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## Original Research

## Prehospital Stressors: A Cross-sectional Study of Norwegian Helicopter Emergency Medical Physicians



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## A B S T R A C T

**Objective:** Personnel working in helicopter emergency medical services (HEMS) and search and rescue (SAR) are exposed to environmental stressors, which may impair performance. The aim of this survey was to study the extent HEMS and SAR physicians report the influence of specific danger-based and non–danger-based stressors.

**Methods:** The study was performed as a cross-sectional, anonymous, Web-based (Questback AS, Bogstadveien 54, 0366 Oslo, Norway) survey of Norwegian HEMS and SAR physicians between December 2, 2019, and February 25, 2020.

**Results:** Of the recipients, 119 (79.3%) responded. In helicopter operations, 33.6% (n = 40) reported involvement in a minor accident and 44.5% (n = 53) a near accident. In the rapid response car, 26.1% (n = 31) reported near accidents, whereas 26.9% (32) reported this in an ambulance. Of physicians, 20.2% (n = 24) received verbal abuse or threats during the last 12 months. When on call, 50.4% (n = 60) of physicians reported sometimes or often being influenced by fatigue.

**Conclusion:** This study shows that Norwegian HEMS and SAR physicians are exposed to several stressors of both a danger-based and non–danger-based nature, especially regarding accidents, threatening patient behavior, and fatigue. Very serious incidents appear to be seldom, and job satisfaction is high.

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Working in emergency medicine can be challenging, and health care professionals are exposed to environmental stressors. These include exposure to critical incidents, unpredictability, workload, workplace violence, and time pressure.<sup>1,2</sup> The prehospital setting includes additional environmental stressors, such as traffic safety issues and unfamiliar accident scenes.<sup>3,4</sup> The disturbing incidence of

posttraumatic stress disorder (PTSD), burnout syndrome, and other relatable health issues among first responders and emergency medical service (EMS) personnel has been documented in several studies.<sup>5–9</sup> Helicopter emergency medical service (HEMS) is an extended arm of regular EMS, and personnel working in this arena are exposed to environmental stressors, which may further impair performance.<sup>10</sup> Vibrations, noise, turbulence, temperature, weather, mission complexity, fatigue, and critical incidents can have a direct physical and/or psychological effect on personnel, and aviation accidents, although seldom, often have serious, if not fatal, outcomes.<sup>11–13</sup> Stressors in this arena can also be described and distinguished as danger based or non–danger based.<sup>14</sup> The first relates to personal life threats, whereas the second incorporates other environmental stressors.

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Identification of the character and overall magnitude of stressors experienced by physicians working in the prehospital context might allow directed actions to minimize the negative effects. Therefore, the aim of this survey was to study to which extent HEMS and search and rescue (SAR) physicians operating in a prehospital environment report the influence of specific danger-based and non–danger-based stressors.

## Methods

### Study Setting

Norway has a publicly funded national air ambulance network consisting of 12 HEMS bases and 7 fixed wing bases.<sup>15,16</sup> In addition, 6 SAR helicopter bases complement the National Air Ambulance Service. The physicians working in HEMS and SAR helicopters are consultant anaesthesiologists employed by the health trusts. A national standard for Norwegian air ambulance doctors aims to standardize qualifications and training requirements.<sup>17</sup> Both services perform air ambulance and SAR missions, but there are certain operational differences.<sup>18</sup> In addition to flying smaller helicopter types with a smaller crew, the HEMS service naturally performs more air ambulance and rapid response car (RRC) missions and shorter SAR missions compared with the SAR service.<sup>19</sup> All helicopter SAR personnel, including the physician, leave active flying duty at 60 years old, whereas HEMS physicians may fly actively until 67 years old. Both services operate day and night; the latter is enabled by the use of night vision goggles. The HEMS helicopter can perform human external cargo (static rope) operations, whereas the SAR helicopters perform hoist operations.<sup>20</sup> Medical emergency calls from the public are handled by the local emergency medical communications center, which decides on the type of response needed, including the dispatch of HEMS. The joint rescue coordination centers have overall operational responsibility during SAR operations. Together with the local emergency communication centers, they coordinate and facilitate multidisciplinary cooperation and communication.

