

## SPECIAL ARTICLE

## Physician utilization in prehospital emergency medical services in Europe: an overview and comparison

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**Background.** National and regional systems for emergency medical care provision may differ greatly. We sought to determine whether or not physicians are utilized in prehospital care and to what extent they are present in different European countries.

**Methods.** We collected information on 32 European countries by reviewing publications and sending questionnaires to authors of relevant articles as well as to officials of ministries of health (or equivalent), representatives of national societies in emergency medicine, or well-known experts in the specialty.

**Results.** Thirty of the 32 of European countries we studied (94%) employ physicians in prehospital emergency medical services. In 17 of the 32 (53%), general practitioners also participate in prehospital emergency care. Emergency system models were described as Franco-German in 27 countries (84%), as hybrid in 17 (53%), and as Anglo-American in 14 (44%). Multiple models were present simultaneously in 17 countries (53%). We were able to differentiate between national prehospital emergency systems with a novel classification based on tiers reflecting the degree of physician utilization in the countries. We also grouped the national systems by average population and area served.

**Conclusions.** There are notable differences in system designs and intensity of physician utilization between different geographic areas, countries, and regions in Europe. Several archetypal models (Franco-German, hybrid, and Anglo-American) exist simultaneously across Europe.

**Palabras clave:** Emergency medical services. Emergency medicine. Health care facilities, manpower and services. Physician, role. Helicopters. Ambulances.

### *Visión general y comparación de la presencia de médicos en los servicios de emergencias médicas prehospitalarios en Europa*

**Antecedentes.** Los sistemas nacionales y regionales de prestación de atención médica a las emergencias pueden diferir mucho entre sí. Se buscó dilucidar la presencia de médicos en la atención prehospitalaria y su implantación en los diferentes países europeos.

**Método.** Se analizaron los datos de 32 países europeos recogidos mediante la revisión de artículos publicados y a través de cuestionarios enviados a los autores de artículos científicos pertinentes, funcionarios del ministerio de sanidad (o equivalente), representantes de sociedades nacionales de medicina de urgencias o expertos reconocidos en medicina de urgencias.

**Resultados.** Treinta de los 32 países europeos investigados (94%) disponen de médicos en los servicios de emergencias prehospitalarios. En 17 de 32 (53%), los médicos generalistas también participan en la atención a las emergencias prehospitalarias. Los modelos de los sistemas de emergencias médicas (SEM) se describieron como francoalemanes en 27 países (84%), híbridos en 17 (53%) o angloamericanos en 14 (44%). En 17 países (53%), coexistían diferentes modelos. Utilizando una nueva forma de clasificación por niveles, basada en la población media y el área atendida por el SEM prehospitalario, se pudieron diferenciar claramente los diferentes modelos existentes.

**Conclusiones.** Se observan notables diferencias en los diseños de los SEM y en la presencia de los médicos entre las diferentes áreas geográficas, países y regiones de Europa. Coexisten varios modelos (francoalemán, híbrido y angloamericano), algunos simultáneamente, en los diferentes países.

**Palabras clave:** Servicios Emergencias. Médicos. Francoalemán. Híbrido. Angloamericano. Prehospitalaria. Helicópteros. Ambulancias.

### Introduction

A stated central goal of European collaboration within the European Union (EU) is to “enhance economic, social and territorial cohesion and solidarity among EU countries”. Contrary to this intended cohesion, national and regional

systems for emergency medical care provision may differ greatly between each other. This also extends to personnel employed and whether physicians are utilized in prehospital care. In a previous review, this difference was already suggested by Tjelmeland et.al in relation to prehospital medical care or care options in case of cardiac arrest.<sup>1</sup>

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Some countries employ systems based on non-physician personnel (referred to as “paramedics” for the sake of simplicity throughout this manuscript) to provide advanced medical care, while others rely on physicians in conjuncture with medical technicians and/or paramedics to perform these tasks. Historically, two archetypical EMS systems have been distinguished: the so-called “Anglo-American” (AA) non-physician EMS system and the “Franco-German” (FG) EMS system relying on physicians.<sup>2</sup>

The Franco-German model is more commonly attributed to countries in central Europe while the Anglo-American model is expected to be found in the English-speaking world.<sup>3</sup> However, the existence of “Hybrid” models – essentially combinations of AA and FG models – has been proposed before.<sup>4</sup> Systems resembling this model seem to be widespread across Europe nowadays; such clear-cut distinctions between systems may therefore be inadequate to represent today’s emergency medical systems throughout the continent.

Although the World Health Organisation (WHO) published an in-depth overview of emergency medical systems in Europe in 2008, there is insufficient knowledge about current prehospital emergency medical system design in general and physician utilization especially<sup>5</sup>. The aim of this analysis is to present and compare different prehospital emergency medical systems related to physician utilization in Europe, to highlight differences and similarities between the different countries, and to ascertain whether “cohesion” has been achieved in Europe.

## Methods

This analysis was set out to include information on all member states of the European Union (EU), the European Free Trade Association (EFTA) and the European Economic Area (EEA) to best resemble Europe in its entirety. Overall, data from 32 countries were collected in this study (Table 2). The study did not involve any human subjects, no IRB (Institutional Review Board) review was obtained.

