Major incident patient evacuation: full-scale field exercise feasibility study

Major incident management relies on efficient patient transportation. Prompt initiation improves patient outcome and optimizes resource expenditure (1). The evacuation of patients is the third initiative in the hierarchy of medical support at major incidents: triage, treatment, and transport (2). Casualty evacuation should be dynamic, because mode of transport, evacuation priority and final destination will be influenced by triage and treatment decisions. To ensure optimal outcomes, patients should be transported as efficiently as possible from the scene to the hospital providing definitive care. In order to avoid unnecessary delay, treatment and packaging should be limited to that necessary for transport (2). Optimal care therefore relies on a well-organized transportation chain using field-friendly evacuation equipment to ensure transport of the “Right Patient to the Right Place at the Right time.”

Major incidents are infrequent, overwhelming events with a heterogeneous nature that favours the “all-hazards” approach. Because rescue capacity varies between systems, an incident may be considered major by one emergency medical service (EMS) but not by another service (2).

EMS systems are primarily designed to respond to the daily burden of injuries and can have delayed access to evacuation material for multiple casualties. Even when major incidents are flooded with resources, rescue workers struggle to coordinate and optimize patient evacuation (3, 4). Additionally, major incident management usually involves emergency workers from multiple rescue services. Standardizing the equipment for patient evacuation seems essential given the multitude of responders. Providing rescue workers with rapid access to a large quantity of standardized stretchers may improve patient transportation efficacy.

In the absence of a coherent and interoperable national civil system for major incident management, the Norwegian Air Ambulance Foundation developed and funded the Interdisciplinary Emergency Service Cooperation Course (TAS), a no-cost training course for all emergency services in Norway. The TAS program was established in 1998. By 2009, approximately 15,500 professionals had participated in one of more than 500 available courses. The TAS curriculum has gradually evolved, and the principles for disaster health education as proposed by World Association for Disaster and Emergency Medicine have been adapted progressively (5). Norway is a sparsely populated,
subarctic country with time-consuming, weather-dependent patient transport (6).

Although large-scale incidents are infrequent in our region, such incidents demand advanced interdisciplinary cooperation of local EMS, fire fighters, police, rescue technicians, and air medical resources. In remote areas, single EMS units may handle multiple casualties for prolonged periods until inter disciplinary assistance arrives. In the absence of a standardized field-friendly approach to multiple casualty management, the Norwegian Air Ambulance Foundation developed “Optimal Patient Evacuation Norway” (OPEN). The OPEN concept has been incorporated as a module in the TAS courses. OPEN aims to save time, improve patient handling, prevent hypothermia, and simplify scene management. In this study, we assessed access to patient evacuation supplies among Norwegian EMS personnel participating in TAS courses. Furthermore, we assessed the feasibility of the OPEN concept for major incident patient evacuation in the extrication and triage phase of full-scale major incident field exercises.

Methods
TAS course
From March to May 2010, we conducted four 2-day TAS courses in mixed urban/rural and coastal/inland municipalities. The courses were free of charge for the participants. The didactic program was piloted and refined through 43 TAS courses before the study. The TAS course combines theoretical and practical didactical techniques to teach local emergency service personnel (healthcare, police, and fire and rescue technicians) major incident cooperation, triage, and patient evacuation (OPEN). The students participated in major incident field exercises, using a standardized bus collision scenario with approximately 20 patients (range, 17 to 21) and a full-size, post-collision bus. The patients were located inside the bus and were provided with standardized descriptions of injury type and physiologic parameters for triage purposes. The major incident field exercise was performed once before the OPEN lectures were given, when participants lacked formal OPEN competence and access to OPEN equipment, and once at the end of the course, when participants had formal OPEN competence and access to OPEN equipment.

The OPEN Concept
We designed car- and helicopter-friendly bags (Figs. 2 and 3) containing five heavy-duty multiple-casualty stretchers (Fig. 6), stretcher carry harnesses, and triage equipment to provide EMS units with rapid access to large quantities of standardized equipment. Ideally, all units responding to the incident should carry a minimum of one stretcher bag. To save time, prevent hypothermia, and avoid patient manipulation, one standardized lightweight, insulating stretcher was allocated to each patient throughout the evacuation chain. These stretchers fit all ground and air EMS units and are radiolucent to optimize logistics during radiological evaluation at the hospital. Furthermore, we designed a field-friendly action card (Fig. 5) depicting the principles for scene-management organization.
Health Research Ethics deemed that approval was unnecessary (2009/1390a). The Norwegian Social Science Data Services approved the study (22991/2/MAB). The SQUIRE (Standards for QUality Improvement Reporting) guidelines and the STROBE (STrengthening the Reporting of OBServational studies in Epidemiology) guidelines for reporting observational studies were used in the drafting of this article (9, 10).

Data analysis
Data were collected in Excel spreadsheets (2007; Microsoft Corporation, Redmond, WA) and analyzed in STATA/SE 10.1 (Statacorp, College Station, TX). Continuous variables measured before and after the TAS course were compared using the paired-sample t-test.

