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ORIGINAL RESEARCH

Static Rope Evacuation by Helicopter Emergency Medical Services in Rescue Operations in Southeast Norway

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Introduction—Physician-staffed helicopter emergency medical services (HEMS) in Norway are an adjunct to existing search and rescue services. Our aims were to study the epidemiological, operational, and medical aspects of HEMS daylight static rope operations performed in the southeastern part of the country and to examine several quality dimensions that are characteristic of this service.

Methods—We reviewed the static rope operations performed at 3 HEMS bases during a 3-y period and applied a set of quality indicators designed for physician-staffed emergency medical services to evaluate the quality of care. Data are presented as medians with quartiles, except National Advisory Committee for Aeronautics (NACA) scores, which are presented as mean (SD).

Results—Fifty-nine static rope operations were identified, involving 60 patients. Median (quartiles) age was 43 (27–55) y. Median (quartiles) take-off time was 9 (5–13) min. Trauma-related injuries were found in 48 patients. The main conditions were lower limb injuries, found in 32 patients. Ten patients experienced medical conditions. Mean (SD) NACA score was 3.3 (1.3). A potential or actual life-threatening diagnosis (NACA score: 4–6) was reported among 15 patients. The main interventions were intravenous lines (19 patients), analgesics (17), and oxygen treatment (14). Four patients were intubated, and 1 thoracostomy was performed.

Conclusions—Static rope operations are rarely performed. The quality indicators suggest that the service is safe, available, and equitable. Its main benefit seems to be evacuation and the maintenance of readiness before rapid transport of the physician to the scene or the patient to the hospital.

Keywords: air ambulances, rescue work, quality indicators, healthcare

Introduction

Helicopter emergency medical services (HEMS) have the capacity to offer advanced emergency medical treatment on scene and the rapid transport of patients to the correct level of care. When accidents or medical emergencies occur at scenes that are not easily accessible for ground emergency medical service (GEMS) personnel or other rescue units, HEMS static rope operations can be performed regardless of the severity of the patient's condition. In Norway, HEMS perform static rope evacuations of patients from the ground and water. Hoist operations are not performed by Norwegian HEMS, in contrast to practices in other countries.[1–4] This policy was made by the National Air Ambulance Services of Norway, the operational authority for the air ambulance services, based on the existing crew-concept and the low incidence of rescue operations. Compared with GEMS in Norway, HEMS enables the rapid transport of an anesthetist to the scene, thereby reducing the time to advanced medical care.[5] The security of both the crew and the patient is essential; HEMS operations have a higher accident and fatality rate than other helicopter operations.[6,7] Ordinary medical missions are performed 24 h a day, 7 d a week; in contrast, HEMS static rope operations in Norway are only performed during daylight hours to reduce risk.

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Data regarding static rope operations are very limited in the medical literature.[8] A few studies about winching operations are available, and to our knowledge, the largest published study included 921 patients.[1]

We aimed to describe the HEMS static rope operations performed by 3 HEMS bases in southeast Norway and applied a selection of quality indicators (QIs) specifically designed for physician-staffed emergency medical services (P-EMS) to evaluate current practices.[9]

OPERATIONAL SETTING

Norwegian search and rescue (SAR) operations can be performed by helicopters operated by the Royal Norwegian Air Force (state funded, responsibility of the Ministry of Justice and Public Security) and by HEMS (state funded, responsibility of the Ministry of Health and Care Services). The HEMS units are dispatched by the local emergency medical communications center (EMCC), while the SAR units are dispatched by 1 of 2 joint rescue coordination centers (JRCC). Depending on the nature of the mission, EMCC or JRCC will have the main responsibility for resource coordination. Medical staffing is similar at both HEMS and SAR.[10]

HEMS Lørenskog, HEMS Ål, and HEMS Arendal are located 14, 142, and 199 km air distance, respectively, from the regional trauma center at Oslo University Hospital (OUH). All bases undertake primary and secondary operations, responding to both injuries and medical emergencies. A primary operation implies transporting medical personnel and equipment to the scene for a patient located outside of the hospital.

