

Local emergency medical response after a terrorist attack in Norway: a qualitative study

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ABSTRACT

Introduction On 22 July 2011, Norway suffered a devastating terrorist attack targeting a political youth camp on a remote island. Within a few hours, 35 injured terrorist victims were admitted to the local Ringerike community hospital. All victims survived. The local emergency medical service (EMS), despite limited resources, was evaluated by three external bodies as successful in handling this crisis. This study investigates the determinants for the success of that EMS as a model for quality improvement in healthcare. **Methods** We performed focus group interviews using the critical incident technique with 30 healthcare professionals involved in the care of the attack victims to establish determinants of the EMS' success. Two independent teams of professional experts classified and validated the identified determinants.

Results Our findings suggest a combination of four elements essential for the success of the EMS: (1) major emergency preparedness and competence based on continuous planning, training and learning; (2) crisis management based on knowledge, trust and data collection; (3) empowerment through multiprofessional networks; and (4) the ability to improvise based on acquired structure and competence. The informants reported the successful response was specifically based on multiprofessional trauma education, team training, and prehospital and in-hospital networking including mental healthcare. The powerful combination of preparedness, competence and crisis management built on empowerment enabled the healthcare workers to trust themselves and each other to make professional decisions and creative improvisations in an unpredictable situation.

Conclusion The determinants for success derived from this qualitative study (preparedness, management, networking, ability to improvise) may be universally applicable to understanding the conditions for resilient and safe healthcare services, and of general interest for quality improvement in healthcare.

INTRODUCTION

On 22 July 2011, Norway suffered from a devastating terrorist attack on the government centre in Oslo and, 2 hours later, on the small island of Utøya. Over both attacks, 77 people were killed and 78 injured, of whom 20 had serious injuries.^{1,2}

The terrorist targeted Utøya island during a summer camp for youth delegates of the Norwegian Social Democratic Party. There he killed 69 adolescents and young adults, and injured 65, 33 having gunshot wounds. Most of the 495 survivors were exposed to life-threatening situations and needed emergency mental health support.^{1,3} Utøya island is located about 500 m off the shore in a lake in a rural area about 1 hour northwest of the regional trauma centre in Oslo. The local Ringerike hospital, about 15 min north of the lake, received most of the casualties because of traffic congestion and limited 'flight following' function and capacity for air ambulance.^{2,4} Ringerike is a community hospital (level III) with 24-hour general surgical service to stabilise trauma patients before transfer to a trauma centre.^{5,6}

A Norwegian government commission evaluated the response of the Norwegian police force (including backup from special units in Oslo) as suboptimal in eliminating the immediate terrorist attack and its devastating impact on the lives of the young party delegates on Utøya island.^{1,7} The same government commission, and the Norwegian Directorate of Health² and the Swedish Disaster Medicine Study Organization³ evaluated the local emergency medical system (EMS) and concluded that it had handled the exceptional challenge in an outstanding manner, highlighting the following:

1. survival: All 35 patients who arrived at the local hospital survived, despite its capacity being exceeded after only 40 min.
2. good emergency preparedness with extra personnel meeting every patient with a complete, well-educated treatment team.
3. good psychosocial support of the victims and their families, crucial because 'part of



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the purpose behind a terrorist attack is to inflict serious, unexpected casualties in order to create fear to achieve political goals’.

4. providing patient lists to the police, recommending a clarifying of the law to support other health professionals to do the same in similar situations.
5. a recommended ‘Sister Hospital’ model for assisting the regional trauma centre.

Prior to 2011, Norway was already at the high end of statistics concerning mortality and morbidity due to injury in Europe.⁸ Large rural areas are harder hit by violent death than are urban areas.⁹ Because of a rather dispersed population, systematic, multidisciplinary trauma team training was recommended at every acute care hospital in 2007, as part of a national trauma system, and was met with various degrees of adaptation.^{6 10–15} In 2008 multiprofessional trauma team training courses in primary care were initiated,¹⁶ and followed up by general practitioners (GPs) and Norwegian health authorities.^{17–19} In contrast, disaster preparedness in American rural hospitals has been limited.²⁰ In the wake of disasters such as Hurricane Katrina, researchers have recommended systematic training and education of healthcare personnel.^{21–23} Systematic reviews, however, point out that evidence of good response preparedness based on training is weak because of the methodological challenges of the performed research.^{24 25}

We were curious about the reasons for the success of the local EMS.^{10 11 26–32} While there is a large literature on emergency preparedness and response, there is a striking lack of scientific evidence aimed at *understanding the conditions required* for resilient and safe healthcare service in remote areas. Learning from high performers stems from a growing number of ‘positive deviance’ approaches to quality improvement.^{33–35}

We here report a study of the organisational structures and intellectual underpinnings of the local Ringerike EMS to explain its success in a crisis situation which overwhelmed the regular EMS capacity.

