National implementation of whole crew on-call in situ simulation in Norwegian HEMS; feasibility, challenges, and possibilities.

An implementation study

by

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“Tell me and I forget,

teach me and I may remember,

involve me and I learn.”

Benjamin Franklin (1706-1790)

Summary

This research project is a PhD-project on implementing medical orientated in situ simulation for on-call air ambulance crews in Norway, and the alternative use of "observed clinical practise" in real-life missions when simulations cannot be carried out. Since HEMS duty is typically a standby emergency service, there are periods between missions where training can be carried out. However, these free periods are unpredictable, and the planning of training can be challenging. Thus, we initially want to test in situ simulation training feasibility on HEMS bases in Norway.

This thesis consists of four different studies using several research methods. The first study is a prospective quantitative interventional study, where one facilitator introduces in situ simulation training on one HEMS base in Norway to evaluate the feasibility of such training. In Study II, the same training concept was sought introduced on all HEMS bases in Norway and one SAR base. Both Studies I and II evaluate the participants' experience with a Likert-style questionnaire as well as using descriptive data. In relation to introducing in situ simulation nationally, the expected barriers to the introduction were studied with a qualitative method. Facilitators from the participating bases underwent structured group interviews in Study III. After the one-year study period, the facilitators were interviewed about the experienced barriers and the tools used to overcome these. Finally, in Study IV, a solution was sought to use facilitators more efficiently by combining in situ training with live mission observations. Study IV combines descriptive data, questionnaires, and phone-based individual interviews.

We have found that in situ simulation training for on-call crews is feasible and can be implemented with a high level of satisfaction from participating crews.

There were some challenges to the implementation that the facilitators have tried to overcome. A more rigid framework and follow up might have improved the implementation. It seemed difficult to conduct

simulations successfully on the busier bases. Some of the key factors for the implementation was found to be the use of a facilitator with local knowledge, support from the departmental managers, dedicated time for the facilitators to prepare and lead the training, and the need for continuous development within the role as facilitator.

We suggest live mission observation with post-mission debriefing as a feasible alternative to in situ simulation to maximise invested resources and maintain the learning output.

List of studies

Study I	Bredmose PP, Hagemo J, Røislien J, Østergaard D, Sollid S. In situ simulation training in helicopter emergency medical services: feasible for on-call crews? Advances in Simulation. 2020;5(1):1-7.
Study II	Bredmose PP, Røislien J, Østergaard D, Sollid S. National Implementation of in situ simulation-based training in helicopter emergency medical services: a multicenter study. Air Med J. 2021;40(4):205-10.
Study III	Bredmose PP, Østergaard D, Sollid S. Challenges to the implementation of in situ simulation at HEMS bases: a qualitative study of facilitators' expectations and strategies. Advances in Simulation. 2021;6(1):1-11.
Study IV	Bredmose PP, Hagemo J, Østergaard D, Sollid S. Combining in-situ simulation and live HEMS mission facilitator observation: a flexible learning concept. BMC Med Educ. 2021;21(1):1-10.

All papers are published as free open access.

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List of Abbreviations

COREQ	Consolidated Criteria for REporting Qualitative research
CRM	Crew Resource Management
ECMO	Extra Corporeal Membrane Oxygenation
HCM	Hems Crew Member
HEMS	Helicopter Emergency Medical Service
HTCM	HEMS Technical Crew Member
NASA	National Aeronautics and Space Administration
PVO	The Privacy Ombudsman (PersonVern Ombudet)
REK	The Norwegian Regional committee for Medical and Health research (Regional Etisk Komite)
SAFER	Stavanger Acute Medicine Foundation for Education and Research (SAFER)
SAR	Search And Rescue
SESAM	Society in Europe for Simulation Applied to Medicine
SNLA	Norwegian Air Ambulance Foundation (Stiftelsen Norsk Luftambulanse)
SOP	Standard Operating Procedure
VAS	Visuel Analogue Scale

Key concepts

Key concepts understanding and meaning used in this thesis.

CRM	Crew resource management (CRM) is the teamwork and interpersonal relations that takes place and affect a mission. CRM is occasionally also named as non-technical skills.
Debriefing	The immediate facilitator led talk through the training session. All participants are welcome to talk. The debrief follows the structure taught at EUSIM courses.
Facilitator	HEMS physician at the base organising and facilitating the simulation training for the on-call crew.
HCM	HEMS crewmember, which recently has changed the nomenclature to HEMS technical crewmember
HEMS base	Location of the Helicopter Emergency Medical Service where the crews work and live when on call.
HEMS crew	Consists of a pilot, H(T)CM and a HEMS physician. One base has elected to add an anaesthetic nurse to the crew.
HEMS physician	Anaesthesiologist, who in Scandinavia is a specialist trained and certified in resuscitation, critical care, intensive care, palliative care, advanced pain medicine, anaesthesia, and prehospital care.

HEMS mission	The mission the crew undertake to assist a patient, perform an interhospital transport, or conduct a SAR tasking.
HTCM	HEMS technical crew member is responsible for rescue missions and is the pilot’s and doctor’s assistant during flying and on the ground (or in the hospital). They were formerly named HEMS crewmembers (HCM).
Interhospital mission	Transport or retrieval of a patient from one hospital to another
In situ	Simulation that occur in the real clinical environment on the HEMS base or in close vicinity hereof.
Observed mission	The facilitator rides along with the HEMS crew on a mission and conducts a debrief after the mission. This contrasts with the simulation, where the facilitator plan and conducts the simulation.
Prehospital	The area of medicine that takes place outside a hospital or during a retrieval
Primary mission	A tasking of the HEMS for a mission outside the hospital. The HEMS service might be first on the incident scene or arrive after the ambulance(s).
SAR base	One participating base with the SAR helicopter from the Norwegian Air Force.
Simulation	Defines a training situation not related to a HEMS mission. The simulation can take place indoors or outdoors with a manikin of a person acting as the patient. Both technical and non-technical skills can be trained. The facilitator plans the theme and clinical development of the scenario. One of the facilitator's roles is to ensure realistic responses to the treatment instituted by the crew who is being trained.

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1 Introduction

Helicopter Emergency Medical Service (HEMS) is a branch of medicine with challenging patient cases and high complexity in care and logistics(1). HEMS are staffed with highly skilled and trained physicians in many European countries, primarily anaesthesiologists or emergency physicians(2). Their unique competencies are regarded as essential in this setting and are shown to save lives(3). At the same time, however, the lifesaving skills are performed at irregular intervals and low frequencies, thus demanding additional clinical practice and training(4). It has been shown that such specific training, directly pointed at prehospital technical skills, can improve the prehospital 'team's performance(5). The HEMS crew is also a team whose performance probably impacts patient care(3). Therefore, training this team together has the potential to save lives, as has been shown to be the case in other critical care teams(6). Some services have implemented simulation-based training for the crew; however, national implementation of such training has never been attempted to our knowledge(7-10). Prehospital care teams train and simulate in many ways throughout the world, and simulation is described using manikins, live actors, and animals, virtual reality(9). Some studies show a small benefit of high-fidelity manikins(11).

Implementing new training methods in an already existing system can be challenging(12-14). The pilots and HEMS technical crew members (HTCM) are exposed to flight-simulation training twice annually in HEMS services. HEMS orientated simulation is new for many HEMS doctors, and very few pilots or HTCM have previously been exposed to medical simulation(1). Some might have experience with cardiopulmonary resuscitation training or skill station training, such as the tube thoracostomy procedure. However, in our experience, only a few crew-members in Norwegian and global HEMS services have been exposed to systematic and organised simulation training during on-call hours at the base.

Since HEMS duty is typically a standby emergency service, there are periods between missions where training can be carried out(7). This "down" time is often used to perform non-clinical on-call duties or manage the crews' fatigue(8). Using part of this time for training on the base is an economically beneficial strategy in a health system already under economic strain(15, 16). Such training has also been implemented in emergency departments, which typically are health services with some (although often limited) time that can be used for simulation training(17).

We hypothesise that it is possible to carry out some form of on-call training for crews if the logistics are taken care of by HEMS personnel not being on-call. However, these free periods are unpredictable, and the planning of training can be challenging. Thus, we initially want to test in situ simulation training feasibility on one HEMS base in Norway. Since barriers might exist to implementing such simulation training on a larger national scale, we illuminate barriers expected and experienced by facilitators whilst nationally implementing in situ simulation on HEMS bases. However, simulation training might be interrupted by real missions. These interrupted or non-conducted training sessions can be demotivating for both HEMS crews and facilitators. We, therefore, aim to test a solution with live mission facilitator observation and post-mission debriefing as an alternative to an interrupted in situ simulation training.

1.1 Background

1.1.1 The Norwegian HEMS system

The Norwegian HEMS is a national service funded by the government. The four regional health trusts contract commercial companies in Norway to manage the flight operations. Medical staffing and medical responsibility for the service lies with the local health trust in which each base is located. There are both HEMS bases and SAR bases.

1.1.2 HEMS crew composition

Each HEMS helicopter in Norway is staffed with a 3-person crew consisting of a physician, an HTCM and a pilot. At the time of the project, one base (included in Studies II, III, IV) also included an anaesthetic nurse in the team. The team resides on the HEMS base throughout the shift. All the physicians are certified anaesthesiologists or within one year of certification and have experience in anaesthesia, intensive care medicine, emergency medicine and advanced pain management. All physicians must also regularly perform in-hospital work. The pilots are experienced pilots from civil and/or military aviation. The HTCM have their basic training as emergency medical technicians, paramedics and some have a nursing background as well. All have prehospital experience. This is combined with extensive additional training in rescue techniques and pilot training theory to assist the pilot. Pilots and HTCM are required to do bi-annual simulation training and tests in a flight simulator. The anaesthesiologists have no formal requirements for simulation training and rely on the availability of simulation-based training at the hospital. This training is, however, rarely mandatory and often irregular. All crew members must do regular currency training on fixed rope rescue operations and an annual aeromedical crew resource management course.

The pattern of shifts varies between bases: pilots and HTCMs are generally on call 24 hours a day for one week, whereas physicians work for 24, 48, 72 or 168 hours, depending on local work rotation. The number of missions and types of missions flown varies between the Norwegian HEMS bases(18).

All HEMS bases respond day and night to a case-mix of primary trauma and medical missions to inter-hospital intensive care transports of patients on ventilator support. Some bases also undertake specialised transports of critically ill patients supported by, for example, extracorporeal membrane oxygenation (ECMO) and neonatal patients in incubators. The HEMS system also perform search and rescue (SAR) missions. The bases also provide assistance with a rapid response vehicle for use when the weather prevents flying and for missions in close vicinity of the base(18).

The Royal Norwegian Air Force operated SAR bases are also dispatched for ambulance missions in the national Norwegian HEMS system. The medical staffing and equipment setup of the SAR helicopters is identical to the civilian HEMS, but the Air Force trains the HTCM, and the helicopter is additionally staffed with two pilots, a technician and a systems operator(19).

1.2 Theory

1.2.1 Adult learning

The art of adult learning, andragogy, consists of five points for optimised learning as described by Knowles(20). The learning is self-directed, experimental and uses background knowledge, is relevant to current roles, is problem-centred, and the adult learner is motivated to learn. These five points apply to simulation training in the HEMS context. Simulation training is self-directed, as this happens when the crew is motivated and ready for it. The crew has background knowledge and experience with HEMS work, in which they are already involved. The training is relevant to the current roles, as the simulation training is about HEMS work. A fictive case or a simulated mission is a key component of the training, and HEMS crews are motivated to learn.
In 'Kolb's learning cycle for experiential learning, four stages describe how we acquire new knowledge(21). The theory describes how we change as a result of the four stages relating to; experience, reflection, conceptualisation and experimentation. Both "active experimentation" and "reflective observation" apply to simulation, where the first one resembles the simulation itself and the latter the debriefing(22). One can also argue that Kolbe's "concrete experience" where a new experience or situation is encountered or a new reinterpretation of existing

experience is relevant with simulation. Thus, adult learning theories apply to simulation training.

1.2.2 Simulation

1.2.2.1 History of simulation

The history of simulation goes back to the infancy of aviation. Only 26 years after the world's first flight, the "Link trainer" was put into practice(23). Later, integration of simulation came to 'NASA's training schedule for the first Apollo missions(24). The development of manikin-based simulation has roots in Norway with the development of the Anne resuscitation mannikin, which started in 1960(25). Shortly after the millennium, simulation conferences started taking place, and anaesthesia crisis management arrived as a concept(26). Thus, anaesthesia was one of the first medical societies to embrace simulation training on a larger scale.

1.2.2.2 Conduction of simulation

Medical simulation training can be separated into various phases. One model suggested and analysed by Dieckmann et al. operates with seven phases on a simulation-based course(27).

These phases are;

1. Setting the introduction; explaining the simulation, and creating a learning environment
2. Simulator briefing; familiarisation with equipment
3. Theory inputs; introduction of concepts for the scenario
4. Scenario briefing; information about the specific scenario for the participants
5. Simulation scenario; the simulation experience itself
6. Debriefing; discussion of the scenario within the group
7. Course ending; conclusion of the course

Although originally applied to simulation courses, these phases can be simplified to three phases, which applies to in situ simulation; The first phase is the planning and preparation of the simulation and introduction of the concept to the participants(28). This is followed by an overview of learning goals and the physical and emotional setting of the simulation. The next phase is the simulation itself, which is obviously an essential part of the training. The simulation is followed by the debriefing phase, which can be undertaken in a variety of ways(22). There is an understanding that debriefing is an essential part of health care simulation(29). Debriefing is a way of reflective practise (30). The debriefing differs from the one-way conveyance of information used in feedback by being a bidirectional or interactive reflective discussion(31). Debriefing can be conducted in numerous ways(22, 32). Most of these have common features that are outsprung from the natural human learning pattern; experience an event, reflect on and discuss it, and then learn and modify behaviour(32). Common sequences are; reaction, analysis, and summary(33). Occasionally an extra phase is added in the beginning to ensure that the participants and the facilitator have a shared mental model of the events during the simulation(34).

1.2.2.3 Centre-based simulation training

Traditionally simulation-based training in medicine has taken place in simulations centres with numerous benefits(29). Firstly, this form for simulation training takes place at a dedicated place, designed and used med simulation training, this being a hospital, a university or a free-standing organisation(35). Secondly, instructors may be engaged in simulation full-time, or they may be clinicians with a working relationship with the simulation centre. Thirdly, his form for training centres makes it possible to invest more widely and utilise a variety of simulators for the training. Finally, an organisation that conducts and develops simulations can be established(35). Some limitations apply to centre-based simulation; it can be costly for participants, on either individual level or organisational level, the equipment may differ significantly from the equipment used in the daily clinical work, participants may be asked to "play" roles which are different from their clinical role, and there might be a limited time-wise availability of the training centre(36).

1.2.2.4 In situ simulation

In situ simulation can be defined as a "team-based training technique conducted in the actual patient care environment using equipment and resources from that unit and involving actual members of the healthcare team" (37).
This form for simulation training uses the ambient atmosphere, thus making helicopter cabins, living areas at the base or the surrounding outdoor area feasible for simulation in contrast to a defined simulation centre. Furthermore, medical equipment and medical packs can be identical to those used in everyday life. In situ simulation during on-call time can circumvent travel time that the trainees would have used for travelling to a simulation centre. In situ simulation allows training in the context of prehospital care and to evaluate the complex system of prehospital patient care, from clinical assessment, diagnostics and treatment to logistical movements and transfers of the patient(37, 38). Whilst training in the emergency department might be negatively affected by phones ringing, frequent alarms going off, and a high number of patients, visitors, and staff around, this is not the case for HEMS bases, which are mostly shielded from the public and most other colleagues(35). Although it does exist, there might be little downtime available for in situ simulation training in the emergency department(39). However, in HEMS work life, more downtime is available for training, thus making in situ simulation feasible.

1.2.2.5 Observed clinical practice

The direct observation of physicians working with patients by supervising physicians constitutes a key component of clinical education(13, 40). This practice is well-established as a part of medical education within many specialities(40-42). Feedback is an essential part of the learning process and essential for the “teacher-learner” relationship(43). Prompt feedback shortly after observation is given in a non-judgemental manner about observed behaviours rather than on general appearance or personality(43, 44). Direct observation of trainees performing clinical skills is commonly stated as the most crucial evaluation method (45).

1.2.2.6 Effect

The effect of simulation training in medicine has been proved in various settings(6, 46). In situ simulation has already been proven effective as a training method for technical and non-technical skills, for example, neonatal resuscitation(47, 48). In particular, in situ simulation has proven to be an effective tool for identifying latent safety threats to patient care as well as identifying logistical challenges(49, 50). Clinical observation and feedback have been shown to improve nursing students’ clinical skills(51).

1.2.2.7 Implementation of simulation based training

Suggestions for overcoming challenges to successfully implementing simulation-based training have been published(12, 17, 52). These publications mention the involvement and support from the leaders and managers of the department as an important prerequisite for successful implementation. The trainee’s motivation is mentioned as important, as well as the need for thinking about sustainability. One measure mentioned to improve implementation and sustainability is sharing positive stories among participants, facilitators, and management (12). This will act as a positive reinforcement of the implementation and continuation. Lazarra et al. have suggested “recruiting champions” to encourage the implementation(12). Spur et al. have suggested training as a multi-professional team reflecting daily practise and making simulations as real as possible(17).

1.3 Aims of the thesis

Overall

This thesis focuses on implementing in situ simulation-based training and how the resources invested in the training can be utilised effectively despite an unpredictable clinical on-call life in Norwegian HEMS. We aimed to introduce in situ simulation-based training at a local (Study I) and national level (Study II) and to identify barriers and challenges for implementing such training (Study III). Furthermore, we aimed to identify factors that will improve the likelihood of success when introducing in situ simulation in HEMS services (Study IV). The overall aim was to pave the road for implementing simulation-based training in Norwegian HEMS.

Study I – One base implementation

The main objective of this prospective study was to investigate the feasibility of introducing in situ simulation-based training for the on-call team on a busy HEMS base measured by the frequency of uninterrupted training. In addition, we wanted to evaluate the time needed to prepare and carry out the in situ simulation training and document the participants' self-reported reactions toward this type of training.

Study II – National level implementation

This prospective study primarily aimed to document the implementation grade of a national program of in situ on-call simulation-based training for the crews in the national HEMS system in Norway and on one SAR base. Secondly, we wanted to explore possible reasons for not starting a training session or why training was interrupted. Thirdly, we aimed to measure the participants' and facilitators' satisfaction with the training.

Study III – What are the expected and experienced barriers to implementation experienced by facilitators

The primary purpose of this explorative interview study was to identify factors that the local facilitators anticipated would challenge the smooth implementation of the in situ simulation-training program and their strategies to overcome these before the national implementation of in situ simulation-based training locally. Secondly, we wanted to identify the actual challenges they had experienced one year after the program was initiated and subsequently their solutions to overcome these.

Study IV – Combining in situ simulation and observed clinical practise

The main goal of this study was to evaluate the feasibility of conducting live mission observation and post-mission debriefing by a simulation facilitator as an alternative to planned but interrupted in situ simulations. Secondly, we wanted to investigate how the facilitators and crew members perceive this alternative training format.

2 Methods

This thesis consists of four different studies using several research methods. The first study is a prospective quantitative observational study, where one facilitator introduces in situ simulation training on one HEMS base in Norway to evaluate the feasibility of such training. In Study II, the same training concept was sought introduced on all HEMS bases in Norway and one SAR base. Both Studies I and II evaluate the participants' experience with a Likert-style questionnaire as well as using descriptive data(53). In relation to introducing in situ simulation nationally, the expected barriers to the introduction were studied with a qualitative method. Facilitators from the participating bases underwent structured group interviews in Study III. After the one-year study period, the facilitators were interviewed about the experienced barriers and the tools used to overcome these. Finally, in Study IV, a solution was sought to use facilitators more efficiently by combining in situ training with live mission observations. Study IV combines descriptive data, questionnaires, and phone-based individual interviews.

Cambell was the first to describe using a combination of methods to determine to which extent measures converge(54, 55). Later Denzin used the word triangulation to describe such a combination of methods to ad breadth and depth to an investigation(56). In this project, a combination of methods is applied on both a thesis level and on a single article level (Study IV).

We aimed to create a logical sequence of investigating the implementation of in situ simulation training in Norwegian HEMS. Firstly, we introduced in situ simulation training on one busy HEMS base, Oslo University Hospital (Study I). Secondly, a national in situ simulation training programme was implemented (Study II). Thirdly, in parallel to the national implementation study, we sought the facilitators' pre-study expectations of barriers to the implementation as well as the post-study experiences by the facilitators (Study III). Finally, to overcome some of the challenges experienced in the first studies, we tested a flexible learning concept with a combination of in situ simulation training and live mission facilitator observation (Study IV).

2.1 Observational data

Observational descriptive data related to the time consumption of the simulation was collected by the facilitators, as well as information about whether a simulation training was conducted uninterrupted or interrupted.

The facilitator collected data on the duration of the in situ simulation and classified it as completed with debriefing or interrupted by a mission call-out with or without subsequent live mission observation. Data was instantly recorded on a preconceived paper form by the facilitator (Appendix A) and later entered into an electronic database. The basic structure for the data collection sheet was used for Study I, II, IV with modifications tailoring the sheet to each study (Appendices A, E, J).

One can argue that this is vulnerable to investigator bias when the simulation facilitator and the researcher are the same (Study I and IV), thus introducing a potential reporting bias. The facilitator was open about the times recorded and showed the data recording form to the crew to reduce this bias. Facilitators were instructed to record the exact time used for the simulations in whole minutes. Due to the workload as a facilitator, they may have ended up estimating the inaccurately with the consequence of potentially under- or overestimating the time used. The same applies to the coding of reasons for non-successful simulations where there is a potential for miscoding with inaccuracy as a consequence.

Using a paper sheet to record times facilitates prompt registration parallel to the simulation training. This minimises the risk of recollection bias. However, when this data is later entered into a database, there is a risk of typing errors. This issue was mitigated by manually checking the data after the entry.

2.1.1 Questionnaire

We used a questionnaire to get prompt feedback from participants. This method was chosen for the convenience of having a standard set of questions. Furthermore, the internal consistency of such a questionnaire is high and answers correlated among the participants, which we believed would be the case.

A questionnaire was developed and used to capture the participants' evaluation of the simulation-based training. A questionnaire was chosen to streamline the answers and be able to semi quantify the answers.

Two of the authors (PB and SS) drafted an initial version. To ensure that the questionnaire was comprehensible, the questionnaire was reviewed by a representative from all professions: a pilot, an HCM and a physician. Using these inputs, the questionnaire was modified to optimise the answer alternatives. Two full HEMS crews from the Oslo University Hospital HEMS base then reviewed this modified version to ensure that the questions were clear and comprehensible. The questionnaires are available in Appendix B, C, and D. Despite these measures, there is still a risk that the participants understand the questions differently from the researchers' intention. However, since we used the questionnaire template for three of the studies, it would be made apparent from a systematic review of the answers if there were systematic "errors" in understanding the questions. The questionnaire was tailored to the different studies by making minor changes only (Appendices F, G, H). For Study IV, we had two different questionnaires, one for simulation and one for live mission observation (Appendices M, N). The questions were matched in pairs to measure the same parameters in both settings. Two of the authors (PB and SS) undertook this process to minimise linguistic and conceptual misunderstandings.

A variety of factors might influence the use of prompt feedback. Potentially crews will rate the training more positive since the facilitator is present and even more favourable since it is fresh in their mind. Thus, an overestimation of the positivity might be presented. It is also possible that the crew members' presence (the whole crew) could interfere with the individuals' answers. Furthermore, in our setting, the crews would always know the facilitator as a work colleague, which may affect the answers, most likely in a way with more positive answers.

Since answering the questionnaire took place straight after the debrief, the crews sat together. If interrupted by a mission, they would complete the questionnaires after the mission; otherwise, it would be completed immediately after the debrief. Having all crew members together might influence the responses. They were encouraged to fill in independently, but that was not controlled.

When paper-based questionnaires are manually transferred to a database, there is the likelihood of typing errors. This issue was mitigated by manually checking the entries and examining the entries for systematic errors.

2.1.2 Likert scale

A Likert scale is commonly used in survey research. The questionnaires used in Studies I, II, and IV consisted of 14 questions answered on a 7-point Likert scale(53). The score ranged from 1 to 7, where 1 equaled "I strongly agree", and 7 equaled "I strongly disagree".
We used the Likert scale to be able to compare crews and professions.

The Likert scale is ordinal but may approximate an interval measurement if well presented with the answers aligned in sequential order. This way, it is possible to apply more comparative statistical methods.

One bias linked to the use of the Likert scale is the acquiescence bias, where respondents have a tendency to select a positive response option or simply mark every answer as satisfied not to appear negative(57). For our studies, it was made clear to the participants that all answers were anonymous, and no answers would have any consequence for the participants. However, we are aware that they answered the questionnaires in front of a facilitator, who was a colleague of theirs, and crews might feel an obligation to answer positively. Additionally, there has been a paucity of medical orientated simulation training in Norwegian HEMS. This may lead crews to "welcome" this form for training by answering in a positive way to ensure the continuation of such training.

Extreme reporting is another phenomenon related to the use of Likert scales, where the most extreme answer options are chosen(58). This phenomenon has, by some authors, been linked to specific cultural identity or level of education(59). However, in our studies, we have a homogeneous group when it comes to culture and a homogeneous group of participants with relation to educational level, which makes this bias less relevant. However, we are aware that there are a high number of participants answering in the most positive group. We have not thoroughly identified this pattern of answers otherwise than accepting this as a sign of a positive attitude to the training.

There are arguments about using a Likert scale with an odd or even number of answers(60). We chose an odd number to make a neutral answer possible. In this way, participants had the option to answer in a "neutral way", rather than forcing them into a positive or negative answer.

2.1.3 Visual analogue scale (VAS)

Following both in situ simulation training and observed live mission debrief in Study IV, the participating crew and the facilitator rated their degree of satisfaction with the session on a visual analogue scale (VAS) from 0 to 100mm, where 0 represented completely unsatisfactory and 100 represented maximum satisfaction(61). This scale was initially invented for the self-reporting of pain(61). However, this continuous scale has gained popularity beyond pain medicine(62). We chose the VAS scale to allow the crews to answer without the answers being categorised.

The participants scoring the simulation in the vicinity of the facilitator might influence the reporting. However, we did underline that no answers in these studies would have any consequence for the participants, although this might not mitigate this bias completely. Retrospectively, one could argue that we could have asked participants to answer later and not in the vicinity of the facilitator. However, we asked for immediate completion of the form to ensure a high proportion of the participants to answer and for the facilitators to collect these replies.

Furthermore, facilitators in Study II and IV could be tempted to report more favourable outcomes of the simulation than the reality was. We did encourage the facilitators to report as honestly as possible. There was no link between the facilitator's economic compensation and the scoring, neither by participants nor by the facilitators themselves.

2.1.4 Interviews

In both Studies III and IV, we used an interview-based method. Qualitative methods are beneficial when only sparse background information about a topic is available(63).