HEMS Lørenskog utilizes 2 aircraft, a Eurocopter (EC) 135 P2+ and an EC 145, and completes approximately 1050 primary operations annually. HEMS Ål is a mountain base located northwest of Oslo. It utilizes 1 EC 135 P2+ and completes approximately 360 primary operations annually. HEMS Arendal, located on the coast southwest of Oslo, utilizes 1 EC 135 P2+, and completes approximately 430 primary operations annually. The 3 bases cover a population of approximately 3 million people. The HEMS crews consist of a pilot, a HEMS rescue member (HCM), and an anesthetist.

HEMS STATIC ROPE OPERATIONS

When dispatched to a static rope operation above land, the HEMS crew surveys the scene from the air and locates a suitable landing site to rig for static rope rescue (Figure 1). From the rig site, the HCM is transported underslung to the scene on a fixed 20- to 60-m rope. The HCM brings the appropriate evacuation device (rescue-bag, harness, or sling; Figure 2), together with medications and other needed equipment, depending on the presumed severity of the situation. From the cockpit, the pilot cannot see the HCM on the rope underneath the helicopter or the patient on the ground. Therefore, the anesthetist operates as a doorman, guiding the pilot toward the scene by radio communication, based on his or her observations and sign language from the HCM. Soon after ground contact, the HCM unleashes from the static rope. The helicopter then leaves the scene, with the static rope hanging underneath, and hovers at a suitable distance, normally in sight of the scene. This also enhances on-scene communication between the patient and the HCM as the helicopter noise diminishes. After necessary stabilization and immobilization of the patient, the helicopter returns to the scene. The HCM reconnects himself and the patient to the rope, and both are evacuated underslung by the helicopter to the rig site, where further treatment can be provided by the anesthetist. Finally, the patient is loaded into the helicopter if air transport to the hospital is indicated. If there is no indication for advanced medical treatment or fast transport, further care can be provided by GEMS or other rescue units.

In static rope operations over water, the HCM relocates to the cabin and attaches the rope to the roof of the helicopter. On arrival at the scene, the HCM jumps into the water and secures the patient in a sling while the helicopter hovers. Both are then evacuated underslung back to a safe site for patient treatment.

Each crew member is required to perform at least 5 static rope rescues every third month, either from ordinary operations or training.

Methods

The HEMS operational database NOLAS (a proprietary database management system; FileMaker Inc, Santa

Figure 1. HEMS (state funded) static rope rescue. Setup with EC 135 P2+ (photograph from training, courtesy of Norwegian Air Ambulance).