Using interviews and focus group investigations with the personnel responsible for the medical and mental care of the Utøya victims, we analyse reasons for the local health services’ success, and highlight important prerequisites for well-functioning systems for continuous quality improvement in healthcare.

METHODS

Geography

Utøya is a small island (approximately 120 acres in size) in Lake Tyri. A camp is organised on the island each year in July, gathering hundreds of delegates from the Norwegian Social Democratic Party’s youth organisation for political debate and leisure activities. Frequently, the camp is visited by national and international top politicians. On 22 July 2011, the area

was difficult to reach because of road maintenance (online supplementary appendix 1).

Local health resources

Ringerike is the community hospital in the town of Hønefoss, 150 km northwest of Oslo. The hospital has 120 beds and serves a mostly rural population of about 80 000. The hospital is situated at the end of a long valley with busy roads and ski resorts and about 20 000 tourists a day. The hospital has departments of general surgery and orthopaedics, internal medicine, radiology, gynaecology and obstetrics, and affiliated psychiatric services. The hospital has 12 intensive care beds and six operating theatres; it is designed to admit and stabilise up to 4 severely injured patients and 10 patients with minor injuries at the same time. The prehospital emergency medical service (EMS) has been described in detail by others.³⁶ The service is organised with on-call GPs and paramedic/emergency medical technician-staffed ambulances. Hole and Ringerike municipalities cooperate to provide the on-call GP function. The nearest air ambulance helicopters are situated in Oslo and Ål, about 20 min flying time from the area.

Pre-event training

In 2003, Ringerike hospital was one of the pioneers in establishing monthly trauma team training as part of a continuous quality improvement system, based on recommendations from the Better and Systematic Trauma Care foundation and in cooperation with the regional trauma centre (see [box 1](#) and online supplementary appendix 1).^{6 10–12} The service was organised to improve the care for the many severe traffic and sports accidents in the area. In 2010, the trauma team was activated 98 times, admitting 120 patients, 24 of whom had an Injury Severity Score (ISS) ≥ 16 .³⁷

Evaluation

In January 2012, the lead author interviewed EMS managers and key personnel at Ringerike hospital to ascertain the structure and context of trauma care during and immediately after the terror attack.

Focus group participants

In January 2013, we asked the 25 healthcare leaders at Ringerike hospital, the ambulance service, the prehospital units of Ringerike and Hole municipalities and the police to identify all healthcare workers and local healthcare leaders who were involved in the attack response. We asked them to exclude individuals who for ethical reasons should not be involved in the study (eg, bereaved family members, friends or neighbours, and rescue workers with health problems after the terror attack). In total, 260 individuals were eligible for interviews. Of these, 120 had moved from the area or were no longer in service, leaving 140 individuals we invited to participate in the study. Of these, 30 (21%) were

