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Can video communication in the emergency medical communication centre improve dispatch precision? A before–after study in Norwegian helicopter emergency medical services

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ABSTRACT

Objectives Dispatching helicopter emergency medical services (HEMS) to the patients with the greatest medical or logistical benefit remains challenging. The introduction of video calls (VC) in the emergency medical communication centres (EMCC) could provide additional information for EMCC operators and HEMS physicians when assessing the need for HEMS dispatch. The aim of this study was to evaluate the impact from VC in the EMCC on HEMS dispatch precision.

Design An observational before–after study.

Setting The regional EMCC and one HEMS base in Mid-Norway.

Participants EMCC operators and HEMS physicians at the EMCC and HEMS base in Trondheim, Norway.

Intervention In January 2022, VC became available in emergency calls in Trondheim EMCC. Data were collected from 2020 2021 (pre-intervention) and 2022 (post-intervention).

Primary and secondary outcome measures The primary outcome was the proportion of seriously ill or injured HEMS patients, defined as a National Advisory Committee for Aeronautics (NACA) score between 4 and 7. The secondary outcome was the proportion of inappropriate dispatches, defined as missions with neither provision of additional competence nor any logistical contribution based on quality indicators for physician-staffed emergency medical services.

Results 811 and 402 HEMS missions with patient contact were included in the pre- and post-intervention group, respectively. The proportion of missions with NACA 4–7 was not significantly changed after the intervention (OR 1.21, 95% CI 0.92 to 1.61, p=0.17). There was no significant change in HEMS alarm times between the pre- and post-intervention groups (7.6 min vs 6.4 min, p=0.15). The proportion of missions with neither medical nor logistical benefit was significantly lower in the post-intervention group (28.4% vs 40.3%, p=0.007).

Conclusion The results from this study indicate that VC is a promising, feasible and safe tool for EMCC operators in the complex HEMS dispatch process.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study is one of the first systematic evaluations of the effects on helicopter emergency medical services (HEMS) dispatch precision following implementation of video calls in the emergency medical communication centres (EMCC).
⇒ The attending HEMS physicians' experience in using the National Advisory Committee for Aeronautics (NACA) score, their blinding of outcome measures and the use of data from the same physicians both pre- and post-intervention represent strengths of this study.
⇒ The before–after design represents limitations regarding robust causality conclusions following the intervention.
⇒ Different pre- and post-intervention periods for primary and secondary outcomes, no assessment of undertriage in HEMS dispatch pre- and post-intervention and the single-centre design represent limitations to this study.

INTRODUCTION

Helicopter emergency medical services (HEMS) constitute a specialised and limited resource in prehospital care.[1] This calls for a continuous effort to evaluate and improve the quality and utilisation of the service.[2 3] To maintain HEMS availability as high as possible, the service should ideally be reserved only for patients with a defined medical or logistical benefit from HEMS. However, due to inadequate information available and high degree of urgency, to prospectively identify the missions with the highest HEMS benefit remains challenging. As various HEMS services may face substantial differences regarding mission characteristics, regional population density and range and travel speed of different helicopters, a standardised set of dispatch criteria will not be suitable for

all services.[4] The lack of consensus regarding reference standards to compare dispatch precision across different HEMS systems further complicates research on this topic. However, the well-established eight-level National Advisory Committee for Aeronautics (NACA) score has been regularly used for this purpose.[5–7]

Ideally, dispatching HEMS to a patient should be rationalised either by bringing required additional *competence* to the scene (advanced interventions not provided by other emergency medical services (EMS)), or by adding a relevant *logistical contribution*, either by rapid transportation for time-critical conditions or by reaching patients not accessible without a helicopter.[8–10] Additional competence provided by the HEMS physician on-scene should be a wide-ranging term, including advanced airway management, blood transfusion and decision making in difficult clinical and operative situations, as described in recently published quality indicators for physician-staffed emergency medical services (P-EMS).[11] If HEMS is dispatched to a mission with neither a benefit from additional competence nor any significant logistical contribution from bringing a helicopter to the scene, we consider it reasonable to define it as an inappropriate HEMS dispatch. Recent publications indicate that such dispatches occur frequently, and that measures should be taken to reduce them.[12 13]

For the emergency medical communication centre (EMCC) operator, capturing all aspects of complex situations by verbal information only in emergency calls represents a challenge.[14] However, the massive expansion of smartphone technology during the last decades has opened new digital possibilities in prehospital communication, including live video calls (VC).[15] Studies have shown that VC are technically feasible,[16–18] affected the situational awareness of EMCC operators positively and led to a more precise perception and triage of the patient's condition.[19] However, studies assessing the direct effects from VC on the ability to increase HEMS dispatch precision and reduce the number of inappropriate flights are lacking.

