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Rognås and Hansen

ORIGINAL RESEARCH

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# EMS-physicians' self reported airway management training and expertise; a descriptive study from the Central Region of Denmark

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## Abstract

**Background:** Prehospital advanced airway management, including prehospital endotracheal intubation is challenging and recent papers have addressed the need for proper training, skill maintenance and quality control for emergency medical service personnel. The aim of this study was to provide data regarding airway management-training and expertise from the regional physician-staffed emergency medical service (EMS).

**Methods:** The EMS in this part of The Central Region of Denmark is a two tiered system. The second tier comprises physician staffed Mobile Emergency Care Units. The medical directors of the programs supplied system data. A questionnaire addressing airway management experience, training and knowledge was sent to the EMS-physicians.

**Results:** There are no specific guidelines, standard operating procedures or standardised program for obtaining and maintaining skills regarding prehospital advanced airway management in the schemes covered by this study. 53/67 physicians responded; 98,1% were specialists in anesthesiology, with an average of 17,6 years of experience in anesthesiology, and 7,2 years experience as EMS-physicians. 84,9% reported having attended life support course (s), 64,2% an advanced airway management course. 24,5% fulfilled the curriculum suggested for Danish EMS physicians. 47,2% had encountered a difficult or impossible PHETI, most commonly in a patient in cardiac arrest or a trauma patient. Only 20,8% of the physicians were completely familiar with what back-up devices were available for airway management.

**Conclusions:** In this, the first Danish study of prehospital advanced airway management, we found a high degree of experience, education and training among the EMS-physicians, but their equipment awareness was limited. Check-outs, guidelines, standard operating procedures and other quality control measures may be needed.

## Background

Prehospital advanced airway management (PHAAM), including prehospital endotracheal intubation (PHETI) continues to be a controversial topic. Some investigators report an alarming rate of complications related to PHAAM, especially to PHETI [1-6], but the results are conflicting, and several other systems reports success rates of PHETI of well over 90% both in American [3] and European [7-16] EMS. Nevertheless: PHAAM is challenging, and recent papers have addressed the need for proper training, skill maintenance and quality

control for EMS personnel [11,17-20]. Several guidelines for PHAAM have been published [21-24], stressing the importance of PHAAM-provider experience.

Sollid *et al.* [25] found that there were significant differences between the self-reported experience with difficult PHETI among full-time and part-time HEMS anaesthesiologist working in three different HEMS-schemes in western Norway. Both Sollid [25] and Hüter [26] found room for improvement in HEMS-doctors experience and training in the use of back-up airway devices. Sollid *et al.*, by using a predictive Bayesian approach [27,28] to risk management in a HEMS, also found that improving the system and culture regarding PHAAM by introducing risk reducing measures would have a far greater risk reducing potential than focusing on the knowledge and performance of the individual

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HEMS-physician. Recent work from the Netherlands found that lack of provider coherence to guidelines possesses a potential serious threat to patient safety [29]. An important step in improving quality control in PHAAM is the Utstein style consensus-based template for uniform reporting of data relating to PHAAM, published in 2009 [30]. This template will make it possible to compare PHAAM - data from different EMS's.

The aim of this descriptive study was, as the first from a Danish EMS, to provide baseline PHAAM-data, as suggested by Sollid *et al* [30]. We focused on EMS-physician training, experience and equipment awareness, as these aspects of PHAAM have been addressed only by a few other papers [31-33], and because knowledge of the present state regarding these aspects may be vital for the improvement of patient safety and for future quality improvement initiatives.

## Methods

### Study population and -area

The eastern and central part of the Central Region of Denmark is an area of approximately 6835 km<sup>2</sup> and a population of 835.500 with an overall population density of 122 inhabitants pr. km<sup>2</sup>. It is a mixed urban and rural area, the largest cities being Århus, Randers, Viborg, Silkeborg and Horsens.

