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Sky-High Safety? A Qualitative Study of Physicians' Experiences of Patient Safety in Norwegian Helicopter Emergency Services

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Background: Patients treated and transported by Helicopter Emergency Medical Services (HEMS) are prone to both flight and medical hazards, but incident reporting differs substantially between flight organizations and health care, and the extent of patient safety incidents is still unclear.

Methods: A qualitative descriptive study based on in-depth interviews with 8 experienced Norwegian HEMS physicians from 4 different bases from February to July 2020 using inductive qualitative content analysis. The study objectives were to explore the physicians' experience with incident reporting and their perceived areas of risk in HEMS.

Results/Findings: The HEMS physicians stated that the limited number of formal incident reports was due to the "nature of the HEMS missions" and because reports were mainly relevant when deviating from procedures, which are sparse in HEMS. The physicians preferred informal rather than formal incident reporting systems and reporting to a colleague rather than a superior. The reasons were ease of use, better feedback, and less fear of consequences. Their perceived areas of risk were related to all the phases of a HEMS mission: the physician as the team leader, medication errors, the handover process, and the helicopter as a work platform.

Conclusions: The sparse, informal, and fragmented incident reporting provides a poor overview of patient safety risks in HEMS. Focusing on organizational factors and system responsibility and research on environmental and contextual factors are needed to further improve patient safety in HEMS.

Key Words: emergency medicine, hems, helicopter, patient safety, qualitative content analysis, incident reporting, organizational factors, nontechnical skills

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Transporting seriously ill or injured patients needing time-critical and advanced interventions with limited human resources and space involves a significant risk of adverse events.[1,2] Air ambulances introduce additional aviation-related hazards. Although not entirely comparable, aviation safety management is in many aspects considered superior to that of health care with a more supportive and nonpunitive incident reporting environment, which is openly accessible while still maintaining the immunity of involved crews.[3]

While the scientific focus on patient safety in prehospital critical care is sparse, some studies have identified factors influencing the safety climate. A Swedish study pointed out preparedness, good teamwork, and communication as essential for transporting critically ill patients in long-distance air ambulance.[4] In a similar study from a Brazilian team, experience, training, and checklists were highlighted as most important.[5] In a systematic review of patient safety in emergency medical services, the included literature was divided into the following 7 themes: adverse events and medication errors, clinical judgment, communication, ground vehicle safety, aircraft safety, interfacility transport, and intubation.[6] This coincides well with the Agency for Healthcare Research and Quality definition of dimensions within patient safety culture: leadership, teamwork within and across units, communication, staffing, and reporting systems with nonpunitive feedback.[7]

A good reporting culture has been defined as 1 of 5 components of a safety culture,[8] and incident reporting systems have become the most widespread strategy for improving patient safety.[9] Studies that compared incident reporting systems in hospitals to medical record reviews showed that only 5% or less of harmful incidents were reported.[10,11] The number of reported incidents in air medical transport is low.[12–14] However, error identification varies with medical education,[15] and the difference between the observed and self-rated performance may indicate that the problem is larger than the reported numbers.[16,17] Despite a national Helicopter Emergency Service (HEMS), Norway also has no unified reporting system to provide an overview of patient safety incidents, where each air medical base reports only within its organization. Thus, a relevant question is if incident-reporting systems can be considered reliable sources for healthcare error rates.[18]

We believe that there is reason to assume an underreporting of patient-related incidents in HEMS. To study the rationale behind this reporting culture, we chose a qualitative approach with in-depth interviews of HEMS physicians with 2 objectives: first, to explore Norwegian HEMS physicians' experiences with incident reporting, and second, their perception of areas of specific risks regarding patient safety in HEMS operations.

METHOD

Study Participants

The Norwegian HEMS is a national government-funded service with 13 bases. All helicopters are staffed by a pilot and a HEMS Technical Crew Member employed by the flight operator, and a physician employed by the local health trust. All HEMS physicians are consultant anesthesiologists and share their

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TABLE 1. Informants' Age and Years of HEMS Experience

Informant	Age	HEMS Experience
A	59	28
B	46	10
C	47	16
D	44	12
E	51	6
F	52	8
G	47	9
H	48	15
Median	47,5	11

HEMS duty with in-hospital clinical work in anesthesia and intensive care medicine. At the time of the study, one base also included a nurse in the crew to assist the physician. As the physician is the sole medical provider on all other bases and is responsible for the medical treatment, we only invited physicians as informants to our study.