The aim of this study was to assess whether introducing VC for the EMCC and the HEMS physician improved dispatch accuracy in HEMS missions, measured by an increased proportion of encountered patients with severe illness or injury (NACA score 4–7). The secondary aim of the study was to assess the impact on inappropriate HEMS dispatches, measured by quality indicators regarding provision of additional medical competence and/or logistical contribution.

MATERIAL AND METHODS

Study setting

Central Norway constitutes approximately 56 000 square kilometres and has approximately 730 000 inhabitants.[20] The eight hospitals in the region are all managed by The Central Norway Health authority, with St Olav's University Hospital in Trondheim being the tertiary centre of the region. The regional EMCC is located in Trondheim, and is on weekdays staffed with six operators at daytime, five in the evenings and four operators at night-time. The operators are either nurses, paramedics or emergency medical technicians. In 2021, the centre received approximately 33 000 emergency calls. When the EMCC operator decides that HEMS dispatch is necessary, based on regional guidelines, the regional HEMS coordinator is contacted and the most appropriate HEMS resource is alarmed.[21]

The rotor wing air ambulances of Central Norway include the HEMS bases in Trondheim and Ålesund and a search and rescue (SAR) helicopter at Ørland Air Force Base. To avoid potential biases related to different staffing and operational routines between HEMS bases in the region, only Trondheim HEMS base was included in this study. The HEMS base in Trondheim operates an Airbus Helicopter H145 and a rapid response car. In 2020, the base had approximately 1300 requests leading to about 950 dispatches (both HEMS and rapid response car missions included). The service is staffed round the clock with a specially trained crew containing a HEMS crew member (HCM), a pilot and an anaesthesiologist. The HCMs have a bachelor degree in either nursing or paramedicine, or relevant prehospital EMS experience without a bachelor degree.[22] On request, the HEMS physician take the final medical decision on whether to accept or reject a mission request. Reasons for rejection might be lack of medical indication, concurrencies or other operational factors. Moreover, the HEMS physician gives medical advice to the Trondheim EMCC regarding medical treatment and prehospital logistics on other patients.

The intervention

On 13 January 2022, the EMCC in Trondheim ('AMK Sør-Trøndelag') introduced the possibility for adding VC in emergency calls. The technical solution has been developed by the Norwegian Air Ambulance Foundation, and has been implemented in 15 EMCCs and 85 local emergency medical centres in Norway. When VC was introduced at Trondheim EMCC, the EMCC operators completed a training programme in which the operators could individually decide when VC was indicated during an emergency call. In calls with verified or suspected acute life-threatening events (red triage), they were instructed to dispatch resources without unnecessary delay before considering VC. When VC was indicated, a text message was sent to the caller's smartphone, with a request to accept remote control of the phone's camera. If this was confirmed by the caller, the EMCC operator could control the camera, including the angle of view. An application installed on the caller's phone to make VC feasible was not necessary. Finally, the EMCC operator could on request also invite the HEMS physician on-call to attend the VC. The video calls were not recorded.

Primary outcome

Primary outcome was the proportion of missions before and after the intervention with seriously ill or injured patients, defined as NACA score between 4 and 7. In the NACA scoring system, the most serious clinical state during a mission is registered, where NACA 0 indicates no injury or illness and NACA 7 means that the patient is declared dead during the mission (with or without resuscitation attempts).[23] A dichotomisation between *serious* (NACA 4–7) and *non-serious* (NACA 0–3) illness or injury was made based on the relative distribution between NACA categories. This was chosen as the primary endpoint to assess proper HEMS dispatch, as previously described in other studies assessing dispatch precision in the EMCC.[7 24]

Secondary outcome

Secondary outcome was the proportion of inappropriate dispatches before and after the introduction of VC in the EMCC. *Inappropriate dispatches* were, based on the quality indicators defined by Haugland *et al*, defined as missions where there were neither provision of additional competence nor any logistical contribution.[11] Definitions of these QI's are presented in the online supplemental appendix.

