Point-of-Care Ultrasound (POCUS) practices in the Helicopter Emergency Medical Services in Europe

Peter Hilbert-Carius

Klinikum Bergmannstrost Halle

Manuel F Struck

University Hospital Leipzig: Universitätsklinikum Leipzig

Marcus Rudolph

DRF Stiftung Luftrettung gemeinnutzige

Jürgen Knapp

Bern University Hospital

Leif Rognås

Danish air ambulance, Danish Air Ambulance

Jürgen Adler

Luxembourg Air Rescue

Cor Slagt

Pain and Palliative Medicine and Helicopter Emergency Service

Lars Jacobsen

Sorlandet Hospital

Henryk Pich

University Hospital Augsburg: Universitätsklinikum Augsburg

Michael D Christian

London's Air Ambulance

Didier Dandrifosse

Luxembourg Air Rescue

Fikri Abu-Zidan (✉ fabuzidan@uaeu.ac.ae)

College of Medicine, UAE University <https://orcid.org/0000-0003-0143-8568>

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Abstract

Background: The extent to which Point-of-care of ultrasound (POCUS) is used in different European helicopter EMS (HEMS) is unknown. We aimed to study the availability, perception, and future aspects of POCUS in the European HEMS.

Methods: A survey about the use of POCUS in HEMS was conducted by a multinational steering expert committee and was carried out from November 30, 2020 to December 30, 2020 via an online web portal. Invitations for participation were sent via email to the medical directors of the European HEMS organizations including two reminders.

Results: During the study period, 69 participants from 25 countries and 41 different HEMS providers took part in the survey. 96% (n=66) completed the survey. POCUS was available in 75% of the responding HEMS organizations when needed (56% always, and 19% occasionally). 17% were planning to establish POCUS in the near future. Responders who provided POCUS used it in approximately 15% of the patients. Participants thought that POCUS is important in both trauma and non-trauma-patients (73%, n=46). The extended focused assessment sonography for trauma (eFAST) protocol (77%) was the most common used protocol. A POCUS credentialing process including documented examinations was requested in less than one third of the HEMS organizations.

Conclusions: The majority of the HEMS organizations in Europe are able to provide different POCUS protocols in their services. The most used POCUS protocols were eFAST, FATE and RUSH. Despite the enthusiasm for POCUS, comprehensive training and clear credentialing processes are lacking in about two thirds of the European HEMS organizations.

Background

Point-of-care of care ultrasound is a **Physiological, On spot Clinical examination** that is **Unique and Safe** [1]. It has been used in acute care settings since more than thirty years [2]. The small size, light weight, portability, improved quality of imaging, ability to store images, and the relatively low cost are clear advantages of the hand-held portable ultrasound machine [3]. These advantages make POCUS useful in many acute point-of-care settings including pre-hospital resuscitation, emergency departments, intensive care units, and operation theatres [4, 5]. POCUS performed in the pre-hospital and mass casualty incidents may affect the clinical decisions, notifications, transport modes, and hospital destination [3]. Pre-hospital POCUS was established two decades ago in various pre-hospital emergency medical services (EMS) in Europe, Australia, and North America [6, 7]. It was available in 9% of the French EMS units [8] and in 4.1% in the USA and Canada [9]. Furthermore, 21% of EMS services in the USA and Canada considered implementing it [9]. Pre-hospital POCUS is not widely used possibly due to limited availability and lack of strong evidence of its clinical value [10–12]. The extent to which POCUS is used in different European helicopter EMS (HEMS) is unknown. There exist no data on applied POCUS protocols, its training and credentialing methods, and the opinions of health care providers in the HEMS on its value. We aimed to

study the availability, perception, and future aspects of POCUS in the European HEMS using an online survey.

Methods

A multinational steering expert committee developed a questionnaire about the use of POCUS in HEMS. The ten-minutes survey consisted of 24 questions regarding demographics, availability, present and future use of POCUS in HEMS, importance of POCUS in different conditions, used POCUS protocols, and if there were any necessary credentialing POCUS processes for medical providers (**Suppl Table 1**). The survey was provided online via the web portal SurveyMonkey®. To ensure that every participant could only answer the survey once, the IP-address was recorded, whereas all data were analyzed anonymously. The invitation link and the QR-code for the survey was sent via email to the medical directors of the European HEMS organizations of 28 countries across Europe and a second and third reminders were sent to non-respondents. The survey was available online from November 30 to December 30, 2020 and it was possible to answer it with any mobile device (smartphone, tablet) or PC.