In Study III, a three-stage explorative design to identify barriers to in situ simulation training implementation. In stage 1, facilitators were invited to a project meeting with a brainstorming session, which ended with three themes that were used to create the interview guides used in stages 2 and 3 (Appendix 1). In this way, the interview guide developed by PB, DØ and SS was more specific for this topic. Stage 2 was the interviews before the simulation year, and stage 3 was the interviews after the simulation year. The interview guide served to reduce the influence of the interviewers' pre-understanding, and in addition, the two interviewers would remind each other of the importance of being non-judgmental before the start of the interview(64). Both interviewers (PB and SS) had extensive experience with simulation-based training and were clinically active senior consultants in anaesthesiology with extensive air ambulance experience and have experience with interviews, which could arguably influence the conduction of the interviews.

Using an interview-based qualitative method allowed us to capture group dynamics and participant interaction to elicit key themes(65, 66). The use of a group-based method might limit the freedom of speech for some participants. However, many of the facilitators knew each other beforehand, so we think that a safe environment was established in which all participants could contribute. The interviewers knew some of the participating facilitators from daily work-related contact. We rationalised that the use of such a homogeneous group with a narrow field of interest was justifiable since the explored topic is narrow too. However, one can speculate whether the homogeneous group excluded the possibilities of gathering different views and thoughts on the topic, which might have emerged if the group were more heterogeneous. There is a chance of information being missed or overlooked during text analysis. This risk was mitigated by each interview being scrutinised by more than one author.

The number of participants in the interviews before the start of the project was higher than in the interview after one year. We did not explore this mismatch but speculate that it might be a result of facilitators' fatigue during the study period or the general time pressure and workload mentioned by the facilitators. This potential selection bias of participants in the second round may have contributed to a more positive tone in the interviews since the least successful and less motivated facilitators would be less likely to participate.

For Study IV, despite experiencing saturation in the answers given in the interviews, the number of participants was limited. A larger group of interviewees might have given a broader insight into the topic, as would more observed live missions.

The recorded interviews were transcribed verbatim by a medical student. This has the benefit of a transcriber that has knowledge of the phraseology, which might make the transcription more accurate. However, it might also introduce errors. One author (PB) compared the transcriptions to the recorded interviews to evaluate the accuracy and quality.

The transcribed interviews were analysed according to Malterud's "Systematic text condensation" (63, 67).

We used the COREQ (Consolidated criteria for reporting qualitative research) checklist for reporting qualitative research in Study III(68).

2.2 Mixed Methods

To explore the possible benefit of introducing live mission debriefing as a proxy for the missed simulation and debriefing in Study IV, we used a mixed-methods design applied to one single study(69, 70). In Study IV, our triangulation included a prospective observational data collection to quantify and describe the number and types of intervention, a questionnaire to collect the participants' immediate experience of the training, and interviews for in-depth information about the experiences. In our study, all methods were given the same priority, called *equal status* by Johnson et al., although used partly in parallel and partly in a sequential manner(55). Using various methods was for the complimentary effects, as suggested by Campbell et al.(54).

2.2.1 Scientific rigour

To assess the scientific rigour of projects that consist of a mixture of qualitative and quantitative methods, the same terminology can be used for both types of methods, although some have questioned this(71-73).

2.1.2 Reflexivity

The researchers' background and preconception of the research subjects is a premise for quality research and is particularly important in qualitative studies. Reflexivity addresses the researcher's role in reflecting on the research itself throughout the research process(74). The researcher should describe the contextual relationships between the participants and themselves and thus increase the creditability of the results in the studies(75). Objectivity is not a goal; instead, one needs to identify the background and position of the researcher(63).

It has been a goal to continuously keep awareness of my own and my research colleagues', positions related to the research. This has been in focus both during the study period as well as during the writing period. I, PB, have experienced medical simulation as an educational tool throughout my medical training and during my specialisation. Especially during some workplaces in HEMS medicine, I have been subject to this form for training. Furthermore, I have published an enthusiastic paper on the topic from my time as Specialist Registrar at London HEMS, where I expanded my simulation practice(7). I, therefore, must declare myself as a true believer in the training concept. This could affect the view of some of our findings. To compensate for this potential effect, we have chosen to have a larger group of authors, of whom one (DØ) has no prehospital engagement. However, DØ, is heavily involved in medical simulation and education. I do also currently work in a system where the use of medical simulation is sparse. Thus, I genuinely believe there is a role for medical simulation training in our system. This belief has also been an inspiration for the project. The idea of using waiting time for in situ training has arisen from numerous shifts at HEMS.

HEMS and simulation training in Norway comprises a small group of physicians. Thus, it is inevitable that there are friendships and work-friendships between researchers and study objects like the facilitators. We have been aware of this throughout the process and have had reflective discussions around this during the process.

2.1.3 Internal validity

This refers to the trustworthiness of the research where the study design, data collection, and appropriate statistical analysis are essentials for internal validity(76). These matters are discussed in relation to each method.

2.1.4 External validity

External validity defines how the research findings relate to, and can be applied to, other settings and new environments and populations(77). For qualitative research, the term "transferability" is used, and in quantitative research, the term "generalisability" is used(63). The external validity of a study is closely related to the internal validity with its discussion of methods used(63).

In Study I, which acted as a pilot study, the study population was the crews on call on the busiest HEMS base in Norway. We hoped that the use of a busy HEMS base would increase the external validity (at the least for Norway). Other bases might not be as busy, thus having a smaller chance of being interrupted by missions while simulating. In Study II, we used the experiences from Study I to implement such training on a national level. Study II is a "Norwegian only" study, and the external validity for other HEMS globally could be questioned. However, the Norwegian HEMS system responds to a broad selection of prehospital patients, undertake interhospital transports, and perform SAR mission. Most other HEMS will operate in somehow similar ways, although the shifts for the on-call crews are often shorter, and the mission profiles might vary.

Study III collected data from facilitators, all chosen by the clinical lead at each HEMS base. Thus, this becomes a uniform group, unique to the Norwegian setting. On the other hand, there was a great diversity among the experience with simulation training in the group. Other HEMS services should be able to identify similar challenges and thus also how to overcome these.

For Study IV, we used three different bases: one busy city base, one rural mountain base, and one with a different operator. We chose these bases to increase the external validity, making it more plausible that other HEMS bases would have operational patterns similar to at least one of the chosen bases.

In general, the Norwegian crew concept is unique, limiting external validity. However, most other HEMS uses a cross-professional crew, and both the simulation training and the observed mission has the potential for being implemented in other HEMS systems. However, the feasibility of such an implementation needs to be clarified.

2.3 Statistical analysis

We summarised continuous data using median (quartiles) and categorical data as numbers (percentages) and compared non-paired observations with the Mann-Whitney U test. Questionnaire responses (Likert scale) were presented as mean, although this is debatable(78). We chose to perceive the Likert scale as an interval scale and applied non-parametric statistics in the analysis. Thus we present results from the Likert scale as median with quartiles (79).

The facilitators' and crew-members satisfaction with the training is presented as median and quartiles VAS scores for all successfully conducted simulations for each base as these did not follow a normal distribution.

In study II, the association between the number of missions and simulation *attempts* at the bases was analysed using robust linear regression(80). Robust linear regression is a variation of traditional linear regression that downplays the importance of outliers that might otherwise disproportionately affect regression coefficients. There were no requirements in terms of the numbers of attempted simulations for the participating bases in Study II thus there was a large variety in the numbers of simulation attempts. Using ordinary linear regression would have been disproportionally affected by the bases with a high or a low number of simulation attempts (outliers). Similarly, the study observed outliers in the number of missions at each base; thus, robust linear regression would be used to mitigate the impact of these outliers. Still, in Study II, when studying the correlation between the number of missions and simulation *success,* the analysis was weighted with respect to simulation attempts in a weighted robust linear regression. This gave the bases with a higher number of missions and simulations more impact on the regression line.

2.4 Ethical considerations

All the project studies were presented for the regional ethical committee at Oslo University Hospital (See Appendices O, Q, S, U). Data were managed according to Norwegian law and guidelines. Approval was given from the Data Protection Authority (Personvernombudet) for Oslo, which stated that no further local approvals were needed (Appendices P, R, T). The project was discussed in advance with both local medical management and essential staff members. Participation was voluntary for both individuals, whole crews, and on a base level. For Study I, the project leader also conducted the simulation training and was thus aware of participants. No data that could link participants to results were stored. For Study II, III and IV, the data were entered anonymously into the database. For Study I, the facilitator (PB), entered data directly into a database. Written and verbal information and instruction were given to all participants before all training sessions, along with information about the right to withdraw before, during and after the training at any time without any consequences. When the facilitator engaged on a live mission, standard rules of conduct and patient confidentiality were followed.

For the interviews, no identifiable information was linked to the transcribed interviews. All data were stored according to the Norwegian legal requirements, and recorded interviews were deleted after the study ended.

The whole project was conducted according to the World Medical Association Declaration of Helsinki(81).

3 Results

3.1 Summary of results:

Study I

A total of 44 simulations were carried out. The total median (quartiles) time consumption for on-call HEMS crew was 65 (59-73) minutes. The time for preparation of scenarios was 10 (5-11) minutes, time for simulations was 20 (19-26) minutes, cleaning up 7 (6-10) minutes and debrief 35 (30-40) minutes. For all items on the questionnaire, most respondents replied with the two most positive categories on the Likert scale.

Study II

All bases agreed to participate initially, but one opted out due to technical difficulties. The number of simulations attempted at each base ranged from 1 to 46 (median=17). Regardless of base and number of attempted simulations, participating crews scored self-evaluated satisfaction with this form of training high. Having two local facilitators increased the number of attempted simulations, whereas facilitators' travel distance to work seemed to make no difference to the number of attempted simulations.

Study III

The dominant themes identified by the facilitators in the pre-study-year interviews were the pedagogical, motivational, and logistical issues. Other key themes included management support, dedicated time for the facilitators and ongoing development of the facilitator. The facilitators identified the same themes in the post-study-year interviews. The facilitators describe increasing motivation levels over the study period by the crews, despite anxiety about the perceptions of, and enthusiasm for, simulation training.

Study IV

Seventy-eight training sessions were attempted, with 46 (59%) of the simulations conducted as planned, and 9 (12%) training sessions were converted to observed live missions. 23 (29%) were not started because the crew had other duties. The interviews identified local knowledge, clinical skills, and excellent communication skills as essential prerequisites for conducting live mission observation successfully. The facilitators considered mission observation more challenging than simulation. Participating crews and facilitators found simulation both valuable and needed. Being observed was initially perceived as unpleasant but later regarded as a helpful way of learning.

3.2 Results

3.2.1 Study I

In Study I, the one base study that served as a pilot study, 44 individual simulations were conducted with 15 physicians, 12 HCM and 15 pilots participating. The most typical reason for not performing a simulation with a HEMS crew was a conflicting live mission or the need for rest after missions during the preceding night. In 11 of the 39 weeks, both helicopter crews on call performed simulation-based training on the same day.

All simulations were conducted by the whole HEMS team apart from four (9%) the pilot opted out from the training due to other flight operations related tasks.

In table 1, the median (quartiles) time consumption for a simulation training session for the on-call crew and the facilitator is presented, as is the time spent in each of the four simulation phases.

Table 1. Time consumption for simulation training sessions for facilitator and HEMS crew.

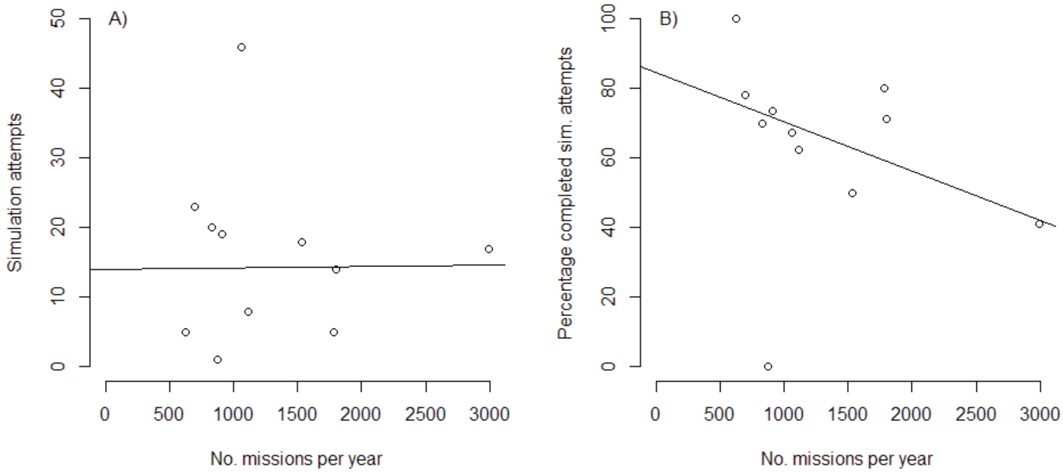
Task	People involved	Time used in minutes Median (quartiles)
Preparation of scenario	Facilitator only	10 (5-11)
Scenario simulation	HEMS crew + Facilitator	20 (19-26)
Cleaning up after scenario	HEMS crew + Facilitator	7 (6-10)
Debrief	HEMS crew + Facilitator	35 (30-40)
Total time consumption for on-call HEMS crew	HEMS crew	65 (59-73)
Total time consumption for facilitator	Facilitator only	75 (64-88)

Of the 44 groups of questionnaires handed out after the simulations, 42 (95%) complete sets of questionnaires available for further analysis. The median score on the Likert scale regarding the relevance of the training was 1, range (1-3). Almost all participants (98.4%) used the two most positive categories. For the entire training concept, the median score was also 1, range (1-2) and all participants used the two most positive categories. For all other questions on the questionnaire, the median score for all three professional groups was in one of the two most positive categories.

3.2.2 Study II

Study I served as a pilot study for Study II, the national implementation base study, where the results and experiences were included in the design. A total of 176 simulation attempts were registered nationally during the one-year study period. Of these, 116 (66%) were completed. We found a declining number of simulations attempted and successfully conducted during the study year. Table 1 shows the number of successful and unsuccessful simulations at each base and background information about the simulation-based training, i.e., the number of facilitators, the time consumption, VAS scores for facilitators and crews' self-reported satisfaction with the simulation. The number of simulations initiated at each base ranged from 1 to 46 (median=17). Reasons for the failure to complete simulations are shown in table 2.

The association between the number of missions and the number of simulations is shown in figures 1a and 1b. The number of simulation attempts was not associated with the total number of annual missions at the base, used as a proxy for how busy the bases are (Figure 2a) -0.002 (95% CI -0.009 to, 0.010), p=0.973, and there was no statistically significant difference in the number of completed simulations between the bases when related to the number of annual missions (Figure 2b) -0.0165 (95% CI -0.029 to -0.0002), p=0.077.



Figures 1a and 1b. The association between the number of missions and the number of simulations attempted (1a) and completed simulations (1b).

A statistically significant difference (p=0.01) in the number of simulation attempts was seen between bases with one facilitator and those with two facilitators: bases with only one facilitator had a median of 8 (range 5 to 16) simulation attempts as compared to 21 (range 18 to 48) for bases with two or more facilitators.

Outcome	Details	Percentage (n=actual number)	Causes of non-completed simulations (actual numbers)
Simulation completed	Completed without interruption	58.0 % (n=102)	
	Started, interrupted, but completed	7.4% (n=13)	Dispatch for an acute mission: 13
Simulation planned or initiated, but not completed	Started, interrupted, but not completed	28.4% (n=50)	Dispatch for an acute mission: 42 Crew needs rest: 5 Crew prioritises other tasks: 9
	Simulation conducted without debrief	3.4% (n=6)	

Table 2. The number of successful and non-successful simulations and reasons for failure to complete simulations.

3.2.3 Study III

Study III was conducted as pre- and post-interviews with the facilitators. This study ran simultaneously with Study II. This exploratory study was planned to capture expectations and experiences regarding the implementation of the simulation training related to facilitators, crews, and management.

The facilitators mentioned the importance of including the whole crew in developing training and considering all team members' learning needs in a safe learning environment. An excessive workload on the base was considered a barrier to implementing simulation training. The workload of the facilitators was also a theme in the interviews. Some facilitators were concerned that they were already busy with full-time clinical work and HEMS shifts. Some facilitators feared that they would not be able to conduct training, debrief and simulation well enough. It was also mentioned that the education of the facilitators was essential to the successful implementation of simulation training. A concern to some of the facilitators was the prospect of travelling a long distance to conduct the simulation without knowing if the simulation could, in fact, be conducted or if it would be interrupted by a mission. Suggestions to overcome this include using more than one facilitator on each base, involving other facilitators, or using video-based remote facilitation. This could also improve the motivation of the facilitator by relieving the workload and providing a fellow facilitator to spar with and increasing the number of simulations offered. Management support is essential for the facilitators. Facilitators felt that some leaders of HEMS departments did not fully support the project or thought that it would compete with already existing simulation training taking place on the base. The costs of the project and the lack of funding for sustainability after the study period were also mentioned.

3.2.4 Study IV

This study used the experiences from Study I and II, where we found that there was a need for alternatives to the simulation training. Furthermore, the facilitators' experiences in Study III were used to generate the idea of observed live missions as an alternative to interrupted in situ simulation training. Seventy-eight training sessions were attempted on the three involved HEMS bases. 9 (12% of the simulation attempts were converted to live mission observations and conducted as so. In 23 (29%) cases, the simulations were not started because the crew had other duties such as daily aircraft and equipment checks or administrative tasks to attend to. The answers on the questionnaire were within the two most positive scores in all but two questions; Following the in situ simulations, most participants indicated that they felt uncomfortable exposing their skills and competencies with being observed during the in situ simulation training and that the in situ simulation training was interfering with "non-mission related" duties. The corresponding questions following the live mission observations scored the completely opposite. The overall satisfaction with the in situ simulations and the observed live missions was above 85 (out of 100), with no differences in VAS scores between simulations and observed missions.

The facilitators expressed in the interviews that they found live mission observation more challenging than the simulations, with the lack of preparation for the debrief as a challenge. They also found that being in the proper role as an observer was essential. They described local knowledge, clinical skills, and excellent communication skills as necessary.

Both facilitators and participating crews indicated that a frequency of training sessions ranging from weekly to monthly training sessions was ideal. All interviewed groups expressed a high degree of motivation and a need for both in situ simulation and observed live missions and emphasised that the training concept requires support from the management.

4 Discussion

In this project, we have demonstrated that it is feasible to implement in situ simulation-based training for HEMS crews during on-call hours. We have identified barriers to implementation and successfully tested an alternative approach to facilitated learning to overcome the challenge of missed opportunities to simulate when missions interrupt the training.

The primary motivation behind the project was to make in situ simulation training accessible for on-call crews in HEMS with the least amount of effort. Studies I and II demonstrated that this is possible in a model where the facilitator plays a central role in preparing and organising the training. The essential role of the facilitator has previously been described for the simulation training of London HEMS(7, 82). Participants' feedback in our studies indicated that the HEMS crews find this form for training useful for the type of work they perform. Zimmermann et al. found similarly that the self-perceived feedback from the participants showed a high effect and acceptance of training with reference to impact(83).

In Study II, we identified considerable differences in the level of implementation. A considerable variation in the number of attempted simulations was observed even though the prerequisite for simulation was almost identical. In Study II, the facilitators were given the freedom to create scenarios and training that they felt were relevant for the base they conducted the simulation training (and worked as HEMS physicians on). The tailoring of the in situ simulation training to the location's needs enabled staff to see a scenario that is relevant to their practice, as described by Walker et al.(84). However, they described unannounced training, which contrasts the announced and predictable training the HEMS crews involved in our studies were exposed to. It still seems reasonable to assume that there are similarities with our studies.

Study III explored these implementation barriers and found that management support was an important factor for successful implementation. This has been mentioned by both Sales and Spur(17, 52). Fortunately, there was a high degree of managerial support on most of the involved bases in our studies. This finding underlines the concept that support from above and below is important for implementing in situ simulation-based training. The importance of not just the facilitator but also the continuous education hereof was described. This might also be of importance for the ongoing sustainable conducting of such training. In some simulation organisations, a network and specialised facilitator courses exist(85). Without a doubt, more focus could have been given to the facilitators during the one-year period of simulation training in Studies II and III. This might have reduced the declining numbers of attempted simulations throughout the one-year study period that we saw in Study II. The focus on the facilitator has been described by Tariq, who emphasised the necessity of focussing on the facilitator's skills end the development of these(82).

One of the prominent implementation barriers found, was the unpredictable context in which the simulation training is carried out. It has been suggested to plan the in situ simulation training to less busy times, where staff are available in emergency departments(17, 86). This may reduce the risk of being interrupted in the simulation training.

Interruptions in planned training by live missions are both a missed training opportunity but also – potentially – something that may over time demotivate both facilitator and crews. It, therefore, seemed reasonable to explore alternatives to in situ simulations that would provide a similar learning experience. Line-check or on-the-job observations are used in aviation to provide pilots with feedback on their actual performance. We postulated that this could be a viable alternative to the in situ simulations if the facilitator observed the mission and debriefing post-mission carried out in the same way as for the simulations. We chose three bases with varying mission profiles for Study IV to explore the use of live mission observations as an alternative to cancelled simulation training sessions. One base never had to explore this option, as all simulations were conducted as planned. On the two other bases, live mission observation was conducted.

The feedback from participating crews was positive, although describing this as a “new, unusual situation”. The participating facilitators described the live mission observation as more challenging than facilitating simulations. We speculate that this is bound in the fact that for simulations, the facilitator can prepare parts of the medical discussion beforehand as the scenario is known. This contrasts with live mission observation, where the mission that is observed is unknown. This puts another strain on the facilitator when conducting the debrief. It might also be experienced as a challenge to observe colleagues in the clinical work setting. Previously it has been reported that the self-perceived learning outcome for the observees was positive(87). In this study, the trainees that were observed reported specifically that management and decision-making time was decreased as well as an increase in clinical knowledge. In the study, there was a gap in the experience of the trainees, with some trainees expressing apprehensions about being observed. Although being on the same educational level, we suspect that such apprehension could be a barrier to the broader implementation of live mission observation.

4.1.1 Facilitators

Our findings suggest that conditions related to the local facilitator are essential for successfully implementing simulation-based training in helicopter emergency services. The importance of the facilitators and his/her competence has been described by others previously(82, 88). In our studies, the facilitators were given a large amount of autonomy; they designed the scenarios themselves; they were free to use any manikins or actors, there were no given numbers of simulations attempts they were expected to meet, and they had a little follow-up. We did offer the possibility of exchanging scenarios or creating a common scenario bank. This did not take place. Other simulations concepts have established facilitator networks and exchange of ideas for support and development of the facilitators(89). Retrospectively, we could have encouraged further networking between the facilitators and enabled further sharing of experiences and scenarios. Some facilitators had more experience with scenario design than others, given the variety of their backgrounds. In Study I, the scenarios were well described, which was easier since there was only one facilitator (a researcher, PB) for the simulation. Establishing a closer network would have enabled us to follow up and support each facilitator if needed.

The leaders of participating bases were free to select one or more facilitators. We speculate whether more facilitators on each base would serve several purposes. This would make co-facilitating feasible, stimulate facilitator development, and lower the scenario development burden by sharing it amongst them(90, 91). Furthermore, having two facilitators increases the options for facilitator development. The use of video evaluation of the facilitator in the debriefing role has been emphasised by Dieckmann et al.(92).

4.1.2 Video-based facilitation

One HEMS base planned to participate with remote facilitated simulation as none of the physicians could act as an on-site facilitator. Due to technical difficulties with establishing a video link, this base opted out before initiating the simulation-based training. However, we speculate whether this could be an option for the future. This form for facilitation of simulation training has been tested in other places for surgical procedures and medical students(93-95). Video-based facilitation would serve two purposes on remotely located bases, where the staff lives further away. Firstly, it enables the use of a facilitator with local knowledge, which is found to be wanted by participants (Study III). Secondly, this would allow for better utilisation of the facilitator that could undertake other duties if simulation training was not conducted. This form for facilitation may pose some challenges with the communication during the debrief(96). The facilitator who is part of the base crew might find it easier to establish good contact and a safe psychological learning environment while debriefing via video link to their "home base". A network for undergraduate health profession students does already exist(94). In this network, a Sim University has been created as an innovative initiative under the Society in Europe for Simulation Applied to Medicine (SESAM). This has been established on an international platform, which could be an inspiration for in situ simulations for HEMS crews. If a video facilitated simulation training is interrupted by a mission, the facilitator cannot convert to live mission observation, and the training session must be abandoned.

4.1.3 Alternatives to simulation

In our studies, we aimed to make in situ simulation easily accessible for the crews. One could popularly call this: "From sofa to simulation", relating to the downtime HEMS crews experience during the on-call time. Study IV expanded the training form to include live mission observation, which gives a unique possibility to get feedback on real HEMS missions. The crews' feedback was mainly positive to these forms for training or observation. However, there are other possibilities for the training on a HEMS base during on-call time. The use of selected skill strainers, for instance, for the insertion of chest drains or ultrasound for arterial line access or neonatal intubation, can be used during downtime when on call.

Another option is the use of repetitively rapid cycle training, where either a single task or a larger scenario is repeated after the feedback is given(97, 98). This enables the crews to rapidly test out the newly learned strategies to improve the task performance. The same is partly true for just repeating the simulation after the debrief, which has been shown to enhance the learning outcome(99). Simple "around the coffee table discussions" of mission-related challenges is a low hanging fruit to explore. In Study I, the on-call crews had received the relevant SOPs for the simulation training the day before. It was frequently described that these had been discussed before the simulation training. When the training could not be conducted successfully for any reason, a reflective discussion of a relevant SOP still potentially brings learning for the crew.

4.1.4 Safety container

In simulation training, the concept of establishing a safety container is well accepted(100, 101). When a facilitator facilitates training on his or her local HEMS base for his or her colleagues, this poses a challenge. A debriefing after simulation or live mission observation can be challenging when giving honest personal feedback to colleagues(33). If there is a discrepancy between the crew's actual performance and the feedback given, this may lead to a false reassurance of competence which may undermine the potential for learning(102). The *learning from success* framework focuses on how good performance is produced(103). By including this framework, which focuses on positive experiences, into the debriefing, the facilitator may increase the feeling of psychological safety for the participating crews.

4.1.5 Frequency of training

We have shown in Study I that weekly simulation is feasible. However, Study II showed large variations in the number of simulations attempted at the different bases. Thus, in Study III, we identified some of the challenges to successful implementation. These barriers might be multifactorial. Some could be caused by external factors such as general workload or competing commitments. Alternatively, internal factors such as local enthusiasm for simulation-based training and interpersonal dynamics may play a role. Furthermore, we saw a decline in the total number of attempted simulations during the one-year period that the study covered. This decreasing number of attempted simulations could be related to facilitator fatigue or that the facilitators sensed fatigue amongst the crews and therefore did not initiate simulation attempts as frequently as at the beginning of the study period. One base did manage to conduct 46 simulations during the one year study period in Study II. There were simulations attempts every week in Study I, apart from during the school holidays. Thus, it seems reasonable to think that simulation training weekly is feasible. Our findings in Studies III and IV, confirms this idea.