Box 1 Monthly local training and quality improvement initiatives

- ▶ The trauma system fulfilled the 17 criteria of the national trauma system recommendations of 2007,⁷ and the trauma team training is based on the principles of the Better and Systematic Trauma Care foundation.¹⁰ Hospital trauma panel meetings are held two to four times a year, at which the trauma care guidelines are revised continuously.
- ▶ The multiprofessional training is performed in accordance with a descriptive 'expected trauma care process' (available at the hospital's intranet), containing standardised targets of the process; expected patterns of actions, interactions and handoffs; and written records and measurements, with links to the actual treatment procedures and guidelines.
- ▶ A resident in general surgery with Advanced Trauma Life Support course accreditation heads the trauma team, consisting of at least one resident orthopaedic surgeon, one consultant anaesthetist, one nurse anaesthetist, two emergency department nurses and one operating room nurse (totalling 10–13 staff members). The surgical consultants have all undergone the Definitive Surgical Trauma Care course.
- ▶ Each team member has a defined role with certain expected tasks, described on laminated 'action cards' (online supplementary appendix 1.2). Everyone keeps a laminated pocket checklist for the ABCDE approach (airway, breathing, circulation, disability and exposure).
- ▶ An emergency department nurse (the trauma coordinator) is planning, preparing and facilitating the training in cooperation with a designated physician. The training is performed between 07:00 and 08:00 every second Thursday each month in the hospital's trauma room by the personnel on duty. Easily available for training at low cost because the clinical schedule includes learning sessions every Thursday morning.
- ▶ A live person or a resuscitation manikin acts as the patient. Based on a real patient story, they focus on teamwork, communication skills and management, in addition to airway management, circulation control and other diagnostic and treatment interventions, mostly non-technical skills.
- ▶ After about 30 min of training, the team performs a structured debriefing using video recordings as an adjunct to discuss and evaluate teamwork. In an atmosphere of mutual respect and empowerment, the team is identifying opportunities for improvement for the next simulation based on a new patient story.

included; the rest either declined, did not reply or were not included because enough healthcare professionals from the same field already had accepted the invitation to participate. The purpose of the focus group evaluation was to share perspectives on why the situation was

managed successfully, and to explore the underlying codes and rules of interaction between the services during the period from the attacks until patients were discharged from the hospital. We aimed at covering perspectives as wide as possible on the situation. Thus, we designed five focus groups to represent the various professions and roles of the service: (1) tactical management, (2) prehospital emergency service, (3) emergency room service, (4) inpatient care and (5) mental health-care.

We assigned employees from the same part of the service in the same focus group. The five groups had an average of 5.2 informants per group (range 4–7), and the discussions lasted 90 min per session. Of the 30 informants, 26 were able to meet at the scheduled time, while 4 physicians were interviewed individually. The informants were 15 physicians, 11 nurses, 1 psychologist, 1 paramedic, 1 hospital maintenance technician and 1 police officer.

Focus group interviews

We applied the critical incident technique.^{38 39}

Recall bias is easier to avoid in a focus group of people with experience from the same part of the care network, reminding each other of relevant issues. In addition, their interaction is observable, and the combined information provided by the group as a whole is greater than the sum of their individual comments.⁴⁰ We communicated the study aim to the informants beforehand: *As you know, the trauma care and psychosocial support of the Utøya victims until discharge from Ringerike hospital has been evaluated as a success by three external bodies. Focusing on the system, how do you think this success was achieved? What did you experience as strengths and weaknesses of the service in action on July 22 to 24, 2011?*

During the group sessions, participants spoke freely about their experiences and thoughts regarding the study question. One researcher (the lead author) was present during all sessions. To avoid researcher-initiated perspectives, she did not participate in the discussion between the group members, asking only follow-up questions for clarification or elaboration. Observing participants and the group, statements were summarised on a flip chart in dialogue with the respondents who assessed the accuracy of the recorded information.

Data transcript and analysis

After each session, the lead author transcribed flip-over notes and audio recordings, gathering all statements in an electronic diary with notes on observations.

We then established an external research team consisting of four professionals with experience in quality improvement (two physicians, one nurse, one social scientist) and a patient representative. The use of external researchers for data analysis is

recommended.³⁹ With access to the focus group statements, they evaluated and structured the content by consensus into five categories, following the conventional content analysis method (online supplementary appendix 2), described in detail by others.⁴¹

Subsequently, we established an internal research team (five physicians and two nurses) with broad experience in crisis management and trauma care from surgery, anaesthesiology, internal medicine, psychiatry and family medicine. First, each member reviewed all focus group statements. Second, they pointed out the most important statements from their own perspective in dialogue with the lead author. They identified comments that could be misleading, and some added a few statements to clarify cases regarding staffing, time to prepare, psychosocial challenges, training frequency and so on. Third, they evaluated the analysis results derived by the external research team, which they endorsed, but they merged the determinants for success from five to four categories.

The focus group discussions and the dialogue between the lead author and the experts in the two research teams have been dynamic cycles of exchange among questions, discussions, data refinement, analysis and writing.⁴²

Ethics approval

The study was waived from approval by the regional ethics committee of South-East Norway. The study

was approved by the Data Protection Authority of Oslo University Hospital (see also online supplementary appendix 2).