Descriptive analysis was done using the analysis tools provided by SurveyMonkey® and the statistic software GraphPad Prism 9.0 (GraphPad Software, San Diego, CA, USA). Data were presented as median (range) and mean (SD) for ordinal and continuous data, and number (%) for categorical data. If data were missing, valid percentages were calculated from the available data. The study is in line with the current European general data protection regulation (GDPR).

Results

General Data

During the study period, 69 participants from 25 countries (89% of the invited countries) and 41 different HEMS organizations took part in the survey. The survey was completed by 96% (n = 66 of 69) of the participants. Most of the participants 95.5% (n = 65 of 69) were males, between 41 and 50 years old, and had a leading position within their HEMS organization (71%, n = 49 of 69). Almost all HEMS programs (97.5%, n = 40 of 41) were physician staffed, in which the physician was joined by a paramedic in 65% (n = 26 of 40) or a flight nurse in 20% (n = 8 of 40) (Table 1). An Infirmier Siamu (Infirmier - French term for a nurse; Siamu - abbreviation for the French term “Soins Intensifs et Aide Medicale Urgente”; intensive care and urgent medical aid) a nurse that combines clinical intensive care medicine and preclinical emergency medicine, were part of the medical team in 7.5% (n = 3 of 40), and a paramedic or flight nurse in 2.5% (n = 1 of 40) respectively (missing data were in 5%, n = 2). The non-physician staffed HEMS was only paramedic service.

Table 1

Overview of countries, HEMS-organizations (anonymous) and POCUS of the survey participants.

Country	No. of responders	No. of providers	HEMS-organizations*	Physician staffed	With Doctor in cabin	POCUS provided
1) Austria	2	2	1	yes	Paramedic	yes
			2	yes	Paramedic	yes
2) Belgium	1	1	3	yes	Infirmier Siamu	Yes
3) Czech Republic	9	5	4	yes	Paramedic	no
			4	yes	Paramedic	yes
			4	yes	Paramedic	no
			5	yes	Paramedic	no
			4	yes	Paramedic	no
			6	yes	Flight nurse	occasionally
			4	yes	Paramedic	yes
			7	yes	Paramedic	no
			8	yes	Paramedic	no
4) Denmark	1	1	9	yes	Paramedic	Yes
5) Finland	2	1	10	yes	Paramedic	Yes
6) France	2	2	11	yes	Flight nurse	no
			12	yes	Flight nurse	occasionally
7) Germany	13	4	13	yes	Paramedic	yes
			14	yes	Paramedic	yes
			15	yes	Paramedic	yes
			16	yes	Paramedic	yes
8) Greece	1	1	17	yes	Flight nurse	Occasionally
9) Hungary	1	1	18	yes	Paramedic	Yes

n.a. – no answer; * HEMS organizations are listed by numbers to keep the data anonymous, every number express a different HEMS organization

Country	No. of responders	No. of providers	HEMS-organizations*	Physician staffed	With Doctor in cabin	POCUS provided
10) Ireland (Republic)	1	1	19	no		No
11) Israel	2	1	20	yes	Paramedic	Occasionally
12) Italy	1	1	21	yes	Flight nurse	yes
13) Liechtenstein	1	1	22	yes	Paramedic	No
14) Luxembourg	1	1	23	yes	Infirmier Siamu	Yes
15) Netherland	6	1	24	yes	Paramedic Flight nurse	yes
16) Norway	5	1	25	yes	Paramedic	Yes
17) Poland	1	1	26	yes	Paramedic	Yes
18) Portugal	1	1	27	yes	Infirmier Siamu	No
19) Romania	1	1	28	yes	n.a.	occasionally
20) Russia	1	1	29	yes	Paramedic	Occasionally
21) Slovenia			30	yes	n.a.	Yes
22) Spain	2	2	31 32	yes yes	Flight nurse Flight nurse	occasionally no
23) Sweden	3	1	33	yes	Flight nurse	Yes
24) Switzerland	5	3	34 35 36	yes yes yes	Paramedic Paramedic Paramedic	no no yes

n.a. – no answer; * HEMS organizations are listed by numbers to keep the data anonymous, every number express a different HEMS organization

Country	No. of responders	No. of providers	HEMS-organizations*	Physician staffed	With Doctor in cabin	POCUS provided
25) United Kingdom	5	5	37	yes	Paramedic	yes
			38	yes	Paramedic	no
			39	yes	Paramedic	yes
			40	yes	Paramedic	yes
			41	yes	Paramedic	yes
n.a. – no answer; * HEMS organizations are listed by numbers to keep the data anonymous, every number express a different HEMS organization						