### The Emergency Medical System involved

The EMS in this part of the region is a two tiered system. The first tier comprises road ambulances staffed with Emergency Medical Technicians (EMT) on an intermediate or paramedic level (EMT-I/EMT-P). No supraglottic airway devices (SAD) are used by EMTs and they do not perform endotracheal intubation. The second tier comprises Mobile Emergency Care Units (MECU). We studied the MECUs stationed in Århus, Randers, Viborg, Silkeborg and Grenå. The MECUs are rapid response vehicles staffed with a physician and a EMT trained to be the doctors' assistant. The physicians all work in departments of anaesthesia and/or intensive care.

### Inclusion criteria

Doctors working in the physician-staffed EMS in Århus, Silkeborg, Viborg, Randers and Grenå and the medical directors of the same MECU programs.

### Exclusion criteria

Anaesthesiological registrars in Randers who, as part of their training, do limited amount of work in the local EMS.

### Study period and sample size

Questionnaires were sent out in June 2010 to 67 EMS-physicians.

## Variables

The medical directors of the MECU- schemes were contacted in order to obtain information about the actual equipment available, the presence of SOPs, guidelines, checklists and specific training programs regarding PHAAM. A questionnaire (see Additional file 1: *Questionnaire* for a translated version) with both open and closed questions was sent to the physicians. It was an adapted version of the one used by Sollid *et al.* [25].

## Ensuring data quality

The questionnaire was tested for readability and ease of use with the assistance of ten randomly chosen EMS-physicians in Århus (who later received the final version of the questionnaire). To ensure as high a response rate as possible, two reminders were sent by e-mail to the participating physicians.

## Statistics

The material was analysed using descriptive statistics.

## Ethics

The physicians answered the questionnaire anonymously and voluntarily. No patients had their treatment altered because of the study. The protocol has been presented to the regional medical ethics committee, who stated that the study did not need the committee's approval.

## Results

Data from the medical directors showed that the MECUs in this part of the region all have full rapid sequence induction (RSI) -capabilities and carry the same equipment for airway management: Bag -Valve-Mask (BVM) with oxygen reservoir, tracheal tubes and standard laryngoscopes with Miller blades, Airtraq laryngoscope, standard intubating bougie, Gum Elastic Bougies, standard laryngeal masks (LMA), intubating laryngeal masks (ILMA) and equipment for establishing a surgical airway. All airway devices except the Airtraq and the ILMA are available in all sizes from neonatal to large adult. For confirmation of correct laryngeal tube placement all units have capnography available, and all have Weimann Medumat volume-controlled ventilators.

There are no specific, local protocols, checklists or SOPs and no formal training program for PHAAM. Of the 67 EMS-physicians 53 (79,1%) returned the questionnaire. 52 (98,1%) were specialist in anesthesiology. Their experience and life-support education are shown in Table 1. Of the physicians 45 (84,9%) reported having attended one or more life support course, only 25,5% fulfilled the curriculum suggested by the Danish Society for Anaesthesiology and Intensive Care [34]. 34 (64,2%) had attended one or more course in advanced airway management/management of the difficult airway.

**Table 1 Self-reported experience and life-support education among EMS-physicians**

	Average (range or %)
Years of experience working in anesthesia	17,6 (7 - 33)
Years as a EMS-physician	7,2 (0,3 - 17)
Percentage of total workload spent in EMS	17,5% (5 - 30)
Attended Advanced Trauma Life Support <sup>TM</sup> (ATLS)	42/53 (79,2)
Attended Advanced Life Support <sup>TM</sup> (ALS)	26/53 (49,1)
Attended Prehospital Trauma Life Support <sup>TM</sup> (PHTLS)	18/53 (33,9)
Attended European Pediatric Life Support <sup>TM</sup> (EPLS)	10/53 (18,9)
None of the above life-support courses	8/53 (15,1)
All of the above life-support courses	5/53 (9,4)
ATLS+ALS +PHTLS (Suggested curriculum by The Danish Society of Anesthesia and intensive Care Medicine) [34]	13/53 (24,5)

The doctors reported a monthly average number of ETI and PHETI of 14,5 and 1 respectively. On average they suggested a minimum of 4,3 ETI/month to maintain the skill.