The HEMS/SAR physicians are defined as medical crewmembers and are responsible for the triage, diagnostics, and treatment of patients on scene and during transport. All 18 bases in both helicopter services use an RRC as an alternative mode of transport. The RRC is used when poor weather conditions or technical problems do not enable flight operations or when other operational factors make it necessary or expedient to use this option. When performing missions by an RRC, the HEMS crewmember/paramedic is the allocated driver, and the physician navigates and operates the radio. Regardless of responding with an RRC or helicopter, most air ambulance missions entail cooperation, especially with ground EMS; therefore, many

patients are transported by the ground ambulance and assisted by the HEMS or SAR physician.<sup>21</sup>

### Study Design

The study was performed as a cross-sectional, anonymous, Web-based (Questback AS, Bogstadveien 54, Oslo, Norway) survey of HEMS physicians working in the National Air Ambulance Service and SAR helicopter service between December 2, 2019, and February 25, 2020. After reviewing the literature, a survey that addressed danger-based or non–danger-based stressors was developed.<sup>10,13,22–27</sup> The questionnaire contains 30 questions (Appendix 1) in 3 categories: category 1 (questions 1–3) relates to operational experience, category 2 (questions 3–18) relates to danger-based issues, and category 3 (questions 19–30) relates to non–danger-based factors. Definitions of questions are described in Figure 1.

We identified 155 eligible participants for this study after contacting the leaders of the respective 18 bases of both services. Five of the eligible participants are authors/coauthors of this study and were excluded. Therefore, 150 participants were contacted by mail with general information about the study and asked for their consent to participate (Appendix 2). The survey was conducted anonymously using the Web-based program Questback. After the first inquiry, 4 reminders were sent to nonresponders.

### Statistical Analysis

Data were analyzed (IBM SPSS Statistics Version 22; IBM Corp, Armonk, NY), and statistical data are presented as frequencies, percentages, average with mean and range, and median with interquartile range (IQR) where appropriate. Because of certain operational differences between the 2 services, we chose to compare the physicians regarding debrief culture, exposure to accidents and threats (Table 1), and retirement age. Therefore, statistical comparisons between the groups are performed, and *P* values for significance ( $P < .05$ ) are reported using the Pearson chi-square test for categorical variables or the Mann-Whitney *U* test to compare median values in continuous variables. In the draft of this manuscript, Strengthening the Reporting of Observational Studies in Epidemiology guidelines were applied.<sup>28</sup>

### Ethics

This study was approved by the Regional Committee for Medical and Health Research Ethics (19/7161).

### Results

Of the 150 recipients of the survey, 119 (79.3%) persons responded. A primary affiliation to HEMS was reported by 90 (75.6%)

(The accident questions do not relate to patient treatment)
<b>A minor accident: an unplanned event that has caused minor equipment damage or less serious human injury requiring medical attention, but not hospital admission</b>
<b>A major accident: an unplanned event that has caused major equipment damage or serious human injury (requiring hospital admission) or death</b>
<b>A near accident: an unplanned event that potentially could have caused equipment damage or human injury</b>
<b>Physical assault: an intentional act of harmful or offensive contact</b>
<b>Fatigue: a subjective feeling of mental or physical tiredness</b>

Figure 1. Definitions of Questions

**Table 1**  
Exposure to Accidents, Assaults, and Threats

Question	HEMS and SAR (n = 106)	SAR (n = 29)	HEMS (n = 77)	P Value
Minor accident helicopter, n (%)	40 (33.6)	8 (27.6)	32 (35.6)	NS
Minor accident RRC, n (%)	11 (9.2)	2 (6.9)	9 (10)	NS
Minor accident ambulance, n (%)	15 (12.6)	5 (17.2)	10 (11.1)	NS
Major accident helicopter, n (%)	4 (3.4)	1 (3.4)	3 (3.3)	NS
Major accident RRC, n (%)	1 (0.8)	0	1 (1.1)	NS
Major accident ambulance	4 (3.4)	2 (6.9)	2 (2.2)	NS
Near accident helicopter, n (%)	53 (44.5)	13 (44.8)	40 (44.4)	NS
Near accident RRC, n (%)	31 (26.1)	10 (34.5)	21 (23.3)	NS
Near accident ambulance, n (%)	32 (26.9)	6 (20.1)	26 (28.9)	NS
Physical assault last 12 months, n (%)	6 (5)	2 (6.9)	4 (4.4)	NS
Verbal abuse last 12 months, n (%)	24 (20.2)	6 (20.7)	18 (20)	NS
All missions debriefed, n (%)	51 (42.9)	26 (89.7)	25 (27.8)	<.05

HEMS = helicopter emergency medical service; NS = nonsignificant; RRC = rapid response car; SAR = search and rescue.

of the participants, and a primary affiliation to SAR was reported by 29 (24.4%) participants. Of the respondents, 40 (33.6%) reported having worked or were working in both HEMS and SAR. The mean number of years of experience in HEMS/SAR of the participants was 10.6 years (range, 0–31 years). SAR doctors had worked a mean of 9.6 years (range, 0–30 years) and HEMS doctors a mean of 11 years (range, 0–31 years).