The busiest bases completed fewer simulations than the rest of the bases. By introducing live mission observation, we provide an alternative to interrupted or cancelled simulation training which maintain the training possibilities for the on-call HEMS crews.

4.1.6 Facilitating live mission observation

In Study IV, the facilitators expressed that the observation and debriefing of live missions were more challenging than after the in situ simulations. Facilitators indicated that they felt poorly prepared for the live mission debriefing setting. We speculate whether this feeling comes from a mixture of unfamiliarity with the role as facilitator in this context, e.g., finding ones' role in the mission, the unpredictability of the mission, and the topics to be debriefed. The facilitators had all attended an instructor course for simulation facilitators, focusing on facilitating learning from simulations and not real-life observation(104). After a live mission, the facilitator is less prepared to debrief the medical aspects after a live mission observation. This is in contrast to the in situ simulation that the facilitator has prepared, and he or she can prepare the underlying medical theories of the scenario.

4.2 Limitations

This project has some limitations. The implementation of the simulation concept was limited to 11 Norwegian HEMS bases and one Norwegian SAR base. Thus, the training concept was tested primarily on one HEMS crew configuration: a 3-person crew concept. This limits the generalisation applicable to larger HEMS crews consisting of four, five or six people. Also, the Norwegian HEMS system is based on a fundamental principle of cross-professional support within the crew, the "integrated crew concept", meaning that crewmembers are trained to and to a certain degree also selected for their ability to support each other's roles in missions. This may have had a positive impact on their attitudes towards training in that the group dynamics have promoted their willingness to take part in training. This may not be the case in other organisations where the pilots are less involved in medical care. The impact of the training culture was not investigated in this project and may, in other services, pose a significant barrier to implementation.

All the crews' questionnaire-based self-evaluation was done immediately after the in situ simulations training or live mission observation. This might introduce a positive bias. No evaluation included an assessment of behavioural change, which should be a focus of further studies.

In Studies I, II, and IV, the facilitators were given the freedom to create and design simulation scenarios independently. If the facilitators had been issued with premade scenarios, their workload in preparing the training may have been reduced and could have been a factor to motivate for more training. On the other hand, by allowing the facilitators to develop the scenarios themselves and adapt them to local needs, we think the facilitators may have achieved a higher degree of ownership to the training.

Lastly, both me and the co-authors are true believers in simulation as an effective tool to improve competence and teamwork. We are heavily involved in medical simulation and education. This may have influenced our interpretation of the results towards a more positive outcome. My involvement in the design of the whole project, the design of the individual studies, my role as facilitator in Studies I and IV, and finally as interviewer and the prime investigator may also have introduced a bias that is hard to circumnavigate. By using various robust research methods to attenuate this bias as much as possible, we believe this bias has been reduced to a minimum. The limitations of each method are discussed in the methods section of this thesis.

4.3 Implications for the future

Our findings indicate that the crews positively rate in situ simulation training and live mission observation, and future implementation of compulsory simulation programmes should perhaps be considered. However, our findings and others suggest that such implementation can be challenging(17). We suggest that there is a focus on the selection and education of facilitators with support from the management.

There are currently no requirements for medical simulation training for HEMS crews in Norway. In the Norwegian HEMS system, pilots, HTCM, and medical personnel are closely linked in daily operations. We speculate whether this raises possibilities for combining training within the crews. In our studies, we did train the whole crew together, and our findings indicate that this is feasible. Furthermore, all members of the HEMS crews find this form for training valuable.

Establishing a simulation network between neighbouring HEMS bases could be one solution. Such training and simulation network has been established for emergency departments successfully previously(105, 106). Furthermore, one could imagine such a network between HEMS services evolving internationally. An interest in collaboration and comparison of prehospital training courses already exists(107). Our findings also suggest that live mission observation with a debrief should be ocnsidered implemented. Such an alternative learning opportunity would utilise the facilitator’s competence effectively but should, at the same time, ensure a safe learning environment for the crews like the in situ simulation training.

4.4 Future research

Further research could include studies with a tighter follow up on the facilitators and standardised scenarios. We have identified the facilitators as a key factor for the successful implementation of in situ simulation on HEMS bases. Thus, it makes sense to gain further knowledge of educating, stimulating, and encouraging the facilitators. Other studies could focus on the challenges and enablers related to the implementation, which we identified in Study III. Studies that tested these individuals to identify which one's matter for real-life implementation would be helpful. We still have not separated the various enablers identified in Study III. By digging deeper into this area and getting more knowledge, implementation in other services could be more successful.

We only looked at the basic levels of behavioural change, according to Kirkpatrick(108). Our studies did not discern whether the training changes safety culture in the crew, on-scene time, time to meaningful interventions, or level of patient safety. These are some of the parameters that may be used to assess level of performance in HEMS services(109). Linking these performance indicators to training may provide more information about the effect of simulation and training.

An in-depth analysis of which kind of scenario type has the more significant impact on the HEMS crews would be interesting. Our studies gave the facilitators free hands to create and choose scenarios that the facilitators expected to be tailored to the individual bases' mission profiles. We do believe that this is a useful approach. However, there might be more than personal preferences among the facilitators in making scenarios for in situ simulation in HEMS.

Ultimately – a detailed study that evaluated mortality and morbidity in a HEMS organisation after implementing in situ simulation-based training and observed live missions would be welcomed. In this way, we could gain more knowledge about the effects of simulation in HEMS organisations and identify the best way to undertake this form for training.

5 Conclusion

Our studies demonstrate that in situ simulation training for on-call crews is feasible and can be implemented with a high level of satisfaction from participating crews. There are some challenges to the implementation, of which some can be overcome by introducing live mission observation. A more rigid framework and follow up might have improved the implementation. It seemed challenging to conduct simulations successfully on busier bases. Some of the key factors for the implementation were found to be the use of a facilitator with local knowledge, management support, dedicated time for the facilitators to prepare and lead the training, and the need for continuous development within the role as facilitator. Despite the challenges, high levels of motivation exist among facilitators and participating crews.

We suggest that live mission observation with post-mission debriefing may be a feasible alternative to in situ simulation to maximise invested resources and maintain the learning output.

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7 Appendices

Appendix 1 – Study I

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Advances in Simulation

INNOVATION Open Access

In situ simulation training in helicopter emergency medical services: feasible for on-call crews?

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Abstract

Simulation-based training of emergency teams offers a safe learning environment in which training in the management of the critically ill patient can be planned and practiced without harming the patient. We developed a concept for in situ simulation that can be carried out during on-call time. The aim of this study is to investigate the feasibility of introducing in situ, simulation-based training for the on-call team on a busy helicopter emergency medical service (HEMS) base.

We carried out a one-year prospective study on simulation training during active duty at a busy Norwegian HEMS base, which has two helicopter crews on call 24/7. Training was conducted as low fidelity in situ simulation while the teams were on call. The training took place on or near the HEMS base. Eight scenarios were developed with learning objectives related to the mission profile of the base which includes primary missions for both medical and trauma patients of all ages, and interhospital transport of adults, children, and neonates. All scenarios included learning objectives for non-technical skills. A total of 44 simulations were carried out. Total median (quartiles) time consumption for on-call HEMS crew was 65 (59-73) min. Time for preparation of scenarios was 10 (5-11) min, time for simulations was 20 (19-26) min, cleaning up 7 (6-10) min, and debrief 35 (30-40) min. For all items on the questionnaire, the majority of respondents replied with the two most positive categories on the Likert scale. Our results demonstrate that in situ simulation training for on-call crews on a busy HEMS base is feasible with judicious investment of time and money. The participants were very positive about their experience and the impact of this type of training.

Keywords: Simulation, Prehospital, Air ambulance, Training, Education, In situ

Introduction

Physician staffed helicopter emergency medical services (HEMS) provide advanced prehospital critical care and are an integral part of many emergency medical services (EMS) worldwide. The provision of such care requires up-to-date knowledge and maintenance of certain skills. Clinical exposure to any particular presentation cannot be guaranteed, and it can be difficult to maintain clinical currency in a high workload HEMS system [1]. Delivering high-quality care also requires non-technical skills (NTS), which comprise cognitive skills (such as situational awareness and decision-making) and social skills (for example leadership, communication, and teamwork) [2]. These skills have for decades been a mandatory part of training programs in aviation. The HEMS pilot and crew members are explicitly trained in non-technical skills, but the full crew is rarely trained together [3]. Similarly, the pilot and HEMS crew member (HCM) are

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not trained in how to assist the physician in providing care for the patient.

Simulation-based training of in-hospital emergency teams has gained popularity as it provides a safe learning environment in which training in the management of the critically ill patient can be planned and practiced without harming the patient [4]. The content, volume, and frequency of training can be adapted and portioned to suit individual needs [5]. Recent findings suggest that brief, low fidelity, but high-frequency simulation training can be effective for training in newborn resuscitation, as well as for work in the operating theater [6, 7]. Simulation training can be a cost-effective way of maintaining skills and competence, [8]. One way of reducing the cost further is to conduct the training in the workplace, as in situ training [9]. Some leading HEMS services have implemented in situ simulation programs, although not specifically targeted at the crew on call [10]. In medical education, the focus is now on workplace-based learning [9]. We speculated, if introducing a program of simulation-based training, to be carried out when the HEMS crew is waiting for a new mission could be feasible and reduce costs associated with training [10].

The aim of this study is to investigate the feasibility of introducing in situ, simulation-based training for the on-call team on a busy HEMS base. We evaluated the time needed to prepare and carry out the training, and the participants' self-reported reactions toward this type of training.

Methods

Location for training

The study was carried out as a prospective study at the HEMS base of Oslo University Hospital (OUH) in Norway, from January 1, 2012 to December 31, 2012 [11]. The base operates two helicopters 24/7 covering a population of approximately two million people. In 2012, the service performed 2577 missions [11]. The case mix includes primary trauma and medical missions; inter-hospital intensive care transfer of ventilated patients; specialized transfer of patients on organ support (e.g., extracorporeal membrane oxygenation (ECMO)) and sick neonatal patients in incubators.

HEMS crew composition

Each HEMS helicopter in Norway is staffed by a three-person crew consisting of a physician (anesthesiologist), a HEMS crew resides member (HCM) and a pilot. The team on the HEMS base throughout the shift. The pilots are highly experienced pilots, with a civil and/or military aviation background. The HCM are emergency medical technicians, paramedics, or nurses, who have received extensive additional training in rescue techniques and aviation theory in order to be able to assist the pilot in navigation and planning of flights. Pilots and HCM are required to do bi-annual simulation training and tests in a flight simulator. There are no formal requirements for simulation training for doctors, who therefore rely on the availability of simulation-based training at their hospital, which is rarely mandatory and often irregular. All crew members are required to do regular training on fixed rope rescue operations and an annual aeromedical crew resource management course. HCMs and pilots are on call for 1 week at a time and the physician for 48 or 72 h.

In situ simulation-based training concept

Simulation-based training builds on social constructivist theories to guide participants through a cycle of learning involving exposure to a scenario and a debriefing with discussion and reflection [12].

The on-call crews were offered the opportunity to train on a specific weekday between 9 am and 4 pm throughout the study period, except during public and school holidays, when the HEMS teams have too many missions to make training feasible. Training was voluntary and only took place if the on-call crews were rested: i.e., not in a mandatory rest period due to high duty load (> 14 h duty within the last 24 h) or by subjective evaluation by the crew themselves. No crew members were able to change their working schedules to either opt in or out of the simulation. Due to variation in the composition of the crews, individuals participated in a varying number of simulations.

Eight patient scenarios were developed by the main facilitator (PB) in consultation with a physician on the base. The scenarios were chosen to cover a wide range of topics relevant to the service, with a focus on current guidelines and best practice (Table 1) and developed in accordance with existing standard operating procedures if available. In all scenarios, the focus was medical treatment and correct use of equipment, and the use of non-technical skills and optimal crew resource management. The facilitator observed the actions of the crew and made the manikin respond accordingly. This form of tailoring the simulation was used to maximize the crew's be immersed and integrated into the scenario.

We tried to avoid exposing the same crew members to similar scenarios during the study period: we ensured that at least the physicians were exposed to different scenarios every time they participated. To ensure this, a coded list of participants for each scenario was kept by the facilitator. If the pilot and the HCM were exposed to the same scenario, the facilitator would alter the context and basic physiological setting and development slightly to allow some variation whilst still adhering to the learning objectives. Hence, each participating crew member

Table 1 Simulation scenarios and medical learning objectives

No.	Scenario	Scenario content	Learning objectives	Clinical vignette
1	RSI 1	Subarachnoid bleeding	To safely conduct an RSI in an adult patient with subarachnoid hemorrhage with focus on i nduction of anesthesia and neurocritical care, team organization, and situational control	Age: 62 years GCS: E2V2M4 = 8 BP: 198/105 HR: 85
2	RSI 2	Convulsions in an adult patient	To handle a difficult airway during RSI of a fitting patient and apply neuroprotective treatment early in the prehospital phase	Age: 25 years GCS: E1V1M2 = 4 BP: 135/88 HR: 105
3	Trauma 1	Fall from height	To perform a rapid sequence induction in a trauma patient and apply early neuroprotective treatment whilst managing scene safety for the whole team	Age: 18 years GCS: E1V2M4 = 7 BP: 110/82 HR: 75
4	Trauma 2	Difficult access to a trauma patient	To control a trauma scene with a patient with an entrapped extremity and provide proper analgesia perform a safe trauma RSI including optimal use of the team	Age: 37 years GCS: E4V5M6 = 15 BP: 125/80 HR: 95
5	Interhospital retrieval	An ICU patient on CPAP	To undertake the interhospital transfer of a patient on CPAP and step up to BiPAP as required	Age: 70 years GCS: E3V5M6 = 14 BP: 105/75 HR: 84
6	Hypothermia	Continuous cardiopulmonary resuscitation during transportation	To initiate advanced life support and apply a mechanical chest compression device to continue CPR en-route to hospital	Age: 42 years GCS: E1V1M1 = 3 BP: Not recordable HR: 24 Temperature: 18.5 °C
7	Intoxication	Cocaine intoxication	To treat a severely intoxicated patient whilst addressing social concerns about the patient's wellbeing	Age: 21 years GCS: E3V3M4 = 10 BP: 190/110 HR: 135
8	Paediatric RSI	A child with convulsions	To follow the algorithm for anticonvulsant treatment in a child and perform a safe pediatric RSI as a team	Age: 5 years GCS: E1V1M1 = 3 BP: 98/52 HR: 73

All scenarios also included learning objectives for non-technical skills
BiPAP bilevel positive airway pressure, *BP* blood-pressure, *CPR* cardiopulmonary resuscitation, *CPAP* continuous positive airway pressure, *E* Eye response, *GCS* Glasgow coma scale, *HR* heart rate, *ICU* intensive care unit, *M* motor response, *RSI* rapid sequence induction, *V* verbal response

was exposed to as many different scenarios as possible during the study period.

We used basic manikins that could be ventilated and intubated. The scenarios were designed to take place in realistic physical settings, for example outdoors, in the helicopter cabin or in a staircase. In accordance with established models of training [10], the equipment used was familiar to the team: monitors, ventilators, and other medical equipment were taken from the helicopter by the crew and replaced immediately after training. The training took place either indoors or outdoors in the immediate vicinity of the HEMS base to minimize any time-delay if the training was interrupted by a tasking.

The day before the scheduled training, the on-call crews received an individual email with the standard operating procedures (SOPs) related to the planned scenario. If a medical observer was present on the base on training day, this person was often enrolled in the scenario, with a role according to their medical background. This protocol is similar to the one used by London Air Ambulance [10].

All simulations started with a short briefing to set the scene, before the crews were taken to the manikin or the scene of the simulation. The facilitator would then verbally give a description of the patient, and provide physiological parameters like blood pressure, heart rate, oxygen saturation when the crews applied appropriate monitoring equipment. Details of pathology, anatomy, and pathophysiology as well as other relevant information, the team would need in the scenario were given in due course as the team performed their assessment of the patient. After completion of the scenario, the team and the facilitator replaced all equipment in readiness for the next mission. Finally, the facilitator led a structured debriefing with the crew to highlight learning points from the simulation [13]. During the scenario and the debriefing, there was a focus on both technical and non-technical skills. If training was interrupted by a real mission, the simulation was aborted, but the opportunity was given to continue the simulation, or debrief, after the mission. All participants are accustomed to simulation within their own field (medicine or aviation). At the end of all debriefing, the crews were encouraged to give feedback and raise any issues related to the training at any time, either in the group setting or individually.

A HEMS physician from the base facilitated the simulations, which could be conducted at any time between 9 am and 3 pm. The facilitator had been trained on a 3-day facilitator course [14]. Except for two occasions, all simulations were facilitated by the same person (PB) to ensure regularity and consistency in content and style of simulation.

Data collection

A questionnaire was developed to capture the participants' evaluation of the simulation-based training. An initial version was drafted by two of the authors (PB and SS). The draft questionnaire was reviewed by a representative from each role: a pilot, an HCM, and a physician. Using their input, the questionnaire was modified to optimize and clarify the answer options. This modified version was reviewed by two HEMS crews from the OUH HEMS base to ensure that the questionnaire was clear and comprehensible. The questionnaire was written and presented to the crews in Norwegian. A translated version of the questionnaire is available (Additional file 1). The questionnaire consisted of 14 questions, to be answered on a 7-point Likert scale [15]. The score ranged from 1 to 7 where 1 equaled *I strongly agree* and 7 equaled *I strongly disagree*.

All participating crew members were asked to rate their experience with the simulation and their attitudes to simulation-based training after the completion of each simulation. The questionnaire was either completed immediately after the debrief in front of the facilitator or later the same day and then collected by the facilitator. The responses were anonymized and recorded in an Excel spreadsheet (Microsoft Corp, Redmond, WA, USA) along with other data from the simulation.

The facilitator manually recorded the time taken (to the nearest minute) in each of the four distinct phases of the simulation: time the facilitator spent on preparing the scenario for the simulation; time the crew spent performing the actual simulation; time spent cleaning up and making all the equipment mission-ready; and time spent in debrief. The time of the day of the simulation was also recorded.

Statistical analysis

Continuous data was summarized using median (quartiles), and categorical data as numbers (percentages). Questionnaire responses were presented graphically using standard bar charts. Data was analyzed using SPSS (IBM Corp. SPSS Statistics for Windows, Version 25, IBM Corporation, Armonk, NY, USA) and R 3.11 [16].

Results

A total of 44 individual simulations were conducted with a total of 15 physicians, 12 HCM, and 15 pilots participating. The commonest reason for not doing performing a simulation with a HEMS crew was a conflicting live mission or the need for rest after missions during the preceding night. Twenty-two (50%) of the simulations were initiated before 12 pm. On one occasion, the crew opted out of a simulation but agreed to do a "talk through" of a scenario. This session is not included in the study, as no feedback questionnaire was completed. In 11 of the 39 weeks, both helicopter crews on call performed simulation-based training on the same day.

In four (9%) of the simulations, the pilot opted out from the training due to other flight operations related tasks. All other simulations were conducted by the whole HEMS team. One simulation was aborted due to the crew being tasked to a mission during the simulation, but the simulation was subsequently resumed and finished. Four debriefs were interrupted by missions for the crew, and were completed after the mission.

In Table 2, the median (quartiles) time consumption for a simulation training session for the on-call crew and the facilitator is presented, as is the time spent in each of the four phases of the simulation.

Of the 44 groups of questionnaires handed out after the simulations, one group was missing responses for all crew members and in one group the physician's response was missing. This left 42 (95%) complete sets of questionnaires available for further analysis.

Table 2 Time consumption for simulation training sessions for facilitator and HEMS crew

Task	People involved	Time used in minutes, median (quartiles)
Preparation of scenario	Facilitator only	10 (5-11)
Scenario simulation	HEMS crew + facilitator	20 (19-26)
Cleaning up after scenario	HEMS crew + facilitator	7 (6-10)
Debrief	HEMS crew + facilitator	35 (30-40)
Total time consumption for on-call HEMS crew	HEMS crew	65 (59-73)
Total time consumption for facilitator	Facilitator only	75 (64-88)

In Table 3, the participant's evaluation of the training is presented. The median score on the Likert scale regarding the relevance of the training was 1, range (1-3). Almost all participants (98.4%) used the two most positive categories. For the full training concept, the median score was also 1, range (1-2) and all participants used the two most positive categories. For all other questions on the questionnaire, the median score for participants of all three professional groups provided responses in one of the two most positive categories.

Discussion

In this study, we found that it was feasible to introduce an in situ simulation concept for the on-call HEMS crews at a base with a high workload. The training took a short time to carry out and was well received by all crew members. The simulations included training in skills, procedures, and teamwork. We aimed to run scenarios in familiar settings so that the crews were able to identify themselves with the situation. We found that this form for training was not seen as disruptive to on-call work and crews found that the time devoted was sufficient. Feedback also showed that crews found it easy to motivate themselves to participate in this form of training.

In situ simulation can be perceived as an additional strain on the on-call crews, and successful integration with the workflow can pose a challenge. However, in our study, most participants reported that such training did not disrupt their non-clinical duties whilst on call. A positive attitude may play an important role in the successful integration of in situ simulation, as mentioned in the paper by Spurr et al. [17]. A possible additional positive contribution to the success of this training was having a dedicated facilitator with knowledge of the local context, which made it easier to adapt and tailor the simulation to the actual crew and maybe more importantly, to sense when and how the simulation training could be undertaken to cause the least stress to the crew. Another possible success factor might be that the crew, in order to minimize time-wasting, went straight from the HEMS base resting area to the brief for simulation and then straight into the simulation itself. We chose a basic manikin, which in a recent study was found to be as effective as a high fidelity manikin in inducing participant self-reported engagement and learning [18].

There are other potential benefits in favor of low fidelity in situ simulation. Costs are lower: there are no travel expenses, clinical equipment is already in place and readily available for use in the training, and the need to replace personnel participating in the training is attenuated since the participating on-call crew is already present. Dotson et al. found reduced training costs with a high-fidelity air medical simulator [19]. The setup by Dotson included running an advanced and expensive

Table 3 Median scores (with quartiles) from the participant's evaluation of the training on a Likert scale

Questions for participants	Physician,median (quartiles)	HCM, median (quartiles)	Pilot, median (quartiles)
1. There was enough time scheduled for the training	1 (1-1)	1 (1-2)	1 (1-2)
2. I felt that the training interrupted my on-call duties	7 (6-7)	6 (5-7)	7 (6-7)
3. There was enough equipment to make the training realistic	2 (1-3)	2 (1.5-3)	2 (1-3)
4. I felt comfortable with the way the training was organized	1 (1-1)	1 (1-2)	1.5 (1-2)
5. I felt uncomfortable when exposing my skills and competencies during the training	6 (6-7)	7 (6-7)	7 (6-7)
6. Simulation is a realistic way of training	2 (1-2)	2 (1-2)	2 (1-2)
7. The topic for the training is relevant to this kind of training	1 (1-1)	1 (1-1.25)	1 (1-2)
8. The clinical aspects of the scenario were good (physician) This type of training is useful for HEMS crew members (HCM) This type of training is useful for HEMS pilots (pilot)	1 (1-1.5)	1 (1-1)	1 (1-1)
9. The scenario relied on procedures that we have already practiced	1 (1-1.5)	1 (1-2)	2 (1-2)
10. The topic for the scenario training seemed relevant for the profile of missions on the base	1 (1-2)	1 (1-2)	1 (1-2)
11. It was useful for me with feedback after the training	1 (1-1)	1 (1-1)	1 (1-2)
12. There was enough time scheduled for feedback after the training	1 (1-2)	1 (1-2)	1 (1-2)
13. It was easy to motivate myself to do this form of training	1 (1-2)	1 (1-2)	1 (1-2)
14. I am positive to this form of training	1 (1-1)	1 (1-1)	1 (1-1)

The score ranged from 1 to 7 where 1 equaled *I strongly agree* and 7 equaled *I strongly disagree*
HEMS helicopter emergency medical service, *HCM* HEMS crew member

manikin simulation in the helicopter with a rotor turning on the ground. Incurring the costs of helicopter use might not be necessary to induce realism and immersion for simulation in HEMS services.

The participants' positive attitude towards the training at Kirkpatrick's level one, (learning evaluation on the reaction level [20]), merely shows that the training was successfully received by the crews. This evaluation is however important to ensure that the concept is seen as useful and that the level of difficulty matches the need of the participants. We planned the training to involve the full HEMS team and included learning objectives related to their skills. This had the potential to improve the interaction within the crew and thus their behavior as team members, but this was not evaluated in this feasibility study. We did, however, observe a possible effect in the organization that the collected data failed to capture: crews' experiences of the simulations did in some cases lead to changes in standard operating procedures, which can be described as learning on an organizational level [20].

In the simulations, we used a facilitator familiar with both the local procedures and the crews. We believe that this maximizes opportunities to tailor not only the scenario but also the debrief to local training needs.

Our study has some limitations. First, only one HEMS base participated in the study. This limits the generalizability of our findings and the study should be repeated in a larger cohort including more bases to explore if there are other factors influencing implementation that we did not identify in this study. Second, almost all simulations were led by one instructor from the OUH HEMS base. While this was done to reduce variability, we cannot tell whether a larger group of instructors would influence the training and its implementation and success due to individual preferences among the instructors, for example, in when to initiate training. Third, all participants were aware that the training was part of a project of interest for the instructor. This might have induced the crews to answer the questionnaire more positively especially when completed in the vicinity of the facilitator. Fourth, the questionnaire was developed solely for this HEMS setting and has not been validated. This could potentially limit some of the conclusions from the questionnaire. However, limiting the study to only one HEMS base and only one instructor can also be considered a strength in that it was possible to ensure that no participants were exposed to identical scenarios more than once and thereby bored or understimulated by to the training.

Future research should be performed to evaluate implementation of in situ simulation in HEMS services and to what extent this training can be shown to improve teamwork and clinical practice.

Conclusion

We found that in situ simulation training for on-call crews at a busy HEMS base is feasible and can be done with a limited investment of time and resources. The participating crews reported high levels of satisfaction with the training, its organization, and the time devoted to it.

Supplementary information

Supplementary information accompanies this paper at https://doi.org/10.1186/s41077-020-00126-0.

Additional file 1.

Abbreviations

BiPAP: Bilevel positive airway pressure; BP: Blood-pressure; CPAP: Continuous positive airway pressure; CRM: Crew resource management; CPR: Cardio pulmonary resuscitation; E: Eye response; EASA: European Aviation Safety Agency; ECMO: Extra corporeal membrane oxygenation; EMS: Emergency medical services; GCS: Glasgow coma scale; HCM: HEMS crew member; HEMS: Helicopter emergency medical service; HR: Heart rate; IABP: Intra-aortic balloon pump; ICU: Intensive care unit; M: Motor response; NIV: Non-invasive ventilation; OUH: Oslo University Hospital; RSI: Rapid sequence induction; SOPs: Standard operating procedures; V: Verbal response

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Authors' contributions

PB initiated the project, wrote the protocol, and led the project. PB was the main facilitator during the study period. SS and PB developed the questionnaire. PB did the data collection, analysis, and first draft writing. SS, JH, JR, and DØ contributed in the analysis of data and the writing process as well as finalization of the paper. All authors approved the final version of the paper.