Inclusion criteria

All requests from the Trondheim EMCC to the Trondheim HEMS regarding HEMS or rapid response car missions in the study periods were included.

Exclusion criteria

Consultations with the HEMS physician as an EMCC medical advisor were excluded as these requests may have other purposes than dispatch of the HEMS unit. Also, secondary missions (i.e. interhospital transfers) were excluded as VC was assumed to be of minor relevance in these circumstances. Finally, requests from other EMCCs in the region (without available VC) were also excluded.

Data sources, collection and cleaning

Data were collected retrospectively from the EMCC database AMIS and the HEMS database LABAS. *AMIS* (CSAM Health AS, Oslo, Norway) is an emergency medicine information system used in every EMCC in Norway, containing various EMS data including patient status, ambulance dispatch and timeline data. Every emergency call to the EMCC is given a unique AMIS number. *LABAS* (Normann IT, Trondheim, Norway) is the operational database and medical record generator of the Norwegian HEMS service. Data were collected between 13 January 2020 and 12 January 2022 (pre-intervention period) and from 13 January 2022 to 31 January 2023 (post-intervention period). The quality indicators were introduced as a tablet application at the Trondheim HEMS base on 7 September 2021, and indicators were registered by the physician on-call after each mission from this date.

For each mission, we obtained timeline parameters such as time of emergency call, time of VC enabled in the EMCC/for the HEMS physician, HEMS alarm time and HEMS take-off time. Patient characteristics including ICD-10 diagnosis of admission were registered. Mission characteristics, such as level of urgency, additional rationale for dispatch, mission deviations and quality indicators regarding logistic contribution and additional competence were also registered. Data were assessed by the main author regarding duplicate AMIS numbers to identify multiple registrations regarding the same request, error registrations and missions where two or more patients were encountered. In such circumstances, the patient with the highest NACA score was included in the primary outcome analyses, whereas the remaining patients were included in the descriptive analyses.

Study design and analyses

In this before-and-after study, the HEMS physicians were blinded for the study outcomes in order to reduce potential observer bias in NACA scoring. Two physicians at the HEMS base (AJK and HH) took part in the study group and missions executed by them during the study periods were excluded.

Based on historical data from 2017 to 2021, a lower proportion of encountered HEMS patients with high NACA scores[4–7] was observed during summer months, indicating a potential seasonal effect. To mitigate this effect, we planned to compare the same periods of the year pre- and post-intervention. According to the study protocol, these periods were predicted to last from January to August; however, due to low inclusion rates, they were extended to include entire years. The study was designed to show a clinically relevant increase of 0.075 in the primary outcome with 0.80 power and a two-sided significance level of 0.05. By using the method by Hsieh *et al*,[25] the estimated sample size for the post-intervention period was 412 missions based on a historical proportion of missions with NACA 4–7 on 0.70.

To analyse the relationship between the primary outcome and VC availability, a multivariate logistical regression model was used with 'additional causes for dispatch' as a dichotomous adjustment covariate. 'Additional causes for dispatch' included patient inaccessibility or lack of local resources, thus justifying HEMS dispatch in missions with low NACA scores. Results are reported with OR and 95% CI. To examine the association between VC availability and inappropriate dispatches, the secondary outcome was analysed by Pearson's χ^2 test.

Epidemiological data and statistical software

The differences in encountered HEMS patients and mission characteristics before and after the intervention were analysed by Mann-Whitney U test, Student's t-test or Pearson's χ^2 test, as appropriate, with a defined significance level of 0.05. Data are reported as the mean with SD, median with IQR or proportions, as appropriate. When comparing HEMS alarm times pre- and post-intervention, extreme outliers, defined as more than 3 SD from the mean, were excluded prior to analyses.

Collected data were stored on a secure server at Central Norway Regional Health Authority's IT department (HEMIT). Statistical analyses were performed using IBM Statistics SPSS V.27 (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, V.27.0. Armonk, NY: IBM Corp), R Statistics V.4.0.4 (R Core Team 2013, R Foundation for Statistical Computing, Vienna, Austria) and Microsoft Excel (Microsoft Office 365 ProPlus, Microsoft Corporation, USA).

The paper was written according to the Standards for Quality Improvement Reporting Excellence guidelines for reporting quality improvement research in healthcare.[26]

Patient and public involvement statement

There was no patient or public involvement in the planning or execution of this study.