RESULTS

The timeline of the events of 22 July 2011 are shown in [table 1](#). These are based on official reports, hospital transcripts and the interviews. In the 104 min between 19:21 and 21:05 on July 22, Ringerike hospital received 34 patients, 22 of whom arrived within 1 hour. The most severely injured were admitted between 19:45 and 20:26. The last patient (no. 35 that day) arrived at 02:09.

All patients survived. Fifteen patients were treated as outpatients for fractures and minor injuries, and two had no physical injuries. Of the 18 patients admitted to the hospital, 5 were in life-threatening condition (ISS >15) and 14 had received a total of 28 gunshot wounds to the head, torso and limbs. During the first 24 hours, seven patients were transferred to the regional trauma centre for further treatment and definitive surgery.³⁷

Determinants for success

We identified a combination of four main elements essential for the success of the local health services: (1) major emergency preparedness and competence based on continuous planning and training;

Table 1 Timeline of the Utøya terrorist attack on 22 July 2011

564 youth representatives of Norwegian labor/Labour Party (age 14– to 19 years) gathered on Utøya island for yearly summer camp. Former Prime Minister Gro H. Brundtland present, but leaves earlier than expected.	
22 July 2011	
17:17	Single male in Norwegian police uniform arrives Lake Tyri shore. Explains local ferry personal to secure island after a terror attack in Oslo earlier that day; transported to island.
17:21	Immediately after arrival, terrorist starts shooting individuals. Moves by foot over island, targets all individuals in sight. Surrenders to arriving police forces at 18:34. 69 people die; 33 survivors have gunshot wounds, 20 of whom sustained life-threatening injuries (Injury Severity Score ≥15).
Log of local emergency response	
17:24	First emergency call to the emergency dispatch centre: 'Shooting at Utøya island!'
17:25	The surgical resident on-call at Ringerike hospital announces code red (full alert). Employees are called from home, vacation and so on; they clear wards and prepare emergency facilities.
17:54	Trauma admittance area and family support centre established at outpatient area. Outpatient services moved to in-hospital locations immediately.
18:26	Ringerike hospital notifies the emergency dispatch centre that they can admit 3–4 severely injured and up to 10 patients with minor injuries.
18:28	Hole municipality establishes victim family centre at Sundvolden Hotel (online supplementary appendix 1).
19:00	Ringerike hospital dispatches one emergency and trauma care team of physicians and nurses (including one surgeon and one anaesthesiologist) to Utøya.
19:21	First five of 35 patients arrive at Ringerike hospital (10–24 years of age).
19:01	Ringerike hospital dispatches acute psychiatry team to Sundvolden Hotel.
20:01	The maximum number of patients the hospital had agreed to handle is exceeded 40 min after admission of the first patient.
20:30	Ringerike hospital opens acute psychiatric care centre for victims and family.
21:05	Patient no. 34 arrives at Ringerike hospital.
02:09	Last patient (no. 35) from Utøya arrives at Ringerike hospital.

(2) well-developed crisis management and leadership based on knowledge, trust, data collection and information; (3) empowerment through multiprofessional networks; and (4) ability to improvise based on acquired structure and competence.

Major emergency preparedness and competence

The successful callback routines of employees and the many volunteering from holiday enabled the hospital to expand the surge capacity,³⁷ which was never short of competent personnel. The informants highlighted the hospital's emergency web immediately, which provided a preliminary ID number to each patient, and has systems for patient flow and continuity of care, triage and clearly defined responsibilities (see [boxes 1 and 2](#) and online supplementary appendix 1).

Then we brought out the red emergency preparedness manual and the action cards [a role & task description so that no details were missed], and I was able to repress my own feelings and concentrate on the job.

We need a plan anyhow, and action cards to « keep on track». We saw they were clinging to their action cards in a way that some cards were worn out.

The same multidisciplinary team followed the same patient through the entire care process, from triage to the general or psychiatric ward, and did not let go of the patient before it was justifiable.

The focus groups particularly highlighted the importance of continuous team training, evaluation and education (see [boxes 1 and 2](#)).

What is most important about experience is that you have the knowledge and skills you get by training. It makes you able to tolerate extreme situations and make quick decisions. Ringerike hospital has activated the trauma team many times, and with valuable debriefings afterwards. This reinforces the value of experience, making you able to tolerate more.