We recruited HEMS physicians with at least 5 years of experience as the ability to identify errors seems to increase with experience.[19] Physicians with any formal leadership role at the base were intentionally not invited.

Data Collection

We approached the medical directors of all Norwegian HEMS bases and encouraged them to appoint a person of contact who was then requested to recruit 1 or 2 informants from their base. All recruited physicians were contacted directly. This procedure ensured the informants' anonymity to avoid the risk of retaliation.

To obtain broad insight and rich information, we sought to recruit from 6 to 12 informants with the same professional background but different experiences regarding incident reporting systems, helicopter types, and crew configuration. Thus, this group of informants served as a purposeful sample.[20,21] Informants were recruited until little new information emerged from the interviews and additional coding no longer seemed feasible.[22] None of the respondents declined to participate or later withdrew their consent.

All interviews took place during regular working hours at the informants' workplace from February to July 2020 but without the presence of others. The first author conducted all interviews; the first 4 using a recorder, and the last 4 informants were interviewed via video (Microsoft Skype or Microsoft Teams; Microsoft Corp, Redmond, Wash) due to COVID-19 restrictions. The mean duration of the interviews was 49 minutes (30–62 minutes). A semistructured interview guide had been developed in advance but was not presented before the interviews (see Interview Guide, English translation in Supplemental Material, http://links.lww.com/JPS/A574). The recorded video files were converted to audio files and then transcribed verbatim.

The interview guide opened with questions about the informants' experience with incident reporting systems and continued with questions about incidents or near misses they had experienced or expected could occur in the different phases of a mission. At the end of the interview, the informants were asked to summarize essential factors for patient safety in HEMS.

Qualitative Description Design

We applied a qualitative descriptive approach to our study.[23] According to Bradshaw et al,[24] quality description is an inductive process designed to describe a phenomenon and develop understanding. The researcher takes the participants' perspectives but has an active role through interviews and interpretation.[24] Quality description is especially amendable in studies with findings not far from the literal description and, thus, a lower level of interpretation.[21,25]

Data Analysis

For data analysis, we applied an inductive qualitative content analysis with a low abstraction and low interpretation degree.[26,27] A process of dividing the text into meaning units, condensing and coding, was followed by sorting the codes by similarities and differences in subcategories and eventually in 2 main categories according to the research objectives.[28] This process was repeated multiple times until the final codes and categories emerged.

Ethics

All informants received written information first through the person of contact and then directly by mail before the interviews. This information contained information about the purpose of the study and the possibility of withdrawing at any point. The study was approved by the Norwegian Data Protection Official (NSD ref. 531035, September 5, 2019) and exempted from ethical approval by the Regional Ethical Committee (REK Vest, ref. 33093, August 20, 2019).

RESULTS

Eight physicians from 4 different bases were included in the study, 7 male and 1 female, with a median age of 47.5 years and a median HEMS experience of 11 years (Table 1).

Two main categories, learning from mistakes and managing the risk, were identified corresponding to the 2 study objectives. The associating subcategories and codes are listed in Tables 2 and 3.

Learning From Mistakes

The Nature of the Mission

The physicians emphasized the different nature of the HEMS missions compared with their intrahospital work. The missions were unpredictable, not by a recipe, difficult to standardize and thus less suitable for written procedures. They expressed that error reports were mainly relevant when deviating from a procedure. Patient assessment was challenging because of time pressure and a demanding environment with noise and limited space. Decisions were often made with little information and less backup possibility. These factors contributed to their higher threshold for defining incidents as errors.

"Maybe we don't define it as an error; it is just what was possible to do in this situation."

TABLE 2. Subcategories and Codes Derived From the Data Analysis in the Category "Learning From Mistakes"

Subcategory	Code
The nature of the mission	Not by a recipe
	Just what was possible
	Part of the game
To report or not	A black hole
	A cumbersome system
	Becoming a scapegoat
	Lack of trust

TABLE 3. Subcategories and Codes Derived From the Data Analysis in the Category "Managing the Risk"

Subcategory	Code
Working as a team	The good leader
	Having the same picture
	Making the right decisions
	The difficult communication
	A plan B
	Procedures and checklists
The challenging conditions	Darkness and noise
	Time and space
	Not enough hands
The difficult collaboration	Clarifying responsibilities
	Passing on information
	Mutual understanding
	Having the same equipment and protocols

Two basic premises were pointed out to enhance reporting: recruiting members who can reflect on their mistakes and having experienced colleagues who act as role models in sharing their errors.