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Availability of data and materials

The dataset used during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Crews participated in the simulation training on a voluntary basis. Responding to the questionnaire was also voluntary and anonymous. Individuals could withdraw their responses to the questionnaire from the study at any time. The project was presented to the Regional Committee for Medical Research (Health Region East), which waivered the need for ethical approval given the nature of the study (REK 2012/777 D). The Norwegian Social Science Data Services approved the recording of data related to the study.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Publisher's Note

Appendix 2 – Study II

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Original Research

National Implementation of In Situ Simulation-Based Training in Helicopter Emergency Medical Services: A Multicenter Study

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A B S T R A C T

Objective: Medical simulation is used in helicopter emergency services as a tool for training the crew. Using in situ simulation, we aimed to evaluate the degree of implementation, the barriers to completing simulation training, and the crew's attitude toward this form of training.
Methods: This was a 1-year prospective study on simulation at all 14 Norwegian helicopter emergency services bases and 1 search and rescue base. Local facilitators were educated and conducted simulations at their discretion.
Results: All bases agreed to participate initially, but 1 opted out because of technical difficulties. The number of simulations attempted at each base ranged from 1 to 46 (median = 17). Regardless of the base and the number of attempted simulations, participating crews scored self-evaluated satisfaction with this form of training highly. Having 2 local facilitators increased the number of attempted simulations, whereas facilitators' travel distance to work seemed to make no difference on the number of attempted simulations.
Conclusion: Our study reveals considerable differences in the number of attempted simulations between bases despite being given the same prerequisites. The busiest bases completed fewer simulations than the rest of the bases. Our findings suggest that conditions related to the local facilitator are important for the successful implementation of simulation-based training in helicopter emergency services.

Medical simulation is an integral part of medical education, postgraduate training, and continuous professional development.[1] Several studies have shown that simulation-based training has a positive effect on patient outcomes.[2,3]

In many countries, helicopter emergency medical services (HEMS) are responsible for the management of the most critical patients outside the hospital. Time-critical interventions must be provided and critical decisions made despite clinical uncertainty. The rapidity of transport by air can be beneficial to the patient but also creates a challenging environment with many hazards. Ensuring that care providers in HEMS have the right skills, experience, and training to provide excellent care and take care of the patient's safety may require tailored training and skills maintenance.[4] Many emergency services have incorporated medical simulation as a core element in the training of personnel and crews in critical technical and nontechnical skills.[5-7] However, simulation is resource demanding, both economically and logistically, and implementing effective training programs can be challenging in busy emergency services.

In a previous pilot study, we showed that in situ simulation is a feasible training concept for simulation-based training at the workplace during on-call hours for HEMS crews.[8] In that study, a simulation program was introduced at a busy HEMS base in Norway. The simulation-based training was shown to take up little time for the crews, and the response from the participating crews was generally very positive.[8] To our knowledge, no other program for simulation-based training of on-call HEMS crews has been implemented on a

Supported by a research grant from the Norwegian Air Ambulance Foundation, who provided compensation for the facilitators as well as provided manikins and training equipment for bases in need of that.

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national level in other systems. In the present study, we introduced a program of in situ simulation-based training through the entire Norwegian HEMS system.

This prospective study aimed to document the implementation of a national program of in situ on-call simulation-based training for the crews in the national HEMS system in Norway and 1 search and rescue (SAR) base. We also explored possible reasons for not attempting to start a training session or why training was interrupted, along with the participants' and facilitators' satisfaction with the training.

Materials and Methods

Norwegian HEMS System

The Norwegian HEMS is a national service funded by the government. Commercial companies are contracted by the 4 regional health trusts in Norway to manage the flight operations. Medical staffing and medical responsibility for the service lie with the local health trust in which each base is located.

At the time of the project, there were 11 HEMS bases run by 2 commercial companies with medical staffing from 11 local health trusts. Each HEMS base is staffed by a physician, a HEMS crewmember (HCM), and a pilot. One base also includes an anesthetic nurse in the crew. The physicians are all certified anesthesiologists or within 1 year of being certified and have experience in anesthesia, intensive care medicine, emergency medicine, and advanced pain management. The HCMs are trained as emergency medical technicians, paramedics, or nurses and have additional training and experience in rescue techniques, including training in aviation theory, to make them able to act as an assistant to the pilot. All physicians must also regularly perform in-hospital work. The pattern of shifts varies between bases; pilots and HCMs are generally on call 24 hours a day for 1 week, whereas physicians work for 24, 48, 72, or 168 hours depending on local work rotation.

All HEMS bases respond to primary medical and trauma missions and perform interhospital transports and SAR missions. Some bases also perform transfers involving incubators, intra-aortic balloon pumps, and extracorporeal membrane oxygenation. The total number of missions and the type of missions flown vary between the HEMS bases.[9]

SAR bases operated by the Royal Norwegian Air Force are also dispatched for ambulance missions in the national Norwegian HEMS system. The medical staffing and equipment setup of the SAR helicopters are identical to the civilian HEMS, but the HCM is trained by the Air Force and the helicopter is additionally staffed with 2 pilots, a technician, and a systems operator.

Participants

All 11 HEMS bases in Norway and 1 SAR base were invited to participate in the study. On each base, 1 or 2 experienced senior HEMS physicians were selected by the lead physician at each base to be trained as simulation facilitators. Before the initiation of the study, these facilitators all completed the same standardized EuSim simulation facilitator course together.[10] To ensure knowledge of local operating procedures, all facilitators only acted as facilitators for the simulation-based training at the bases on which they usually worked. All facilitators received remuneration for simulation-based training outside their regular hours of work.

Ethics Approval and Consent to Participate

Crews participated in the simulation-based training voluntarily, and the study was conducted according to relevant local, national, and international ethical guidelines. Responding to the questionnaire was also voluntary and anonymous and only took place after informed consent. Individuals could withdraw their responses to the questionnaire from the study at any time. The project was presented to the Regional Committee for Medical Research (Health Region East), which waived the need for ethical approval given the nature of the study (REK 2014/1425). The Norwegian Social Science Data Services approved the recording of data related to the study (2014/10220, Oslo University Hospital).

Study Design

The study was conducted as a prospective multicenter study from October 31, 2014, to October 31, 2015. Simulation-based training was offered to the HEMS crews on call during the daytime on days selected by the local facilitator on a convenience basis when the facilitator could prepare and conduct the training. There were no requirements or expectations regarding the total number of sessions or their frequency during the study period. The simulation was presented as an optional learning and training opportunity for the crew rather than as a compulsory task because there was no previous tradition of simulation-based training as a crew. Before a training day, the facilitator would inform the on-call crew about upcoming training and at his or her discretion send the on-call crew relevant standard operational procedures. All crewmembers were encouraged to participate in the training, and the scenarios were designed to involve the physician, HCM, and pilot. On the SAR base, the training was designed for the HCM and the physician primarily, but other crewmembers were invited to participate by the nature of SAR operations; the remaining 4 crewmembers of the 6-person SAR crew are less involved in medical care. We emphasized that the training should interfere with normal operations as little as possible.

Scenarios and Equipment

Because of large variations in the mission profiles between the Norwegian HEMS bases, the facilitators were encouraged to develop scenarios tailored to the mission profile of their base. The facilitators were asked to design scenarios to involve all members of the crew. The simulation-based training was designed to be in situ simulation on the base and could take place indoors, outdoors, or both, although they were confined to the vicinity of the HEMS/SAR base to avoid disruption to crew readiness and a delayed response to real missions. The facilitators were encouraged to have specific learning aims for each scenario and to ensure that no participants were exposed to the same scenario more than once. A total time consumption of 1 hour was regarded as optimal, but this could vary.[8] Facilitators were invited to share scenarios between bases, but to what extent this was done was not monitored.

The facilitators were encouraged to create packs of medical equipment specifically for training, similar in layout to those used at their base, and to use the helicopter's medical monitors to increase immersion in the scenarios. The facilitators were free to choose high- or low-fidelity manikins or live actors for the simulations depending on what they regarded as most appropriate for the specific scenario. Real-time physiological parameters were provided by either verbal information or via apps for smartphones and tablets that are commercially available. Additional diagnostic data could be made available if requested by the crews.

All simulation-based training sessions were planned to end with a structured debriefing performed using the PEARLS (Promoting Excellence and Reflective Learning in Simulation) framework for debriefing, which is structured as reaction, description, analysis, and application/summary.[11]

Data Collection

The facilitator in each case recorded the duration of the simulation-based training. The facilitator also noted if the simulation-based training was completed successfully and, if not, the reason for interruption or cancellation. A simulation attempt was regarded as completed if the simulation and debriefing were completed regardless of any interruptions. After each simulation, the participating crew and the facilitator individually and anonymously evaluated the degree of satisfaction with the simulation as a whole on a visual analog scale (VAS) from 0 mm to 100 mm, where 0 mm represented completely unsatisfactory and 100 mm represented maximum satisfaction.[12] The facilitator's previous experience with medical simulation was noted, as was whether the facilitator lived close by or far away from the base (the latter was defined by convenience as a travel distance of more than 30 km). All data were recorded anonymously on a preconceived data collection sheet by the facilitator immediately after each attempted simulation-based training and later entered anonymously into a digital database (Questback Essentials, Oslo, Norway). Data from the collected questionnaires were also entered into the same database. No data involving the identity of participants were entered.

Statistical Analysis

Continuous data were summarized using the median (quartiles) and categoric data as numbers (percentages). Comparisons of nonpaired observations were made with the Mann-Whitney *U* test. The facilitators' and crewmembers' satisfaction with the training is presented as median and quartile VAS scores for all successfully conducted simulations for each base. The association between the number of missions and the simulation attempts at the bases was analyzed using robust linear regression. Robust linear regression is a generalization of traditional linear regression that downplays the importance of outliers that might otherwise disproportionately affect regression coefficients. For the association between the number of missions and simulation success, the analysis was weighted with respect to simulation attempts in a weighted robust linear regression. Data were analyzed using SPSS (SPSS Statistics for Windows, Version 25; IBM Corp, Armonk, NY) and R 3.5.2 (R Foundation for Statistical Computing, Vienna, Austria).

Results

All 11 Norwegian HEMS bases and 1 SAR base were invited to participate in the study. One HEMS base planned to participate with remote facilitated simulation because none of the physicians could act as an on-site facilitator. Because of technical difficulties, this base opted out before the initiation of the simulation-based training. All other invited bases participated, thus providing us data form 10 of the 11 Norwegian HEMS bases.

A total of 176 simulation attempts were registered. Of these, 116 (66%) were completed. The total monthly number of attempted simulations among all participating bases throughout the study period is shown in Figure 1A, and the successful and unsuccessful simulations, respectively, are shown in Figure 1B. Table 1 shows the number of successful and unsuccessful simulations at each base as well as background information about the simulation-based training (ie, the number of facilitators, the time consumption, VAS scores for facilitators, and crews' self-reported satisfaction with the simulation). The number of simulations initiated at each base ranged from 1 to 46 (median = 17). The reasons for the failure to complete simulations are shown in Table 2.

The association between the number of missions and the number of simulations is shown in Figure 2A and B. The number of simulation attempts was not associated with the total number of annual missions at the base, which was used as a proxy for how busy the bases are (Fig. 2A) (−0.002; 95% confidence interval = −0.009 to 0.010; P = .973), and there was no statistically significant difference in the number of completed simulations between the bases when related to the number of annual missions (Fig. 2B) (−0.0165; 95% confidence interval, −0.029 to −0.0002; P = .077). Figure 2A and B shows the association between the number of missions and the number of simulations. A statistically significant difference (P = .01) in the number of simulation attempts was seen between bases with 1 facilitator and those with 2 facilitators; bases with only 1 facilitator had a median of 8 (range, 5-16) simulation attempts compared with 21 (range, 18-28) for bases with 2 or more facilitators. Neither the facilitator's previous experience with simulation-based training did not have a significant influence on the number of attempted simulations nor the travel distance for the facilitator.

Discussion

In this study, we found variations in the success of implementing in situ simulation for on-call crews in the 11 HEMS bases of the Norwegian air ambulance system and 1 SAR base. The workload of the bases, expressed through the total number of yearly missions, had no impact on the number of attempted simulations. However, there was an indication that bases with a low workload did manage to complete the simulations successfully more often. The number of facilitators at each base positively impacted the number of simulations attempted.

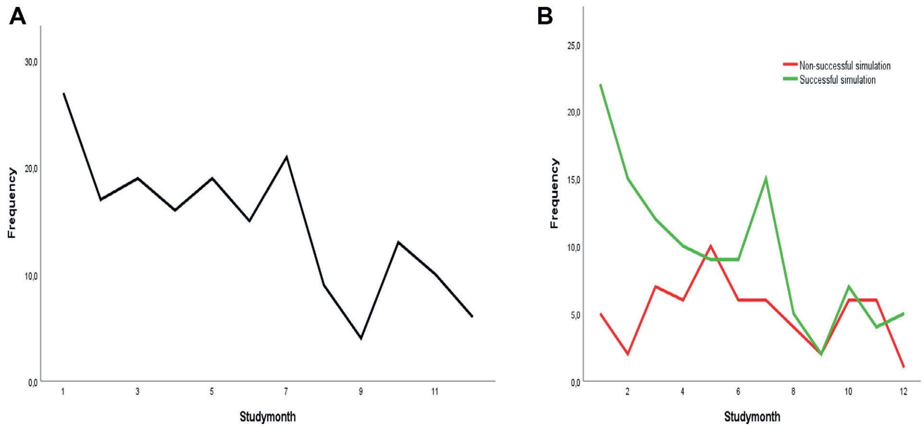

Figure 1. A, The total number of monthly simulations at all bases during the study period. B, The number of monthly successful simulations (green line) and nonsuccessful simulations (red line) during the study period.

Table 1
The Distribution of Background Variables Related to the Simulation Training at Each of the 11 Participating Bases

Base	Missions per Year	Number of Facilitators	Crew Size	Attempted Simulations	Successful Simulations (%)	Time Consumption Mean (SD), Minutes		VAS Score Median (Quartiles)		Facilitator With Previous Experience	Facilitator Living Close to Base
						Facilitator	Crew	Facilitator	Crew		
A	2,997	2	3	17	7 (41)	98 (51)	57 (22)	67 (51-79)	87 (83-90)	Y	Y
B	1,112	2	3	8	5 (63)	166 (47)	86 (18)	80 (54-95)	90 (83-95)	Y	Y
C	628	1	3	5	5 (100)	99 (11)	76 (6)	86 (82-88)	83 (76-98)	Y	N
D	1,783	1	3	5	4 (80)	145 (46)	59 (15)	79 (75-80)	87 (84-96)	Y	Y
E	1,531	1	3	18	9 (50)	101 (20)	90 (18)	86 (71-88)	93 (80-97)	N	Y
F	909	2	3	19	14 (74)	118 (55)	86 (22)	85 (74-90)	85 (79-91)	N	Y
G	1,805	1	3	14	10 (71)	116 (32)	92 (18)	88 (80-92)	90 (86-96)	Y	Y
H	875	1	3	1	0 (0)	90 (–)	60 (–)	86[86-86]	92[92-92]	N	Y
I	833	1	3	20	14 (70)	79 (15)	57 (9)	88[75-92]	88[82-97]	N	N
J	696	2	3	23	18 (78)	118 (41)	62(10)	74[65-83]	89[86-91]	Y	N
K	1,061	2	4	46	31 (67)	177 (64)	95 (28)	90[84-90]	91[87-93]	Y	Y

VAS = visual analog scale.
The VAS score represents the self-reported satisfaction with the training scored after each simulation session.

Table 2
The Number of Successful and Nonsuccessful Simulations and Reasons for Failure to Complete Simulations

Outcome	Details	Percentage (n = Actual Number)	Causes of Noncompleted Simulations (Actual Numbers)
Simulation completed	Completed without interruption	58.0 (n = 102)	
	Started, interrupted, but completed	7.4 (n = 13)	Dispatch for an acute mission: 13
Simulation planned or initiated, but not completed	Started, interrupted, but not completed	28.4 (n = 50)	Dispatch for an acute mission: 42
	Simulation conducted without debrief	3.4 (n = 6)	Crew needs rest: 5
			Crew prioritizes other tasks: 9

Participating crews universally reported high levels of satisfaction with the simulation-based training with little variation between the bases.

More than half (58%) of the simulations were completed without interruption. Most interruptions were due to acute missions. Only a few cancellations of planned simulations were due to crews' lack of motivation or fatigue. This is in agreement with the crews' positive evaluation of the training and our findings in a previous study.[8]

As Figure 2B depicts, there is an indication that the number of successfully completed simulations is related to the workload in terms of the number of yearly missions at the base. Bases with a low workload tended to be able to complete more simulations than bases with a higher workload. However, this relation was not significant ($P = .07$) but would seem natural because a low workload base is less likely to be interrupted once a simulation session has started. We speculate whether this finding could have reached significance with more data (eg, a more extended study period). For implementation purposes, such a finding would be of importance in the planning of simulation training (eg, by offering training on more days in the week to increase the likelihood of completing the training in a quiet period).

One of the bases attempted to run 46 simulations over the 1-year course of the trial, which corresponds to 1 simulation per

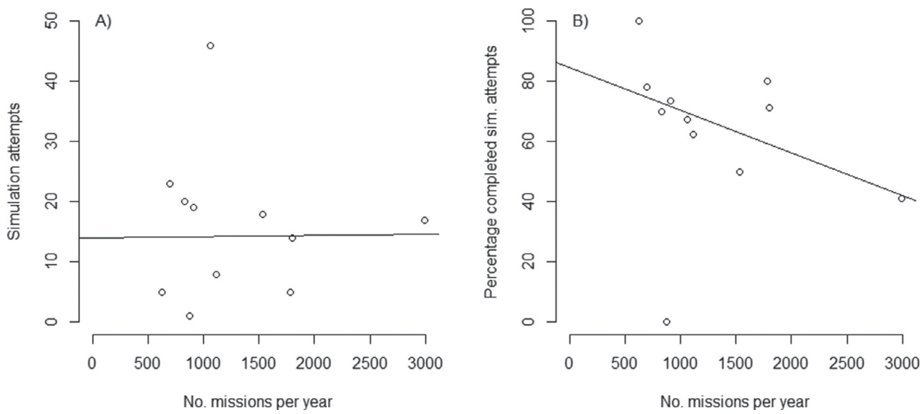

Figure 2. A, The association between the number of missions at a base and the attempted simulations. B, The association between the number of missions at a base and the completed simulations. The corresponding linear regression models are superimposed.

week if training is kept out of the busiest weeks of the year. Thus, arranging for weekly simulations seems feasible. The other bases had a lower number of attempted simulations, mostly less than half of the aforementioned base, which indicates that the implementation was difficult.

Our study did not directly document implementation barriers. One study by Hosny et al[13] on the implementation of simulation training in surgery pointed at costs, practicality, and motivational factors as main barriers to implementing their training concept. Practicality was maintained because training was tailored to the workload of the crews and the facilitator prepared everything before and after the simulation to minimize the additional workload for the crew.

The impact of motivational factors is more difficult to evaluate from our data material.

For example, it might be necessary for leaders to promote and prioritize the simulation. Leadership approved the project but were not involved during the implementation period. We speculate that more support and encouragement of facilitators might have increased the number of attempted simulations. Different levels of support from leaders throughout the project might explain some of the variations between bases.

One base never started simulations because of technical difficulties. This shows the importance of managing logistical and practical issues during the early phase of implementing simulation on a HEMS bases.

Because the attempted simulations are tightly coupled with the facilitators initiating them, the internal motivation and the work capacity of the facilitator may also play a role. Their travel distance to the base did not seem connected to the number of attempted simulations, but this was not tested for significance because of the low number of simulations on some bases.

In our study, we attempted to provide each base with equal resources. The facilitators were given the same training and tools to run the simulation program. We tried to avoid imposing a rigid framework onto the program, which might stifle its adaptation to the local context and learning needs. For example, the facilitators could choose the level of fidelity, the day of the week, and the content of the simulations. Nevertheless, there were significant differences between the bases in how frequently simulation-based training was initiated.

Tariq et al[14] previously described the importance of the follow-up and supervision of facilitators being critical to successful in situ training at London HEMS. They recognized the complexity of the facilitators' role and the need for education and feedback to facilitators. We had no impact on the selection of facilitators on each base and therefore were unaware of their motivations or previous experience.

Although cautious in our interpretation, we accept that the training of facilitators, the concept of the training, and the follow-up of the facilitators throughout the project may have influenced the overall number of attempted simulations. We are less convinced that this also explains the variance in the number of simulations attempted at different bases; in this context, it seems more likely that other external factors (eg, general workload and competing commitments) or internal factors (eg, local enthusiasm for the simulation-based training and interpersonal dynamics) played a role. However, this remains only speculation because our data did not record the motivations of the facilitator. Furthermore, it is unclear whether the decreasing number of attempted simulations is related to facilitator fatigue. Another explanation could be that the facilitators sensed a fatigue among the crews and therefore did not initiate simulation attempts as frequent as in the beginning of the study period. During the study period, there was no follow-up of the facilitators or the achieved numbers of simulations on each base. Others have shown that the motivation and encouragement of the facilitator are essential factors for the successful implementation of in situ simulation in emergency departments.[15] It is plausible that a monthly follow-up from the project coordinator might have motivated some facilitators to run more simulations. The decreasing number of total simulations per month on all bases throughout the study period suggests that maintaining a program of simulation-based training over some time is likely to require ongoing support (Fig. 1A) and encouragement. Therefore, future and similar projects should focus on removing barriers to the successful completion of training and keeping the spirit alive among the facilitators.

The facilitators were free to deliver training as often as they wanted. However, we speculate that it might have been helpful for the facilitators to have regular and frequent contact with either other facilitators or the leaders of the project. In this way, encouragement and support could be given.

In our study, we allowed each base to have 1 or 2 facilitators, and we know that bases with 2 facilitators were able to attempt more simulations than bases with only 1 facilitator. The redundancy of having 2 facilitators may improve the ability to initiate simulations, and the facilitators may be able to motivate and support one another. After the completion of the study, we became aware that some facilitators were unable to conduct simulation-based training because of long-term sick leave. This was not recorded during the study, so we cannot know how this influenced the frequency of simulations, but it emphasizes the central role of the facilitator in the simulation program. We pragmatically suggest that making at least 2 facilitators available at each base reduces the vulnerability of a simulation program and increases its chances of success. The participating crews at all bases reported high satisfaction scores in their evaluations of the simulation-based training (Table 1). This is in accordance with findings in a previous pilot study.[8]

Discussion of Methods Used

In this study, participation was voluntary; if weekly training were compulsory, more simulations might have occurred. After the group training course, facilitators operated as individuals with no formal follow-up or collaboration between the bases. To our knowledge, facilitators did not share any scenarios or experiences between bases. Potentially, such collaboration might have improved the simulations and supported the facilitators, enabling them to collaborate on solving problems that they encountered. All facilitators were encouraged to adapt the training to their local standard operational procedures and to create training packs that mimicked the actual equipment setup on the base to increase the realism and appropriateness of the training. However, this did create more work for the individual facilitator, especially in the initial setup phase.

By leaving the responsibility to record data during the simulations to the facilitators, we may have introduced a potential reporting bias. Although facilitators were instructed to record the exact time used for the simulations, they may have ended up estimating the time due to the workload with the consequence of potentially under- or overestimating the time used. The same applies to the coding of reasons for nonsuccessful simulations where there is a potential for miscoding.

The participating crews evaluated the simulation-based training immediately after the simulation on a questionnaire. Such immediate self-reporting may introduce a positive bias in the reporting (eg, participants entering overly positive attitudes in order to please the facilitator). Future similar projects could include the assessment of the learning outcome or behavioral changes over time.

Future Perspectives

Often simulation-based training was not completed because of interfering missions for the on-call HEMS crews. It is a waste of human resources for a facilitator to prepare the training and attend the base without being able to complete the simulation. Also, this experience might demotivate the facilitator. As an alternative, it might be better for the facilitator to join the on-call crew and observe the live mission and then conduct a structured debrief upon completion. Such observed practice is described positively by others.[16] Our study did not identify all barriers to the implementation of our simulation-based training program or the reasons why the implementation was so different between the bases in the study. This knowledge could be useful for future programs of this kind and should be explored in future studies.

Conclusion

We found that it is possible to implement in situ simulation-based training for on-call crews on some HEMS bases with a high degree of satisfaction among the participating crews. However, at a national level, implementation was challenging. Although all participating HEMS bases were offered the same prerequisites for an identical training and compensation for facilitators, we found a large spread in the number of attempted simulations. The deliberate lack of a rigid framework and follow-up may have been a contributing factor. There were indications that the proportion of simulations that were conducted successfully were related to the number of missions on each base.

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Appendix 3 – Study III

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Advances in Simulation

RESEARCH Open Access

Challenges to the implementation of in situ simulation at HEMS bases: a qualitative study of facilitators' expectations and strategies

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Abstract

Introduction: Facilitators play an essential role in simulation-based training on helicopter emergency medical services (HEMS) bases. There is scant literature about the barriers to the implementation of simulation training in HEMS. The purpose of this explorative interview study was to identify factors that the local facilitators anticipated would challenge the smooth implementation of the program, and their strategies to overcome these before the national implementation of in situ simulation-based training locally, and subsequently, one year after the programme was initiated, to identify the actual challenges they had indeed experienced, and their solutions to overcome these.

Methods: A qualitative study with semi-structured group interviews of facilitators was undertaken before and after one year of simulation-based training on all HEMS bases and one Search and Rescue base. Systematic text condensation was used to extract facilitators' expectations and experiences.

Results: Facilitators identified 17 themes in the pre-study-year interviews. Pedagogical, motivational and logistical issues were amongst the dominant themes. Other key themes included management support, dedicated time for the facilitators and ongoing development of the facilitator. In the post-study-year interviews, the same themes were identified. Despite anxiety about the perceptions of, and enthusiasm for, simulation training amongst the HEMS crews, our facilitators describe increasing levels of motivation over the study period.

Conclusion: Facilitators prognosticated the anticipated challenges to the successful implementation of simulation-based training on HEMS bases and suggested solutions for overcoming these challenges. After one year of simulation-based training, the facilitators reflected on the key factors for successful implementation.