In helicopter operations, 33.6% (n = 40) of all physicians reported having been involved in a minor accident, and 44.5% (n = 53) had experienced a near accident (Table 1). In the RRC, 26.1% (n = 31) reported near accidents, and 26.9% (32) reported near accidents in an ambulance. Of the physicians, 25.2% (n = 30) reported sometimes or often being anxious on missions in the ambulance compared with 11.7% (n = 14) in the helicopter (Table 2). During missions, 20.2% (n = 24) had received verbal abuse or threats during the last 12 months (Table 3).

Of the respondents, 82.3% (98) agreed that fatal accidents in the service had affected them emotionally, and 31.1% (37) reported that family or domestic life suffered negatively from on-call work (Table 3).

When on call, 50.4% (n = 60) of physicians reported sometimes or often being influenced by fatigue (Table 3). Respondents reported that retirement from active flying duty in HEMS should be 65.0 years (median; IQR, 60–65 years). HEMS physicians quoted a retirement

age at 65.0 years (median; IQR, 60–66 years) and SAR doctors at 60.0 years (median; IQR, 60–65 years) (P < .05). Of the respondents, 39 (32.8%) reported that they at the most were on call 4 to 7 days at a time, and 72 (60.4%) reported being on call a maximum of 49 to 72 hours.

**Discussion**

This study shows that Norwegian HEMS and SAR physicians working in a prehospital environment report an exposure to several environmental stressors, both danger-based and non–danger-based stressors. Of most concern is exposure to accidents, threatening patient behavior, and fatigue. However, there appear to be very few serious incidents in the services, and the vast majority of physicians report high job satisfaction.

One third of physicians reported being involved in a minor accident, and almost half of the respondents experienced a near accident in the helicopter. One study showed that German HEMS experienced 2 to 4 helicopter crashes a year and that German, Australian, and American HEMS had fatal helicopter crash rates between 0.04 and 2.12 per 10,000 missions.<sup>29</sup> An American study showed that human and pilot errors were the major cause of accidents and that HEMS qualified as one of the most dangerous occupations in the United States.<sup>30</sup>

A quarter of physicians in our study had experienced near accidents on both an RRC and an ambulance, less than on the helicopter.

**Table 2**  
Anxiety, Reactions, Motion Sickness, and Fatigue

Question	Never, n (%)	Rarely, n (%)	Sometimes, n (%)	Often, n (%)	Always, n (%)
I am anxious on helicopter missions	43 (36.1)	62 (52.1)	13 (10.9)	1 (0.8)	—
I am anxious on RRC missions	39 (32.8)	58 (48.7)	20 (16.8)	2 (1.7)	—
I am anxious on ambulance missions	35 (29.4)	54 (45.4)	27 (22.7)	3 (2.5)	—
I have emotional reactions after missions that make me depressed/sad	38 (31.9)	61 (51.3)	20 (16.8)	—	—
I suffer insomnia/flashbacks after missions	64 (53.8)	43 (36.1)	12 (10.1)	—	—
I am anxious for making wrong clinical/operational decisions	23 (19.3)	65 (54.6)	27 (22.7)	4 (3.4)	—
I suffer from motion sickness in helicopter	45 (37.8)	51 (42.9)	20 (16.8)	3 (2.5)	—
I suffer from motion sickness in RRC	83 (69.7)	31 (26.1)	4 (3.4)	1 (0.8)	—
I suffer from motion sickness in ambulance	51 (42.9)	43 (36.1)	23 (19.3)	2 (1.7)	—
I am influenced by fatigue when on call	5 (4.2)	54 (45.4)	57 (47.9)	3 (2.5)	—

RRC = rapid response car.

**Table 3**  
Well-being and Satisfaction

Question	Strongly Disagree, n (%)	Disagree, n (%)	Neither, n (%)	Agree, n (%)	Strongly Agree, n (%)
Fatal accidents in service have affected me emotionally	2 (1.7)	9 (7.6)	10 (8.4)	73 (61.3)	25 (21)
On call has negative influence on family/domestic life	7 (5.9)	37 (31.1)	38 (31.9)	35 (29.4)	2 (1.7)
Satisfied with HEMS/SAR position	2 (1.7)	—	—	41 (34.4)	76 (63.9)

HEMS = helicopter emergency medical services; SAR = search and rescue.