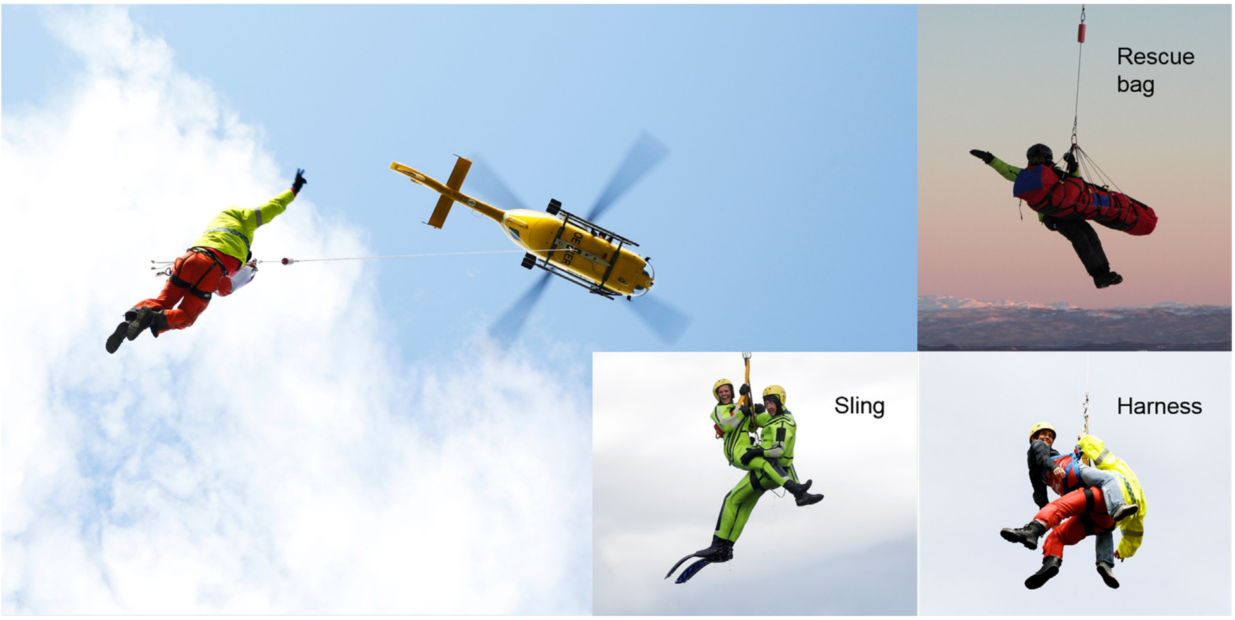

Figure 2. HEMS (state funded) static rope rescue. Evacuation devices (photographs from training, courtesy of Norwegian Air Ambulance).

Clara, CA) was retrospectively searched for static rope operations performed in the period from January 1, 2013 to December 31, 2015. Operations involving the evacuation of persons known to be dead before arrival at the scene were excluded because these are extraordinary events not defined as primary operations. The included operations were identified in the HEMS medical database LabasNG (a proprietary database management system; NormannIT, Trondheim, Norway) and relevant data, including operational descriptors (time call received at dispatch center, HEMS unit alarm call, take-off time, time of arrival at the patient, startup time of transport from scene, time of arrival at hospital), patient descriptors (age, sex, diagnosis [International Classification of Diseases version 10], severity of injury/illness, activity when injured/falling ill), and interventions provided (therapeutic procedures, type of medication) were extracted. The geographical location of the scene was obtained from LabasNG and plotted in a map application (www.norgeskart.no) to calculate the distance from the HEMS base. When the helicopter was dispatched while airborne, the calculated distance was relative to the base.

Table 1. Description of the NACA scoring system

NACA score	*Description*
1	Injuries/Diseases without any need for acute physician care
2	Injuries/Diseases requiring examination and therapy by a physician, but hospital admission is not indicated
3	Injuries/Diseases without acute threat to life but requiring hospital admission
4	Injuries/Diseases that can possibly lead to deterioration of vital signs
5	Injuries/Diseases with acute threat to life
6	Injuries/Diseases transported after successful resuscitation of vital signs
7	Lethal injuries or diseases (with or without resuscitation attempts)

NACA, National Advisory Committee for Aeronautics.

No medical records from hospitals were accessed.

The severity of injury or illness was scored by the HEMS anesthetist according to the National Advisory Committee for Aeronautics (NACA) score (Table 1)[11] as part of mandatory reporting.

We applied a set of QIs (Table 2) that cover multiple quality dimensions in P-EMS to evaluate the static rope operations.[9] Reductions in wait times and harmful delays are considered to be important quality aspects for HEMS. These aspects were measured by registering the availability of the HEMS unit at the time of dispatch and 4 time variables: take-off time, response time, on-scene time, and care time (Table 3). Moreover, patient survival to hospital admission was registered. The safety of both the crew and the patient was evaluated by assessing whether the static rope operations were debriefed and by searching for possible adverse events in the operation log. To assess whether the quality of care is equitable, the following 3 QIs were measured: presence of guidelines for the actual medical condition, involvement of the HEMS crew in the dispatch

Table 2. Response-specific quality indicators for physician-staffed emergency medical services