24 physicians (45,3%) had experienced a difficult PHETI (defined as more than two intubation attempts, a Cormack - Lehan - score of 3 or more, or more than two minutes intubation time) and 20 (37,7%) had been in a situation where PHETI proved impossible. The patient categories in which difficult or impossible PHETI was encountered are summarised in Table 2. Only one (1,9%) of the EMS-physicians had knowledge of any airway management-related deaths within their own EMS.

The physicians' awareness of the PHAAM devices available to them is shown in Table 3.

The numbers of EMS-physicians who had received formal training in the use of the different airway devices and the numbers who felt that they had "some" or

**Table 2 Percentage of EMS-physicians who reports having experienced difficult or impossible prehospital endotracheal intubation (PHETI) in different patient categories**

		Number (%)
<b>Difficult PHETI in</b>	Patient in cardiac arrest	19/53 (35,8)
	Trauma patient	18/53 (33,9)
	Patient with respiratory failure	5/53 (9,4)
	Child	3/53 (5,7)
	Other types of patients	2/53 (3,8)
<b>Impossible PHETI in</b>	Patient in cardiac arrest	10/53 (18,9)
	Trauma patient	5/53 (9,4)
	Patient with respiratory failure	1/53 (1,9)
	Child	1/53 (1,9)
	Other types of patients	1/53 (1,9)*

\*Patient with epiglottitis.

**Table 3 EMS-physicians knowledge of airway devices available**

		Number (%)
<b>Knows that these devices are available (which they are)</b>	Standard Laryngeal Mask	48/53 (90,6)
	Intubation Laryngeal Mask	45/53 (84,9)
	Gum-Elastic-Bougie	34/53 (64,2)
	Airtraq Laryngoscope	30/53 (56,6)
	Equipment for surgical airway	51/53 (96,2)
<b>Thinks that these devices are available (which they are not)</b>	All of the above	15/53 (28,3)
	McCoy laryngoscope	4/53 (7,5)
<b>Knows all, and not too many, of the devices available</b>	Combitube/Larynx tube	2/53 (3,8)
	Set for needle tracheotomy	16/53 (30,2)
		11/53 (20,8)

"considerable" clinical experience in using them, are displayed in Table 4.

The doctors were asked to highlight their preferred airway backup device in two different clinical scenarios: a "can't intubate - can ventilate situation" and a "can't intubate - can't ventilate situation". The answers are shown in Table 5.

## Discussion

This is, to our knowledge, the first study of its kind from a Danish physician-staffed EMS.

The lack of local airway management guidelines or SOPs stands in contrast to what has been reported from for instance London HEMS [15]. It may possess a potential threat to patient safety; it has been shown that SOPs can reduce complications associated with PHAAM and PHETI [11,32]. Whether this applies to practitioners at this level of expertise is to our knowledge not known.

**Table 4 EMS-physicians training and experience with different airway devices**

	Have trained Numbers (%)	Have "Some" or "considerable" clinical experience Numbers (%)
<b>Standard Laryngeal Mask</b>	51/53 (96,2%)	51/53 (96,2)
<b>Intubation Laryngeal Mask</b>	48/53 (90,6%)	39/53 (73,6)
<b>Gum-Elastic-Bougie</b>	45/53 (84,9%)	32/53 (60,4)
<b>Airtraq Laryngoscope</b>	38/53 (71,7%)	18/53 (34,0)
<b>Equipment for surgical airway</b>	52/53 (98,1%)	9/53 (17,0)