Despite this, in excess of a quarter reported being sometimes or often anxious on ambulance missions, more than on the helicopter. Missions in which HEMS and SAR physicians accompany patients in an ambulance are often improvised in the field; therefore, crew compositions are frequently characterized by unfamiliarity and increased “ad hoc” solutions. Vehicle-related accidents have been reported as being the major reason for fatalities among first responders of the fire, police, and EMS departments, and, therefore, there has been an increased focus on addressing safety issues and culture related to the use and possible abuse of “lights and sirens.”<sup>3,4</sup>

Training and robust risk analysis has been shown to improve safety.<sup>31</sup> Helicopter crewmembers live, train, and work together, often several days at a time. This could also explain why some physicians in our study reported being emotionally unaffected by fatal accidents in the service.

There has been an increasing focus on the prevalence of workplace violence in emergency medicine, both in the emergency department and in EMS.<sup>32,33</sup> Studies have shown an association between the development of PTSD and exposure to dangerous situations, including violence and threats.<sup>22,34</sup> In our study, one fifth of physicians reported having received verbal abuse during the last 12 months, whereas fewer reported an actual physical assault. These occurrences should be taken seriously with compulsory debrief and opportunity of counseling, which can be beneficial in terms of reducing the risk of PTSD.<sup>35</sup>

Under half of the physicians answered that all missions were debriefed, although there appeared to be a much higher debriefing compliance in the SAR environment compared with HEMS. For comparison, a study from 2019 documented that 74% of the missions in Nordic physician-staffed air ambulance services were debriefed.<sup>36</sup> The Norwegian SAR helicopter is flown by a military crew, which could explain a more disciplined approach in this area. The debrief culture originates from a military setting but has now seen a wide implementation also in health services, especially after critical incidents.<sup>37</sup>

Half of the physicians reported sometimes or often being influenced by fatigue when on call. The significance of fatigue on performance and alertness may affect both operational and patient safety but also the ability of self-evaluation and insight into actual detrimental effects.<sup>38</sup> Strategies and training to mitigate the effects of fatigue on aircrews have now become an important part of on-call duty management.<sup>39</sup>

Job dissatisfaction is an important indicator for burnout.<sup>40</sup> Virtually all respondents reported high job satisfaction, although almost a third agreed that on-call work had a negative effect on family or domestic life. Job satisfaction may also be reflected in the years of SAR/HEMS experience, which approached a decade, reported by physicians in both systems. Despite this, this study showed that physicians would choose to retire from active flying duty in HEMS at a lower age limit than the general pension age for physicians in this service in Norway. This may be due to an acknowledgment of the physical and mental robustness necessary for personnel in the service and the complicit understanding of possible physiological deterioration with increasing age.<sup>25</sup>

There are several limitations to this study. The response rate was nearly 80%. This is an acceptable response rate but means that missing answers could have influenced study results and interpretations.<sup>41</sup> There were 4 reminders of the survey to nonresponders. In addition, this is a self-reported survey, and, therefore, there may be bias in the answering of questions (eg, reporting bias and recall bias). Nevertheless, the reporting bias may have been limited by the absence of open-ended questions in the questionnaire and the anonymity of study respondents. Our study does not document the rate of PTSD, burnout syndrome, or other stress-related symptoms among Norwegian HEMS and SAR physicians. This also applies to all studies

based on self-reporting questionnaires in mental health surveys, which are more suited for the screening of a condition. Diagnosis can only be achieved by standardized in-depth personal interviews.<sup>42</sup>

## Conclusion

This study shows that Norwegian HEMS and SAR physicians working in a prehospital environment report an exposure to several stressors of both danger-based and non-danger-based nature, especially regarding accidents, threatening patient behavior, and fatigue. Very serious incidents appear to be seldom, and job satisfaction is high. A holistic approach with a focus on training, simulation, safety and debriefing culture, operational patterns, and procedures may contribute to both mitigating and managing the burden of risks and stressors in this environment. A proactive systems approach to build a safety culture should be of the highest priority for leaders. Mandatory debriefing after missions and the possibility of structured follow-ups are important measures to reduce the long-term consequences of stressors.<sup>14</sup>

## Appendix 1. Questionnaire for Helicopter Emergency Medical Services (HEMS)/Search and Rescue (SAR) Physicians

1. For the purpose of this study my primary affiliation is in which service?
  - a. HEMS b. SAR
2. How many years of HEMS/SAR experience (combined if appropriate) do you have?
 

