ Unknown

**27.13. Is there an in-hospital major incident response plan for each hospital receiving patients? ***

- ◯ Yes
- ◯ No
- ◯ Unknown

**27.14. Is there a regional major incident response plan incorporating all emergency services within the area that the the major incident occured? ***

- ◯ Yes
- ◯ No
- ◯ Unknown

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# Additional files upload (OPTIONAL)

Please upload the previously downloaded files with your own data.

**28.1. Upload *time of events* document (Download document click here). Optional.**

Velg fil ingen fil er markert

Upload Delete

**28.2. Upload *flow chart of patient surge* document (Download document click here). Optional.**

Velg fil ingen fil er markert

Upload Delete

# Finished!

That's it! All you have to do now is hit the submit button to send us your reported data.
When submitting the form an e-mail with details on your submitttion will go out to the e-mail address as provided in the form.

**Thank you for your interest and contribution!**

# Appendix 4

# A consensus based template for reporting data on the use of Helicopter Emergency Medical Services in the immediate pre-hospital response to a major incident

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# A consensus based template for reporting data on the use of Helicopter Emergency Medical Services in the immediate pre-hospital medical response to a major incident

○ Indicates that only one option can be ticked
□ Indicates that several options can be ticked

## HEMS BACKGROUND INFORMATION

| | |
|---|---|
| **1a** | **Number of units available 24/7?** |
| **1b** | **Number of units with restricted working hours?** |
| **1c** | **Do the available units have rapid response cars as well?** |
| | ○ Yes<br>○ No |

| | |
|---|---|
| **2a** | **Is the HEMS unit staffed by a doctor?** |
| | ○ Yes<br>○ No |
| **2b** | *If yes:* **Is the HEMS service manned by physician with special training in pre-hospital critical care?** |
| | ○ Yes<br>○ No |

| | |
|---|---|
| **3** | **What, if any, is the pre-planned role of HEMS physician during major incidents? Please tick all options that apply** |
| | □ Medical commander<br>□ Treatment leadership<br>□ Triage<br>□ Provide medical care<br>□ Transportation of patient<br>□ Other |

| | |
|---|---|
| **4** | **What, if any, is the pre-planned role of the HEMS unit? Please tick all options that apply** |
| | □ Provide medical care<br>□ Search and rescue<br>□ Transportation. If yes: personnel? Equipment? Patients?<br>□ Command<br>□ Reconnaissance flights<br>□ Scene of accident only accessible by helicopter<br>□ Other (please specify) |

## MAJOR INCIDENT CHARACTERISTICS RELEVANT FOR HEMS

| 5 | **Was the site accessible for helicopters only, within a timeframe considered reasonable according to incident and local resources?** |
|---|---|
| | ○ Yes |
| | ○ No |
| | If possible, please explain |

| 6 | **Could lack of HEMS resources have changed the major incident operation adversely?** |
|---|---|
| | ○ Yes |
| | ○ No |
| | If possible, please elaborate |

| 7 | **Were there any hazards at the scene that specifically affected HEMS approach or access to the incident site? Please tick all options that apply** |
|---|---|
| | ☐ Weather |
| | ☐ Visibility |
| | ☐ Weapons |
| | ☐ Explosives |
| | ☐ Fire |
| | ☐ CBRN (chemical, biological, radiological, nuclear) |
| | ☐ No hazards |
| | ☐ Other (please specify) |

## HEMS RESPONSE TO MAJOR INCIDENT

### DISPATCH

| 8a | **Time of activation of first HEMS (DD:MM:YY and hh:min)** |
|---|---|
| 8b | **Time first HEMS arrived on-scene (DD:MM:YY and hh:mm)** |

| 9 | **How was HEMS alerted to respond to major incident?** |
|---|---|
| | ☐ By responsible emergency medical dispatch center immediately after receiving emergency call from bystanders |
| | ☐ Request from the ground EMS team(s) already at the scene |
| | ☐ Request from other rescue organization or institution (e.g. fire brigade, mountain rescue etc.) |
| | ☐ Other (please specify) |