### *Study conduction and data acquisition*

We planned to conduct a systematic review of published literature on the subject according to the PRISMA statement. Article searches in PubMed and the Cochrane Library database from January 1st, 2000 to December 31st, 2020 were performed.

The following Medical Subject Heading (MeSH) terms were used: “Emergency Medical Services”, “Ambulances”, “Air Ambulances”, paired with “Europe” and country-specific MeSH terms. The search string used is depicted in Table 3. Studies were eligible for inclusion if they included country-specific information about prehospital emergency care or prehospital emergency services. The Prisma flowchart with the search result is shown in Figure 1.

Because information retrieved using this search strategy proved incomplete, a questionnaire-based

**Table 1.** List of countries

European Union (EU) countries (n = 27)	Code
Austria	AT
Belgium	BE
Bulgaria	BG
Croatia	HR
Cyprus	CY
Czechia	CZ
Denmark	DK
Estonia	EE
Finland	FI
France	FR
Germany	DE
Greece	GR
Hungary	HU
Ireland	IE
Italy	IT
Latvia	LV
Lithuania	LT
Luxembourg	LU
Malta	MT
Netherlands	NL
Poland	PL
Portugal	PT
Romania	RO
Slovakia	SK
Slovenia	SI
Spain	ES
Sweden	SE
European Economic Area (EEA) and European Free Trade Association countries (n = 5)	Code
Iceland	IS
Liechtenstein	LI
Norway	NO
Switzerland	CH
United Kingdom	GB

study was conducted subsequently. Within their respective countries, ministry of health (or equivalent) officials, representatives of national societies in emergency medicine, or known experts in emergency medicine were kindly asked to provide information based on a pre-specified set of questions (depicted in Table 3) via email.

We sent out questionnaires to 68 recipients from all 32 countries in order to cross-check and compared the returned results with findings from the literature review (Table 4). In total, 34 recipients responded (return rate = 50%), however, in two countries (Liechtenstein and Romania) no useful data could be collected via email correspondence or literature review. For these countries, information and data presented were solely retrieved by an alternative Internet search using free-text search terms in the common Internet search engines (Figure 1).

Data on national population and area for the year 2020 were retrieved from the Eurostat data explorer (<https://ec.europa.eu/eurostat/data/database>).

### *System classification and comparison*

Qualitative classification of prehospital physician utilization was based on national officials’ or experts’ opin-