Keywords: Simulation, Prehospital, Air ambulance, Training, Education, In situ, Implementation

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Introduction

Simulation is well recognised as a useful training method for teams within critical care and emergency medicine [1–4]. This includes prehospital care, where crew-based simulation has been implemented [5–7]. Recommendations for the implementation of simulation-based training have been published, and criteria for success have been suggested [8–10]. Some of these criteria might also apply for prehospital simulation, although the prehospital working situation might differ from in-hospital work with more "down time" waiting for missions. Simulation in prehospital care and helicopter emergency medical systems (HEMS) are often initiated and led by a single enthusiast, which makes such training programmes fragile [5]. Knowledge is sparse about how to implement simulation training in HEMS, and even less about the barriers to such implementation. Facilitators play an essential role in simulation on HEMS bases [11]. However, little is known about their expectations of the role. The facilitator role has been described as a demanding, complex task with a high cognitive load [12]. Participants on a train-the-trainer course for simulation facilitators in the emergency department expressed the view that debriefing is the most challenging part [13]. However, little is known about facilitators' expectations of the logistics of implementing simulation training on HEMS bases or the pedagogic aspects of facilitating such training.

The purpose of this explorative interview study was firstly to identify what local facilitators anticipated would be the challenges to the implementation of an in situ simulation programme on their HEMS bases and their strategies to overcome these. An in situ simulation-based training was implemented at each HEMS base nationwide [14]. After this programme had been running for one year, the study explored the same facilitators' reflections on the real challenges to implementation of the program, and how these could be overcome.

Methods

We used a three-stage explorative design to identify barriers to implementation of in situ simulation training, of the on-call team working in Norwegian HEMS bases. This approach was chosen for practical reasons.

Stage 1 was a session for all participants to identify key topics. Stages 2 and 3 were interviews conducted pre and after one year of simulation training, respectively. The participants were the simulation facilitators. A group-based interview method was chosen to allow group dynamics and participant interaction to elicit key themes [15, 16].

Participants

Participants in the study were physicians engaged as facilitators in a project to implement in situ on-call simulation at all HEMS bases and one search and rescue (SAR) base in Norway. Both HEMS and SAR are part of the national air ambulance system in Norway and are similar in medical staffing (doctor and assistant) and equipment setup. But whereas HEMS is operated by a civilian operator and mostly runs a three-crew concept where each crew member supports the other, SAR is operated by the Norwegian Royal Air Force with a six-crew concept (two pilots, navigator, technician, HEMS crew member and HEMS physician) where the medical part of the crew is less supported by the rest of the crew [6, 14]. Each facilitator would lead the implementation of the simulation programme on their local HEMS or SAR base.

The local clinical leads at all HEMS bases in Norway, and one SAR base, were invited by e-mail to take part in the program, and to recruit one or two physicians in the air ambulance staff to be trained as facilitators and take responsibility for the local implementation of the program. Because of the differences in crew interaction between HEMS and SAR we decided to only include one SAR base in the project to test if this would influence the implementation of the simulation programme [14]. Sixteen HEMS and SAR physicians were recruited representing all 11 HEMS bases and one of the six SAR bases. Facilitators were required to be clinically active senior prehospital consultants at the HEMS or SAR bases where they would facilitate medical simulation training, but previous simulation experience was not mandatory. None of the authors had any influence on the selection of facilitators. The recruited HEMS physicians were trained as facilitators using the EuSim concept [17].

Data collection

Data collection was conducted at three different stages during the project.

Stage 1: At the beginning of the project, facilitators were invited to a project meeting where the upcoming project was presented. At a brainstorming session, the facilitators were individually asked to name three topics that they expected would be challenging and potentially obstructive for the implementation of in situ simulation at their HEMS base and anonymously write each topic down on post-it notes. The post-it notes were collated, and the facilitators collectively discussed how to cluster and group the topics into themes. The facilitators agreed on three themes: *Motivation*, *frequency* and *delivery* of simulation-based training. The purpose of stage 1 was to identify themes and use these to create the interview guides used in stages 2 and 3.

Stage 2: Immediately before the facilitator course, the facilitators were randomly split into two groups of eight. Due to the nature of the small community of prehospital care physicians in Norway, some facilitators would know each other and others not. Two of the authors (PB, SS) conducted a semi-structured interview with each group using an interview guide based on the themes generated in stage 1 and developed by two authors (PB(MD), SS(PhD)) (Appendix 1). The interview guide served to reduce the influence of the interviewers' pre-understanding, and in addition, the two interviewers would remind each other of the importance of being non-judgmental before the start of the interview [18]. Both interviewers had extensive experience with simulation-based training and were clinically active senior consultants in anesthesiology with extensive air ambulance experience as well as having experience with interviews. The interviewers knew some of the participating facilitators from daily work-elated contact.

Stage 3: One year after the start of the simulation training program, all facilitators were invited to participate in a follow-up group interview. Seven facilitators attended. The interview was conducted as a semi-structured interview with one group by the same interviewers (PB, SS) as in stage 2.

A timeline showing the three different stages of the project is shown in Fig. 1.

Setting and analysis of interviews

The interviews took place in a closed room during the daytime. The interview guide guided the conversation, but when facilitators raised other issues related to the themes, their spontaneous contribution was encouraged and allowed to be explored further during the interview. The facilitators were also encouraged to follow the thread of previous comments. This is frequently referred to as the "snowball method of sampling" [19]. When a conversation revealed no more new information concerning a topic, the interviewer would prompt them according to the interview guide. The interviews started with an introduction to the research project. All interviews ended with an opportunity for the facilitators to comment and mention anything that they felt had not been addressed.

The interviews were recorded digitally on two independent recording devices. One interviewer (SS) made a coded note of who was talking in the interview. This was subsequently used as an aid in the transcription to identify individual speakers, but each speaker was referenced anonymously in the final transcription and before analysis. The recordings were kept as a safety precaution during analysis but were not used in the analysis process and were deleted upon study completion.

The recorded interviews were transcribed verbatim by a medical student who was not part of the project and received an hourly payment for the job. One author (PB) compared the transcriptions to the recorded interviews to ensure the quality and accuracy of the transcription.

Data analysis

The data were analysed using Malterud's "Systematic text condensation" [20, 21]. The data from the interviews at stage 2 were analysed separately from stage 3 data from the post-simulation year.

Two authors (DØ and PB) independently read the transcripts to gain an overview of the interviews and to identify themes. The themes from Step 1 were applied only if appropriate and were not subject to any analysis. The interviews were then annotated to define and identify "meaning units" which covered the themes identified in the previous step. A "meaning unit" is a text fragment/quotation with information about the facilitator's thoughts. The authors (DØ and PB) discussed and sorted the meaning units into subthemes. Each of these

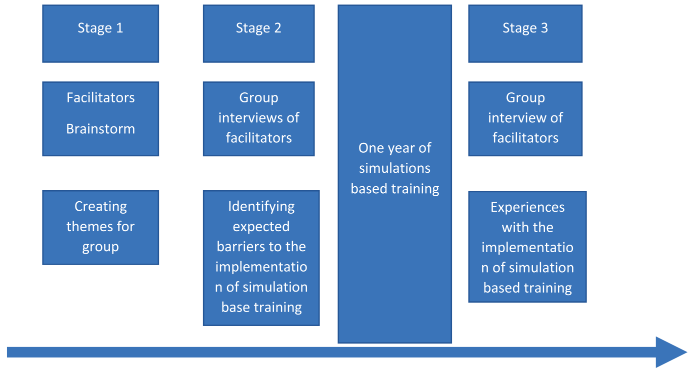

Fig. 1 Timeline showing the three different stages of the project

units provided the essence of the subtheme. The meaning units were then synthesised into text. After synthesising, the interviews were reread through to ensure that no information was lost.

We used the COREQ (COnsolidated criteria for REporting Qualitative research) checklist for reporting qualitative research (Appendix 2) [22].

Results

Sixteen facilitators were included in the interviews before the implementation of the training (stages 1 and 2). The demographic data of the participants are shown in Table 1.

Interviews before the implementation (Pre-interviews)

Seventeen themes emerged from stage 2 pre-interviews of the facilitators. Nine of these themes were related to the facilitators' considerations about pedagogical issues in the development, delivery and ongoing improvement of the project. These are shown in Tables 2 and 3.

Pedagogical issues (Table 2)

Several facilitators mentioned the importance of including the whole crew in the development of training and considering all team members' learning needs and their preferences for training topics. They felt this was important in order to be able to implement crew resource management (CRM) in the training. It was also suggested that the training should be optional rather than compulsory and use the most positive crew members as advocates for the training.

Some suggested that starting with more straightforward scenarios would ensure a safe start, after which the complexity of the training and the level of medical expertise needed could be increased. It was felt that it was important to establish a safe learning environment, since simulation training might be intimidating for some participants. The creation of a safe learning environment includes focusing on the goal of learning and emphasising that this is not testing. It was mentioned that conducting training at the end of the work week, when all crew members were "settled in" with each other, might make training less anxiety-inducing. The facilitators had high ambitions and mentioned that their own training and education in the simulation was essential to the success of the project.

Table 1 Demographics of the facilitators

	Median	Range
Age (years)	43	36–52
Experience as physician (years)	14.8	8–23
Experience in prehospital care (years)	7.2	2–17
Experience as simulation facilitator (years)	3.0	0–10

The facilitators emphasised the importance of maintaining a high level of quality in the scenarios. In addition, they mentioned that the levels of difficulty of the scenarios should be adjusted to the crew members' level of competence and that repetition of the scenarios should be avoided.

Crews

Table 3 shows the remaining eight themes from the interviews of the facilitators, which can be classified as expedient factors, barriers and suggestions for how to overcome these barriers. There were two major themes related to the crew members: workload and expectations/motivation. An excessive workload on the base was considered a barrier to the implementation of simulation training, but an inevitable one which had to be accepted. Some interviewees suggested that it could be overcome by being flexible in scheduling and planning less training in busy periods like mid-summer and holidays. Some facilitators were worried that it might be challenging to involve pilots, who are used to simulation training that focuses on non-technical skills, in this form of training which focuses on medical topics. An expressed fear was that this might worsen if the pilots had a marginal role in the simulations. It was mentioned that any crew members might feel stressed by having their performance exposed and might feel they have not fulfilled others' expectations of their skills and knowledge.

Facilitators and leaders

The workload of the facilitators was also a theme in the interviews. Some facilitators were concerned that they were already busy with full-time clinical work and HEMS shifts. The prospect of having to spend time travelling a long distance to some of the bases was also a concern of some facilitators. One suggested way to overcome this was to involve facilitators from other bases. Another suggestion was to facilitate remotely via video link. The mooted advantages of these solutions were that they would share the workload as facilitators and facilitate mutual support. Some facilitators feared that they would not be able to conduct training, debrief and simulation well enough. These high personal expectations constituted a potential barrier, which they felt could be mitigated by training or collaboration with other facilitators. The facilitators mentioned that they felt that some leaders of the HEMS department might not fully support the project, and other leaders might find that it would compete with already existing simulation training taking place on the base. The costs of the project and the lack of funding for sustainability after the study period were also mentioned.

Table 2 Pedagogical considerations expressed in the interviews of the facilitators before the training (*CRM*, crew resource management)

Phases	Themes	Citations
Development of training	Consider all team members' learning needs	Ask all crew members what they think should be included
		Include both medical aspects and technical aspects to involve the pilot and the assistant
		Include CRM aspects, which can contribute to shared situational awareness
		Develop good scenarios
	Development of scenarios	Involve the pilot in the development and assign them precise tasks, e.g. find medication, communicate with the relatives
		Ask the crew members about engaging scenarios
	Motivation of the participants	If the crew see training as useful—they will learn from it
		Make it voluntary and not mandatory to participate
		Involve the most engaged crew members and make them spread the enthusiasm
Delivery of training	Level of difficulty	Start with easy scenarios to make crew members familiar with the concept
		Prepare yourself by identifying the individual crew members and think of what they can do
		Keep all crew members motivated by involving them
		Focus on CRM initially and thereafter on medical expertise and skills
		Focus on basic competences in the beginning
	Prepare the participants	Send the theme of the scenario and procedural guidelines in advance
	Psychological safety	Establish a safe learning environment
		What happens in the room stays in the room
		Focus on learning—it is not a test
		Making it safe for the participants will help in making training a part of regular work
	Frequency of training	Take into consideration the shift periods of the individual crew members
		Plan the training at the end of a week, so that the crew know each other
		Consider training once a week except in the busiest periods
		It should be an exemption that training is not conducted
	Faculty training	Training is vital to be able to run the scenarios
		Faculty have high ambitions
Continuous improvement	Quality of the training	Crew members will lose interest if we do not secure the quality of the training
		High level of medical expertise to be sure the crew members bring something back
		Be sure that there is not too much repetition

Interviews after the implementation (Stage 3)

Four themes emerged: pedagogical issues, timing and planning, crew- and faculty members' expectations, and motivation (Table 4). The facilitators provided statements representing both barriers and expedient factors. Overall, the facilitators mentioned more expedient factors than barriers.

Pedagogical issues

The facilitators had expected crews would demand a high degree of realism in the scenarios, but this turned out to not be the case. Furthermore, facilitators experienced that as the crews got used to simulations, it was easier to motivate them, less demanding to get started, and less introduction was needed before the simulations. Feedback from crews to the facilitator was mentioned as being an essential tool in the development of the facilitator.

Timing and planning for facilitators

The facilitators expressed frustration over spending time planning for simulations and travelling to bases, only for the simulation to be interrupted or not completed. A suggested way to compensate for this was to ensure time is allocated to the facilitator for them to conduct training: participants mentioned the positive impact of having a facilitator that is not on call during the training day, and therefore able to schedule training, and substitute other training forms as needed.

Expectations and motivation

The facilitators reported that some crew members were sceptical before simulation and that some even managed to completely avoid participating in simulations during the project period. Some facilitators had experienced

Table 3 Individual and organisational factors, barriers and expedient factors expressed in the interviews with faculty before the simulation training period started

	Themes	Barriers	Expedient factors suggested by the facilitators before the simulation period
Crew members	Workload	High workload on the base	The facilitator and the crew members have to be flexible
			Accept variation on workload. Plan less training in high seasons and more training in quiet periods
	Expectations and motivation	Pilots are used to frequent simulation of technical skills, and it can be a challenge to involve them in the medical treatment of patients	Involve the pilot in the development of the scenarios
			Clear learning objectives for each crew member
		Pilots are the leader of the crew and can decide that other things should be trained	
		Participants who have a passive role in the training, may lose interest	
		The physician might be the most motivated for training	Focus on both medical, non-technical and technical skills
		The physician is afraid to be tested in their role as a medical expert their knowledge and skills will be exposed to the crew	
		Some pilots will feel exposed. It is expected that they know where things are	You see that the pilot is asked to fetch things, and you will have questions, they have never dared to ask. They ask about the treatment, CRM challenges and other issues that have not been discussed openly before
Facilitators	Workload	My own calendar is full	To involve another instructor
			An advantage to have two facilitators, because they can share the workload. A secondary benefit is that they can try both the role of the facilitator and course participant
		The distance to the base is long	Train either before or after being on call myself
		Only one instructor on the base	Facilitation by distance solutions
			Create a facilitator network; a buddy to contact and discuss with would help, could be from another base
	Expectation and motivation	High personal expectations	
		It can be difficult to get started	Be more enthusiastic in the beginning, and then, later, it will be easier for the facilitator
	Expertise in simulation-based training	Lack of routine in/habit of conducting training	Participate in a 3-day instructor course
			It will be easier when you have more routine
			Exchange or visit a facilitator on another base, see how others do it. In addition, you discover the culture at other bases
		Logistical challenge to get the technical things ready	
		Manage to structure the debriefing	Contact other facilitators that can guide you
			Continuous development with the help of other more skilled facilitators from other bases to ensure that I learn from my mistakes. To help me develop my competence
	Development of own competence	Participate in training myself	
		Learning from being a facilitator	The facilitator learns from conducting simulations; they see different solutions and hear reflections. You discover how your colleagues work and you learn a lot from seeing how they solve the tasks
			Learning from colleagues is a benefit—we have to talk more about medical skills in the group on the base. The CRM aspect can also be useful
Leaders	Expectation and motivation	Some leaders might be sceptical and do not fully support it	My leaders are very positive—they fully support me and have sent mail stating that simulation is planned and to be seen as equal to other training activities
		Competition with daily missions	In the weekly plan, the facilitator should be free to run the training at least once a week

Table 3 Individual and organisational factors, barriers and expedient factors expressed in the interviews with faculty before the simulation training period started *(Continued)*

Themes	Barriers	Expedient factors suggested by the facilitators before the simulation period
	Another simulation project is running already	We have to find a way so both projects can run
		If there is maintenance on the helicopter, the crew can still train
Financial issues	Payment of the facilitators	The project is financed for one year
	At the end of the project, the payment will stop	If the crew members see the training as a positive, a learning experience, they will ask for training after the project has ended

profound differences in motivation in the crews from the first to the last simulation in the period and regarded this as a positive development. There was a reported shift in the attitudes of the crew through the project period towards them asking for simulation training, and this was taken as a sign that the training was well-received. The expectations and motivation of the crew members to take part in simulation training increased if recent topics and skills from a simulation scenario were encountered and used in real missions.

Having more than one facilitator at the base was mentioned as a factor that could improve the motivation of the facilitator by relieving the workload and providing a fellow facilitator to spar with as well as increasing the number of simulations offered. It was felt it was important that facilitators were well prepared and able to pitch the scenario and feedback to an appropriate standard of clinical performance. The facilitators found it useful and educational to see how other HEMS crews work. They also mentioned how interesting it was to see how the same scenarios unfold differently when performed by different crews.

Discussion

In this exploratory study, we found that the pedagogical challenges that facilitators expected were indeed the challenges they encountered. The facilitators described strategies to overcome these challenges. The crews' positive attitude towards the training was taken as evidence that these challenges were sufficiently mitigated for the scenario training to become a useful educational experience.

The facilitators also expected that a lack of time for conducting simulation training would impede the number of attempted simulations, and this turned out to be true. However, they did not implement all the strategies suggested before the start of the project, such as exchanging ideas between facilitators from different bases. Some strategies were used, and others were not. Although the intention was to give the facilitators individual power to tailor the simulation training to each base, we speculate whether the predetermined structure of this project inhibited this. Despite the availability of project leaders, none of these were consulted during the study period for unknown reasons.

Participating in an initial simulation instructor/facilitator course seems essential, but a focus on ongoing development seems equally important to the participants. This is in concordance with Tariq et al.'s findings, where the complexity of the facilitator role is described [11]. The facilitators emphasised that the success of the simulation-based training depended on expert facilitation, and expressed some anxieties about the new role, and—for some—their lack of experience therein. They suggested that the initial facilitator course should be followed by a continuous development plan for facilitators. Our facilitators did not try to establish a network, although encouraged to do so. However, it was suggested that having more than one facilitator at each base would not only distribute the workload but also contribute to facilitator development. This would be a useful case of micro-network building amongst facilitators: for example, if two facilitators debrief the same scenario (so-called co-debriefing), this interaction could foment mutual development. Co-debriefing has previously been described as a useful tool for facilitator development [23]. However, this was not feasible in the context of this project. Future projects should attempt to pair facilitators with a "buddy" to challenge and stretch their pedagogical skills and role. This would also facilitate scenario development and scenario sharing between bases. Such cooperation could be further enhanced with the implementation of a network between the facilitators.

The facilitators felt it was important that all members of the crew were involved and stayed in their usual professional roles. Our programme was organised in this way a priori. In the interviews before the programme started, the facilitators expressed concerns about how they might engage all members of the crew. The approach that proved successful was starting with simple scenarios and then gradually increasing the complexity of the simulation scenarios. This experience agrees with the findings of Spurr et al. who advocate both the strategy of increasing complexity in the simulations over

Table 4 The facilitator's experiences with in situ on-call simulation-based training *(Continued)*

Themes	Citations about challenges	Citations about expedient factors
		The system, organisation and equipment were tested
Faculty expectations and motivation	Do we get enough training during the facilitator course?	It was good that we were trained before we started. The tips were useful. Then I had the strength to do it even though the crew was more experienced than me
	It would have been useful to develop the scenarios with another instructor and to be able to discuss the scenario and think of the learning objectives.	It is crucial that you are well prepared—to be able to give the crew something to work with. It is important for the discussions, where to set the level. You must have something with you back as a participant.
	More simulations could be conducted if there were more instructors at the base.	Interesting to see how differently similar scenarios evolve with different crews.
	Can I stay motivated as facilitator?	Faculty has an opportunity to see things from a broader perspective.
		Beneficial to see how others work, see different ways of solving a problem. You get many tips.

time and involving the entire multi-professional team members in the simulations [10].

The facilitators reported that the motivation of the crews and their ability to quickly engage in the simulation on the bases increased over time. Motivational factors have previously been described as essential for the implementation of simulation programmes [24]. The facilitators' lack of experience was concerning, as it could compromise the quality of the training delivered, but the positive attitudes of participants to the training suggest that they felt they largely overcame anxieties mentioned in the pre-project interviews.

The increased motivation and positive attitude towards the simulations may result from the discussion of positive experiences within the relatively small group of staff working at each HEMS base. Sharing positive experiences between bases could further have enhanced this. Facilitators described this sharing of success stories as important for the successful implementation, a finding that is in accordance with one of the eight critical factors listed as essential for successful implementation [8]. The facilitators mentioned the importance of sustainability, which is one of the other factors mentioned by Lazarra [8].

There were concerns amongst the facilitators about the feasibility of continuing the simulation training after the study year. The facilitators mentioned that managerial support for the project would be essential to its viability. The involvement of leadership was similarly mentioned as an essential factor by both Sales and Spurr [9, 10].

Discussion of the method used

By using an interview-based qualitative method, we captured facilitators' expectations of barriers to, and expedient factors of, the implementation of simulation-based training. The use of a group-based method might limit the freedom of speech for some participants. However, many of the facilitators knew each other beforehand, and so we think that a safe environment was established in which all participants could contribute. We rationalised that the use of such a homogeneous group with a narrow field of interest was justifiable since the explored topic is narrow too. However, one can speculate whether the homogeneous group excluded the possibilities of gathering different views and thoughts on the topic, which might have emerged if the group were more heterogeneous. During text analysis, there is a chance of information being missed or overlooked. This risk was mitigated by each interview being scrutinised by more than one author. All the authors have experience with simulation training, and these previous experiences can interfere with the conduction of this study. However, one of the authors (DØ) has no prehospital experience. This may have contributed positively to the analysis by introducing a broader perspective since the two other authors are both experienced prehospital care providers, with an existing positive experience with simulation in HEMS systems.

The number of participants in the interviews before the start of the project was higher than in the interview after one year. We did not explore this mismatch but speculate that it might be a result of facilitators' fatigue during the study period or the general time pressure and workload mentioned by the facilitators. This potential selection bias of participants in the second round may have contributed to a more positive tone in the interviews since the least successful and less motivated facilitators would be less likely to participate.

Conclusion

The facilitators expected challenges to the implementation of simulation-based training on HEMS bases and suggested strategies for overcoming these challenges before the start of the program. In the one-year follow-up interviews, it was revealed that many of these strategies

Table 4 The facilitator's experiences with in situ on-call simulation-based training

Themes	Citations about challenges	Citations about expedient factors
Pedagogical issues	Some crew members were sceptical before the simulations	Crew members go smoothly in and out of simulations
		Simulation is not dangerous
	Some crew members have managed to avoid participation in the simulations	The doctors work very independently—good to get feedback
	Some crew members are sceptical to simulation	Big difference between the first simulations and the last
		Positive experience with one team observing another team and providing them feedback afterwards. This was a positive experience—the best moment of learning to receive feedback from a colleague.
		An advantage to receive the scenario before the training
		I expected that it was difficult to get crew members engaged in the simulation and that they would want a high degree of realism. That was not the case.
		In the beginning, the scenarios were easier to make crew members familiar with the setup. To create a safe learning environment. To get the crew into learning mode and not be afraid of showing their weaknesses. Then they were ready to increase their competence
		The more the crew is familiar with simulations, the less they need information beforehand is less
		The more familiar the faculty is with simulations, the easier it is to get the simulation started
		It works, the feedback from the crew is that they have experienced scenarios which they have handled differently after the simulations. The flow and the solutions have not been the same as if we had no training and discussion after the simulations
		Training does not equal simulation—other methods can be used.
		Big-scale scenarios could be useful. Others find it more useful with the small-scale simulations.
Time and planning	It is difficult to plan and conduct simulation-based training	It is an advantage if an external facilitator comes and initiates the training
	You spend a considerable amount of time to plan the training, and end up with no simulations on a given day	Best to start at 10-12 and on faculty's day off.
	There are many interruptions such as visits, inspections and meetings on a busy base	To substitute other types of training with this.
	Crew members mention that they have other on-call duties	Simulation-based training during on-call is not a hindrance to other duties.
Crew members expectations and motivation		The pilot and medical assistant have trained to prepare medication and equipment for introducing an arterial line.
		Pilot and medical assistant have used their new skills in critical situations after the training.
		The pilots might have fewer expectations to their own medical skills and hence see it as a less dangerously exposing situation
		They ask for training now.
		The training is well received.
		Crew members like to train, get experiences and reflect
		Medical discussion was needed—"how should this scenario be handled". An example is provided where the wrong dose of medication and fluids were administered to a child in a simulation.
		The learning gain was considerable—two hours after the training a clinical case where the learning was applied. We knew what we should do.

had not been utilised and that critical barriers to implementation had been experienced, identified, and overcome. The most prominent factors contributing to success were management support, dedicated time for the facilitators to prepare and lead the training, and the need for continuous development within the role as facilitator. Despite fears about the perception of and enthusiasm for the training amongst the HEMS crews, the facilitators described increasing levels of motivation amongst the crews during the study period.

Abbreviations
COREQ: COnsolidated criteria for REporting Qualitative research; CRM: Crew resource management; HEMS: Helicopter emergency medical services; SAR: Search and rescue

Supplementary Information
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Additional file 1: Appendix 1
Additional file 2: Appendix 2

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Authors' contributions
PB initiated the project, wrote the protocol and led the project. Interviews were conducted by PB in conjunction with SS. PB and DØ analysed the transcribed interviews and drafted the article. SS and DØ contributed to the analysis of data and the writing process as well as the finalisation of the paper. All authors approved the final version of the paper.

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Availability of data and materials
The dataset used during the study is available in an anonymous form from the corresponding author on a reasonable request. The recorded interviews have been deleted.

Declarations

Ethics approval and consent to participate
The study was approved by local representatives for the Norwegian Date Protection Authority (2014/10220) and the local Ethical Committee (REK 2012/777 D). Verbal and written information both about the study and the rights to withdraw at any time was given to the participants. The participants had the right to withdraw before, during and after the study without any consequences which was emphasised. A written consent form was signed by all participants on the first day of the study. None of the invited study participants denied participation or withdrew their consent to participate before or after the study period.

Consent for publication
Not applicable

Competing interests
The authors declare that they have no competing interests.

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Appendix 4 – Study IV

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Combining in-situ simulation and live HEMS mission facilitator observation: a flexible learning concept

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Abstract

Background: Continuous medical education is essential in Helicopter Emergency Medical Services (HEMS). In-situ simulation training makes it possible to train in a familiar environment. The use of a dedicated facilitator is essential; however, when an in-situ simulation training session is interrupted by a live mission, the efforts invested in the training are left unfulfilled. This study aims to evaluate if HEMS mission observation and debriefing by the simulation facilitator is a feasible alternative to mission-interrupted simulation training, and how this alternative to simulation training is perceived by both facilitators and HEMS crew members.