RESULTS

Mission and patient characteristics

Approximately 60% of the requests for HEMS resulted in patient contact, both in the pre- and post-intervention period (table 1). The mission requests were comparable before and after the intervention in terms of mission type distribution, mode of transportation (helicopter/car) and deviation categories including aborted and rejected missions. Besides some requests regarding patients inaccessible without HEMS (7.8% vs 5.7%), the vast majority (>90%) of mission requests had no additional rationale for HEMS dispatch both pre- and post-intervention. There was no significant difference in the overall median alarm time (from emergency call to HEMS alarm) before and after the intervention. Patients encountered by HEMS were similar regarding age and gender pre- and post-intervention.

VC utilisation by the EMCC and HEMS physician

Trondheim EMCC received 64 621 and 42 273 emergency calls in all triage categories during the pre- and post-intervention period, respectively. VC was activated by the EMCC operator in 1849 (4,4%) of the post-intervention calls. The triage category was set to acute (immediately or potentially life-threatening event) in 44.7% (826) of VC. Technical issues related to establishing VC, including poor mobile phone reception and user errors by the callers, were registered in 113 calls (6.1%).

In the post-intervention period, Trondheim HEMS received 651 mission requests, of which VC was used in 110 requests (16.9%) (table 2). Video was used by the HEMS physician in addition to the EMCC operator in 2 (1.8%) of these VC. There was no significant difference in HEMS alarm time when comparing VC and non-VC post-intervention.

In missions with VC, 72.1% of patients were classified as NACA score 3 or 4. These patients were in general younger (median age 52.5 vs 62 years, p=0.007), and a higher proportion were children<11 years of age (29.4% vs 10.2%, p≤0.001), compared with patients in the non-VC group (table 2). A higher proportion of patients with circulatory disorders (ICD chapter I) was found in the non-VC group (49.7% vs 22.1%, p≤0.001), whereas traumatic injuries (ICD chapters S and T) occurred more frequently in mission with VC (39.7 vs 20.4%, p≤0.001).

Primary outcome

After excluding requests without patient contact, 1213 missions involving 1226 patients were included in the primary outcome analysis (figure 1). The percentage of missions with severe illness or injury (NACA 4–7) was 70% and 75% pre-and post-intervention, respectively. In the logistic regression analysis, the covariate 'VC available in the EMCC' had no significant effect on the proportion of missions with NACA 4–7 (OR 1.21, 95% CI 0.92 to 1.61, p=0.17). A significant relationship was demonstrated between the occurrence of any additional cause for dispatch and a lower proportion of NACA score 4–7 (OR 0.15, 95% CI 0.09 to 0.24, p<0.001).

Secondary outcome

A total of 246 requests resulting in 154 missions with patient contact were obtained during the pre-intervention period after the quality indicator application was available (table 3). The HEMS physicians assessed that additional competence was offered in 25.3% versus 34.3% (p=0.04) and that a logistical contribution was present in 36.4% versus 44.8% (p=0.07) of the missions in the pre- and post-intervention group, respectively. A higher proportion of missions with provision of procedures or medications only offered by P-EMS in the actual region was found post-intervention (19.5% vs 28.6%, p=0.028). Finally, the proportion of missions with neither medical nor logistical benefit was significantly lower in the post-intervention group (28.4% vs 40.3%%, p=0.007).

DISCUSSION

In this before-and-after study, the proportion of patients with serious illness or injuries (NACA 4–7) treated by Trondheim HEMS base did not change significantly after introducing VC in Trondheim EMCC. A significantly lower proportion of HEMS missions without medical or logistical benefit was found post-intervention. In missions where VC was used as a part of HEMS dispatch, a larger proportion of patients were children <11 years of age. Also, more patients had traumatic injuries compared with HEMS dispatch without VC.

How to assess proper HEMS use?