No.	*Quality indicator*	*Type of quality indicator*	*Quality dimension*
1	Was the P-EMS unit able to respond immediately to the actual response?	Structure	Timeliness
2	What is the time interval from the dispatch center receives the alarm call until P-EMS unit arrives at the patient?	Structure	Timeliness
3	What is the time interval from P-EMS unit arrives at the patient until transportation of patient is initiated?	Process	Timeliness
4	What is the time interval from the P-EMS unit received the alarm call until the patient was delivered at the preferred destination?	Process	Timeliness
5	Did the patient arrive at the hospital alive?	Outcome	Timeliness
6	Was the P-EMS response debriefed?	Process	Safety
7	Did you experience any adverse events during the P-EMS response?	Process	Safety
8	Are all defined key variables measured and documented in the patient chart?	Process	Efficiency
9	Did the service have a guideline for the medical problem encountered in the response?	Structure	Equity
10	Was a physician and/or a paramedic from P-EMS involved in deciding if the P-EMS unit should be dispatched to the particular job?	Process	Equity
11	Without the assistance of the P-EMS unit: Do you consider that the level of competence on scene was sufficient to give the patient appropriate care?	Process	Equity
12	Did P-EMS provide advanced treatment in the actual response?	Process	Effectiveness
13	Did the logistical contribution by P-EMS give the patient a significantly better service than the existing alternative?	Process	Effectiveness
14	Was the patient enrolled in a scientific study involving the prehospital care?	Structure	Effectiveness
15	Did you ensure that the relatives' needs were addressed, either by P-EMS or by collaborating services?	Process	Patient-centeredness

P-EMS, physician-staffed emergency medical services.

decision, and the need for the HEMS crew's competence to provide adequate care. Finally, to assess the added value of HEMS, it was registered if advanced medical treatment (defined as treatment not available from GEMS) was performed or if the logistical contribution resulted in significantly better care for the patient.

The QIs were retrospectively applied by the authors to evaluate the quality of the service. A consensus on QI application was reached through group discussion.

Table 3. Time definitions

Take-off time	The time interval from the time that the HEMS unit receives the alarm call to the time that the helicopter lifts off of the ground. Operations in which the HEMS unit was already airborne were excluded.
Response time	The time interval from the time that the HEMS unit receives the alarm call until the first HEMS anesthetist arrives at the patient.
On-scene time	The time interval from the time of the first HEMS anesthetist-patient contact to the time that transportation of patient is initiated, the patient is referred to another EMS unit, or the patient is left at the scene.
Care time	Time interval from the time that the HEMS unit receives the alarm call to the time that the patient is no longer under care, meaning that the patient was delivered to a definitive destination, referred to another EMS unit, or left at the scene after examination.

From the original set of QIs for P-EMS, 3 variables were omitted. The compliance and completeness of patient-describing key variables (QI #8) were not assessed because they were considered outside the scope of this study. Furthermore, the care for relatives of the patients (QI #15) and whether the patient of a static rope operation was included in a prehospital research project (QI #14) were not assessed because these aspects could not be evaluated due to a lack of information in the operational documentation given the retrospective methodology applied in this study.

STATISTICS

Operational descriptors and patient characteristics are presented as medians and quartiles. To present the NACA scores (noncontinuous variable, with 7 categories) in a way that differentiates among the groups, we made an approximation to a continuous variable. Hence, the NACA scores are expressed as the mean (SD). The Kruskal-Wallis nonparametric test was used when assessing both the difference in the NACA scores between the medical and trauma group and the difference in the NACA scores between the bases. An association between NACA score and take-off time were assessed by calculating the Spearman's rho correlation coefficient r. All analyses were performed using IBM SPSS version 23 (IBM, Armonk, NY).

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The Regional Committees for Medical and Health Research Ethics/Section South-East did not classify this study as a medical and healthcare project requiring approval. However, dispensation from professional secrecy requirements for "other types of research" was granted in accordance with Regional Committees for Medical and Health Research Ethics decision 2014/1510. Furthermore, the project was recommended by the data protection officer at OUH, the accountable data-processing entity, in accordance with recommendation 2014/13855.

Results

A total of 5521 primary operations were completed at HEMS Lørenskog, HEMS Ål, and HEMS Arendal during the study period. There were 59 static rope operations (1.1%); 58 were above land and 1 was from a lake (Table 4). In total, 60 patients were evacuated (1 operation involved 2 persons). No accidents or other adverse events in terms of safety were reported during the static rope operations in the study period.

Table 4. Operational figures

HEMS	*Primary missions (n)*	*Static rope (n)*
Lørenskog	3156	28
Ål	1085	21
Arendal	1280	10
Total	5521	59

HEMS, helicopter emergency medical services.