Methods: Facilitator observation during live missions and post-mission debriefing was offered as an alternative to mission-interrupted simulation training over a one-year period at three HEMS bases. Immediate feedback was requested from crews and facilitators after each observed live mission on a predefined questionnaire. At the end of the study period, semi-structured interviews were performed with a sample of HEMS crew members and facilitators to further explore the experience with the concept. Numerical data about the sessions were recorded continuously.

Results: A total of 78 training sessions were attempted, with 46 (59%) of the simulations conducted as planned. Of the remaining, 23 (29%) were not started because the crew had other duties (fatigued crew or crew called for a mission where observation was inappropriate/impossible), and 9 (12%) training sessions were converted to observed live missions. In total, 43 (55%), 16 (21%) and 19 (24%) attempts to facilitate simulation training were undertaken on the three bases, respectively. The facilitators considered mission observation more challenging than simulation. The interviews identified local know-how, clinical skills, and excellent communication skills as important prerequisites for the facilitators to conduct live mission observation successfully. Participating crews and facilitators found simulation both valuable and needed. Being observed was initially perceived as unpleasant but later regarded as a helpful way of learning.

Conclusion: Live mission observation and debriefing seems a feasible and well-received alternative to an in-situ simulation program in HEMS to maximise invested resources and maintain the learning outcome. Furthermore, additional training of simulation facilitators to handle the context of live mission observation may further improve the learning output.

Keywords: Simulation, In-situ simulation, Debriefing after observed missions, Education, HEMS, Prehospital

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Background

Continuous professional development in medicine is essential to maintain competence and quality of care. Simulation training has a central role in combining experienced-based learning with a safe and patient independent learning environment [1]. In-situ simulation-based training combines a familiar working environment with simulation technology, thus providing safe and possibly time-effective training that has been shown to reduce mortality [2]. We have previously shown that in-situ simulation-based training is feasible even in an environment with an unpredictable and heavy workload, such as helicopter emergency medical services (HEMS) [3]. A prerequisite for implementing this training concept is positive acceptance by the crews and a devoted and appropriately skilled facilitator [3, 4]. A major obstacle for implementation, however, is the relatively large number of in-situ simulations that are interrupted or never started due to actual HEMS missions [3]. These interruptions will mostly leave the invested time and resources in training untapped with the potential of demotivating the facilitators and consequently disrupt the successful implementation and maintenance of the in-situ simulation training program. Ways to overcome this barrier must therefore be sought.

Observation of actual professional conduct as a means for improved performance has long been used in aviation, where the observation of the cockpit performance during actual flights by a third-party instructor is an integrated part of the professional development of pilots [5]. We speculate that a similar concept, where the facilitator joins the mission interrupting the planned simulation as an observer and subsequently governs a post-mission debriefing, could be a training opportunity. In this way, the facilitator's availability and competence could be used while maintaining a safe learning environment for the crews, similar to the in-situ simulation training. However, no previous studies have evaluated the use of a facilitator as a live mission observer to our knowledge.

This study aims to evaluate the feasibility of conducting live mission observation and post-mission debriefing by a simulation facilitator as an alternative to planned but interrupted in-situ simulations and how the facilitators and crew members perceive this alternative training format.

Methods

To explore the possible benefit of introducing live mission debriefing as a proxy for the missed in-situ simulation and debriefing, we used a mixed-methods design [6–8]. Our triangulation included a prospective observational data collection to quantify and describe the number and types of intervention (i.e. simulation or live mission observation), a questionnaire to collect the facilitators' and crews' immediate experience of the training, and interviews for in-depth information about the experience. In our study, all data collection methods were given the same priority, although used partly in parallel and partly in a sequential manner.

Norwegian HEMS system

The Norwegian HEMS is a national service funded by the government. At the time of the project, two private companies were contracted to provide helicopters, pilots and HEMS technical crew members (HTCM). The standard crew configuration consists of a certified anaesthesiologist, an HTCM and a pilot. One base also includes an anaesthetic nurse in the crew at the time of the study. All HEMS bases respond to primary medical and trauma missions, day and night, and perform interhospital transports and search and rescue (SAR) missions. The organisation of the Norwegian HEMS has been described in detail in a previous article [9].

Study population

To achieve a representative sample of HEMS bases in Norway for our study, we recruited three bases with different mission profiles for the adapted simulation program. The base at Lørenskog covers a densely populated area and is the busiest HEMS base in Norway in terms of the number of missions. The base at Ål is located in the mountain region of South Norway with a low population density. The base at Ålesund is located in South West Norway's coastal region with a mixed population density and is the only HEMS base in Norway with a 4- crew configuration. In the study period, the flight operation at Ålesund HEMS was run by a different company than at the other two bases. All bases operate 24 h a day, all week, all year around. The number of annual missions for the bases at Lørenskog (two helicopters), Ålesund and Ål are approximately 1900, 650 and 600, respectively [10].

Study design

The study was conducted in two stages. The first stage was a prospective multicentre study with observational data collected between May 19th, 2016, and May 18th, 2017. In-situ simulation training was offered as described in a previous study from an earlier stage of the project [3, 9]. The facilitators developed scenarios tailored to each base depending on each base mission profile. The in-situ simulation could be located indoor or outdoor and would involve all members of the crew. The training at each HEMS base was run by one or two experienced senior HEMS physicians selected by the lead physician at the HEMS base to be facilitators [9]. The facilitators were trained according to the EUSim simulation facilitator course [9, 11]. The facilitators were only responsible for the training at their own base and received remuneration for simulation training outside their ordinary hours of work at the HEMS base. The training was planned by the local facilitator on a convenience basis and took place during the daytime on weekdays. There were no requirements or expectations regarding the total number of sessions or their frequency during the study period. The facilitators emphasised to the crews that the training was an optional learning and training opportunity, rather than a compulsory task. In cases where the planned simulation was interrupted by live missions the facilitator could opt to join and observe the mission if appropriate. Crews were informed verbally and in writing, that the in-situ simulation could be changed to an observed live mission with debriefing if the in-situ simulation was interrupted. The debriefing after both in-situ simulation and live mission observation was performed using the PEARLS framework which is structured as; reaction, description, analysis, application/summary [12].

In the second stage of the project, structured individual interviews were conducted with selected crew members from the three bases that participated and the facilitator at each base to explore their experiences with HEMS mission observation as an alternative to the in-situ simulation. The second stage took place between June 1st and June 15th, 2017.

Data collection and analysis

Observational data

The facilitator collected data on the duration of the in-situ simulation and classified it as completed with debriefing or interrupted by a mission call-out with or without subsequent live mission observation. Data was instantly recorded on a premade paper form by the facilitator and later entered into an electronic database (Questback Essentials, Oslo, Norway). This paper form was designed by one author (PB) and approved by the other authors. It was designed for a practical purpose and collecting data about practicalities of the simulation including information about cancellations. The form was completed after the training and subsequently entered into the database. No data related to individual crew members was recorded. We summarised continuous data using median (quartiles) and categorical data as numbers (percentages) and compared non-paired observations with the Mann-Whitney U test. All statistics were calculated using SPSS (IBM Corp. SPSS Statistics for Windows, Version 25, IBM Corporation, Armonk, NY, USA).

Questionnaires

Following both in-situ simulation training and observed live mission debriefing, the participating crew and the facilitator rated their degree of satisfaction with the session on a visual analogue scale (VAS) from 0 to 100 mm, where 0 represented completely unsatisfactory and 100 represented maximum satisfaction [13]. The participating crew members were then asked to respond to one of two questionnaires with 14 questions, adapted to either training as planned with an in-situ simulation or observed live mission with a debriefing. All answers had to be indicated on a 7-point Likert scale where 1 corresponded to "*I strongly agree* "and 7 to "*I stro*ngly disagree" [14]. The questionnaires, to capture the participants evaluation of the simulation-based training, were similar to the questionnaire used at a previous stage of this project but adapted to the current context [3]. An initial draft was made by two of the authors (PB and SS). The questionnaire was then reviewed by a pilot, a HTCM and a physician. The modified questionnaires were piloted and reviewed by two separate full HEMS crews from the Lørenskog HEMS base to ensure that the questions were clear and comprehensible. An English version of the questionnaires, translated independently by two authors (PB and SS) is available as Additional file 1.

Interviews

Following the one-year study period, we invited a group of physicians, HTCMs and facilitators to take part in a structured individual interview. Interview candidates were chosen so that all participating bases were represented. We did not include the pilots in these interviews since they only had a minor role in the patient-centred part of the missions. An interview guide was used (Additional file 2), but interviewees were encouraged to elaborate and discuss other topics that would emerge during the interview if they wanted to. All interviews were done on a weekday during daytime and lasted approximately 20 min each. The interviews were undertaken via telephone for practical reasons and by the first author (PB) exclusively. The interviewer is experienced both as a consultant in prehospital critical care and as a simulation facilitator. He has conducted interviews previously and has conducted studies on in-situ simulation in HEMS services demonstrating a positive effect on training culture [3, 9]. When no further information emerged on a topic, the interview would continue according to the interview guide. At the end of the interview, the interviewees were encouraged to mention anything they felt had not been addressed. The interviews were recorded on two separate digital recorders for proper redundancy in case of technical difficulties or quality issues with the recordings. The digital interview files were stored on an encrypted server to which only the first author (PB) was granted access.

The recorded interviews were transcribed verbatim by a medical student who received an hourly payment for the job and was not part of the project. The primary author (PB) compared the transcriptions to the recorded interviews to ensure the transcription's quality and accuracy. All digital recordings of the interviews were deleted after analysis.

The transcribed interviews were analysed according to Malterud's "Systematic text condensation" by two of the authors (DØ and PB) [15, 16].

To obtain a total impression of the interviews, the main author (PB) read through the transcripts to get a sense of the interviews and identify themes. The themes were applied if appropriate by two authors. The interviews were then reread to define and identify "meaning units" covering the themes identified in the previous step. These meaning units were text fragments/quotations with information about the participant's thoughts. The meaning units were then sorted into subthemes and then synthesised into text. After synthesising, the interviews were reread through to ensure that no information was lost.

Results

Descriptive observational data

A total of 78 training sessions were attempted, with 43 (55%), 19 (24%) and 16 (20%) attempts at each of the three bases, respectively. In-situ simulations were completed as planned in 46 (59%) of the cases. In 23 (29%) cases, the simulations were not started because the crew had other duties such as daily aircraft and equipment checks or administrative tasks to attend. In nine (12%) of the simulation attempts, a live mission interrupted the training. All these situations were converted to live mission observations with debriefing (Table 1).

Questionnaires

The overall satisfaction with the in-situ simulations and the observed live missions was high, with no differences in VAS scores between the two (Table 2). All crewmembers found both in-situ simulation and observed live missions had an appropriate duration, and that relevant standard operating procedures (SOPs) were included in the in-situ simulation and the debriefings after missions. The answers were within the two most positive scores except for two questions; Following the in-situ simulations, most participants indicated that they felt uncomfortable exposing their skills and competencies while being observed during the in-situ simulation training and that the in-situ simulation training was interfering with "non-mission related" duties. Interestingly, the corresponding questions following the live mission observations scored the completely opposite. For observed missions, the participating crews neither expressed concerns about exposing skills and competencies nor did they indicate that it interfered with non-mission related tasks. Data from the questionnaires are presented as medians with quartiles in Table 3.

Table 1 The number of attempted in-situ simulations and live mission observations summarised for each participating base

Name of the base	In-situ simulation conducted with no interruption	In-situ simulation attempted but not conducted	In-situ simulations changed to live mission observations
Lørenskog	8	4	4
Ål	14	5	0
Ålesund	24	14	5
Total	46	23	9

Table 2 Visual analogue scale (VAS) scores expressing to what degree the crewmembers were satisfied with the in-situ simulation and live mission observations summarized with means and standard deviation (SD) for each crew member group, with 0 mm representing the least of satisfaction and 100 mm representing the most of satisfaction

Crew member	In-situ simulation and debriefing		Live mission observation and debriefing		*P*
	n	Mean VAS score (mm) ± SD	*n*	Mean VAS score (mm) ± SD	
Physician	46	86 ± 10	9	88 ± 14	0.765
HTCM	46	91 ± 7	9	93 ± 4	0.952
Pilot	45	87 ± 11	7	87 ± 11	1.0
Nurse	24	92 ± 4	5	91 ± 10	0.339

HEMS Helicopter Emergency Medical Service, *HTCM* HEMS technical crew member

Interviews

The demographics of the participants in the interviews are shown in Table 4. Only two facilitators were able to participate in the interviews. The gender ratio has an overweight of male participants, which reflects the gender ratio in Norwegian HEMS services. As Table 4 shows the majority of the participants are experienced as HEMS crew members.

In the interviews, we identified four recurring themes; the facilitator role, the training itself, the outcome of the training and comparison of in-situ simulation and observed missions.

The interviewed facilitators expressed that they considered live mission observation to be more challenging as a facilitator and that being in the proper role as an observer only was essential. The facilitators describe that the lack of preparation for the debriefing was a challenge. They also mentioned that a benefit of observing missions was the opportunity to debrief both rare events and routine

Table 3 The participant's evaluation of the training on a 7-point Likert scale, where 1 represent "I strongly agree", and 7 represent "I strongly disagree" (Median scores with quartiles) (*Obs* observation, *Sim* simulation)

Modality	Question	Physician		HTCM		Pilot		Nurse	
		Median (quartiles)	n	Median (quartiles)	n	Median (quartiles)	n	Median (quartiles)	n
Obs	Sufficient time was allotted for debriefing and feedback after the mission observation	1(1–1.5)	9	1.5(1–2.75)	8	1(1–2)	7	1(1–1)	5
Sim	Sufficient time was allotted for crew simulation training	1(1–2)	46	1(1–2)	46	1(1–1)	44	1(1–1)	4
Obs	The live mission observation was completed without interrupting other on-call duties	1(1–2)	9	1.5(1–2)	8	2(1–2)	7	1(1–3)	5
Sim	The simulation training was completed without interrupting other on-call duties	7(5–7)	46	6(3.75–7)	46	7(1–7)	45	7(7–7)	4
Obs	I am comfortable with being observed by a peer during a live mission	1(1–2)	9	1(1–1)	8	1(1–1)	7	1(1–1)	5
Sim	There was enough equipment available to make the simulation training realistic	2(1–2)	46	2(1–2)	46	1(1–2)	45	1(1–2)	4
Obs	I felt comfortable with the way the live mission observation was carried out	1(1–2)	9	1(1–1)	8	1(1–1.25)	6	1(1–1.5)	5
Sim	I felt comfortable with the way the simulation training was set up	1(1–1)	45	1(1–1)	45	1(1–1)	44	1(1–1)	4
Obs	I felt comfortable with exposing my skills and competencies during a live mission	2(1–3.5)	9	1(1–1)	8	1(1–1)	7	1(1–1)	5
Sim	I felt comfortable with exposing my skills and competencies during the simulation training	7(2.75–7)	46	6(2–7)	45	7(1–7)	45	7(7–7)	4
Obs	Live mission observation with debriefing and feedback gives me the same benefits as simulation training	1(1–4.5)	9	2(1–4.25)	8	2(1–2)	7	1(1–3)	5
Sim	Simulation was a realistic way to train	1(1–2)	46	1(1–2)	45	1(1–2)	45	1(1–1)	4
Obs	The mission characteristics were well suited for mission observation with consequent debriefing and feedback	2(1–3)	9	1.5(1–2	8	1(1–2)	7	1(1–2)	5
Sim	The topic of the simulation training is relevant for this kind of simulation training	1(1–1)	45	1(1–1)	46	1(1–1)	44	1(1–1)	4
Obs	Live mission observation with feedback and debriefing is useful for my occupational category	1(1–1)	9	1(1–1.75)	8	1(1–2)	7	1(1–1)	5
Sim	This type of simulation training is useful for my occupational category	1(1–2)	44	1(1–1)	45	1(1–2)	44	1(1–1)	4
Obs	The facilitator managed to create a learning environment by relating elements from the mission observation to our SOPs	1(1–1.5)	9	1(1–1)	8	1(1–2)	7	1(1–2.5)	5
Sim	The simulation scenario was representative of the SOPs we trained on	1(1–2)	46	1(1–2)	46	1(1–2)	45	1(1–1.75)	4
Obs	The execution of the mission was not disrupted by the peer joining for mission observation	1(1–2)	9	1(1–1)	7	1(1–2)	7	1(1–1)	5

Table 3 (continued)

Modality	Question	Physician		HTCM		Pilot		Nurse	
		Median (quartiles)	n	Median (quartiles)	n	Median (quartiles)	n	Median (quartiles)	n
Sim	The topic of the scenario training was relevant to the mission profile of the base	1(1–1.5)	45	1(1–1.5)	45	1(1–2)	44	1(1–1)	4
Obs	The debriefing and feedback after the mission observed was useful	1(1–1)	9	1(1–1)	9	1(1–2)	7	1(1–1)	5
Sim	The feedback after the simulation training was useful	1(1–1.25)	46	1(1–2)	45	1(1–2)	45	1(1–1)	4
Obs	Enough time was allotted for debriefing and feedback after the mission observation	1(1–1.5)	9	1(1–2)	9	1(1–2)	7	1(1–1)	5
Sim	Enough time was allotted for feedback after the simulation training	1(1–1.5)	45	1(1–2)	45	1(1–1)	45	1(1–1)	4
Obs	It was easy to motivate oneself to complete the mission with mission observation	1(1–1.5)	9	1(1–1)	9	1(1–2)	7	1(1–1)	5
Sim	It was easy to motivate oneself to complete the simulation training	1(1–2)	46	1(1–2)	45	1(1–1)	45	1(1–1)	4
Obs	I have a positive attitude towards this kind of training	1(1–1.5)	9	1(1–1)	9	1(1–1.25)	6	1(1–1)	5
Sim	I have a positive attitude towards this kind of training	1(1–1)	46	1(1–1)	44	1(1–1)	45	1(1–1)	4

Table 4 Demographics of interviewees

Participant	Age (years)	HEMS experience (years)	Gender	Position in the project
1	43	7	Male	Physician
2	38	1	Male	Physician
3	39	2	Female	Physician
4	32	5	Male	HTCM
5	31	3	Male	HTCM
6	38	9	Male	HTCM
7	44	15	Male	Facilitator
8	31	7	Male	Facilitator

HEMS Helicopter Emergency Medical Service, *HTCM* HEMS technical crew member

missions. Prerequisites highlighted by the facilitators for a successful live mission observation and debriefing were: a background with local knowledge, clinical skills, and excellent communication skills. They further expressed scepticism towards facilitators evolving from the group of physicians who are also a part of the management group and that the availability of the facilitators could be a challenge.

Both facilitators and participating crews indicated that a frequency of training sessions ranging from weekly to monthly training sessions was ideal. All interviewed groups expressed a high degree of motivation for both in-situ simulation and observed live missions but also emphasize that the training concept requires support from the management.

Participating HTCM and physicians describe learning outcomes within the areas of both clinical skills and communication skills. Furthermore, they describe that debriefing leads to a perception of an overall improvement of the mission, ranging from the planning phase all the way to the end of the mission.

Although some interviewees initially perceived it as stressful to be observed, they describe it as being beneficial. Some also commented that being observed had an impact on the team dynamics. The interviewees express a need for both planned in-situ simulations and observed missions and that they both can play a role in training. In-depth analysis and results from the interviews are shown in Table 5, where both facilitators and crew members' opinions and experiences are expressed.

Discussion

In this study, we found that observed live missions can successfully be used as an alternative to in-situ simulations when live mission interrupts the planned simulation training. The observed mission concept was well received by the crews, and especially the debriefing from live missions was experienced as useful. The facilitator role was, however, more demanding during live missions due to the unpredictable nature of the missions and the consequent inability to plan both content and subsequent debriefing. The facilitator's local knowledge, clinical skills

Table 5 Results from the interviews of the crew members with code groups, subgroups, meaning units and quotations shown

Themes	Subthemes	Meaning units	Text condensation
Facilitator	Availability	Availability Timing	Interviewees described the challenges to incorporate time to facilitate into a busy working schedule. 10 am is mentioned as a good time for starting training. One facilitator occasionally found it difficult to go onto a mission in the case that it would interfere with parents following their child during an incubator transport.
	Pedagogical	Pedagogical challenges Experience	Participants describe joining a live mission as more challenging than conducting the simulation and feel that experience is vital for that role. It is also mentioned that it can be a challenge to comment on habits that colleagues have used for decades. On some occasions, facilitators felt it was difficult for ambulances to know whom to interact with.
	Role	Role Trust	It is essential for the facilitator to be able to observe and not participate in the mission, and facilitators need to "know their place" and preferably wear an observer west. Important to keep the role as facilitator and not start any talk about the mission or simulation outside the participating crew.
	Background	Facilitator background Selection	The facilitator does preferably have local knowledge, and it is even mentioned that several local HEMS physicians could be trained as facilitators and go on missions with others. For some, the thought of management or external facilitators riding along on a mission is frightening, whereas others suggest that this is a chance for external feedback. Overall, there is scepticism to having facilitators coming from the management group.
	Skills	Communication Interest Local knowledge	Interviewees agree on the importance of right skills for the facilitator. This includes having a genuine interest, clinical experience and good communication skills as well as and local knowledge.
Training	Frequency	Frequency of training	Some participants mention a training frequency of once a week, and at least once a month.
	Motivation	Motivation Variation	Both facilitators and crew participants report a high level of motivation among the participating crews, although it did vary.
	Organisation	Organised into service Management support	The support from the management is mentioned as necessary. There are wishes for getting such training organised into the Norwegian HEMS services. The general acceptance and priority of training are noted.
Outcome	Peer feedback	Peer feedback Difficult cultures Communication	Participants report the usefulness of feedback from a (participating/facilitating) colleague. This is seen as an exchange of experiences rather than top-down teaching that often has been practised in traditional teaching.
	Correction of habits	Impractical habits feedback Everyday topics Practicalities	Some participants mention this as an arena where not only communication in general, i improved, but even tricky topics in a challenging crew composition are easier during simulation than during regular workdays. Since most HEMS crews are alone on a mission, this is seen as an opportunity to get feedback and suggestion for improvement of minor daily mission details.
	Longitudinal learning	Longitudinal debrief	In this form for training, participants mention that it is a possibility that they do not receive feedback on all aspects of a mission. This includes not only the clinical part but also the planning phase and choice of equipment brought on the mission.
Comparison	Simulation	Artificial setting Simulate rare/frequent events Debrief structure Predictability	It is described that it is easier to have a planned debriefing structure during the simulation training. More challenging to facilitate mission observation. The simulation gives rise to train rare events as well as optimising the handling of frequent challenges. The predictability of simulation regarding the debriefing topics is essential. The trust among the crew in simulation is mentioned. Simulation can feel more as an artificial setting.
	Mission	Anxiety Performance improvement Supervision Planned vs unplanned Peer feedback	Some participants have been nervous before having someone observing them on a mission; however, they describe this as a positive experience regardless. This form of supervision is beneficial. It is found stressing but at the same time; they learned a lot. Some are more worried about exposure but like to get feedback. Participants meant this leads to improved performance of them as individuals and for the team.
	Comparison	Choice anxiety No difference Different outcomes	Interviewees agree on the usefulness of both simulation training as well as having one observing them on a mission, although it can feel intimidating initially. There are pros and cons to both training forms.
	Priority/Choice	Mission Both forms	Participants explain that they think both forms for of training have a role in the Norwegian HEMS services. Interviewees would like to have both forms of training integrated into the service. If to choose, some distinctively prefer having one accompanying them on a mission.

and communication skills seem essential to create a good learning experience for the participating crews for both in-situ simulations and observed live missions.

Our primary motivation for evaluating the concept of live mission debriefing as an alternative to in-situ simulation was the realisation in previous studies that a relatively high number of in-situ simulation training sessions were interrupted by live mission callouts and eventually aborted [3]. By including the facilitator in the live missions, we hoped to maximise the use of the dedicated facilitators time spent preparing and executing the training and increasing the learning outcome for the crews. The facilitators did experience the observation and debriefing of live missions as more challenging than the in-situ simulations. In the interviews, the facilitators indicate that they felt poorly prepared for the live mission debriefing setting. This feeling seems to come from a mixture of unfamiliarity with the role as facilitator in this context, e.g. finding ones' role in the mission, and the unpredictability of the mission and consequently the topics to be debriefed. The facilitators had all attended an instructor course for simulation facilitators; a course focused on facilitating learning from simulations and not real-life observation [11]. The debriefing techniques taught in the course might be more challenging to apply in the debriefing of a real-life observation, or the context they are taught in does not promote their generic use. We also speculate whether the challenge of debriefing the live missions is experienced as more challenging by the facilitators because they are less prepared to debrief the medical aspects. This in contrast to the in-situ simulation that has been prepared by the facilitator and allows the facilitator to be more immersed in the medical theory of the scenario. For instance, in the in-situ simulation, the facilitator knows the "condition" of the patient, whereas in live mission observation the facilitator only knows "what the crew see", and the rest is assumptions. This means that the facilitator is unable to prepare for the session and may feel les prepared to provide high quality feedback. Still, the non-technical components in the debriefing will be the same as in the in-situ simulation. It, therefore, seems reasonable that facilitators need additional training to manage the specific contextual challenges of debriefing experienced colleagues after live missions and prepare the facilitator for the challenges of riding along on a live mission as an observer. This is something we did not consider in the preparation of the facilitators for the project.

The crew members interviewed further emphasised that the facilitator must be a skilled communicator and a HEMS physician, preferably from the local base. Having a clinically proficient facilitator able to share expertise with good judgment can be motivational [17]. The continuous development of facilitators for both simulation and observed live missions seems essential for the success of a concept like the one presented in this study, which others have stated [18, 19].

The contextual role of the facilitator is quite different in a live mission than in a simulation. The facilitator's presence on the mission also raises some fundamental questions: should the facilitator be just a passive observer or available as a potential resource in the mission, and how does the facilitator presence influence the crews' team dynamics? Is it e.g. ethically acceptable that the facilitator does not contribute to the mission if it would impact the patient's outcome positively, and how would such a contribution influence the debriefing and the mission? The feedback from the interviewees is that the role of the facilitator in the mission must be clearly stated before the facilitator joins the mission.

In the interviews, it is mentioned by the facilitator that they experience there is a time of the day, which is the most suitable for in-situ simulation with the least risk of interruption. Adaptive behaviour is important for the sustainability of a project, as fewer interruptions are favourable.

The data from the questionnaire showed that crews found the two learning opportunities similarly helpful in terms of learning experience and overall satisfaction. Interestingly though, the in-situ simulations generated more discomfort regarding being observed by a peer than the live mission observations. One explanation could be that the crews found the in-situ simulation cases more challenging than the live missions. Intuitively one might think that being observed in real clinical practice would be more stressful than being observed in a simulation under controlled circumstances and with no risk of harming a patient. Participants' perception of stress during simulation and observation is not unheard of. Taylor et al. found that paramedic students participating in learning-orientated simulation almost all expressed feelings like stress and anxiety after the simulation [20]. However, some adaptation occurs; in a study by Rosenzweig, emergency medicine residents were video recorded during patients encounters and reported a discomfort that diminished over time [21].