The eight-level NACA score is well established in prehospital emergency services of western Europe, leading to proper availability of historical data.[5 6] The score is simple to use and has been shown to be a reliable predictor of mortality.[23 27] As it describes the prehospital phase exclusively, the score is not affected by in-hospital treatment or diagnostic procedures. As such, it seems relevant to

Table 1 Mission and patient characteristics in HEMS missions pre and post introduction of video calls in the EMCC

	Pre-intervention			Post-intervention			Missing	
	N	%	Median (IQR)	N	%	Median (IQR)	N	P value
Mission requests	1316			651				
Primary missions	1273	96.7		635	97.5			
SAR missions	43	3.3		16	2.5			
Missions with patient contact	811	61.6		402	61.8			
Patients encountered	814			412				
Missions with NACA score 4–7* (primary outcome)	811	70.3		402	74.6			
Mission characteristics								
Helicopter requests	841	63.9		397	61			
Rapid response car requests	475	36.1		254	39			
Missions requests with deviations	522	39.7		248	38.1			
Type of deviation								
Delayed response	28	2.1		7	1.1			
Aborted mission	213	16.2		122	18.7			
Rejected mission	275	20.9		116	17.8			
Other deviations	6	0.5		3	0.5			
Additional rationale for dispatch								
None	1211	92		612	94			
Patient not accessible without HEMS	102	7.8		37	5.7			
Other	3	0.2		2	0.3			
Alarm time from emergency call to HEMS alarm	1298		7.6 min (25.9)	630		6.4 min (20.3)	39	0.15†
Patient characteristics								
Age	814		57.5 years (40)	411		61 years (43)	1	0.33†
Gender								0.99‡
Males	545	67		276	67			
Females	269	33		136	33			
NACA score	814			412				
NACA 1	5	0.6		–	–			
NACA 2	29	3.6		11	2.7			
NACA 3	210	25.8		100	24.3			
NACA 4	280	34.4		135	32.8			
NACA 5	116	14.3		48	11.7			
NACA 6	86	10.6		55	13.3			
NACA 7	88	10.8		63	15.3			

*In case of multiple patients in a mission, only the one with the highest NACA score was included in the analysis.
†Mann-Whitney U-test.
‡χ^2 test.
AMIS, emergency medical information system ; HEMS, helicopter emergency medical services; NACA, National Advisory Committee for Aeronautics; SAR, search and rescue.

examine NACA score when assessing proper HEMS dispatch.[7]

As no physiological or other objective parameters are included in the scoring algorithm, the NACA-score evaluation of each patient largely depends on the subjective assessment and experience level of the individual HEMS physician.[28] Although a substantial inter-rater reliability and an acceptable rater-against-reference reliability for the NACA-score has been demonstrated, the subjectivity of the NACA-score has been outlined as a major weakness, and different physicians have been shown to score incorrectly even in indisputable clinical settings like cardiac

Table 2 Mission and patient characteristics in HEMS missions with and without use of VC post-intervention

	No video			Video			Missing	P value
	N	%	Median (IQR)	N	%	Median (IQR)	N	
Mission requests	541			110				
Patients encountered	344			68				
Missions requests with use of VC								
Total number				110 (651)	16.9			
Video used by EMCC				108				
Video used by EMCC and HEMS physician				2				
Time from emergency call to video enabled				108		8 min (7.6)		
Time from emergency call to HEMS alarm	523		6.8 min (24.1)	107		5.9 min (7.4)		0.396*
NACA score on missions	344			68				
NACA 2	7	2.0		4	5.9			
NACA 3	75	21.8		25	36.8			
NACA 4	111	32.3		24	35.3			
NACA 5	40	11.6		8	11.8			
NACA 6	50	14.5		5	7.4			
NACA 7	61	17.7		2	2.9			
Missions requests with deviations	204	37.7		44	40			
Type of deviation								
Delayed response	6	1.1		1	0.9			
Aborted mission	97	17.9		25	22.7			
Rejected mission	99	18.3		17	15.5			
Other deviations	2	0.4		1	0.9			
Age	343		62.0 years (40)	68		52.5 years (66)	1	0.007†
0–10	35	10.2		20	29.4			<0.001†
Diagnoses (ICD-10)‡	344			68				
I00-I99	171	49.7		15	22.1			<0.001†
J00-J99	26	7.6		4	5.9			
R00-R99	33	9.6		13	19.1			
S00-T88	70	20.4		27	39.7			<0.001†
Other diagnoses	43	12.5		9	13.2			

Mann-Whitney U-test.
*Mann-Whitney U-test.
†χ^2 test.
‡I00-I99: diseases of the circulatory system; J00-J99: diseases of the respiratory system; R00-R99: symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified; S00-T88: injury, poisoning and certain other consequences of external causes.
EMCC, emergency medical communication centres; HEMS, helicopter emergency medical services; ICD-10, international classification of diseases v10; NACA, National Advisory Committee for Aeronautics; VC, video calls.