"Sometimes I think that we do not always pick the right people because we may pick those showing great self-confidence, but at the same time, they are star-struck by the service. And then, admitting your mistakes may be difficult."

Some, but not all, informants remembered having written formal reports themselves. They conveyed that their reports related primarily to technical failures in the medical equipment or medication errors, such as giving the wrong medication or dose. Otherwise, most decisions made during a mission, even if in retrospect wrong, were understood to be part of the game and not errors.

"In retrospect, when you get to know the diagnosis, you can argue that it was a mistake based on that diagnosis, but at that point in time, you did not have that information, so you made that assessment on an incomplete basis."

To Report or Not

The formal incident reporting system was described as a black hole, meaning the informants often did not get the investigation results from their reports. The informants seemed to prefer informal reporting at the base, which is experienced as less cumbersome and more suitable for reporting cases and making improvement suggestions.

"It's not always easy to know where to report it, and it's quicker to think that … it's probably going well, and then we talk about it on the debrief, and we're done with it. However, that's not good."

Another objection to reporting from many informants was the fear of consequences. They emphasized the long tradition that flight operative crews had in reporting errors and near misses and how this was rewarded. They perceived that the health trust system often looks for a scapegoat.

The physicians expressed general confidence in informal reporting to colleagues at their base but skepticism toward reporting to other bases because of the lack of a system and trust between them.

"We also lack cooperation across the bases. Because I do not have to make the same mistake you made, …. so it would have been nice to know about it. Maybe I don't have to do it."

Managing the Risk

Working as a Team

The physicians considered that they were responsible for the team functioning well. Qualities highlighted for a good leader were accepting and encouraging input, assigning tasks, and giving clear instructions to bring out the best in all team members. Their goal was to ensure that the whole team had the same understanding of the situation and the same priorities. To achieve this, they tried to make a joint plan en route to the scene and, if needed, gather the team to get back on track and communicate a plan B in critical procedures.

"I think it is wise to gather all before major decisions are made, like a "war council." What will we do next? What is our plan? Because then the others I work with can come up with important input that helps me make a better decision."

Written procedures and checklists are tools to accomplish this, but a common understanding was that these must be brief and specific, mainly for complicated or seldom-performed procedures. The downside of checklists mentioned was that they do not cover every option and can be time-consuming in certain critical situations.

"I think checklists are handy when there is complex stuff where we have poor or limited knowledge and training."

The Challenging Conditions

All informants pointed out different aspects of what it means to be working under the challenging conditions of a HEMS mission, from the demanding scene to the troublesome transport.

At the scene, noise, cold, and demanding access to the patient made a thorough and systematic patient assessment demanding. An incomplete assessment may lead to both undertriage and overtriage and transport to the wrong facility.

"In a chaotic work situation, it can be anything from having overlooked severe symptoms in patients due to noise. I have been in a tunnel accident, fire trucks are running,…. We cannot communicate, so it is obvious that these are very demanding working conditions where adverse events can happen."

The type and size of the helicopter and its interior were factors affecting patient safety mentioned by all informants; this was mainly due to the problematic loading and unloading of the patient and limited access to the patient or medical equipment in-flight in some of the helicopters in use.

Informants operating helicopters with rear loading underpinned this as a critical point in patient transport. The stretcher needed to be lifted high and may tilt. The patient needing an elevated upper body had to lie supine during loading, and medical equipment was difficult to monitor. They all had experienced tubes and cannulas hooking up and dislocating when sliding the stretcher into the cabin. Still, as they were aware of the possibilities, none of them had reported events that eventually had severe consequences for the patients. Nevertheless, side loading with lower height was considered safer by those with experience in both.

The medical cabin of the smallest helicopters was described as cramped and with suboptimal ergonomics and overview. If the patient should deteriorate during transport, the physicians stated that they had limited possibility of intervention. If this was expected, they often chose transport by ground although longer transport duration.