POCUS and HEMS organizations

Unrestricted availability of POCUS was in 56% (n = 23 of 41) of the HEMS organizations (standardized equipment at all related HEMS bases), occasionally possible in 19.5% (n = 8 of 41), and not possible in 24.5% (n = 10 of 41) (Table 1). The time since POCUS had been established in the different HEMS organizations ranged from less than one year up to 20 years. Of the HEMS organizations not yet providing POCUS, 70% (n = 7 of 10) stated planning to integrate it in the future within a median (range) time of 2 (1–4) years. Responders of the HEMS providers in which POCUS was available estimated that POCUS had been used in a median (range) percentage of 15% (0.8–37.5) of patients (Table 2).

Table 2
Time since POCUS is provided or will be provided and frequents of use.

Question	Number	Median (range)	Mean (SD)
For how many years have your HEMS been providing POCUS?	51	6 (0.5–20)	6.54 (4.4)
In how many years does your HEMS organization plan to integrate POCUS in the patients care in the future?	11	2 (1–4)	2.81 (1.1)
How often has POCUS being used in the last 1000 patients of your HEMS organization?	40	150 (8–375) 15% (0.8–37.5)	146 (100) 14.6% (10)

Regarding the credentialing process for using POCUS in the different HEMS organizations providing POCUS, 35% (n = 11 of 31) has an established credentialing process. If a credentialing process was established, a POCUS-course led by an expert was requested in 9 HEMS, an additional didactic teaching of an average of 6.5 hours and hands-on training of an average of 5.5 hours were requested in four HEMS. In two of the four mentioned HEMS organizations, documented POCUS cases were needed before using POCUS in HEMS. In the other two HEMS organizations, own didactic teaching and hands-on training were requested. Generally, comprehensive training and credentialing activities are scarce in the European HEMS organizations.

Participants' opinion

Table 3 summarizes the results of the importance of POCUS in general, in different areas and different patient conditions. Most participants think that POCUS is important in both trauma and non-trauma patients (73%, n = 46 of 63), whereas 19% (n = 12 of 63) think that POCUS is more important in trauma patients, while 8% (n = 5 of 63) think that it was important in non-trauma patients. Standard examination protocols are being used by the majority of participants 63% (n = 38 of 60), whereas 32% (n = 19 of 60) do not use such protocols and 5% (n = 3 of 60) were not sure. The (e)FAST protocol is the most used protocol (77%). The findings of POCUS were recorded in a reliable way (video clip or electronic database) in less than 30%, and mainly put down in writing on the mission protocols (Table 4).

Table 3
Importance of POCUS in general, in different areas and different patient conditions

	Number	Median (range)	Mean $\pm$ SD
How important is POCUS for your HEMS organization in daily HEMS practice? (1 not important at all, 10 extremely important)?			
	61	7 (1–10)	6.72 (2.19)
What are the areas mainly investigated with POCUS in your HEMS and how important are they? (1 not important, 2 possible importance, 3 important, 4 very important, 5 of utmost importance)			
Airway	55	2 (1–5)	2.04 (1.05)
Chest	60	4 (1–5)	3.85 (0.92)
Regional anesthesia	56	2 (1–4)	1.89 (0.89)
Abdomen	60	4 (1–5)	3.63 (0.92)
Echocardiography	58	4 (1–5)	3.69 (1.06)
Vascular (Aortic aneurysm)	58	3 (1–5)	2.98 (1.03)
What are the clinical conditions in which POCUS is important? (1 – I disagree, 2 – I am not sure, 3 – I agree)			
Traumatic shock	60	3 (1–3)	2.92 (0.33)
Non traumatic shock	59	3 (1–3)	2.78 (0.5)
Acute abdomen	59	3 (1–3)	2.49 (0.78)
Dyspnea	60	3 (1–3)	2.77 (0.5)
CPR	60	3 (1–3)	2.68 (0.57)

Table 4
Used POCUS protocols and mode of recording of the findings.