arrest.[29 30] As timing of the NACA score is essential, using scores registered after initial patient contact on-scene and not based on available information at the time of dispatch has some obvious limitations when assessing proper HEMS dispatch retrospectively.[31]

Following this, it seems valuable to assess the question of proper HEMS dispatch by a multidimensional approach, in the same manner as depicted by Haugland *et al* regarding the overall quality of P-EMS.[11] Thus, an assessment of the medical and logistical contribution by the HEMS physician on each mission might add important information regarding the value of HEMS dispatch not necessarily captured by the patient's NACA score. Although potentially limited by both subjectivity as well as recall and registration bias, a significant lower proportion of missions with neither medical nor logistical benefit was observed post-intervention. This might indicate a positive trend in the ability of the EMCC system to identify missions with HEMS benefit following the intervention. Following this, a multidimensional approach is likely to

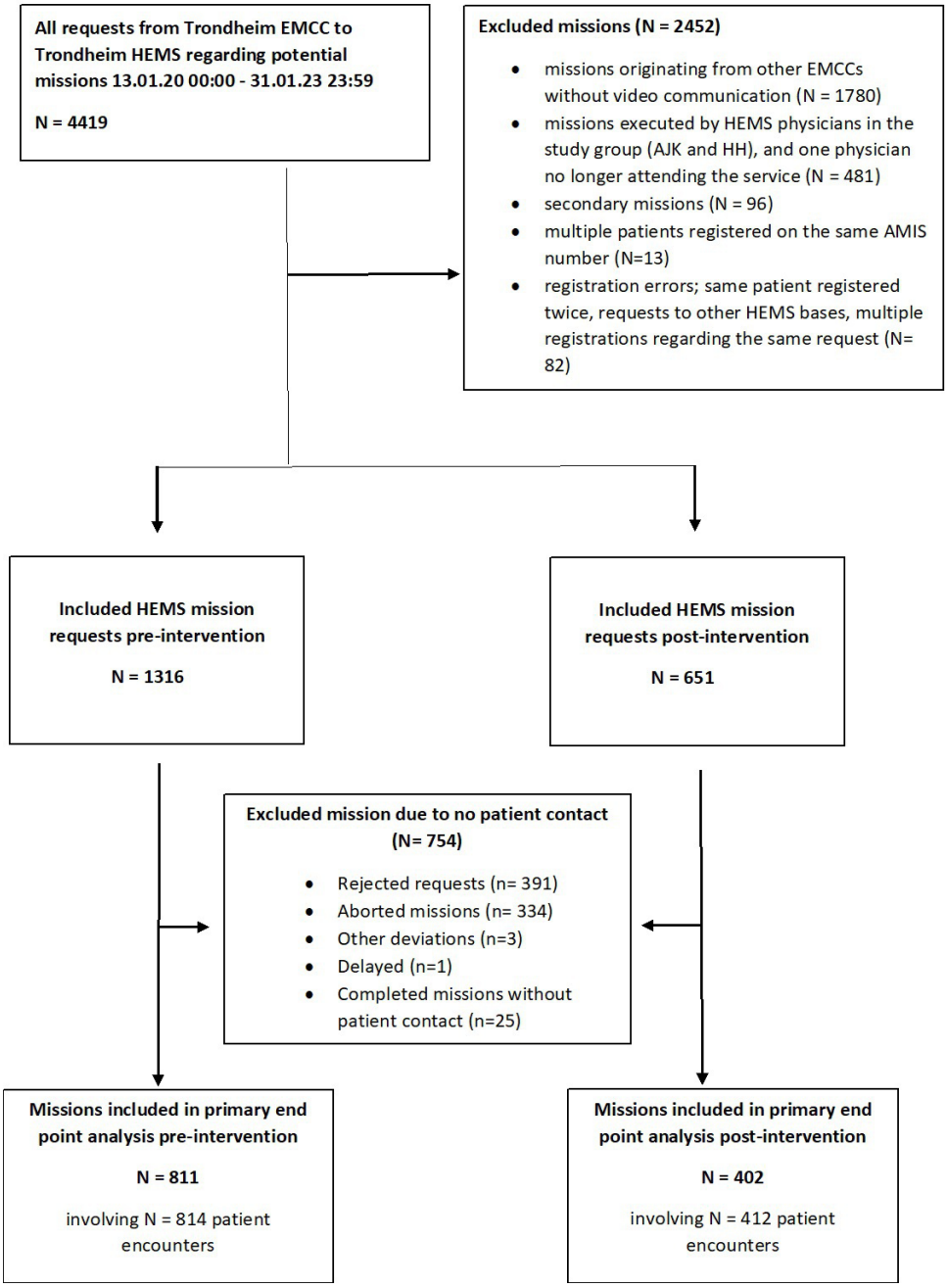

Figure 1 Flow chart of inclusion and exclusion criteria for primary end point analysis. EMCC, emergency medical communication centres; HEMS, helicopter emergency medical services.

be preferable to single scoring systems for future studies evaluating HEMS dispatch precision in the EMCC.[7]

Video use in the EMCC

Except for out-of-hospital cardiac arrest, where a few clinical studies have shown promising results on video-assisted bystander cardiopulmonary resuscitation quality, ROSC rate and survival to hospital discharge,[32 33] considerable knowledge gaps exist regarding the effects from implementing VC in clinical practice of emergency medicine.[34 35] However, as adding video to conventional emergency calls in medical dispatching has been shown to change the dispatcher's assessment of patient severity and help determining appropriate prehospital resources to the mission, VC could be a potential way to assess the known challenges related to appropriate HEMS dispatch.[4 16 17] Besides one small feasibility study,[17] this is one of the first studies to explore this topic.

EMCC operators were instructed to consider activating VC when they thought this could add valuable information and help dispatch the appropriate EMS response. The operators decided to activate VC in 4.4% of all emergency calls, whereas VC was enabled in 16.9% of the HEMS requests in the post-intervention period (table 2). Technical difficulties related to VC transmission occurred

Table 3 Quality indicators regarding HEMS benefit before and after VC introduction in the EMCC

	Pre-intervention		Post-intervention		P value