| 10 | **Was HEMS activated as a part of local/regional/national major incident algorithm?** |
|---|---|
| | ○ Yes |
| | ○ No |

| 11a | **How many HEMS units were requested?** |
|---|---|
| 11b | **How many HEMS units responded?** |
| 11c | **During the response, how many flights in total were performed?** |

| 12 | What were the reasons for HEMS response? Please tick all options that apply |
|---|---|
| | ☐ Provide medical care |
| | ☐ Search and rescue |
| | ☐ Transportation. If yes: personnel? Equipment? Patients? |
| | ☐ Command |
| | ☐ Reconnaissance flights |
| | ☐ Scene of incident only accessible by helicopter |
| | ☐ Other (please specify) |

| 13 | If HEMS was unavailable or inoperable, what was the reason(s)? Please tick all options that apply |
|---|---|
| | ☐ Weather conditions * |
| | ☐ Other mission |
| | ☐ Distance* |
| | ☐ Personal decision* |
| | ☐ Communication issues |
| | ☐ Technical failure * |
| | ☐ Medical team unavailable |
| | ☐ Helicopter unavailable * |
| | ☐ Pilot unavailable * |
| | ☐ No landing site * |
| | ☐ Other* (please specify) |
| | ☐ Unknown |

*If question marked * is ticked a follow up question will appear: did HEMS crew respond by ground vehicle instead of helicopter*

## TASKS

| 14 | Was HEMS the first medical response team on scene? |
|---|---|
| | ○ Yes |
| | ○ No |
| | ○ Unknown |

| 15 | Did HEMS deliver the first physician on scene? |
|---|---|
| | ○ Yes |
| | ○ No |
| | ○ Not applicable (HEMS was not staffed with a physician) |
| | ○ Unknown |

| 16 | What was the HEMS role on scene during the major incident? Please tick all options that apply |
|---|---|
| | ☐ Purely medical treatment of patients |
| | ☐ Search and rescue |
| | ☐ Patient treatment |
| | ☐ Transportation. If yes: personnel? Equipment? Patients? |
| | ☐ Command |
| | ☐ Other (please specify) |

| 17 | Which tasks did the HEMS medical crew perform? Please tick all options that apply |
|---|---|
| | ☐ Medical incident commander |
| | ☐ Triage officer |
| | ☐ Treating patients on scene |
| | ☐ Treating patients in a designated treatment area |
| | ☐ Treatment area organisation / leadership |
| | ☐ Patient transportation to nearest facility |
| | ☐ Patient transport to secondary / tertiary facilities |
| | ☐ RSI (rapid sequence induction) |
| | ☐ Blood products |
| | ☐ Thoracotomies |
| | ☐ Amputation |
| | ☐ Other advanced procedure(s) or treatment(s) |
| | ☐ Other tasks (please specify) |
| | ☐ None |

| 18 | What did HEMS transport during the major incident? |
|---|---|
| | ☐ Patients. If ticked: total number of patients (% of all casualties) |
| | ☐ EMS physicians. If ticked: total number inclusive own crew |
| | ☐ EMS personnel. If ticked: total number inclusive of own crew |
| | ☐ Medical supplies |
| | ☐ Rescue material to be used on ground |
| | ☐ Advanced rescue material (i.e. search dogs, technical devices i.e. infrared camera) |
| | ☐ Support material for rescue teams |

| 19a | Total number of patients treated and/or transported by HEMS |
|---|---|
| 19b | Please describe the categories (age group, severity) of these patients. Free-text field |

## KEY LESSONS

| 20 | What, if any, were the safety challenges during HEMS major incident response? |
|---|---|
| | ☐ No challenges |
| | ☐ Aircraft crowding- air |
| | ☐ Aircraft crowding- ground |
| | ☐ Drones or press helicopters |
| | ☐ Difficult landing site |
| | ☐ Darkness |
| | ☐ Other flight hazards |
| | ☐ Use of protective gear |
| | ☐ Working in ”hot zone” (please specify) |
| | ☐ Other challenges |
| | ☐ Not able to comment |

| 21 | Please describe other key lessons. Free-text field |
|---|---|