POCUS protocol	Number	%
If you use standard protocols – What protocols are used?		
(p)FAST (pre-hospital focused assessment sonography for trauma)	9	23
(e)FAST (extended focused assessment sonography for trauma)	30	77
FATE (focus assessed transthoracic echo)	14	36
RUSH (rapid ultrasound in shock)	10	26
Others (see below)	7	18
Not specified	5	12.5
FEEL (focused echocardiography in emergency life support)	1	2.5
Lung-US for COVID-19	1	2.5
How are the POCUS findings recorded in your HEMS?		
Mission protocol / Patient Record Form	33	57
Video clip	8	14
Electronic data base	8	14
Not recorded, if not relevant	11	19
Not recorded at all	16	28

POCUS devices

The most commonly used portable ultrasonography devices were, GE healthcare V-scan in 40% (n = 21), FUJIFILM Sonosite iviz in 36% (n = 19), Philips healthcare Lumify and Butterfly Network iQ in 6% (n = 3) respectively. Some HEMS organizations use more than one POCUS device manufacturer. Most of the participants (71%, n = 39) were pleased with the devices used.

Discussion

Our study indicates that more than two-thirds of the European HEMS organizations provide POCUS in their helicopters and that a considerable number is planning to establish it soon. HEMS providers appreciate the increased need for POCUS integration in pre-hospital care. To our knowledge, this is the first survey regarding the pre-hospital use of POCUS in HEMS organizations across Europe.

Data suggest that POCUS is feasible and useful in HEMS. Nevertheless, the evidence regarding improving direct patient outcome is weak and needs to be clarified by properly designed prospective studies [10, 11, 13–18]. There are different POCUS protocols that can be used in the pre-hospital setting which include

extended (e)FAST to search for intraperitoneal fluid, peri-cardiac fluid, haemothorax and pneumothorax, [19, 20], Rapid Ultrasound for Shock (RUSH) to define the cause of the shock, and Focused Assessment Transthoracic Echocardiography (FATE) to quickly evaluate the cardiac function [21–24]. Our results show, that (e)FAST is the most used protocol in HEMS.

With advancements in technology and training, the use of POCUS extended to more indications like diagnosis of eye injuries and bone fractures [25, 26]. POCUS training should be tailored towards the specific needs of the HEMS staff. The operators should be familiar with their own ultrasound machines and should be particularly knowledgeable of the sonographic artefacts that can mislead them [4, 27].

The participants thought that POCUS examinations of the chest, abdomen and heart are very important, vascular access are important, while POCUS for airway management and regional anesthesia is less important, (see Table 3). It is of interest to note that the needed POCUS skills for airway management and interventions are more advanced. Currently less than one-third of the participating HEMS organizations seems to have a credentialing process for using POCUS. The other two-third assumed that the HEMS crews can perform POCUS. Training must be standardized to maximize the benefit of POCUS. European HEMS organizations should agree on common POCUS curriculum with an accepted standard that suits their needs. Competency is a key factor in successful clinical applications [4, 28]. Using a Delphi methodology, Micheller et al. defined a total of five modalities (cardiac, thoracic, FAST, aorta, and procedural), with 32 measured competencies and 72 sub competencies [29] as the basis for the needed curriculum. Consecutive quality assurance and governance are probably more challenging, as POCUS findings are interpreted in a dynamic clinical context.

POCUS seems to be accepted and available in Europe. Besides the more frequent use of POCUS compared with North America, the survey underlines that HEMS in Europe is mainly physician staffed which can explain the frequent use of POCUS (9, 28). Some participants stated that POCUS is used in more than 30% of their patients indicating proper training in a wide range of applications.

Limitations

The represented study has some limitations which we would like to highlight. *First*, it was a voluntary online survey that carries the risk of selection bias of participants who encourage the use of POCUS. This may overestimate the value of POCUS. *Second*, the majority of participants are leaders in their HEMS organization, with the risk of reporting results that are preferred by them and may be different from those who use it. *Third*, we did not get the response of all invited HEMS organizations carrying the risk of selection bias. The survey was asked in a limited period of 30 days possibly explaining the small sample size. *Fourth*, female responders were few with the majority being males. *Finally*, some of the participating countries and HEMS organizations were overrepresented. This was taken into consideration when reporting availability of POCUS in the organizations but could have skewed the opinion data.

Conclusions

Our study has shown that most of the HEMS organizations in Europe are able to provide different POCUS protocols in their services. The most commonly used POCUS protocols were (e)FAST, FATE and RUSH. Despite the enthusiasm for POCUS, comprehensive training and clear credentialing processes are not available in about two thirds of the European HEMS organizations.

Abbreviations

Abbreviation	Full terminology
COVID	corona virus infection disease
CPR	cardio pulmonary resuscitation
EMS	emergency medical service
FAST	focused assessment sonography for trauma
FATE	focused assessment transthoracic echocardiography
FEEL	focused echocardiography in emergency life support
HEMS	helicopter emergency medical service
n.a.	no answer
POCUS	Point-of-care ultrasound
RUSH	rapid ultrasound in shock
SD	standard deviation
SIAMU	Soins Intensifs et Aide Medicale Urgente “intensive care and urgent medical aid”
UK	United Kingdom

Declarations

Ethical Approval and Consent to participate: Not applicable.