	N	%	N	%	
Mission requests	246		651		
Missions with patient contact	154		402		
Quality indicator: Did the P-EMS service provide advanced treatment in the actual response?					
Yes (all categories)	39	25.3	138	34.3	0.041*
Yes; procedures (both medical and rescue techniques) or medications only offered by P-EMS units in the actual region	30	19.5	115	28.6	0.028*
Yes; procedures or medications also offered by other local prehospital units than the P-EMS, but these were not present on scene	2	1.3	3	0.7	
Yes; avoidance of unethical/unnecessary treatment	2	1.3	6	1.5	
Yes; presence in particularly demanding situations, for example, the death of a child, major incidents, and so on.	5	3.2	14	3.5	
No	106	68.8	249	61.9	0.13*
Missing	9	5.8	15	3.7	
Quality indicator: Did the logistical contribution by P-EMS give the patient a significant better service than the existing alternative?					
Yes (all categories)	56	36.4	180	44.8	0.07*
Yes; by a) reducing the estimated time to admitting facility with≥30 min for time critical conditions like STEMI, stroke and severe trauma	47	30.5	143	35.6	0.181*
Yes; by b) reducing the estimated time to admitting facility with 15–29 min for time critical conditions like STEMI, stroke and severe trauma	5	3.2	19	4.7	
Yes; by c) accessing and/or evacuating the patient from an area otherwise difficult to access	4	2.6	13	3.2	
Yes; both a) and c)	-	-	4	1	
Yes; both b) and c)	-	-	1	0.2	
No	89	57.8	207	51.5	0.183*
Missing	9	5.8	15	3.7	
No HEMS benefit					
Missing information on one or both QI	9		15		
Neither medical nor logistical benefit	62	40.3	114	28.4	0.007*

*χ^2 test.
EMCC, emergency medical communication centres; HEMS, helicopter emergency medical services; P-EMS, physician-staffed emergency medical services; QI, quality indicators; STEMI, ST-elevation myocardial infarction; VC, video calls.

only sporadically, as observed in previous studies.[16 17 34 36] The infrequent use of VC during the first year after implementation is comparable to previous findings and might reflect the complexity of introducing a new telemedical solution affecting established routines and guidelines in the EMCC.[16 36 37] Also, the vast majority of emergency calls are responded to following a criteria-based dispatch guideline, that is, the Norwegian Index for Medical Emergency Assistance.[38] If the emergency call and the dispatch guideline provide the operator with enough information to dispatch the assumedly adequate resources, VC might be considered unnecessary.[16] However, when dispatching the more specialised and limited HEMS resource, the need for supplementary information provided by VC might be considered more relevant—as reflected in the relatively high proportion of VC in HEMS dispatches found in this study.