The median (quartiles) distance to the scene from the HEMS base was 27 (23–47) km. At a median (quartiles) of 83 (42–93) km, HEMS Arendal had distances to the scene that were more than 3 times longer than those of HEMS Lørenskog (median [quartiles] 26 [18–40] km) and HEMS Ål (median [quartiles] 25 [25–27] km).

CHARACTERISTICS OF THE PATIENTS AND THE INCIDENTS

The median (quartiles) age was 43 (27–55) y. Five patients were under 16 y of age, with the youngest being 9 y. The oldest patient was 88 y. More men (39) than women (21) were evacuated, and the patients were engaged in a variety of activities at the time of the injury or falling ill (Table 5). The median (quartiles) response time was 47 (33–62) min, including a median (quartiles) take-off time of 9 (5–13) min. The median (quartiles) care time was 82 (63–118) min, including a median (quartiles) on-scene time of 16 (6–34) min.

The median (quartiles) monthly static rope operations performed on the 3 HEMS bases were 2 (1–2) with little seasonal variation (winter [December–February]: 16; spring [March–May]: 16; summer [June–August]:

Table 5. Activity of the evacuated patients at the time of injury or medical emergency

Activity	*Lørenskog*	*Ål*	*Arendal*	*Total*
Hiking	18[a]	2	4	24
Off-piste skiing	1	14[b]		15
Mountaineering		2	2	4
Working	1		3	4
Downhill/Mountain biking	1	2		3
Paragliding	2			2
Trail running	2			2
Other[c]	3	2	1	6
Total	28	22	10	60

[a] Accounts for 64% of the rescue operations at HEMS Lørenskog.
[b] Accounts for 64% of the rescue operations at HEMS Ål.
[c] Includes ice climbing, ice fishing, hunting, suicide attempt in a remote area, wood chopping, and zip-lining.

Table 6. Main conditions of the evacuated patients

Condition	*No.*
Trauma diagnosis (n=48)	
Lower limb injuries	32
Head/Neck injury	5
Abdominal/Pelvic/Back injury	5
Thoracic injury	3
Other/Minor injuries	2
Traumatic asphyxiation	1
Medical diagnosis (n=10)	
Syncope/Collapse	4
Cerebral infarction[a]/Stroke[b]	3
Cardiac arrest	2
Neurologic disorders	1
No injury or medical disorder (n=2)	2

[a] International Classification of Diseases version 10 (ICD-10) code I63; n=1.
[b] ICD-10 code I64; n=2.

14; autumn [September–November]: 13). More than one-third of the incidents occurred during the weekend, with the most on Saturdays (n=14). The fewest incidents occurred on Mondays (n=4).

SEVERITY OF THE INJURIES OR ILLNESSES

A total of 48 patients had a trauma diagnosis, 10 patients had a medical diagnosis, and 2 persons had no injuries or medical disorders (Table 6).

The mean (SD) overall NACA score was 3.3 (1.3), 3.3 (1.2) for trauma patients, and 4.0 (1.6) for medical patients. The difference in mean NACA score between medical patients and trauma patients was not statistically significant (P=0.057). Fifteen patients had a potentially or actual life-threatening condition (NACA score: 4–6) (Table 7). There was no association between the NACA score and the take-off times for the bases (r=0.024, P=0.863).

The mean (SD) NACA scores for the bases were 3.4 (1.6) at HEMS Ål, 3.3 (1.2) at HEMS Lørenskog, and 3.2 (1.1) at HEMS Arendal. The differences in the mean NACA score between the bases were not statistically significant (P=0.865)

Of the 48 trauma patients, 11 were admitted to trauma teams in the emergency department, with 7 at OUH and 4 at local hospitals (all transported by HEMS). Twenty-five patients were admitted without trauma team activation to local hospitals (9 transported by HEMS, 16 transported by GEMS). Ten patients were transported to the local general practitioner on call by GEMS for diagnosis and treatment. One patient was left on scene after examination, and 1 was declared dead on scene.

Table 7. Injuries and medical conditions by NACA score

NACA score	*Trauma (n)*	*Medical (n)*
1	1	0
2	8	1
3	27	4
4	6	2
5	2	1
6	3	1
7	1	1
Total	48	10

NACA, National Advisory Committee for Aeronautics.