About 210 parents and siblings lost a child or a sibling, some lost their partners or parents, and many adolescents lost a close friend. Many desperate youths had cellphone contact with their parents as they were hunted around the island until they were shot in their hiding places.⁴³

Proximity to the mental healthcare unit and a written emergency cooperation plan was crucial.

Crisis management based on knowledge, trust and continuous data collection

Tactical management quickly established inpatient care and dispatched mobile health teams to the terror attack site.

I would not have been able to lead over 200 persons without good structure as foundation. Neither would I have been able to manage the major incident without enough human resources at hand.

We knew we could trust the competence of our trained personnel, thanks to our monthly simulation

Box 2 The teams did what they had been training for, but at a larger scale

- ▶ The hospital personnel had time to clear wards and prepare emergency facilities, call the employees from home and include the highly competent volunteers from vacation, and so on. Hence, they were never short of personnel and were able to exceed the surge capacity as the majority of casualties were overwhelming the planned capacity.
- ▶ The scope of the attack was unknown until late night, and the only 'external' information source was the horrible patient stories and the terror threat against the hospital. Nevertheless, the personnel working with the patients were focusing on the patients, and felt mentally prepared and calm because they were in their own and well-known surroundings, knew each other well and knew their own roles and expected tasks to be performed from the many training sessions.
- ▶ A surgical consultant was in charge of the response, tailoring a trauma team to each patient. The teams generally consisted of a surgeon/orthopaedic surgeon, an anaesthetist nurse, an emergency department nurse and an operating room nurse, involving surgeons and anaesthetist only for the severely injured and those requiring immediate surgery.³⁷ Another surgical consultant performed triage at the entrance to the emergency department.³⁷
- ▶ Patients were transferred to the emergency department, intensive care unit, operating room or trauma centre, or to the outpatient clinic (for those with minor injuries), and further to the mental care clinic for psychosocial support. The team was preventing handoff-related communication problems by not leaving the patient during transfer unless this was done thoughtfully and safely.
- ▶ The interaction between the crisis management teams of the hospital and the crisis management teams of the municipalities and with the police was crucial.
- ▶ An informant compared the psychosocial support they were providing on 22–24 July with abdominal packing for severe haemorrhage before transferring the patient to the right level of treatment. By providing practical help and psychosocial support, they were sort of 'packing people together' so that they could manage until they were home, receiving professional help, spending time on 'packing them back out'.

and team-training system. Knowing this, tactical management was able to concentrate on other issues. Fortunately, an experienced senior manager was available to take the responsibility as ambulance commander.

Although the number of patients the hospital should handle according to plans was surpassed after 40 min, the hospital staff responded in a timely and successful manner.^{1–3} Present and competent leadership at the

entrance point, with clear predefined tasks and responsibilities (see [boxes 1 and 2](#) and online supplementary appendix 1), was identified as crucial for success.

There was progress all the way; good flow, well directed by the (hospital) medical commander, and people did what was expected from them.

Tactical management collected and provided information both internally and externally, based on real-time registrations (event log) and a patient list (see online supplementary appendix).

According to the crisis plan, tactical management contacted the leader of the local mental health clinic. Calling back 10 employees, he formed two multidisciplinary teams and sent one to establish a crisis centre close to the scene on Utøya.

We endeavored to bring together the right professionals, forming good, multidisciplinary teams.

The other opened a crisis centre at the mental health clinic to take care of discharged patients and to provide care and information for families searching for their children.

Empowerment through multiprofessional networks

The local network of emergency and mental care was based on mutual empowerment in recognition of each other's knowledge, needs and skills, with a common interest in the patient. This was recognised as a main factor for prehospital and in-hospital success.

Then we spoke to the youngsters for hours. Their stories were heart-breaking, and we knew that we must not lose each other if we were to be able to withstand this.

When the hospital was blocked by the police due to a terror threat, those who did not have patient contact were scared. We who worked with the patients were not scared.

Cooperation, and that we knew each other well, helped us manage the situation. It would have been very difficult to be alone. We needed each other in making the right decisions.

The ability to improvise based on structure and competence

All informants pointed out the importance and necessity of the involved healthcare workers' and leaders' ability for improvisation in the extraordinary situation.

Easier to improvise because we have regular training, both as individuals and together with the others in the team. Enough to understand each other and to know where we had to improvise.