Give the answer in digits:
3. Have you worked in both an HEMS and SAR service?
  - a. Yes b. No
4. I have been involved in a minor accident in the helicopter. (A minor accident is defined as an unplanned event that has caused minor equipment damage or less serious human injury requiring medical attention, but not hospital admission (The accident questions do not relate to patient treatment)).
  - a. Yes b. No
5. I have been involved in a minor traffic accident in the rapid response car.
  - a. Yes b. No
6. I have been involved in a minor traffic accident in an ambulance.
  - a. Yes b. No
7. I have been involved in a major accident in the helicopter. (A major accident is defined as an unplanned event that has caused major equipment damage or serious human injury (requiring hospital admission) or death).
  - a. Yes b. No
8. I have been involved in a major traffic accident in the rapid response car.
  - a. Yes b. No
9. I have been involved in a major traffic accident in an ambulance.
  - a. Yes b. No
10. I have been involved in a near accident in the helicopter. (A near accident is defined as an unplanned event that potentially could have caused equipment damage or human injury).
  - a. Yes b. No

11. I have been involved in a near traffic accident in the rapid response car.
  - a. Yes b. No
12. I have been involved in a near traffic accident in an ambulance.
  - a. Yes b. No
13. Fatal accidents in the National Air Ambulance System have affected me emotionally.
  - a. Strongly disagree b. Disagree c. Neither d. Agree e. Strongly agree
14. Due to accidents/near accidents/reported accidents with the helicopter, I am anxious when on missions in the helicopter.
  - a. Never b. Rarely c. Sometimes d. Often e. Always
15. Due to accidents/near accidents/reported accidents with rapid response car, I am anxious when on missions in the rapid response car.
  - a. Never b. Rarely c. Sometimes d. Often e. Always
16. Due to accidents/near accidents/reported accidents with ambulance, I am anxious when on missions in an ambulance.
  - a. Never b. Rarely c. Sometimes d. Often e. Always
17. I have been physically assaulted on missions during the last 12 months. (Physical assault is here defined as an intentional act of harmful or offensive contact).
  - a. Yes b. No
18. I have been verbally abused on missions during the last 12 months.
  - a. Yes b. No
19. What I experience during or after missions gives me emotional reactions that make me depressed or sad.
  - a. Never b. Rarely c. Sometimes d. Often
20. What I experience during or after missions gives me emotional reactions that lead to insomnia or flashbacks.
  - a. Never b. Rarely c. Sometimes d. Often
21. On prehospital shifts I am troubled by anxiety for making wrong clinical or operational decisions related to patient treatment.
  - a. Never b. Rarely c. Sometimes d. Often
22. How often do you suffer from motion sickness during helicopter missions?
  - a. Never b. Rarely c. Sometimes d. Often
23. How often do you suffer from motion sickness during rapid response car missions?
  - a. Never b. Rarely c. Sometimes d. Often
24. How often do you suffer from motion sickness during ambulance missions?
  - a. Never b. Rarely c. Sometimes d. Often
25. How often are you influenced by fatigue when on call in HEMS/SAR? (Fatigue is here defined as a subjective feeling of mental or physical tiredness)
  - a. Never b. Rarely c. Sometimes d. Often
26. How many consecutive hours do your regularly scheduled on-call duties last at most?
  - a. 12 hours b. 24 hours c. 25–48 hours d. 49–72 hours e. 4–7 days f. More than 7 days
27. All performed missions are debriefed?
  - a. Yes b. No
28. Being on call has a negative influence on family/domestic life.
  - a. Strongly disagree b. Disagree c. Neither d. Agree e. Strongly agree
29. The age limit for SAR personnel and other HEMS crewmembers is 60. In my opinion, HEMS physicians should retire from active flying duty at:
 

Give the answer in digits:
30. I am overall satisfied with my position as an HEMS/SAR physician.
  - a. Strongly disagree b. Disagree c. Neither d. Agree e. Strongly agree

## Appendix 2. Stressors and Risks in the Prehospital Environment: A Survey of Norwegian Prehospital Physicians

Thank you for taking time to respond to this national survey from St Olavs Hospital, Trondheim, Norway.

The survey maps the influence of stressors (danger-based and non-danger-based) on flight physicians working in a Norwegian HEMS and SAR environment.

The survey is anonymous and fulfills guidelines for GDPR. Your response will be treated strictly confidentially and your identity will not be traceable.

Read the statements carefully. Be honest when answering. For each statement, choose the one that fits best. The questionnaire should take approximately 10 minutes to complete.

Some of you may work in both the HEMS and SAR service. You may only answer the survey once. Therefore, in question 1, you must state in which service you are primarily affiliated. This also applies to participants who may receive the questionnaire through more than one e-mail address. Again, please answer the questionnaire only once, and we apologize for any inconvenience this may cause.

I have received information about the study and I am willing to participate.

YES/ NO

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