Of the 10 medical patients, 1 was transported to OUH by HEMS. Eight patients were transported to local hospitals (2 by HEMS, 6 by GEMS). One patient was declared dead on scene.

Two uninjured persons were exclusively evacuated by static rope operation without the provision of any other actions.

MEDICAL INTERVENTIONS PERFORMED

Medical interventions were performed in 34 patients by the HEMS unit (Table 8). Four out of 5 intubation attempts (3 traumas, 2 medical emergencies) succeeded. The one failed intubation (medical emergency) was caused by massive aspiration, and the airway was secured with an intubating laryngeal mask airway.

In 8 static rope operations, other resources (GEMS/ski patrol) had established intravenous lines and initiated pain therapy with morphine before the arrival of the HEMS unit.

Of the drugs administered by the HEMS unit, approximately one-fourth was given by the HCM on scene and

Table 8. Main interventions performed

Intervention	*n*
Analgesics (fentanyl, ketamine, morphine)[a]	22
Intravenous lines	19
Oxygen treatment	14
Vacuum splint/Fracture realignment	9
Intubation[b]	5
Vasoactive drugs (epinephrine, atropine)[c]	5
Cardiopulmonary resuscitation	4
Thoracostomy	1

[a] Fentanyl: n=9; ketamine: n=7; morphine: n=6; provided to 17 patients.
[b] Includes 1 intubating laryngeal mask airway.
[c] Epinephrine: n=4; norepinephrine: n=1; atropine: n=1; 1 patient received both norepinephrine and atropine.

three-fourths were given by the anesthetist after evacuation. All intubations were performed by the anesthetist.

QUALITY INDICATORS

In 58 static rope operations, the HEMS crew was available for immediate response when receiving the alarm call. On one occasion, the HEMS crew had to postpone the operation due to poor visibility. A standard operating procedure for HEMS static rope operation exists, and in all 59 operations, the physician and/or the HCM was involved in the dispatch decision. Of the patients, 58 were alive on either admission to a definitive healthcare facility, referral to another EMS, or at the time that they were left on scene after examination. Two patients died (1 trauma and 1 medical illness), indicating a mortality rate of 3.3%. Furthermore, adverse events occurred in 2 operations; both were delays. One was due to a request for a new operation before the ongoing one was completed, and the other was due to a prolonged discussion between the coordinating entities, EMCC and JRCC. All HEMS static rope operations were subject to mandatory debrief by the crew.

Advanced treatment was provided in 23 static rope operations. In 20 static rope operations, the added competence of the P-EMS unit was considered to be needed or probably needed to provide appropriate care.

All operations were located at scenes that were difficult for regular EMS to access. Sixteen operations were perceived as time critical (15 had NACA score ≥4, and 1 operation involved evacuation of people in imminent risk of falling from a cliff). Based on the scene location, topography, and infrastructure, we compared the time needed for alternative evacuation and transportation with static rope evacuation and transportation by HEMS. In all 16 operations, we estimated that static rope evacuation led to a reduction of time to the admitting facility of 30 min or more. Maps and web-based driving time calculators were used as tools for this assessment. The estimation was done by 3 of the authors, and consensus was obtained in all 16 operations.

Discussion

We found that static rope evacuation was performed in 1.1% of the HEMS primary operations in southeast Norway. Static rope operations were performed twice as frequently at HEMS Ål; all of these operations were trauma related. Considering that HEMS Ål is a mountain base located in a relatively sparsely populated rural region with national parks and several ski resorts, this result is expected. Being an urban base located near the center of Norway's most populated region, HEMS Lørenskog had the highest number of primary operations and the most static rope operations nominally. Compared with HEMS Lørenskog, HEMS Arendal had approximately the same proportion of static operations and approximately the same proportion of injuries.

Fifteen of the 60 evacuated patients had NACA scores of 4 to 6, indicating a serious condition. Despite the fact that a low number of patients with a critical condition were evacuated, the existence of this service seems justified given that alternative evacuation methods would have significantly delayed hospital admission. Furthermore, patients who are not severely injured also profit from static rope evacuation when they are located in a cold or hostile environment, where even minor illnesses or injuries potentially can result in life-threatening situations if the evacuation is delayed.