Results
Student background and access to major incident material
Among the 110 emergency service professionals who attended the course, 93 (84.5%) enrolled in the study. Among the study participants, 26 (28.0%) worked in health care (nurse, ambulance, other), 47 (50.5%) were firefighters, 13 (14.0%) were police officers, and 7 (7.5%) had “other” backgrounds. The mean participant age was 38.6 years (range, 20–62), with a median working experience of 8 years (range, 0–34), and 83.7% were men.

Approximately half of the students (51.2%) were not aware of any stretcher storage in their coverage area. A minority (18.6%) of the learners confirmed that fewer than 16 stretchers were available, and 30.2% had access to over 15 stretchers. Thirty-one percent of the students confirmed that multiple stretchers could be available at the scene within 30 minutes in their catchment area, 26.4% would need longer than 30 minutes, and 42.5% were unable to describe stretcher delivery times.

Self-efficacy and reaction to training
Each question on the questionnaire was scored on a 7-point Likert scale, with points labeled “Did not work” (1) through “Worked excellently” (7). The students replied to “How did patient evacuation work?” with mean 5.4 (95% CI, 5.2–5.6) before the course versus a mean of 5.8 (95% CI, 5.7–6.0), after the course (P < .001). Students’ estimations of the success of interdisciplinary cooperation improved, with a mean of 5.4 (95% CI, 5.2–5.6) before the course and a mean of 5.8 (95% CI, 5.7–6.0) after the course (P < .001). The students also described improved use of patient evacuation materials between their initial (mean, 5.3 [95% CI, 5.0–5.5]) and postcourse (mean, 6.0 [95% CI, 5.8–6.15]) evaluations (P < .001). The mean time from “scene secured” to complete patient evacuation to the casualty clearing station was 22 minutes (range, 19–26) without and 21 minutes (range, 17–28) with TAS–OPEN training and supplies. Both the stretcher bag and the scene-management action card were reported to work adequately (median, 6 [interquartile range (IQR), 6–7] and median, 6 [IQR, 5–6], respectively).

Discussion
We found the OPEN concept for multiple casualty evacuation to be feasible for interdisciplinary emergency service personnel participating in full-scale major incident field exercises. The students found the stretcher equipment useful in evacuating patients in a structured and field-friendly manner. Unnecessary patient mobilization is a time-consuming threat to patient safety, and several papers describe movement-associated adverse events (11–13). Although these studies are conducted inside the hospital, eliminating unnecessary physical movement of the patient will result in safer and more effective major incident management.

Currently, the absence of standardized patient evacuation equipment increases the risk for patient manipulation both during the immediate scene management phase and during later organization of the patient evacuation clearing station. The OPEN concept stresses rapid EMS access to large number of stretchers, allowing provision of a personal stretcher to every patient in the extrication phase.

Our study confirmed that Norwegian rescue workers struggle to provide all patients with rapid access to a...
stretcher. By avoiding improvised transportation methods that occur when stretchers are unavailable, OPEN reduced unnecessary physical manipulation of the injured. The OPEN stretcher fits all patient transportation units in our area, and it reduces the inherent risks of patient mobilization associated with variable stretcher types across EMS units.

Efficient patient evacuation relies on interdisciplinary cooperation from all emergency services managing the scene. We found high interdisciplinary satisfaction with both the equipment and the principles.

The OPEN concept introduced standardized handling of patient evacuation from scene extrication through patient evacuation clearing station without increasing on-scene time expenditure. We believe the time required for complete evacuation and transport to definitive care will most likely be reduced. However, we acknowledge that this study did not evaluate the entire evacuation chain, and we plan to address this question in a future study.

We intended to ensure the appropriateness of the OPEN concept for safe implementation in our vehicle and helicopter EMS units. Optimally, the stretcher material and scene-management principles would have been evaluated in real multiple-casualty incidents to avoid the unrealistic aspects of exercises. However, research on major incident management is mostly observational, because disasters are difficult to study via interventional study designs. Furthermore, this study relied on self-reported variables as measures of effect, although they may vary in accuracy (14). To address this limitation, the instructors measured time consumption objectively.

Major incidents are infrequent in our area, and EMS providers have little experience handling multiple casualties. The low incidence of large accidents favours systems that allow providers to follow their daily routine. We found that Norwegian EMS providers have reduced access to field-friendly patient evacuation equipment. Delayed access to stretchers combined with absence of interdisciplinary routines for patient evacuation remains a gap in Norwegian preparedness for major incidents.

Conclusions
Efficient and structured patient evacuation can be taught effectively to multidisciplinary emergency service professionals attending a 2-day major incident course. The OPEN concept provides rapid access to standardized, field-friendly patient evacuation equipment in a feasible and time-efficient manner.

References:

Fig. 6: Providing rescue workers with rapid access to a large quantity of standardized stretchers may improve patient transportation efficacy.