The action-cards freed up mental capacity to improvise. E.g., when the police closed the road to Oslo, we established a second support center in cooperation with primary care services, taking care of the families being shut out from the main support center. This was useful.

Important examples are the ad hoc establishment of patient lists and the three crisis centres.

We regularly provided updated patient lists to the police through the entire evening. Never felt this could be wrong.

Sundvolden Hotel was requisitioned ad hoc by Hole municipality as a support centre nearby the scene, where about 1000 victims and about 200 healthcare workers were assembled.¹ Sundvolden was described as an ideal place for keeping patients with minor physical injuries away from the hospital and for providing support for the many bereaved survivors and relatives.³⁶

The support center at the hotel constituted a solid and comforting environment for providing psychosocial support.

The fact that three helicopter ambulances could land safely at the same time around the single helipad of Ringerike hospital is another example of a creative solution.

DISCUSSION

Generalisation in the light of informant statements

This study aimed at increasing our understanding of the prerequisites for delivery of high-quality health service, even under extraordinary circumstances. From the evaluation of the emergency response service of a small hospital and affiliated services (police, municipalities, ambulance, mental health) after a devastating terrorist attack in a rural area, we identified four main determinants for success. The domains reflect a combination of (1) structure and competence based on continuous planning, training and learning; (2) leadership based on knowledge, trust and data collection; (3) empowerment through multiprofessional networks; and (4) ability to improvise based on structure and competence. We assess the interaction of these determinants to be universally applicable in the continual improvement of healthcare services, reflecting important conditions for resilient and safe care ([figure 1](#)).

Generalisation in the light of the literature

We have extracted six principles from the literature that may contribute to explain the success of the local EMS. In accordance with Kotter's theory, the development of an emergency preparedness and response plan is a matter of leadership, while coordinating the complex response situation is a matter of management.⁴⁴ First, *our findings indicate the written preparedness and response plan was structured just enough to remind the health professional of their role and task, yet flexible enough to enable them to release their creativity to improvise solutions to the problems confronting them during this unthinkable event.* Others have found that no plan can cover every conceivable situation. The number of details necessary to write such a plan would also render it useless; emergency personnel would have to take precious time determining which tasks to perform and which were irrelevant.^{15 45-47}

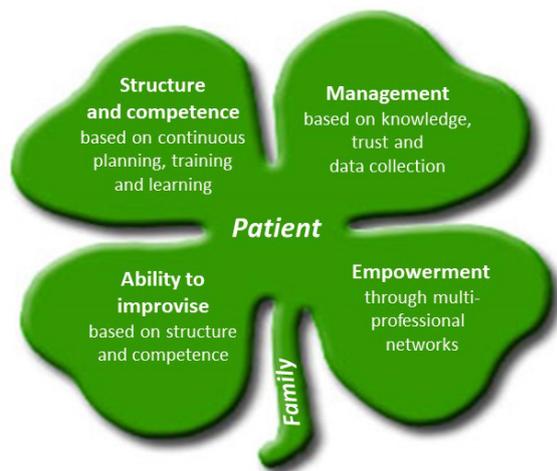


Figure 1 The four-leaf clover of the quality performance conditions.

Second, *the most severely injured were transferred to the regional trauma centre after initial treatment*. Recognising the limit of the available expertise is crucial to operative management.^{6 45 48} Third, *the same team transferred the same patient through the entire acute care process*. This is life-saving by preventing handoff-related communication errors.^{49–52} Fourth, *the close proximity of all disciplines of healthcare*—including a mental health clinic and the hotel nearby the scene organised by the municipality and *the written emergency cooperation plan*—was fundamental in managing the complex situation, providing information and support to the survivors, bereaved and affected families.^{1 3 4 27 43 53}

Fifth, *tactical management avoided intervening in the details of the service, focusing on getting an overview of the situation*. They recorded data continually, to be able to make good decisions, and improvise when necessary (online supplementary appendix 3). Successful emergency preparedness encourages appropriate actions and response flexibility by emergency managers.⁴⁵ Appropriateness of response is more crucial than speed. In a disaster situation, it is more important to obtain valid information as to what is happening than to take immediate action (eg, rescue workers always check before acting, doing so rapidly because they are trained (box 1, point 4).^{45 54 55} An excellent illustration of management's improvisational ability was in continually updating patient lists. Because of uncertainties as to both regulations and privacy concerns, other involved hospitals and institutions did not provide such patient lists to the police. At Ringerike hospital, this was a matter of improvisation in the given situation.