The crew also seemed to find the observed live mission concept less intrusive than simulations in that it did not interfere so much with other on-call duties. This makes sense since missions are part of the duties when on-call and making a learning experience out of it is an effective use of time. A similar finding where in-situ simulation was found to be interruptive has been published [22].

The scores were almost identically positive for the two ways of training. We speculate whether this is a sign of the crews' need and desire for feedback on their performance. On most missions, the crews work without peer support and the possibility to receive peer feedback. With the facilitator joining the mission, feedback can be provided. Another explanation for the almost identically positive scores could be that the facilitators were skilled to perform both tasks satisfactorily, despite their expressions of challenges with live mission debriefing.

We have previously addressed the challenges of implementing in-situ simulation for on-call crews (unpublished data; "Challenges to the implementation of in situ simulation at HEMS bases: a qualitative study of facilitators' expectations and solutions", Bredmose et al.). The findings in this study confirm our previous finding that implementation is tightly coupled with the facilitator's contribution and commitment, and support from the management, and it seems this also applies to live mission observations. The management must support both the in-situ simulation training and provide an organisational structure for the facilitators to conduct training [23].

Discussion of the methods used

This study was limited to three HEMS bases in Norway. By involving more bases in the study, we may have achieved a higher number of observed live missions that may have influenced our experience with the concept. On the other hand, the three bases represented the typical profiles of Norwegian HEMS, and one of the bases is the busiest HEMS base in Norway in terms of the numbers of missions. Given the explorative design of this study and the mixed-method approach, we think the study identify valuable challenges with the concept of in-situ simulations and observed live mission that will be useful in the future development of the concept. Although we experienced saturation in the answers in the interviews, the number of participants was limited. A larger group of interviewees might have given a broader insight into the topic, as would more observed live missions.

The use of facilitators as debriefers after live missions is, in our view, an interesting concept that requires more investigation. Our results provide an initial experience and identify areas of improvement that should be the basis for further studies. The concept may even prove to be helpful in other prehospital services.

Conclusion

Live mission observation with post-mission debriefing is a feasible alternative to in-situ simulation programs in HEMS when missions must be prioritised over simulation training. This concept helps maximise the use of the facilitator as a resource to facilitate learning and reflection, irrespective of missions interrupting the in-situ simulation training. The facilitators do however need additional training beyond simulation facilitation to handle the live mission observation setting and their role in the live missions must be clear.

Abbreviations

HEMS: Helicopter emergency medical services; SAR: Search and rescue; HTCM: HEMS technical crew member; PEARLS: Promoting excellence and reflective learning in simulation; VAS: Visuel analogue scale; SD: Standard deviation.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-021-03015-w.

Additional file 1.

Additional file 2.

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Authors' contributions

PB initiated the project, wrote the protocol and led the project. Interviews were conducted by PB. PB and DØ analysed the transcribed interviews and drafted the article. SS, JH and DØ contributed to the analysis of data and the writing process as well as the finalisation of the paper. All authors read and approved the final version of the paper.

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Availability of data and materials

The dataset used during the study is available in an anonymous form from the corresponding author on a reasonable request. The recorded interviews have been deleted.

Declarations

Ethics approval and consent to participate

The study was approved by local representatives for the Norwegian Date Protection authority (2016/2751) and the local Ethical Committee (REK 2015/2444a). Verbal and written information both about the study and the rights to withdraw at any time was given to the participants. The participants had the right to withdraw before, during and after the study without any consequences, which was emphasised. A written consent form was signed by all participants on the first day of the study. None of the invited study participants denied participation or withdrew their consent to participate before or after the study period.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Publisher's Note

Appendix – A_Study I_Data recording sheet

Samtreningslog

Dato: **Scenarie:**

Deltagere: 1-1 1-2 Læge: Redn mand: Pilot:

Gennemført Afbrudt Gennemført uden fascilitator Ikke gennemført

Årsager til ovenstående:

Tidsforbrug:

Klargøring start(klokkeslet):

Start Scenarie:

Scenarie tidsforbrug i min:

Debrief tidsforbrug i min:

Oprydding tidsforbrug i min:

Udstyr:

Scenarie:

Forløb af scenarie (momenter, mørke, lys, tilstuere, tilkomst, vanskelig sygdomsforløb)

Erfaringer (fascilitator) fra scenari (hvad fungerte og hvad fungerte ikke)

Feedback:

Konklusioner fra deltagere:

Konklusioner for procedurer:

Appendix – B_Study I_Questionnaire_HTCM

Redningsmand

Feedback for SAMTRENING projektet

Dato:

Simuleringen evalueres primært på en 5 punkts Likert Skala hvor du angir i hvilken grad du er enig med utsagnet:
1: Helt enig
2: Ganske enig
3: Delvis enig
4: Nøytral
5: Delvis uenig
6: Ganske uenig
7: Helt uenig

Format på samtreningen

Det var satt av tilstrekkelig tid til samtreningen						
1	2	3	4	5	6	7
Jeg synes treningen var forstyrrende for vaktarbeidet						
1	2	3	4	5	6	7
Det var tilstrekkelig utstyr tilgjengelig for å gjøre treningen realistisk						
1	2	3	4	5	6	7
Jeg følte meg komfortable med måten treningen var lagt opp						
1	2	3	4	5	6	7
Jeg synes det var ubehagelig å eksponere min faglige kompetanse i treningen						
1	2	3	4	5	6	7
Simulering var en realistisk måte å trene på						
1	2	3	4	5	6	7

Innholdet

Temaet for treningen er relevant for denne typen trening						
1	2	3	4	5	6	7
Denne type trening er nyttig for redningsmenn						
1	2	3	4	5	6	7
Scenariet reflekterte godt innholdet i de prosedyrene vi har trent på						
1	2	3	4	5	6	7
Temaet for treningen er relevant for basens opdragsprofil						
1	2	3	4	5	6	7

Feedback

Det var nyttig for meg med feedback etter treningen						
1	2	3	4	5	6	7
Det var satt av nok tid til feedback etter treningen						
1	2	3	4	5	6	7
Det var lett å motivere meg selv til å gjennomføre treningen						
1	2	3	4	5	6	7

Overordnet

Jeg er positiv til denne typen trening						
1	2	3	4	5	6	7

Kommentarer til samtreningen:
Forslag, ris, ros, temaer, ideer, kritikk

Appendix – C_Study I_Questionnaire_physician

LEGE

Feedback for SAMTRENING prosjektet

Dato:

Simuleringen evalueres primært på en 7 punkts Likert Skala hvor du angir i hvilken grad du er enig med utsagnet:
1: Helt enig
2: Ganske enig
3: Delvis enig
4: Nøytral
5: Delvis uenig
6: Ganske uenig
7: Helt uenig

Format på samtreningen

Det var satt av tilstrekkelig tid til samtreningen						
1	2	3	4	5	6	7
Jeg synes treningen var forstyrrende for vaktarbeidet						
1	2	3	4	5	6	7
Det var tilstrekkelig medisinsk utstyr tilgjengelig for å gjøre treningen realistisk						
1	2	3	4	5	6	7
Jeg følte meg komfortable med måten treningen var lagt opp						
1	2	3	4	5	6	7
Jeg synes det var ubehagelig å eksponere min faglige kompetanse i treningen						
1	2	3	4	5	6	7
Simulering var en realistisk måte å trene på						
1	2	3	4	5	6	7

Indholdet

Temaet for treningen er relevant for denne typen trening						
1	2	3	4	5	6	7
Det kliniske scenarie var bra						
1	2	3	4	5	6	7
Scenariet reflekterte godt innholdet i de prosedyrene vi trent på						
1	2	3	4	5	6	7
Temaet for treningen er relevant for basens opdragsprofil						
1	2	3	4	5	6	7

Feedback

Det var nyttig for meg med feedback etter treningen						
1	2	3	4	5	6	7
Det var satt av nok tid til feedback etter treningen						
1	2	3	4	5	6	7
Det var lett å motivere meg selv til å gjennomføre treningen						
1	2	3	4	5	6	7

Overordnet

Jeg er positiv til denne typen trening						
1	2	3	4	5	6	7

Kommentarer til samtreningen:
Forslag, ris, ros, temaer, ideer, kritikk

Appendix – D_Study I_Questionnaire_pilot

PILOT

Feedback for SAMTRENING projektet

Dato:

Simuleringen evalueres primært på en 7 punkts Likert Skala hvor du angir i hvilken grad du er enig med utsagnet:

1: Helt enig
2: Ganske enig
3: Delvis enig
4: Nøytral
5: Delvis uenig
6: Ganske uenig
7: Helt uenig

Format på samtreningen

Det var satt av tilstrekkelig tid til samtreningen						
1	2	3	4	5	6	7
Jeg synes treningen var forstyrrende for vaktarbeidet						
1	2	3	4	5	6	7
Det var tilstrekkelig utstyr tilgjengelig for å gjøre treningen realistisk						
1	2	3	4	5	6	7
Jeg følte meg komfortable med måten treningen var lagt opp						
1	2	3	4	5	6	7
Jeg synes det var ubehagelig å eksponere min faglige kompetanse i treningen						
1	2	3	4	5	6	7
Simulering var en realistisk måte å trene på						
1	2	3	4	5	6	7

Indholdet

Temaet for treningen er relevant for denne typen trening						
1	2	3	4	5	6	7
Denne type trening er nyttig for piloter						
1	2	3	4	5	6	7
Scenariet reflekterte godt innholdet i de prosedyrene vi trent på						
1	2	3	4	5	6	7
Temaet for treningen er relevant for basens opdragsprofil						
1	2	3	4	5	6	7

Feedback

Det var nyttig for meg med feedback etter treningen						
1	2	3	4	5	6	7
Det var satt av nok tid til feedback etter treningen						
1	2	3	4	5	6	7
Det var lett å motivere meg selv til å gjennomføre treningen						
1	2	3	4	5	6	7

Overordnet

Jeg er positiv til denne typen trening						
1	2	3	4	5	6	7

Kommentarer til samtreningen:
Forslag, ris, ros, temaer, ideer, kritikk

Grader hvordan du oplevde DAGENS simulering: hvor «0» er DÅRLIGST TENKELIGE og «100» representerer BEDST MULIGE på denne skala: (set kryds)

0 I---I 100

Appendix – E_Study II_Data recording sheet

Samtreningslog

Base:

Dato: **Scenarie:**

Deltagere: Læge: Redn mand: Pilot: Hospitant: ja/nej

Gennemført Afbrudt Ikke gennemført

Årsager til avvik (ie afbrydelse) og håndtering af denne:

Tidsforbrug: **Udstyr:**

Klargøring (antal minutter):

Start Scenarie(klokkeslet):

Scenarie tidsforbrug i min:

Debrief tidsforbrug i min:

Oprydding tidsforbrug i min:

Samlet tidsforbrug i min for fasilitator (fra start klargøring til ryddet etter færdigt scenario):

(Skal bruges til dokumentation af ressource forbrug og har ingen konsekvenser for fasilitators aflønning af SNLA).

Monitorerings måde (ipad, verbalt, advanced sim, gule lapper….):

Scenarie:

Forløb af scenarie (momenter, mørke, lys, tilstuere, tilkomst, vanskelig sygdomsforløb)

Erfaringer (fascilitator) fra scenari (hvad fungerte og hvad fungerte ikke)

Feedback:

Konklusioner fra deltagere:

Konklusioner for procedurer:

Grader hvordan DU oplevde DAGENS simulering: hvor «0» er DÅRLIGST TENKELIGE og «100» representerer BEDST MULIGE på denne skala: (set kryds)

0 I--I 100

(ovenstående, samt tilsvarende fra deltager feedback måles i milimeter og tastes i databasen)

Appendix – F_Study II_Questionnaire_HTCM

Redningsmand

Feedback for SAMTRENING projektet

Dato:

Simuleringen evalueres primært på en 7 punkts Likert Skala hvor du angir i hvilken grad du er enig med utsagnet:

1: Helt enig
2: Ganske enig
3: Delvis enig
4: Nøytral
5: Delvis uenig
6: Ganske uenig
7: Helt uenig

Format på samtreningen

Det var satt av tilstrekkelig tid til samtreningen						
1	2	3	4	5	6	7
Treningen ble gjennemført uden å forstyrre ikke-opdrags relatert arbeide på vakten						
1	2	3	4	5	6	7
Det var tilstrekkelig utstyr tilgjengelig for å gjøre treningen realistisk						
1	2	3	4	5	6	7
Jeg følte meg komfortable med måten treningen var lagt opp						
1	2	3	4	5	6	7
Jeg følte mig komfortabel med å eksponere min faglige kompetanse i treningen						
1	2	3	4	5	6	7
Simulering var en realistisk måte å trene på						
1	2	3	4	5	6	7

Innholdet

Temaet for treningen er relevant for denne typen trening						
1	2	3	4	5	6	7
Denne type trening er nyttig for redningsmenn						
1	2	3	4	5	6	7
Scenariet reflekterte godt innholdet i de prosedyrene vi har trent på						
1	2	3	4	5	6	7
Temaet for treningen er relevant for basens opdragsprofil						
1	2	3	4	5	6	7

Feedback

Det var nyttig for meg med feedback etter treningen						
1	2	3	4	5	6	7
Det var satt av nok tid til feedback etter treningen						
1	2	3	4	5	6	7
Det var lett å motivere meg selv til å gjennomføre treningen						
1	2	3	4	5	6	7

Overordnet

Jeg er positiv til denne typen trening						
1	2	3	4	5	6	7

Kommentarer til samtreningen:
Forslag, ris, ros, temaer, ideer, kritikk
Grader hvordan du oplevde DAGENS simulering: hvor «0» er DÅRLIGST TENKELIGE og «100» representerer BEDST MULIGE på denne skala: (set kryds)

0 |--| 100

Appendix – G_Study II_Questionnaire_physician

LEGE

Feedback for SAMTRENING prosjektet

Dato:

Simuleringen evalueres primært på en 7 punkts Likert Skala hvor du angir i hvilken grad du er enig med utsagnet:

1: Helt enig
2: Ganske enig
3: Delvis enig
4: Nøytral
5: Delvis uenig
6: Ganske uenig
7: Helt uenig

Format på samtreningen

Det var satt av tilstrekkelig tid til samtreningen						
1	2	3	4	5	6	7
Treningen ble gjennemført uden å forstyrre ikke-opdrags relatert arbeide på vakten						
1	2	3	4	5	6	7
Det var tilstrekkelig medisinsk utstyr tilgjengelig for å gjøre treningen realistisk						
1	2	3	4	5	6	7
Jeg følte meg komfortable med måten treningen var lagt opp						
1	2	3	4	5	6	7
Jeg følte mig komfortabel med å eksponere min faglige kompetanse i treningen						
1	2	3	4	5	6	7
Simulering var en realistisk måte å trene på						
1	2	3	4	5	6	7

Indholdet

Temaet for treningen er relevant for denne typen trening						
1	2	3	4	5	6	7
Denne type trening er nyttig for leger						
1	2	3	4	5	6	7
Scenariet reflekterte godt innholdet i de prosedyrene vi trent på						
1	2	3	4	5	6	7
Temaet for treningen er relevant for basens opdragsprofil						
1	2	3	4	5	6	7

Feedback

Det var nyttig for meg med feedback etter treningen						
1	2	3	4	5	6	7
Det var satt av nok tid til feedback etter treningen						
1	2	3	4	5	6	7
Det var lett å motivere meg selv til å gjennomføre treningen						
1	2	3	4	5	6	7

Overordnet

Jeg er positiv til denne typen trening						
1	2	3	4	5	6	7

Kommentarer til samtreningen:
Forslag, ris, ros, temaer, ideer, kritikk

Grader hvordan du oplevde DAGENS simulering: hvor «0» er DÅRLIGST TENKELIGE og «100» representerer BEDST MULIGE på denne skala: (set kryds)

0 I--I 100

Appendix – H_Study II_Questionnaire_pilot

PILOT

Feedback for SAMTRENING projektet

Dato:

Simuleringen evalueres primært på en 7 punkts Likert Skala hvor du angir i hvilken grad du er enig med utsagnet:

1: Helt enig
2: Ganske enig
3: Delvis enig
4: Nøytral
5: Delvis uenig
6: Ganske uenig
7: Helt uenig

Format på samtreningen

Det var satt av tilstrekkelig tid til samtreningen						
1	2	3	4	5	6	7
Treningen ble gjennemført uden å forstyrre ikke-opdrags relatert arbeide på vakten						
1	2	3	4	5	6	7
Det var tilstrekkelig utstyr tilgjengelig for å gjøre treningen realistisk						
1	2	3	4	5	6	7
Jeg følte meg komfortable med måten treningen var lagt opp						
1	2	3	4	5	6	7
Jeg følte mig komfortabel med å eksponere min faglige kompetanse i treningen						
1	2	3	4	5	6	7
Simulering var en realistisk måte å trene på						
1	2	3	4	5	6	7

Indholdet

Temaet for treningen er relevant for denne typen trening						
1	2	3	4	5	6	7
Denne type trening er nyttig for piloter						
1	2	3	4	5	6	7
Scenariet reflekterte godt innholdet i de prosedyrene vi trent på						
1	2	3	4	5	6	7
Temaet for treningen er relevant for basens opdragsprofil						
1	2	3	4	5	6	7

Feedback

Det var nyttig for meg med feedback etter treningen						
1	2	3	4	5	6	7
Det var satt av nok tid til feedback etter treningen						
1	2	3	4	5	6	7
Det var lett å motivere meg selv til å gjennomføre treningen						
1	2	3	4	5	6	7

Overordnet

Jeg er positiv til denne typen trening						
1	2	3	4	5	6	7

Kommentarer til samtreningen:
Forslag, ris, ros, temaer, ideer, kritikk

Grader hvordan du oplevde DAGENS simulering: hvor «0» er DÅRLIGST TENKELIGE og «100» representerer BEDST MULIGE på denne skala: (set kryds)

0 |--| 100

Appendix – I_Study III_ Interview guide

Tema/Struktur for interview

Fasilitator
Interview'er

Intro/forberedelse

Skriftlig protokol samt info skal være sendt på forhånd
La kandidaten **lese** innholdet: **Du må bare spørre hvis noe er uklart**.

Presiser

- rett til å trekke deg når som helst
- anonymitet, (får respondentnummer)
- rett til å få intervjuet slettet (kan ikke endre deler av intervjuet)

Intervjuet

Formalia

Hva er **din formelle og uformelle erfaring/kendskab/uddannelse rundt medicinsk simulation**? (noteret på papir)

Hvor lenge har du arbeidet med dette?

Hvor har du drevet med medicinsk simulation?

Hvor arbeider du **nå:** (for båndet)

Hvor **gammel** er du:

Hvor **mange år** har du jobbet som LA lege ?

Hva skal vi snakke om:

I denne samtalen vil vi **høre om dine dine tanker knyttet til barrierer ved indføring/opstart af medicinsk simulation i LA tjenesten.**
Vi skal både tale om hvad du mener er barrierer og høre dine forslag til løsning af disse.

Med **medicinsk simulation mener vi indføringen af whole crew simulation i LA tjenetsen i Norge for vagtgående crew.**

Vi har tidligere identificeret flg. 3 hoved grupper af udfordringer :

a. Motivation blandt deltagerne
b. Hyppighed af simulationen
c. At få det realt gennemført

1

To typer barrierer til implementering af medicinsk simulation:

1.
Barrierer på din egen base hvor du skal drive og indføre simulationen.

2.
Indføring på et national plan

1. Lokale barrierer på din base

a. **MOTIVATION:**
Hvordan tror dere motivationen er bland det vagtgående crew vil være ?
Tenker dere at der vil være motivations forskelle mellem piloter, redningsmen og leger ? – kan du uddybe dette ?
Drejer dette sig om generelle holdninger eller holdninger hos enkelt personer i hver faggruppe ?

Kan dere give eksempler på ovenstående ?

b. **FREKVENS:**
Hva tror dere den enkelte lege/rdm/pilot synes om hyppigheten av treningen?
Har dere noen tanker om hvorvidt frekvensen av trening betyr noe for crewene?
Hvilke belastsninger tenker dere at crew'ene vil opleve?

c. **GENNEMFØRING:**
Hvilke udfordringer tenker dere der kan blive for at få dette gennemført innemfor rammerne som er gitt ?
Hva tenker dere om at skulle holde på sådan hele året ?
Hvad tror dere bliver det vanskeligste i forbindelse med at gennemføre dette?

Kan dere give eksempler på ovenstående ?

Kan du komme med tanker og ideer til løsning af de tidligere nevnte udfordringer, når det gælder:

a. Motivation
Hvordan tenker dere at bevare (eller skabe) motivation innenfor alle faggrupperne?

b. Frekvens
Hvilke tiltag kan gøres for at crew'ene ikke findes hyppigheden belastende?

c. Gennemføring
Hvilke tiltag/metoder tenker dere kan anvendes for at gennemføre dette innenfor rammerne?

Kan dere nevne andre tiltag som kan gøres for at øke implementeringsgraden af medicinsk simulation i LA tjenesten ?

2

B. Generelt om indføring af simulation på nationalt plan

Udover de lokale forhold vi allerede har talt om, tror dere så der er nogen særlige forhold som kommer til at hindre/reducere indføringen af medicinske simulation på nationalt plan i luftambulansetjenesten i Norge?

Hvad mener dere er nødvendigt for at opnå succes med dette projektet ?
Hva tenker dere er de vigtigste tiltak for succes med dette projektet?

C. Fremtiden
Hvad ser dere mest frem til med dette projektet ?

Avslutning

3

Appendix – J_Study IV_Data recording sheet

Samtreningslog

Dato: **Base:**

Scenarie:_____________(type) **LIVE mission:**_______________ (type oppdrag)

Deltagere: Læge: Redn mand: Pilot: Sypl: Hospitant: ja/nej

Gennemført SIM: Afbrudt Ikke gennemført

Primært gennemført Live-mission Konvertert fra SIM til Live-mission

Beskrivelse af SIM/opdrag forandringen/årsag til valg:

Tidsforbrug SIM:

Klargøring (antal minutter):

Start Scenarie(klokkeslet):

Scenarie tidsforbrug i min:

Debrief tidsforbrug i min:

Oprydding tidsforbrug i min:

Tidsforbrug Live-mission

Mission start:
Mission varighed (minutter):
Debrief gennemført umiddelbart ja/nej:
Debrief etter forsinkelse (antal minutter)
Årsag til forsinkelse (ie nyt opdrag/rydde/spise)
Debrief varighed (min):

Samlet tidsforbrug i min for fasilitator (fra start klargøring til ryddet etter færdigt scenario):

(Skal bruges til dokumentation af ressource forbrug og har ingen konsekvenser for fasilitators aflønning af SNLA).

Monitorerings måde (ipad, verbalt, advanced sim, gule lapper):

Scenarie:

Forløb af scenarie (momenter, mørke, lys, tilstuere, tilkomst, vanskelig sygdomsforløb)

Erfaringer (fascilitator) fra scenari (hvad fungerte og hvad fungerte ikke)

Live-mission:

Type opdrag:

Måtte du som fasilitator gøre kliniske ting eller bidrag på annen måde?

Erfaringer som "observatør"

Feedback (enten SIM eller live-mission):

Konklusioner fra deltagere:

Grader hvordan DU oplevde DAGENS trening: hvor «0» er DÅRLIGST TENKELIGE og «100» representerer BEDST MULIGE på denne skala: (set kryds)

0 I---I 100

(ovenstående, samt tilsvarende fra deltager feedback måles i milimeter og tastes i databasen)

Appendix – K_Study IV_Interview guide_crew

Tema/Struktur for interview

Deltagere:
Lege/Redningsman/pilot
Interview'er

Intro/forberedelse

Skriftlig protokol samt info skal være sendt på forhånd
La kandidaten **lese** innholdet: **Du må bare spørre hvis noe er uklart**.

Presiser

- rett til å trekke deg når som helst
- anonymitet, (får respondentnummer)
- rett til å få intervjuet slettet (kan ikke endre deler av intervjuet)

Intervjuet

Formalia

Hva er **din formelle og uformelle erfaring/kendskab/uddannelse rundt medicinsk simulation**? (noteret på papir)

Hvor lenge har du arbeidet med dette?

Hvor har du drevet med medicinsk simulation?

Hvor arbeider du **nå:** (for båndet)

Hvor **gammel** er du:

Hvor **mange år** har du jobbet som LA lege ?

Hva skal vi snakke om:

I denne samtalen vil vi **høre om dine dine tanker rundt forskellene på medisinsk simulation og struktureret debrief (a la simulation) i LA tjenesten på reale opdrag.**
Vi skal både tale om hvad du mener er godt og dårligt ved begge måder at trene/lære/udvikle sig på.

Med **medicinsk simulation mener vi indføringen af whole crew simulation i LA tjenesten i Norge for vagtgående crew.**
Med **live-mission observation** mener vi at fasilitator er med ude på opdrag.

Vi har tidligere identificeret flg. 3 hoved grupper af udfordringer :

a. Motivation blandt deltagerne
b. Hyppighed af simulationen
c. At få det realt gennemført

1

Kan du beskrive forskellene i oplevelsen af simulation m debrief og live-mission med debrief?

Er der forskelle i læringsudbyttet ?
Dels som individ ?
Dels som crew ?

Kan du give eksempler på ovestående?

Hvis du bare skulle velge én metode for læring – hvilken af disse to skulle du da velge ?

Hvordan føltes det at blive observeret i praksis ?

a. **MOTIVATION:**
   Er der forskellge i motivationen hos det vagtgående crew mellem simulation og debief etter live-mission debrief?
   Tenker dere at der vil være motivations forskelle mellem piloter, redningsmen og leger ? – kan du uddybe dette ?

Kan dere give eksempler på ovenstående ?

b. **FREKVENS:**
   Hvor ofte er det passende at tilbyde simulation eller live-mission debrief?
   Skal der være en likelig fordeling mellem disse to formerne for trening ?

c. **GENNEMFØRING:**
   Hvilke udfordringer tenker dere der kan blive for at få dette gennemført innemfor rammerne som er gitt ?

   Kan dere give eksempler på ovenstående ?

Kan du beskrive hvordan føltes det at det var en «base kollega» som observerte/fasiliterte ?

Ville det vært en anderledes oplevelse og udbytte hvis det var en leder (ie seksjonsoverlege/avd overlege) som gennemførte live-mission /SIM observation ?

Kan du uddybe ovenstående?

Kan du beskrive udbyttet af live-mission debrief

Hvordan opleves "udnyttelsesgraden" af fasilitator ved henholdsvis simulation og live-mission debrief?

Ønsker du at dette projekt kunne fortsette ? – og kan du beggrunde dit svar ?

Tak for din deltagelse !

2

Appendix – L_Study IV_Interview guide_facilitator

Tema/Struktur for interview

Deltagere:
Fasilitator
Interview'er

Intro/forberedelse

Skriftlig protokol samt info skal være sendt på forhånd
La kandidaten **lese** innholdet: **Du må bare spørre hvis noe er uklart**.