"Of course, you never want someone to have such a problem that you cannot handle in the air.… If I had had a similar incident, I think I might have chosen to transport the patient by ground ambulance to the hospital."

Most of the informants were the sole medical provider in the cabin during most patient transports, which was experienced as a problem when the patient unexpectedly became agitated, or intervention was needed, and multiple tasks needed to be done simultaneously. A recurring experience among the informants was medication errors due to a lack of an assistant to do dual control.

"Since we are alone in the back (of the helicopter), we cannot double-check medication en route…. This is perhaps what I think is the most critical risk in flight; you pick the wrong drug for injection or miscalculate the infusion."

The Difficult Collaboration

The handover process was another situation highlighted by the informants with a potential for adverse incidents. A clear point in time where the transport team took over responsibility for the patient at interhospital transfers was often missing. Situations were mentioned where the referring doctor was not present or disappeared as soon as the transport team arrived, and responsibility had to be taken over by the transport team without all vital information present.

"And often, when we have just walked in the door, it is as if the patient is ours before we have any overview."

Examples of such vital information were if tube position was checked or IV lines were flushed, and even if considered potentially harmful, they often relied on good faith.

"So we assume someone has done it. You have a lot to focus on, right? Somehow you cannot verify everything…. Sometimes, you have to trust that the sender has done these things."

A common understanding was that, when delivering the patient, the report had to be systematic and not too long, preferably with a structure common to the recipient. The hospital trauma teams could be so focused on the patient that they did not listen to the report by the transport team. To avoid this, some informants awaited moving the patients to the trauma bed until after the report.

"So I usually leave the patient on the stretcher until I have given a report. Because as soon as the patient is lying on the trauma bed, someone starts to handle him and does not listen to the report."

The report given contains information on prehospital treatment but also which measures had been refrained from being done. For the receiving team to understand this, it was emphasized that a mutual understanding of the prehospital working conditions was needed.

"What is possible to do outside and what is possible to do inside is one thing; there is also a lack of understanding of what life is like outside among those who work in-hospital."

Taking over or handing over intensive care patients was underlined as a critical phase of interhospital transfers. Different medication protocols and pumps between the hospital and transport team, for instance, increased the risk of longer infusion pauses and dosage errors.

"It can easily go wrong when taking over infusions and drugs on syringe pumps. We often have different protocols. And then, the receiving nurse must take our syringe and program a new pump, so what is the guarantee that this is programmed correctly? There are many pitfalls."

DISCUSSION

In our study, Norwegian HEMS physicians reported that they produce only a limited number of formal incident reports as they regard the variations observed and experienced as the "nature of the HEMS missions" and reports mainly relevant when deviating from procedures, which are sparse in HEMS. The HEMS doctors prefer informal rather than formal incident reporting systems. The reasons cited are ease of use, better feedback, and less fear of consequences. Four main hazard areas related to all the phases of a HEMS mission were identified in the interviews: the physician as the team leader, medication errors, the handover process, and the helicopter as a work platform.

Patient Safety Culture and Incident Reporting

Formal incident reporting was described as cumbersome and a black hole, meaning that reports rarely elicited valuable feedback or led to improvements. Pham et al[29] suggested that the perceived value of incident reporting systems must be increased by making reporting more accessible and meaningful in that reports that have a potential for quality improvement and learning are prioritized and used to evoke changes.[29] The HEMS physicians all seemed to prefer low-threshold reporting at the base that is processed by one of their own. This finding is consistent with a study of healthcare professionals in England; physicians are most likely to report adverse events to a colleague rather than a superior.[30]

Even though the informants did not report any negative personal experiences with reporting, they still perceived the incident reporting system as punitive, which seemed to be another obstacle to formal reporting. To address this, healthcare needs to provide confidentiality better, adapt to the aviation system of immunity from disciplinary actions,[3] and change the culture from looking at errors as personal failures to an opportunity to improve the system to prevent harm.[31]

The fact that the HEMS physicians have to relate to multiple incident reporting systems fragments the reporting and does not provide a comprehensive overview of hazards and areas for improvement. Therefore, it seems evident that the HEMS system needs a unified safety management and quality improvement system that includes both medical and flight operative crew with an easy option for sharing with other bases.