**Table 5 EMS-physicians' preferred airway backup devices in two different scenarios**

	Can't intubate - can ventilate Numbers (%)	Can't intubate - can't ventilate Numbers (%)
Bag-mask-valve-ventilation	14/53 (26,4)	–
Standard Laryngeal Mask	9/53 (17,0)	16/53 (30,2)
Intubation Laryngeal Mask	35/53 (66,0)	34/53 (64,2)
Gum-Elastic-Bougie	25/53 (47,2)	–
Airtraq Laryngoscope	15/53 (28,3)	–
Equipment for surgical airway	–	30/53 (56,6)
Other equipment (not available)	10/53 (18,9)	9/53 (17,0)

Compared to other physician-staffed EMS/HEMS [7-12,14], the physicians in this study are relatively homogeneous, especially when it comes to speciality; similar to what has been reported from Norway [25] and Göttingen in Germany [13,33].

Few other investigators have reported EMS-physician-experience. We found a higher level of overall experience in anaesthesia than what has been reported from Baden-Württemberg [10], while the HEMS-doctors in Western Norway [25] have more prehospital experience than the EMS-doctors in our region. The EMS-physicians in this study are highly experienced in ETI, performing on average 14,5 ETI/month totally, but only 1 PHETI/month. This total number of ETI/month is considerably more than reported by others [10,25]. Our results, as well as the results of Sollid [25] and Gries [10], demonstrates that prehospital work alone may not be sufficient to maintain adequate PHAAM-/PHETI- skills. This notion is supported by the findings by Fullerton *et al.* [18] showing a higher incidence of airway management problems among HEMS-doctors from specialities where airway management and especially ETI is not part of their day to day work (general practice and surgery) compared to anaesthesiologists and emergency physicians.

In our study, the physician - reported incidence of difficult or impossible PHETI (“non-intubation situation”) is low and deaths related to PHAAM apparently very rare compared to the findings of Sollid [25]. We believe that this is mainly due to the doctors' extensive experience. This is supported by the findings of Combes *et al.* [11], demonstrating a higher incidence of PHAAM-problems among non-specialist working in the EMS as opposed to consultants. The recently published guidelines [21-24], as well as the 2008 Cochrane review [19] also emphasises the importance of a high degree of operator experience and skill-maintenance in PHAAM and PHETI.

The equipment available for the physicians in this study is more extensive than what has been reported by others, as highlighted in Table 6. We have found no other study addressing the question of EMS-physician equipment awareness. Knowing one's options when it comes to PHAAM seems vital, and it may be especially critical for the physicians who (wrongly) think that for instance the McCoy Laryngoscope is available and plans his/her actions accordingly. The relatively poor equipment awareness in this study may be explained by the lack of formal introductory programs, both for new physicians and when new equipment is introduced. Mandatory teaching and check-out procedures may be needed as the lack of equipment awareness may pose a threat to patient safety.

The physicians training with the airway devices is in general satisfactory and in line with what has been reported from anaesthesiologists working as EMS-physicians in northern Germany [33]. The level of expertise is considerably higher than that reported for non-anaesthesiological EMS-physicians [33]. The reported clinical experience in the use of especially the LMA and the ILMA, but also the Gum-Elastic-Bougie, is considerable, and our results correspond well with those of the part-time employed HEMS - doctors in western Norway [25]. This part of our study further supports the notion that when it comes to anaesthesiologist achieving and maintaining experience in advanced airway management, it may be better to be employed both in- and pre-hospital, rather than working full-time in the EMS/HEMS.

Most of the EMS - physicians rely on their clinical work for maintaining airway management skills and 75,5% know that this is left to their own discretion as is the case for their Norwegian [25] and some German [26] colleagues. This differs from what has been reported from the UK [15,16].

Again, a uniform training and certification system for all EMS-physicians may be necessary to ensure a minimum of ongoing training and clinical experience with the available equipment [35].