The study is in line with the current European general data protection regulation (GDPR).

Consent for publication: Not applicable.

Availability of supporting data: The dataset generated and analysed during the current study are not publicly available due the ownership of the different air ambulance providers but are available from the corresponding author on request.

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Authors' contributions

P.H-C. and F. A-Z developed the study. All authors were involved the development of the questionnaire. P. H-C and M. St wrote the first manuscript draft. All authors were involved in the data analysis and the improvement of the manuscript. Statistical analysis was done by P.H-C and F.A-Z. All authors read and approved the final manuscript.

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Czech Army – Czech Republic

Den Landsdækkende Akutlægehelikopterordning – Denmark

DRF-Luftrettung – Germany

DSA Aviation Company – Czech Republic

EMRS (Emergency Medical Retrieval Service) – Scotland UK

FinnHEMS – Finland

GAMMA AIR MEDICAL – Greek

Heli South Tirol – Italy

Helikopter Air Transport Austria - Czech Republic

Hungarian Air Ambulance Ltd. – Hungary

IDF (Israeli Defense Forces) – Israel

INEM (Instituto Nacional de Emergência Médica) – Portugal

LAR (Luxembourg Air Rescue) – Luxembourg

Lifeline (Medical Air Assistance) - Netherlands

London's Air Ambulance – UK

National Air Ambulance Service – Russia

Norsk Luftambulans – Norway

Northern Helicopter – Germany

NWAA (North West air ambulance) – UK

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Svensk Luftambulans – Sweden

Zivilschutzhubschrauber – Germany

POCUS in HEMS collaborators

Alistair Maddock, Scotland UK; alistair.maddock@ggc.scot.nhs.uk

Anatolij Truhlar, Czech Republic; truhlaran@zzskhk.cz

Antonio Joaosagla, Portugal; antoniojoaosagla@gmail.com

Daniel Nevin, UK; daniel.nevin@nhs.net

Daniel Werner, Germany; Daniel.Werner@luftrettung.adac.de

Didier Moens, Belgium; didier.moens@centremedicalheliporte.be

Diego Aylagas, Spain; diego.aylagas@ua.es

Eimhear Quinn, UK; @eimsyeire

Eva Smrzova, Czech Republic; eva.smrzova@mzcr.cz

Frederic Pernot, France: pernotf@ghrmsa.fr

Fredrik Helliksson, Sweden; Fredrik.Helliksson@regionvarmland.se

Geert Jan van Geffen, The Netherlands; g.vangeffen@anes.umcn.nl

Gernot Aichinger, Austria; gernot.aichinger@ara-flugrettung.at

Jason van der Velde, Ireland; jason@ataccgroup.com

John Chatterjee, UK; djchatterjee@hotmail.com

Jörg Seifert, Germany; joerg.seifert@drf-luftrettung.de

Kirsti Strømmen Holm, Norway; kirsti.holm@norskluftambulanse.no

Manfred Hirner, The Netherlands; m.hirner@anest.umcg.nl

Marcel de Leeuw, The Netherlands; ma.deleeuw@amsterdamumc.nl

Marcin Kowalski, Poland; m.kowalski@lpr.com.pl

Marton Radnai, Hungary; marton.radnai@airambulance.hu

NikoRebling , Switzerland; n.rebling@air-ambulance.ch

Philipp Lakatos, Germany; Philipp.Lakatos@luftrettung.adac.de

Rein Ketelaars, The Netherlands; rein@ketelaars.nu

Richard Lyon, UK; richardl@aakss.org.uk

Robert Galazkowski, Poland; r.galazkowski@lpr.com.pl

Robert Gebei, Hungary; robert.gebei@airambulance.hu

Sebastian Daniel Tranca, Romania; Tranca.Sebastian@umfcluj.ro

Stephen Sollid, Norwegen; stephen.sollid@norskluftambulanse.no

Uros Lampic, Slovenia: u.lampic@gmail.com

Urs Pietsch, Switzerland; urs.pietsch@kssg.ch

Uwe Schweigkofler, Germany; Uwe.Schweigkofler@bgu-frankfurt.de

Ville Voipio, Finland; voipio@me.com

Wolfgang Voelckel, Austria: Wolfgang.Voelckel@auva.at

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