Areas of Risk and Factors for Enhanced Safety

The physicians highlighted their responsibility as team leaders to accommodate good communication as imperative for shared situational awareness, thus helping decision making. Previous research in air medical transport has pointed to communication problems as the most frequent cause of events.[4,12]

A common understanding among the HEMS physicians was that checklists could be helpful if brief and reserved for complicated or seldom performed procedures. Initially adapted from aviation, checklists were introduced to reduce risk in health care.[32] The effect of checklists in prehospital work is still under debate.[5,19,33,34] However, most will agree that they must be tailored to the providers' competence.[35]

In our study, the reason for medication errors was mainly the lack of an assistant to perform independent double checking in line with standard drug management safety principles. In the literature, the reported frequency of medication errors in prehospital work is significant. However, it varies in different settings and research methods.[36,37] Systematic reviews are inconclusive regarding the effect of double checking on medication errors due to the quality of the included studies.[38,39] However, in a before-after study, overall medication errors decreased by 49% and for fentanyl by 71% after introducing a team-based medication administration cross-check procedure in a ground EMS service. Research is still insufficient on whether these results can be transferred to physician-staffed HEMS.

Informants using helicopters with rear loading and limited cabin space stated that they preferred ground transport when in-flight intubation or resuscitation during transport was anticipated. Studies have shown that in-flight intubation is as fast and safe as on-ground intubation, given a helicopter interior and staffing that facilitate this.[40,41] The possibility of intervention during flight could reduce both on-scene and transportation time and, thus, time for definitive care.

In collaboration with other health personnel, the handover process was perceived as challenging. Transferring information was often suboptimal, and different medication protocols and syringe pumps made errors with vital infusions more likely. Previous research has also found that the transition of care is associated with several risk factors; inadequate communication, lack of vital information, and adverse drug events.[42] Joint procedures and collaborative training should be relevant initiatives.

System and Individual Responsibility

Of the factors associated with risk that emerged in the interviews, some will be an individual responsibility while others are a pure system responsibility. However, also personal errors may be caused by organizational factors. The physician's qualities as a team leader require a systematic approach to recurrent training in nontechnical skills.[43,44] Checklist use is an individual decision, but a prerequisite is that they exist and are fully implemented.[35] The choice of staffing could impact medication errors and, together with the choice of helicopter type, the possibility of intervening during transport. Applying a more system-centered approach focusing on latent risk factors such as training, equipment, staffing, procedures, and organization[45] seems required to bring HEMS forward to a more proactive safety culture.[46]

The Relation to Standards and the Need for Further Research

There seemed to be a common understanding among the physicians that in-hospital standards and procedures are often not applicable in the prehospital setting and that this needs to be understood by their hospital colleagues. Although several international standards on transportation medicine have been published,[47–50] Eiding et al[19] also called for a national standard to ensure the same quality and safety for treatment prehospital as in-hospital. Thus, whether incidents affecting patient care outside the hospital can be regarded as part of a "normal variation" not leading to formal incident reports due to the exceptional environment and context of prehospital care is questionable and remains to be investigated.

LIMITATIONS

We invited experts in a field with a common background of experience. The informants in such a study are not recruited by randomization but by purposive sampling, and this should not be seen as a limitation but strength of the study.[20,23] In HEMS services with other health care professionals than physicians, different experiences and reporting cultures may exist.[30]

The main investigator and interviewer is an experienced HEMS physician, which may have influenced the analysis of the interviews and the interpretation of the results. On the other hand, it may just as well be considered a strength as it aids in taking the insider view and thus facilitates follow-up questions and richer descriptions from the informants.[24]

The study was performed in a Norwegian context. A transfer of the results to other services with different helicopter types, crew configurations, and incident reporting systems should be made with caution.[51] However, we assume that results regarding nontechnical skills also apply to other HEMS services.

Because of travel restrictions during the COVID-19 pandemic, half of the interviews were performed via video. Both interviewees and interviewer experienced this well-functioning and we do not consider this a limitation to our study.

CONCLUSIONS

In this study, Norwegian HEMS physicians preferred informal incident reporting to colleagues because of ease of use, better feedback, and less fear of personal consequences. The overall limited incident reporting was explained by the lack of procedures and the inherent unpredictability of HEMS missions. The role as team leader and the handover process was highlighted as challenging, in addition to helicopter cabin size, rear loading, and the lack of an assistant. Future studies need to investigate the bold statement that incidents in prehospital care are part of the normal and expected variation.

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