Although all HEMS physicians attending the study were informed twice about the possibilities of VC (once before and once during the post-intervention period), the physicians requested to join the video conference in only 1.8% of VC. Considering the high availability and technical stability of VC demonstrated in this study, this might indicate that the physicians relied on the visual information obtained by the EMCC operators when assessing the need for HEMS dispatch.

Adding video to an emergency call might represent a delay in prehospital response times, as VC is shown to be more time consuming compared with audio calls.[16] Also, it seems disadvantageous to use VC for dispatch

considerations in settings where dispatching HEMS is clearly indicated (i.e. critical injuries, cardiac arrest, etc.), although VC might be useful for instructing bystanders in first aid before EMS resources arrive at the scene.[16 33] Hence, EMCC operators were instructed to alarm EMS resources instantly before considering VC in calls with immediate (red) triage. Following this, an important finding in our study is that the median HEMS alarm time was unchanged post-intervention. Also, when VC was used in HEMS missions, only 1/10 of the patients had NACA scores 6–7, while most patients (72.1%) had NACA scores of 3 and 4. This might indicate that the most important value of VC related to precise HEMS dispatch is in cases with moderately injured or ill patients where the decision to send HEMS or not might be questionable.

The more frequent use of VC in cases with sick children found in previous studies was also demonstrated in our data, with 29.4% vs 10.2% of patients aged 0–10 years in the video versus non-video group post-intervention, respectively (p<0.001).[16] This might reflect an important feature of VC, namely the possibility for the EMCC operator to perform an objective assessment of patients not being able to verbalise their symptoms. Also, the observed higher proportion of trauma patients in the video group has been reported previously,[18 36] and might be addressed to the need for further objective information than mechanism of injury following trauma. In a road traffic accident for instance, VC enables the EMCC operator to visually assess both patients and involved cars.

Strength and limitations

To our knowledge, no other interventions or major events that could affect the outcomes of this study took place in the Trondheim EMCC or Trondheim HEMS base during the pre- and post-intervention periods. This supports addressing the observed outcomes to the intervention. Based on the rich access to historical data, blinding of outcome measures and the attending HEMS physicians' extensive experience in using NACA score, it's likely to assume that the severity scoring of patients was consistent throughout the data collection period and unaffected by the intervention. Using data from the same physicians both pre- and post-intervention also represents a strength of this study.

The pre–post design in our study is inferior to a randomised controlled trial in order to draw robust causality conclusions following the intervention. However, as the intervention was introduced and managed outside the study group, randomisation was not considered practically feasible. Another limitation is the short pre-intervention data collection of quality indicators, resulting in different pre- and post-intervention periods for primary and secondary outcomes. Assessing quality indicators for rapid response car and helicopter missions combined (table 3) might affect results, as the logistical contribution of road responses probably is of less importance. Finally, it would be preferable to include hospital data from the emergency department to assess the rate of EMCC undertriage regarding HEMS dispatch (patients admitted to hospitals by ambulance with illness or injury requiring HEMS) before and after the intervention. However, this was considered to be beyond the scope of this study.

Conclusion

In this before–after study, the proportion of encountered HEMS patients with serious illness or injury (NACA 4–7) was not changed significantly the first year after introducing VC in Trondheim EMCC. However, we observed a decrease in the proportion of HEMS missions without medical or logistical benefit following the intervention. HEMS alarm times were not prolonged after the intervention. Our findings indicate that VC in the EMCC is a promising, feasible and safe add-on to help EMCC operators in the challenging HEMS dispatch process. Randomised controlled trials are warranted to further explore the potential benefits of VC in emergency medicine.

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Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The Regional Committee for Medical and Health Research Ethics in Mid-Norway (REC) assessed the study, found the project to fall outside the working area of the Norwegian Health Care Research Act (REC 450458/2022) and approved an exemption from the duty of confidentiality (REC 453156/2022). REC stated that only anonymised data would be collected and analysed for patient groups, not individuals. They also stated that obtaining a consent form from critically ill or injured patients with high mortality rates transported by HEMS would be both infeasable and imply a greater threat to privacy.

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