Presiser

- rett til å trekke deg når som helst
- anonymitet, (får respondentnummer)
- rett til å få intervjuet slettet (kan ikke endre deler av intervjuet)

Intervjuet

Formalia

Hva er **din formelle og uformelle erfaring/kendskab/uddannelse rundt medicinsk simulation**? (noteret på papir)

Hvor lenge har du arbeidet med dette?

Hvor har du drevet med medicinsk simulation?

Hvor arbeider du **nå:** (for båndet)

Hvor **gammel** er du:

Hvor **mange år** har du jobbet som LA lege ?

Hvor **mange år** har du fasilitert simulation ?

Hva skal vi snakke om:

I denne samtalen vil vi **høre om dine dine tanker rundt forskellene på medisinsk simulation og struktureret debrief (a la simulation) i LA tjenesten på reale opdrag.**
Vi skal både tale om hvad du mener er godt og dårligt ved begge måder at trene/lære/udvikle sig på.

Med **medicinsk simulation mener vi indføringen af whole crew simulation i LA tjenetsen i Norge for vagtgående crew.**
Med **live-mission observation** mener vi at fasilitator er med ude på opdrag.

Vi har tidligere identificeret flg. 3 hoved grupper af udfordringer :

1

a. Motivation blandt deltagerne
b. Hyppighed af simulationen
c. At få det realt gennemført

Kan du beskrive forskellene i oplevelsen af simulation m debrief og live-mission med debrief?

Er der forskelle i læringsudbyttet ?
Dels som individ ?
Dels som crew ?

Kan du give eksempler på ovestående?

Hvis du bare skulle velge én metode for læring – hvilken af disse to skulle du da velge ?

Hvordan føltes det at observere kolleger jobbe ?

Oplever du det som anderledes/udfordrende at skulle debriefe live-missions ?

Hvordan føltes det ikke å skulle blande sig i løsningen af opdraget ?

a. **MOTIVATION:**
   Er der forskellge i motivationen hos det vagtgående crew mellem simulation og debief etter live-mission debrief?

Kan dere give eksempler på ovenstående ?

b. **FREKVENS:**
   Hvor ofte er det passende at tilbyde simulation eller live-mission debrief?
   Skal der være en likelig fordeling mellem disse to formerne for trening ?

c. **GENNEMFØRING:**
   Hvilke udfordringer tenker dere der kan blive for at få dette gennemført innenfor rammerne som er gitt ?

   Kan dere give eksempler på ovenstående ?

2

Appendix – M_Study IV_Questionnaire_live mission observation

OPPDRAG

Dato:

1: Helt enig
2: Ganske enig
3: Delvis enig
4: Nøytral
5: Delvis uenig
6: Ganske uenig
7: Helt uenig

Faggruppe (set kryds):
Pilot ____
Redningsman ____
Lege ____
Sygeplejer ____ (Ålesund)

Format på samtreningen

Det var satt av tilstrekkelig tid for debrief og feedback etter observert praksis						
1	2	3	4	5	6	7
Observert praksis ble gjennomført uten å forstyrre ikke-oppdrags relatert arbeid på vakten						
1	2	3	4	5	6	7
Jeg er komfortabel med å bli observert av en kollega under et faktisk oppdrag						
1	2	3	4	5	6	7
Jeg følte meg komfortabel med måten observert praksis ble gjennomført på						
1	2	3	4	5	6	7
Jeg følte meg komfortabel med å eksponere min faglige kompetanse i observert praksis						
1	2	3	4	5	6	7
Observert praksis med debrief og feedback gir like bra utbytte som SIM trening						
1	2	3	4	5	6	7

Indholdet

Oppdragets art var godt egnet for observert praksis med påfølgende debrief og feedback						
1	2	3	4	5	6	7
Observert praksis med feedback og debrief er nyttig for min yrkesgruppe						
1	2	3	4	5	6	7
Fasilitator relaterte læringsmomenter fra observert praksis til prosedyrer i vårt prosedyreverk på en måte som gav læringsutbytte						
1	2	3	4	5	6	7
Det er ikke forstyrrende for gjennomføringen av oppdrag at en kollega skal være med og observere hva vi gjør						
1	2	3	4	5	6	7

Feedback

Det var nyttig for meg med debrief og feedback etter observert praksis						
1	2	3	4	5	6	7
Det var satt av nok tid til debrief og feedback etter observert praksis						
1	2	3	4	5	6	7
Det var lett å motivere seg til å gjennomføre oppdrag med observert praksis						
1	2	3	4	5	6	7

Overordnet

Jeg er positiv til denne typen trening						
1	2	3	4	5	6	7

Grader hvordan du oplevde DAGENS simulering: hvor «0» er DÅRLIGST TENKELIGE og «100» representerer BEDST MULIGE på denne skala: (set kryds)

0 I--I 100

Kommentarer til samtreningen:
Forslag, ris, ros, temaer, ideer, kritikk

Appendix – N_Study IV_Questionnaire_simulation

SIMULERING

Dato:

1: Helt enig
2: Ganske enig
3: Delvis enig
4: Nøytral
5: Delvis uenig
6: Ganske uenig
7: Helt uenig

Faggruppe (set kryds):
Pilot ____
Redningsman ____
Lege ____
Sygeplejer ____ (Ålesund)

Format på samtreningen

Det var satt av tilstrekkelig tid til samtreningen						
1	2	3	4	5	6	7
Observert praksis ble gjennomført uten å forstyrre ikke-oppdrags relatert arbeid på vakten						
1	2	3	4	5	6	7
Det var tilstrekkelig utstyr tilgjengelig for å gjøre treningen realistisk						
1	2	3	4	5	6	7
Jeg følte meg komfortable med måten treningen var lagt opp						
1	2	3	4	5	6	7
Jeg følte meg komfortabel med å eksponere min faglige kompetanse i observert praksis						
1	2	3	4	5	6	7
Simulering var en realistisk måte å trene på						
1	2	3	4	5	6	7

Indholdet

Temaet for treningen er relevant for denne typen trening						
1	2	3	4	5	6	7
Denne type trening er nyttig for min faggruppe						
1	2	3	4	5	6	7
Scenariet reflekterte godt innholdet i de prosedyrene vi trent på						
1	2	3	4	5	6	7
Temaet for treningen er relevant for basens opdragsprofil						
1	2	3	4	5	6	7

Feedback

Det var nyttig for meg med feedback etter treningen						
1	2	3	4	5	6	7
Det var satt av nok tid til feedback etter treningen						
1	2	3	4	5	6	7
Det var lett å motivere meg selv til å gjennomføre treningen						
1	2	3	4	5	6	7

Overordnet

Jeg er positiv til denne typen trening						
1	2	3	4	5	6	7

Grader hvordan du oplevde DAGENS simulering: hvor «0» er DÅRLIGST TENKELIGE og «100» representerer BEDST MULIGE på denne skala: (set kryds)

0 I---I 100

Kommentarer til samtreningen:
Forslag, ris, ros, temaer, ideer, kritikk

Appendix – O_Study I_REK

UNIVERSITY OF OSLO
FACULTY OF MEDICINE

Regional Committee for Medical Research Ethics
Southern Norway, Section D
Post.Box 1130 Blindern
NO-0318 Oslo

Telephone: 22 84 55 23

E-mail: post@helseforskning.etikkom.no
Homepage: http://helseforskning.etikkom.no

Date: 13th of August 2013
Your ref.:
Our ref.: 2012/777

Dear Per B. Bredmose,

Re: Medisinsk samtrening i luftambulansetjenesten på oppdrag med høy vanskelighetsgrad

I am writing in reference to your project application form received on the 24th of April 2012.

The Committee reviewed your application during it's meeting on the 10th of May 2012. The project was assessed in accordance with the Norwegian Research Ethics Act of 30th June 2006 and Act on Medical and Health Research (the Health Research Act) 20th of June 2008 for The Regional Committees for Medical and Health Research Ethics.

The aim of this project is to maintain and improve an already implemented practise. Therefore, the Committee considers the study to lie outside the remit of the Health Research Act. The project can be implemented without the approval by the Regional Committee for Medical Research Ethics.

The project can be done without the approval by the the Regional Committees for Medical Research Ethics of Norway.

Yours Sincerely

Finn Wisløff
Chair of the Regional Committee for
Medical Research Ethics of Southern Norway
(P.P.)
Section D

Emil Lahlum
Higher Executive Officer

Appendix – P_Study II_PVO

Oslo universitetssykehus

PERSONVERNOMBUDETS TILRÅDING

Oslo universitetssykehus HF

Postadresse:
Trondheimsveien 235
0514 Oslo

Sentralbord:
02770

Org.nr:
NO 993 467 049 MVA

www.oslo-universitetssykehus.no

Til:	Per P. Bredmose Overlege Luftambulanse avd OUS
Kopi:	
Fra:	Personvernombudet ved Oslo universitetssykehus
Saksbehandler:	Tor Åsmund Martinsen
Dato:	16.07.14
Offentlighet:	Ikke unntatt offentlighet
Sak:	Personvernombudets tilråding til innsamling og databehandling av personopplysninger
Saksnummer/ ePhortenummer:	2014/10220

Personvernombudets tilråding til innsamling og behandling av personopplysninger for prosjektet "Medisinsk samtrening i luftambulansetjenesten"

Vi viser til innsendt melding om behandling av personopplysninger / helseopplysninger. Det følgende er personvernombudets tilråding av prosjektet.

Med hjemmel i personopplysningsforskriften § 7-12, jf. helseregisterloven § 36, har Datatilsynet ved oppnevning av personvernombud ved Oslo Universitetssykehus (OUS), fritatt sykehuset fra meldeplikten til Datatilsynet. Behandling og utlevering av person-/helseopplysninger meldes derfor til sykehusets personvernombud.

Databehandlingen tilfredsstiller forutsetningene for melding gitt i personopplysningsforskriften § 7-27 og er derfor unntatt konsesjon.

Personvernombudet tilrår at prosjektet gjennomføres under forutsetning av følgende:

1. Databehandlingsansvarlig er Oslo universitetssykehus HF ved adm. dir.
2. Avdelingsleder eller klinikkleder ved OUS har godkjent studien.
3. Behandling av personopplysningene / helseopplysninger i prosjektet skjer i samsvar med og innenfor det formål som er oppgitt i meldingen.
4. Data lagres som oppgitt i meldingen. Annen lagringsform forutsetter gjennomføring av en risikovurdering som må godkjennes av Personvernombudet.
5. Studien er frivilling og samtykkebasert.
6. Det må etableres en databehandleravtale med Qustback.
7. Dersom formålet eller databehandlingen endres må personvernombudet informeres om dette.
8. Data slettes eller anonymiseres ved prosjektslutt. Når formålet med registeret er oppfylt sendes melding om bekreftet sletting til personvernombudet.

Prosjektet er registrert i sykehusets offentlig tilgjengelig database over forsknings- og kvalitetsstudier.

Med hilsen

Tor Åsmund Martinsen
Personvernrådgiver

Oslo universitetssykehus HF
Stab pasientsikkerhet og kvalitet
Seksjon for personvern og informasjonssikkerhet

Epost: personvern@oslo-universitetssykehus.no
Web: www.oslo-universitetssykehus.no/personvern

Appendix – Q_Study II_REK

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Vivi Opdal	22845526	02.10.2014	2014/1425/REK sør-øst A
			Deres dato:	**Deres referanse:**
			19.08.2014	

Vår referanse må oppgis ved alle henvendelser

Per P. Bredmose
Luftambulanse avd

2014/1425 Medicinsk samtrening i luftambulanse tjenesten

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst) i møtet 18.09.2014. Vurderingen er gjort med hjemmel i helseforskningsloven § 10, jf. forskningsetikklovens § 4.

Forskningsansvarlig: Luftambulanse avd
Prosjektleder: Per P. Bredmose

Prosjektbeskrivelse

Luftambulansetjenesten skal være i front flyoperativt, redningsteknisk og medisinsk.

Luftambulansetjenestens 3-crew konsept er unikt, men krever at man trener sammen. Man har kalt dette «medisinsk samtrening». Med «medisinsk samtrening» menes altså en strukturert forberedt innlæring og vedlikehold av de mest krevende praktiske oppgavene som blir utført av crewet i kritiske medisinske situasjoner. Det langsiktige målet med dette er å styrke den reelle handlingsevnen også på de mest krevende oppdragstypene.

Prosjektet belyser kvaliteten og gjennomførbarheten av denne type trening. Målet er å forbedre treningen/simuleringen for å heve kvaliteten i luftambulansetjenestens medisinske ytelser.

Vurdering

Etter komiteens vurdering er prosjektet å anse som helsetjenesteforskning.

Helsetjenesteforskning er et flerfaglig vitenskapelig felt hvor man studerer hvordan sosiale faktorer, finansieringssystemer, organisatoriske strukturer og prosesser, helseteknologi og personellatferd påvirker tilgang til helse- og omsorgstjenester, kvaliteten og kostnadene ved helse- og omsorgstjenester samt helse og velvære. Helsetjenesteforskning er også forskning på forbedring av helsetjenesten og effektiv bruk av ressurser for samfunnet. I helsetjenesteforskningen studerer man blant annet hvordan helsetjenester leveres, hvordan de er utformet, og hvordan helsetjenesten fungerer som system.

Helsetjenesteforskning omfattes ikke av helseforskningslovens virkeområde, som omfatter prosjekter med det formål å skaffe ny kunnskap om helse og sykdom, jf. helseforskningsloven § 2 og § 4 a, og er dermed ikke fremleggingspliktig for REK.

Vedtak

Besøksadresse:
Gullhaugveien 1-3, 0484 Oslo

Telefon: 22845511
E-post: post@helseforskning.etikkom.no
Web: http://helseforskning.etikkom.no/

All post og e-post som inngår i saksbehandlingen, bes adressert til REK sør-øst og ikke til enkelte personer

Kindly address all mail and e-mails to the Regional Ethics Committee, REK sør-øst, not to individual staff

Prosjektet faller utenfor helseforskningslovens virkeområde, jf. § 2, og kan derfor gjennomføres uten godkjenning av REK.

Det er institusjonens ansvar på å sørge for at prosjektet gjennomføres på en forsvarlig måte med hensyn til for eksempel regler for taushetsplikt og personvern.

Komiteens vedtak kan påklages til Den nasjonale forskningsetiske komité for medisin og helsefag, jf. helseforskningsloven § 10, 3 ledd og forvaltningsloven § 28. En eventuell klage sendes til REK Sørøst A. Klagefristen er tre uker fra mottak av dette brevet, jf. forvaltningsloven § 29.

Med vennlig hilsen

Knut Engedal
Professor dr. med.
Leder

Vivi Opdal
Seniorrådgiver

Kopi til:hheimda@online.no

Appendix – R_Study III_PVO

Oslo universitetssykehus

Oslo universitetssykehus HF

Postadresse:
Trondheimsveien 235
0514 Oslo

Sentralbord:
02770

Org.nr:
NO 993 467 049 MVA

www.oslo-universitetssykehus.no

PERSONVERNOMBUDETS TILRÅDING

Til:	Per P. Bredmose Overlege Luftambulanse avd OUS
Kopi:	
Fra:	Personvernombudet ved Oslo universitetssykehus
Saksbehandler:	Tor Åsmund Martinsen
Dato:	16.07.14
Offentlighet:	Ikke unntatt offentlighet
Sak:	Personvernombudets tilråding til innsamling og databehandling av personopplysninger
Saksnummer/ ePhortenummer:	2014/10218

Personvernombudets tilråding til innsamling og behandling av personopplysninger for prosjektet:

"Kartlegging av utfordringer i forbindelse med innføring av whole-crew-simulation i Luftambulansetjenesten i Norge"

Vi viser til innsendt melding om behandling av personopplysninger / helseopplysninger. Det følgende er personvernombudets tilråding av prosjektet.

Med hjemmel i personopplysningsforskriften § 7-12, jf. helseregisterlovens § 36, har Datatilsynet ved oppnevning av personvernombud ved Oslo Universitetssykehus (OUS), fritatt sykehuset fra meldeplikten til Datatilsynet. Behandling og utlevering av person- /helseopplysninger meldes derfor til sykehusets personvernombud.

Databehandlingen tilfredsstiller forutsetningene for melding gitt i personopplysningsforskriften § 7-27 og er derfor unntatt konsesjon.

Personvernombudet tilrår at prosjektet gjennomføres under forutsetning av følgende:

1. Databehandlingsansvarlig er Oslo universitetssykehus HF ved adm. dir.
2. Avdelingsleder eller klinikkleder ved OUS har godkjent studien.
3. Behandling av personopplysningene / helseopplysninger i prosjektet skjer i samsvar med og innenfor det formål som er oppgitt i meldingen.
4. Data lagres som oppgitt i meldingen. Annen lagringsform forutsetter gjennomføring av en risikovurdering som må godkjennes av Personvernombudet.
5. Studien er frivillig og samtykkebasert.
6. Dersom formålet eller databehandlingen endres må personvernombudet informeres om dette.

Prosjektet er registrert i sykehusets offentlig tilgjengelig database over forsknings- og kvalitetsstudier.

Med hilsen

Tor Åsmund Martinsen
Personvernrådgiver

Oslo universitetssykehus HF
Stab pasientsikkerhet og kvalitet
Seksjon for personvern og informasjonssikkerhet

Epost: personvern@oslo-universitetssykehus.no
Web: www.oslo-universitetssykehus.no/personvern

Appendix – S_Study III_REK

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Regional Committee for Medical & Health Research Ethics
South East Norway, Section B
Postbox 1130 Blindern
NO-0318 Oslo
Norway

Phone: + 47 22 84 55 13
E-mail: harsha@medisin.uio.no
Webportal: http://helseforskning.etikkom.no

Our ref.: 2014/1524b

Date: 15th of November 2017

To whom it may concern,

Re: REC Letter of Exemption

I am writing in reference to a request from Per Bredmose via email dated the 7th of November 2017 for a letter of exemption from REC.

Review
The Regional Committee for Medical & Health Research Ethics, Section B, South East Norway, reviewed the Research Project *"Kartlegging av udfordringer i forbindelse med innføring af whole crew simulation i Luftambulansetjenesten i Norge"* (*Norwegian title)* at its Committee Review Meeting on the 17th of september 2017. The Project Manager for this study is Per Bredmose, and the Institution Responsible for Research is Oslo University Hospital, Oslo, Norway.

The application was assessed accordance with the Norwegian Research Ethics Act 2006 and Act on Medical and Health Research 2008.

The Committee's Decision
The Regional Committee for Medical & Health Research Ethics, Section B, South East Norway, found the Research Project to be outside the remit of the Act on Medical and Health Research 2008 and therefore can be implemented without its approval.

As the Research Project is exempt from Review, any future changes to the Patient Information Sheet, Consent Form and other relevant documents will not require Review by REC.

Ethics Committee System
The Ethics Committee System in Norway consists of seven Independent Regional Committees with authority to either approve or disapprove Medical Research Studies conducted within Norway, or by Norwegian Institutions, in accordance with the Act on Medical and Health Research 2008.

Please do not hesitate to contact the Regional Committee for Medical and Health Research Ethics Section South East B (REK Sør-Øst B) if further information is required, as we are happy to be of assistance.

Yours faithfully,

Ragnhild Emblem
Chair of the Regional Committee for Medical & Health
Research Ethics of South East Norway, Section B

Harsha Gajjar Mikkelsen
Senior Executive Officer

Appendix – T_Study IV_PVO

Oslo universitetssykehus

Oslo universitetssykehus HF

Postadresse:
Trondheimsveien 235
0514 Oslo

Sentralbord:
02770

Org.nr:
NO 993 467 049 MVA

www.oslo-universitetssykehus.no

PERSONVERNOMBUDETS TILRÅDING

Til:	Per P. Bredmose Overlege Luftambulanse avd OUS
Kopi:	
Fra:	Personvernombudet ved Oslo universitetssykehus
Saksbehandler:	Tor Åsmund Martinsen
Dato:	19.02.16
Offentlighet:	Ikke unntatt offentlighet
Sak:	Personvernombudets tilråding til innsamling og databehandling av personopplysninger
Saksnummer/ ePhortenummer:	2016/2751

Personvernombudets tilråding til innsamling og behandling av personopplysninger for prosjektet:

«Sammenligning af simulation og live-mission observation»

Vi viser til innsendt melding om behandling av personopplysninger / helseopplysninger. Det følgende er personvernombudets tilråding av prosjektet.

Med hjemmel i personopplysningsforskriften § 7-12, jf. helseregisterloven § 36, har Datatilsynet ved oppnevning av personvernombud ved Oslo Universitetssykehus (OUS), fritatt sykehuset fra meldeplikten til Datatilsynet. Behandling og utlevering av person-/helseopplysninger meldes derfor til sykehusets personvernombud.

Databehandlingen tilfredsstiller forutsetningene for melding gitt i personopplysningsforskriften § 7-27 og er derfor unntatt konsesjon.

Personvernombudet tilrår at prosjektet gjennomføres under forutsetning av følgende:

1. Databehandlingsansvarlig er Oslo universitetssykehus HF ved adm. dir.
2. Avdelingsleder eller klinikkleder ved OUS har godkjent studien.
3. Behandling av personopplysningene / helseopplysninger i prosjektet skjer i samsvar med og innenfor det formål som er oppgitt i meldingen.
4. Data lagres på K-området ved OUS.
5. Studien er frivilling og samtykkebasert.
6. Dersom formålet eller databehandlingen endres må personvernombudet informeres om dette.
7. Opptak slettes etter transkribering. Data slettes eller anonymiseres ved prosjektslutt. Når formålet med registeret er oppfylt sendes melding om bekreftet sletting til personvernombudet.

Prosjektet er registrert i sykehusets offentlig tilgjengelig database over forsknings- og kvalitetsstudier.

Med hilsen

Tor Åsmund Martinsen
Personvernrådgiver

Oslo universitetssykehus HF
Stab pasientsikkerhet og kvalitet
Seksjon for personvern og informasjonssikkerhet

Epost: personvern@oslo-universitetssykehus.no
Web: www.oslo-universitetssykehus.no/personvern

Appendix – U_Study IV_REK

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Anne S. Kavli	22845512	04.02.2016	2015/2444/REK sør-øst A
			Deres dato:	Deres referanse:
			08.12.2015	

Vår referanse må oppgis ved alle henvendelser

Per Bredmose
Oslo universitetssykehus HF

2015/2444 Sammenligning mellem simulation og observert klinisk praksis i luftambulanse tjensten

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst) i møtet 14.01.2016. Vurderingen er gjort med hjemmel i helseforskningsloven § 10, jf. forskningsetikkloven § 4.

Forskningsansvarlig: Oslo universitetssykehus HF
Prosjektleder: Per Bredmose

Prosjektbeskrivelse (revidert av REK)

Formålet med prosjektet er å undersøke effekt og gjennomførbarhet av medisinsk samtrening og observert praksis med etterfølgende debriefing blant personell i luftambulansetjenesten i Norge.

Det er økende bruk av medisinsk simulering i opplæring av helsepersonell, dette gjelder også for luftambulanse og andre pre-hospitale tjenester. Medisinsk simulering består dels av det medisinsk-faglige og også opptrening i ikke-tekniske ferdigheter, der balansen mellom de to delene er en viktig faktor. I simuleringer av pre-hospitale tjenester trener hele team sammen, såkalt medisinsk samtrening. Luftambulansen bemannes av et team på tre personer; en pilot, en redningsmann og en lege. Målet med medisinsk samtrening er strukturert forberedt innlæring og vedlikehold av de mest krevende praktiske oppgavene som blir utført av mannskapet i kritiske medisinske situasjoner. Tidligere studier på medisinsk samtrening har vist at debrifing er viktig for læringsutbyttet av treningen.

I dette prosjektet vil vaktgående luftambulanse mannskap ved luftambulansebaser i Ål, Ålesund og Oslo tilbys ukentlig samtrening/simulering i vakttiden. Dersom mannskapet blir utkalt til et reelt oppdrag vil simuleringsleder (luftambulanselege) delta i oppdraget som observatør. Det er kun samhandling i luftambulanseteamet som skal observeres under oppdrag. Debriefing skal gjennomføres etter trening og observasjon.

Etter hver simulering eller observert oppdrag skal teamet fylle ut spørreskjema der de svarer på spørsmål om opplevelse nytteverdi, tidsbruk og opplevelse av trening, observert praksis og debriefing. Det vil videre gjennomføres telefonintervjuer av simuleringsledere og 3 team, etter at samtreningsperioden er avsluttet.

Vurdering

Slik komiteen forstår prosjektet, er formålet med dette prosjektet primært å sammenligne nytte og gjennomførbarhet av medisinsk samtrening og observert praksis, for å forbedre ytelsen til luftambulanseteam.

Besøksadresse: Gullhaugveien 1-3, 0484 Oslo
Telefon: 22845511
E-post: post@helseforskning.etikkom.no
Web: http://helseforskning.etikkom.no/
All post og e-post som inngår i saksbehandlingen, bes adressert til REK sør-øst og ikke til enkelte personer
Kindly address all mail and e-mails to the Regional Ethics Committee, REK sør-øst, not to individual staff

Prosjektet er dermed etter komiteens syn å anse som helsetjenesteforskning.

Helsetjenesteforskning er et flerfaglig vitenskapelig felt hvor man studerer hvordan sosiale faktorer, finansieringssystemer, organisatoriske strukturer og prosesser, helseteknologi og personellatferd påvirker tilgang til helse - og omsorgstjenester, kvaliteten og kostnadene ved helse og omsorgstjenester, og endelig helse og velvære.

Helsetjenesteforskning er også forskning på forbedring av helsetjenesten og effektiv bruk av ressurser for samfunnet. I helsetjenesteforskningen studerer man blant annet hvordan helsetjenester leveres, hvordan de er utformet, og hvordan helsetjenesten fungerer som system.

Helsetjenesteforskning omfattes ikke av helseforskningslovens virkeområde, som omfatter prosjekter med det formål å skaffe ny kunnskap om helse og sykdom, jf. helseforskningsloven § 2 og § 4 a, og er dermed ikke fremleggingspliktig for REK.

Vedtak

Prosjektet faller utenfor helseforskningslovens virkeområde, jf. § 2, og kan derfor gjennomføres uten godkjenning av REK. Det er institusjonens ansvar å sørge for at prosjektet gjennomføres på en forsvarlig måte med hensyn til for eksempel regler for taushetsplikt og personvern.

Komiteens vedtak kan påklages til Den nasjonale forskningsetiske komité for medisin og helsefag, jf. helseforskningsloven § 10, 3 ledd og forvaltningsloven § 28. En eventuell klage sendes til REK Sørøst A. Klagefristen er tre uker fra mottak av dette brevet, jf. forvaltningsloven § 29.

Med vennlig hilsen

Knut Engedal
Professor dr. med.
Leder

Anne S. Kavli
Seniorkonsulent

Kopi til:marten.sandberg@gmail.com; oushfdlgodkjenning@ous-hf.no