Finally, *a written plan does not guarantee preparedness*, which is a state of readiness to respond to environmental threats. Planning should be a continual improvement process of vulnerability analysis, capability assessment, plan development, testing, training,

learning and improvement.^{10 15 26 28 45 56–58} The emergency preparedness and response planning at Ringerike is a continual improvement process (see box 3). Consequently, the plan had been revised 2 weeks before the attack during their monthly team training work in plan–do–study–act cycles (detailed in box 3; see also box 1 and online supplementary appendix 1).^{12 57 58}

The intellectual underpinnings

In philosophy of science, abduction is to first observe a fact, and then explain how it happened by using a theory. Since there may be more theories that can explain the same fact, abduction applies an inference to find the best explanation.⁵⁹ We here use the framework of continual improvement theory to explain the intellectual underpinnings of the successful EMS, summarised in box 3.

Strengths and limitations

This study adds knowledge to quality improvement approaches that are struggling with the methodological challenges of finding evidence for training effects.^{24 25} Assessing learning from high performers from a known, successful outcome is an important quality improvement approach (in contrast to the relentlessly negative focus on what goes wrong in a situation).^{33–35} Thus, our research question does not ask what went wrong; the informants were encouraged to tell 'their whole story'. Hundreds of desperate parents and young people were searching for their children, siblings and friends, and the capacity was inadequate to meet the overwhelming need for information and communication. At the same time, the hospital was hit by a bomb threat and had no system for protection (box 2). Others have found similar problems,^{36 37} and every opportunity for improvement was immediately included in the continual improvement process.

Recall bias can represent a limitation because most data were collected 1½ year after the event. We applied the critical incident technique in focus groups of people with experience from the same part of the care network to compensate for this limitation. It is not the aim of this report to compare the healthcare service with that of the police. We still find it important to show that our findings indicate that the police acted as a valuable member of the same emergency care service that was evaluated by the Norwegian government commission as successful (online supplementary appendix 4).

CONCLUSION

Successful emergency response in rural areas without available specialised resources requires continuous emergency preparedness planning, organisation, regular training and learning, and team empowerment through networking and training. Prioritising this in a situation with financial hardship and focus on the 'bottom line' is challenging. Hence, well-developed management and leadership is also crucial.

Box 3 The intellectual underpinnings of the local emergency medical service (EMS)

The local EMS is here analysed with the continual improvement theory of Batalden and Stolz as reference frame. Continual improvement is described as a combination of the professional knowledge of the involved disciplines with the following four improvement knowledge domains.^{57 60}

System

Focus on the conditions for a resilient and safe interaction of rescue workers. 'We cannot change the human condition, but we can change the conditions under which humans work'.⁶¹ The whole is not the sum of its parts but the sum of the interaction of its parts.^{40 62} The prehospital and in-hospital network of rescue workers from Utøya to discharge from Ringerike hospital worked in a web of interaction. Their inter-relationship was based on structure and knowledge, mutual dependence, trust, respect and empowerment across disciplines, enabling good decisions and improvisations where needed.^{11 55 63}

Variation

Focus on the process and study variation to improve and coordinate practice. Continuous (monthly) learning, training and process monitoring (video records, observations and written records). The team reflect together on their common performance, discuss possible improvements and monitor a new simulation to test how the changes work in a continuous plan-do-study-act cycle.^{12 58 64}

Psychology

Focus on the patient's needs is a glue in the multiprofessional collaboration.⁶⁵ The tactical management build their management on trust and empowerment of the teams.^{12 55 61} Systematic training of interprofessional communication crew resource management (CRM),⁶⁶ decision-making and operative management skills are performed in their own context. Building confidence in each team members' role is crucial.^{10 15} Free creative ability in unpredictable situations by building reminders related to the different roles into the system (manuals, ABCDE (airway, breathing, circulation, disability, and exposure) checklist, action cards) without too many (confusing) details.^{45 67}

Theory of knowledge

*Focus on learning and diversity as a key to innovation.^{55 62 68} Leadership should be adaptable, flexible and open to new learning, recognising that different professions may have different perspectives on the same reality.^{45 55} Multiprofessional teams work together, train together and learn together, with clinic-level coaching as the common mode of interaction.^{11 12 65 69} The teams build knowledge by linking theory and action in continual improvement cycles.*¹⁰⁻¹²

This all means the trauma system has:

*...realised its full potential because change making has become an intrinsic part of everyone's job, every day, and in every part of the system.*²⁸

This facilitates the ability of the teams and individuals to improvise when necessary, based on structure and competence, a major asset to making the right decisions in stressful situations.