In areas such as the Alps, where rescue operations are much more common than in Norway, winching operations may be a better rescue technique than static rope operations. Winching equipment is more resource intensive than the equipment needed for static rope operations, so the latter may be a better option in areas where this kind of operation constitutes a low fraction of the total HEMS workload.

CHARACTERISTICS OF THE PATIENTS AND THE INCIDENTS

The majority of the patients were men, and the median patient age was 43 y. These numbers comply with findings from other studies—approximately 3 out of 4 evacuated patients are men.[1,2,4,12] Only 5 patients were aged under 16 y, echoing that a majority of the patients were engaged in activities that are infrequently performed by children when the need for evacuation arose. More than half of the patients were immobilized by lower limb injuries, resulting in a need for evacuation.

With growing interest in off-piste skiing in the winter combined with hiking during the rest of the year, no seasonal variation was observed. In some other systems, a more pronounced seasonal variation exists.[4,13] An additional issue is that the static rope operations are only performed during daylight hours, which have 10 to 18 h of seasonal variation in southeast Norway. More than one-third of the incidents occurred on Saturdays or Sundays. This result is probably due to more outdoor activities being performed on the weekends.

The median take-off time was 9 min in our study. In the literature, we found a take-off time of 7 min for winching operations. In most missions, a 2-min difference will have no clinical consequence. The relatively long take-off time for static rope operations compared with ordinary HEMS missions is probably partly due to the need to unload unnecessary equipment and fuel before commencing on a technically demanding project, where helicopter weight is an issue. The median response time was 47 min, while the corresponding number in a Swiss study was 22 min.[2] The longer response time in our study is probably due to the scene being located further from the helicopter base than is common in Switzerland, where the transport time from scene to hospital was 7 min.

The severity of injuries or illnesses

The NACA score is widely used to measure the severity of illness or injury in the prehospital setting, but it has many critics due to its subjectivity. One study assessed the NACA score's ability to predict mortality and the need for advanced in-hospital interventions in a cohort from 1 anesthetist-staffed helicopter service in northern Norway.[11] In that kind of emergency medicine system, they concluded that the NACA score had good discrimination for predicting mortality and the need for respiratory therapy and was a useful tool to measure the overall severity of the patient population.[11]

Even though a scale must be relatively crude to include all kinds of conditions, 1 study found that the mortality for NACA scores of 4, 5, and 6 was 8.7%, 15.3%, and 63.2%, respectively.[14] Forty-eight patients were trauma victims, and we found that medical patients had higher NACA scores than injured patients. This result is not statistically significant but nevertheless in accordance with a Swiss study, where an even higher portion (91%) was composed of trauma patients.[1] In this study, 25% of the trauma patients and 44% of the medical patients had NACA scores of 4 to 6.

Three patients were left at the scene after evacuation because they did not need further medical attention. These operations resulted from "overtriage"—the misidentification of patients who have minor illnesses or injuries but on initial assessment appear to be critically ill. In a study from Switzerland, the corresponding number was 10%.[2]

MEDICAL TREATMENT

The fact that most patients did not receive any medical treatment on the scene implies that they experienced minor trauma or illness. However, a certain degree of undertreatment cannot be excluded. This result is in accordance with other studies.[1,4,13] Intubation was attempted in 5 patients, and 1 thoracostomy was performed, suggesting that advanced procedures were indicated on occasion. In our HEMS, these procedures are only performed by the anesthetist. The fact that the anesthetist gets access to the patient only after evacuation delays the initiation of these procedures. Of the 921 patients included in 1 study, only 2% needed a secured airway.[1] In another Swiss study, 133 patients were included and 5 of these patients (4%) were intubated.[2]

In approximately three-fourths of the operations in which analgesics were provided, the analgesics were administered by the anesthetist at the rig site or during transport, not by the HCM on the scene of the accident. Here, we have identified a potential area for improvement. In an Australian study, 40% of the patients evacuated by winch needed medical interventions that could only be administered by the HEMS physician, and the authors use this high frequency as an argument to advocate for physicians in winching operations.[12] However, with only a few annual evacuations of critical patients per HEMS base in our region, implementing a protocol dictating winching operations with an anesthetist may not be warranted compared with systems with a higher workload.[15] However, several studies have indicated that prehospital treatments and helicopter transport positively influence patient outcomes.[16]

In our study, advanced treatment has been defined as interventions that are not performed by ground ambulance paramedics. As the treatment delegations vary between services, so does what is considered to be an "advanced" treatment. For example, analgesia with fentanyl qualified as an advanced treatment because ground ambulances, as a rule, are not equipped with that drug.