We found that the ILMA, followed by the surgical airway, is the most favoured back-up devices in a “can't intubate - can't ventilate situation”. To our knowledge, this kind of data has not been reported before. Our findings are not in complete accordance with the guidelines for treatment of the unexpected difficult airway [36], which recommends the use of a standard LMA or a surgical airway in these situations. In the “can't intubate - can ventilate situation” following RSI, the guidelines [36] recommend oxygenation using BVM-ventilation or a standard LMA and awakening the patient while postponing surgery if possible. These possible deviations from the guidelines may be due to the fact that awakening the patient is often not a very attractive option in the

**Table 6 The availability of different airway back-up device as reported by other investigators**

	Laryngeal Mask	Intubation Laryngeal Mask	Larynx tube	Combitube	Gum-elastic-bougie	Surgical airway
Hüter (Thuringia, D) [29]	36		10	5		100
Schmid (Bavaria, D) [24]	26	7	26	18		71
Genzwürker (Baden- Württemberg, D) [20]	51	1		68,3*		70
Timmermann (Northern Germany) [26]	37,1	6,1		15,5*		57,8
Schmid (UK) [30]	73	8		23*	69	62
Current study (DK)	100	100	0	0	100	100

Numbers are percentage of the investigated EMS/HEMS in each study who carry the device.

\*Larynx tube and Combitube reported together.

prehospital setting. They, as well as the considerable variation among the physicians' preferred back-up devices, may however also be due to the lack of SOPs, guidelines and standardised PHAAM-training in the investigated EMS. Again this seems to be a point of possible improvement in the programs in this study.

A limitation, but also a strength of this study is that the data comes from the EMS-physicians themselves. The true frequency of PHAAM/PHETI in our schemes is not known, nor is the rate of complications. Our results reflect the physicians' perception of their work. Recall bias and a (subconscious) denial of one's own shortcomings cannot be ruled out. Gathering more precise and prospective data related to PHAAM should be a priority in the following years.

The response rate in this study is satisfactory, and we have no reason to believe that the characteristics of the repliers should be different from those of the whole group of EMS physicians. Nevertheless, selection bias cannot be ruled out.

We primarily used fixed response questions, thus minimizing the risk of instrument bias.

Most of the MECUs in Denmark operate with case-loads, staffing, staff-education and call-out-criteria that are comparable to those of the programs investigated in this study. And even though the number of EMS-physicians in this study is limited, we believe that our results are representative for most Danish MECUs. We also believe that the challenges of low PHAAM equipment awareness, lack of formal PHAAM training, lack of local guidelines and SOPs identified in this study may be applicable to EMS/HEMS in other countries as well, especially those with a similar organisation to the one in this study, e.g. EMS/HEMS in Norway, Finland, Germany, The Netherlands, Switzerland, Austria and France.

## Conclusion

In this first Danish study of prehospital advanced airway management, we found that the anaesthesiologists working as part-time EMS- physicians in the central and

eastern part of The Central Region of Denmark are highly experienced in endotracheal intubation.

They have a high degree of education and training in the use of back-up devices for airway management, but their equipment awareness is limited. The EMS in this study did not have formal training programs regarding PHAAM, nor did they have any local airway management guidelines, checklists or SOPs. Improvement on an organisational level may be needed to ensure patient safety.

Prospective studies, using the new Utstein template [30] for collecting a standardised set of data, are wanted; both to establish baseline of prehospital advanced airway management in different EMS and to measure the effect of interventions, such as the implementations of check-outs, guidelines, SOPs and other quality control measures.

## Author information

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## Additional material

Additional file 1: A translated version of the questionnaire used to gather the data from the EMS-physicians in this study is provided as Additional file 1: *Questionnaire*.

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#### Authors' contributions

LKR conceived the study and designed the questionnaire, managed and analyzed the data and drafted the manuscript.

TMH helped conceive the study and participated in the design of both the study and the questionnaire.

Both authors have read and approved the final manuscript.

#### Competing interests

The authors declare that they have no competing interests.

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