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Contributors ASB (RN, MSc): As the main researcher, I am responsible for every part of the study and the manuscript, and have a deep knowledge of the database and its content. I designed the study, collected data in focus groups and interviews and in dialogue with the experts in the two research teams. I managed the interaction in dynamic cycles of exchange among questions, discussions, data refinement, analysis and writing. I am accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. MiB (MD, PhD): MiB has supervised the design and conduction of the work described in the article, know the database and its content, has revised the paper critically for important intellectual content, and participated in writing the manuscript and in the final approval of the version published. GB (MD): As a member of the internal research team, GB has contributed substantially to the data collection part of the study, know the database and its content, has participated in the analysis and in writing the manuscript, revised it critically for important intellectual content and participated in the final approval of the version published. MJBP (RN): As a member of the internal research team, MJBP has contributed to the data collection part of the study, know the database and its content, has participated in the analysis, participated in writing the manuscript, revised it critically for important intellectual content and participated in the final approval of the version published. KH (RN MSc): As a member of the internal research team, KH has contributed to the data collection part of the study, know the database and its content, has participated in the analysis, contributed to the writing of the manuscript and participated in the final approval of the version published. KM (MD): As a member of the internal research team, KM has contributed to the data collection part of the study, know the database and its content, has participated in the analysis, contributed to the writing of the manuscript and participated in the final approval of the version published. TB (MD): As a member of the internal research team, TB has contributed substantially to the data collection part of the study, know the database and its content, and has participated in the analysis and in the final approval of the version published. BN (MD): As a member of the external research team, BN has contributed substantially to the analysis part of the study, know the database and its content, and has participated in editing the manuscript and in the final approval of the version published. LS (MD): As a member of the external research team, LS has contributed substantially to the analysis part of the study, know the database and its content, and has participated in editing the manuscript and in the final approval of the version published. AS (BS): As a member of the external research team, AS has contributed substantially to the analysis part of the study, know the database and its content, and has participated in editing the manuscript and in the final approval of the version published. GSH (RN, MSc): As a member of the external research team, GSH has contributed to the analysis part of the study, know the database and its content, and has participated in editing the manuscript and in the final approval of the version published. MaB (MSc): As a member of the external research team, MaB has contributed to the analysis part of the study, know the database and its content, and has participated in editing the manuscript and in the final approval of the version published. EN (MPH, DSc): As a cosupervisor, EN assisted in planning the study and the data collection method, and participated in

outlining the contents of the article and in the final approval of the version published. TSM (MA): TSM has participated in editing the paper, revised it critically for important content and English language and participated in the final approval of the version published. PH (MD, PhD): PH assisted in planning and designing the project, know the database and its content, supervised the initial data analysis by the external research team, has revised the paper critically for important intellectual content and participated in the final approval of the version published.

Competing interests None declared.

Patient consent We are studying the clinicians' assessments of healthcare as a system. No patient, guardian or next of kin were involved in this study. Because the terrorism is a traumatic event, we considered the risk of causing emotional or psychological harm to the study participants, and decided to exclude three groups from the research: (a) survivors and bereaved families; (b) providers who were personally affected by losing a sibling, family friend or neighbour at Utøya; and (c) providers with health problems who had been absent from work because of the terrorist event. Permissions were obtained from the relevant managers before individuals (rescue workers, 22–24 July 2011) were approached. Study participation was voluntary, confidential and based on informed verbal consent, as well as a written consent with freedom to terminate participation at any time without consequences. Participants were also informed (in writing) that a support team by District Psychiatric Services was available in case they should need help after recalling the traumatic events in the process of data collection. The lead researcher is unaware if informants sought psychological help after their participation in the study because this is viewed as a confidential and private matter. The data were stored on the research server of Vestre Viken Health Trust, and the informants' names were separately encrypted as required by the Data Protection Office of Human Subjects.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The 400 statements of this study are available by contacting the main researcher at aleidis@online.no. 150 of the most relevant statements are translated from Norwegian to English.

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