QUALITY INDICATORS

According to the QIs, advanced treatment was provided to 23 patients, even though this added competence was only considered "needed" or "probably needed" in 20 patients to provide appropriate care. For instance, this treatment could represent the intravenous administration of analgesia with fentanyl or ketamine when morphine may have been an adequate alternative, based on retrospective assessment.

Quality in healthcare can be understood as the degree to which provided care increases the likelihood of a positive health outcome.[17] Thus, it becomes evident that there is a distinct difference between the terms "quality" and "outcome." On one hand, a patient can have a good outcome despite poor quality of care. On the other hand, a patient can have a poor outcome despite good quality of care. Therefore, the isolated measurement of outcomes, such as survival, does not necessarily tell the whole truth about the healthcare quality provided. Using a balanced set of quality indicators, however, enables measurement of not only outcomes but also the different care processes that make up a P-EMS operation.

Traditionally, efforts of quality measurement in prehospital medicine have been dominated by the use of time variables.[18,19] Time variables are important quality indicators for time-critical conditions, such as cardiac arrest and airway obstruction. However, shorter time intervals affect outcomes for only a small fraction of the total number of prehospital patients.[20] For all the prehospital patients who do not belong to this fraction, quality is primarily related to factors other than time. To adequately measure quality, it is essential to apply a comprehensive selection of QIs to all prehospital responses. Finally, limiting quality measurements to the use of time variables is practical to assess only the logistic contribution of HEMS. The quality of the providers' clinical care given to the patient then remains unassessed, resulting in a narrow and inadequate approach to quality measurement.

Although Norwegian HEMS rescue operations are performed using a static rope, the Westland Sea King Mk.43 rescue helicopters of the Royal Norwegian Air Force offer winch operations as a part of their capacity. In contrast to Norwegian HEMS, they can also perform rescue operations without daylight. Thus, Norwegian dispatch centers can request the assistance of this additional resource when it is considered appropriate. Reasons for requesting a rescue helicopter might be a shorter distance to the scene, lack of daylight, or the location of the patient (when the location requires winching). Although both HEMS and SAR units contribute to SAR operations in Norway, optimal resource utilization is undecided, especially for time-critical operations. In general, very little has been reported about the time aspects of HEMS static rope operations. This is a topic that should be addressed in future studies to determine the time expenditure of static rope operations compared with winching operations.

Sixteen static rope operations resulted in an estimated reduction of time to the admitting facility of 30 min or more for conditions that were perceived as time critical. However, the clinical importance of this observation is unclear, given that we did not have access to medical records to assess the mortality or morbidity outcomes.

LIMITATIONS

Even though all static operations (n=59) in the area were included, this study is small. This limitation must be considered when postulating any potential associations or other matters of causality. Furthermore, in-hospital data remained inaccessible, making it impossible to depict morbidity and mortality and the validation of prehospital diagnostics. Nevertheless, other studies have found that NACA scores correlate well with clinical outcomes.[14] This study is retrospective and the data variables are limited to existing registries. Furthermore, it cannot be ruled out that some time points have been registered heterogeneously by the different crews. Generally, the external validity of the study is limited by the characteristics of the Norwegian SAR and HEMS organizations and similar HEMS organizations abroad.

Conclusions

Static rope operations are an important capacity of Norwegian HEMS despite being performed in only 1.1% of the primary operations. The QIs suggest that the service is safe, available, and equitable. Even though some critically injured/ill patients are evacuated, most patients do not experience life-threatening conditions. The main benefit seems to be evacuation and the maintenance of readiness by sparing other rescue units from time-consuming and/or hazardous operations, before rapid transport of the physician to the scene or rapid transport of the patient to the hospital.

In general, very little has been reported about the time aspects of HEMS static rope operations. This topic should be addressed in future studies.

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