**Table 2.** Search string used for initial data retrieval

```
(("emergency medical services"[Title/Abstract]) OR
("ambulances"[Title/Abstract]) OR ("air ambulances"[Title/
Abstract])) AND (("europe"[Title/Abstract]) OR ("austria"[Title/
Abstract]) OR ("belgium"[Title/Abstract]) OR ("bulgaria"[Title/
Abstract]) OR ("croatia"[Title/Abstract]) OR ("czechia"[Title/
Abstract]) OR ("denmark"[Title/Abstract]) OR ("estonia"[Title/
Abstract]) OR ("finland"[Title/Abstract]) OR ("france"[Title/
Abstract]) OR ("germany"[Title/Abstract]) OR ("greece"[Title/
Abstract]) OR ("hungary"[Title/Abstract]) OR ("iceland"[Title/
Abstract]) OR ("ireland"[Title/Abstract]) OR ("italy"[Title/Abstract])
OR ("latvia"[Title/Abstract]) OR ("liechtenstein"[Title/Abstract])
OR ("lithuania"[Title/Abstract]) OR ("luxembourg"[Title/Abstract])
OR ("malta"[Title/Abstract]) OR ("netherlands"[Title/Abstract])
OR ("norway"[Title/Abstract]) OR ("poland"[Title/Abstract])
OR ("portugal"[Title/Abstract]) OR ("romania"[Title/Abstract])
OR ("slovakia"[Title/Abstract]) OR ("slovenia"[Title/Abstract])
OR ("spain"[Title/Abstract]) OR ("sweden"[Title/Abstract]) OR
("switzerland"[Title/Abstract]) OR ("united kingdom"[Title/Abstract]))
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ions; questionnaire participants were asked to classify their respective country's prehospital emergency medical service according to the archetypal models (FG, HY, AA). Multiple selections were possible, especially in countries where regional differences in service provision existed.

For quantitative classification of prehospital physician utilization, we calculated the mean number of inhabitants served by a prehospital physician response system [ $\text{popmean} = \text{npop} / \text{nphysicians}$ ] and the mean area covered by a prehospital physician response system [ $\text{Amean} = \text{A} / \text{nphysicians}$ ]. We further derived a

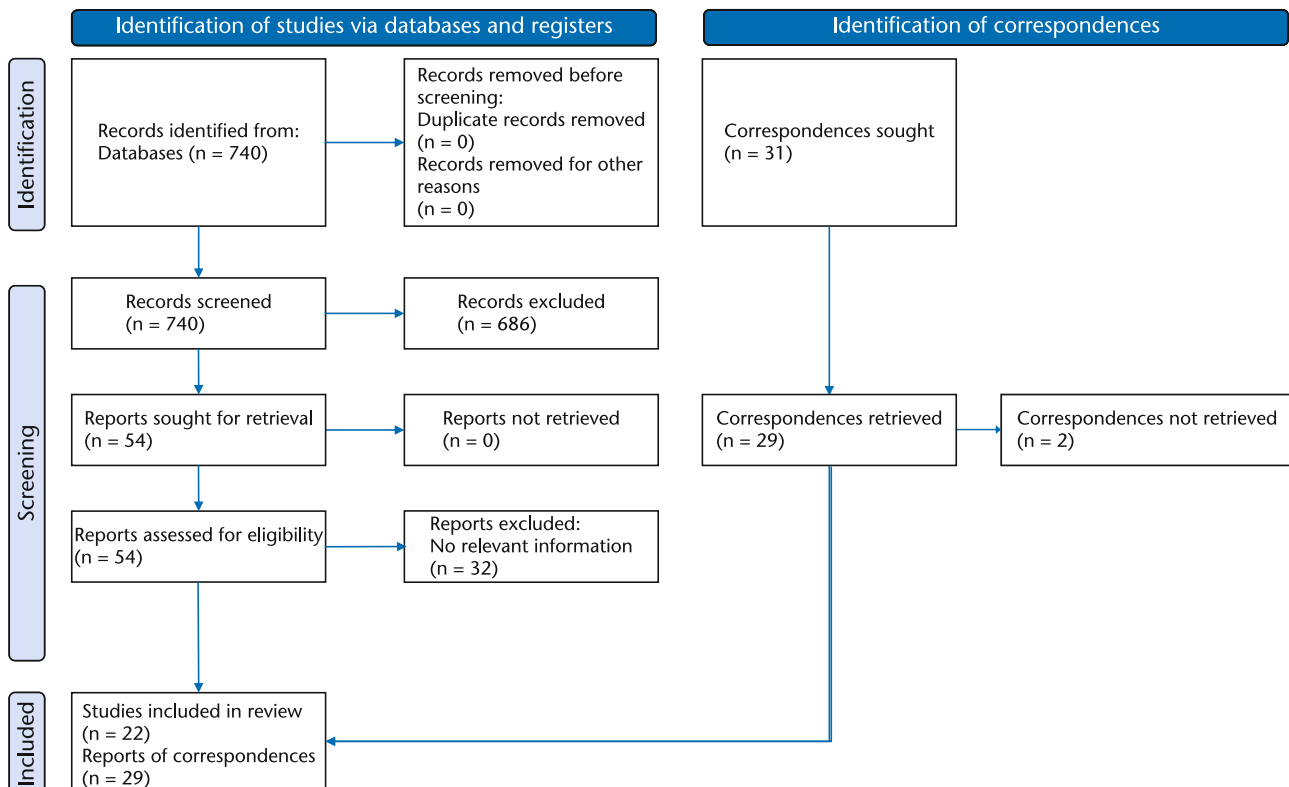
"physician utilization index" (PUI) as the inverse of the product of the mean number of inhabitants served by a prehospital physician system and the mean area covered by a prehospital physician system [ $\text{PUI} = 1 / (\text{popmean} * \text{Amean})$ ].

Based on this physician utilization index, every country was assigned to one of four "physician utilization tiers". Countries not employing physicians in prehospital emergency services at all were categorized in tier 4. Others were classed in terciles of the physician utilization index; tier 1 denoted high or exclusive reliance on physician response in EMS services, tier 2 indicated significant contribution by physicians in EMS, and tier 3 corresponded to little or select physician utilization in EMS only.

## Results

The search strategy described above yielded 740 full text articles for further review. These were screened for country-specific information based on title and abstract. 54 articles were read in full, 22 of which provided useful data (Figure 1).

Information retrieved from systematic review of the literature and from questionnaires was contradictory in some instances. We therefore presented synthesized information within this manuscript as well as two further tables with data from systematic review or expert correspondences only (Table 5 and 6).

**Figure 1.** PRISMA-style study flow chart.

**Table 3.** Example of email correspondence with experts for questionnaire-based information gathering

Prehospital Emergency Medicine in Europe

Dear Sir or Madam,  
our group of academic prehospital care physicians aims to produce an overview about the current situation of prehospital emergency physician utilization in Europe.

We have condensed information already supplied by literature review; we now kindly ask you to provide missing information to complete the data set. We aim to submit the derived review article to a high-ranking journal focusing on prehospital emergency care. Your contribution would be highly appreciated and will be acknowledged in the article.

Here is the information of your country to be checked (for example Austria is mentioned):

Country	EMS- models (FG, AA, Hybrid)	Prehosp. Emerg. Care Level (I-IV)	pEP staffed ground based systems (quantity)	pEP staffed helicopter emergency medical systems (quantity)	Organized prehospital emergency care supported by general practitioners (yes/no)
Austria	FG	I	120	40	Yes
?	?	?	?	?	?

We would appreciate your answer by an informal email sent to this address.  
Thank you very much for your time.

With kind regards

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Level 1: FG model= Franco-German model= country-wide network of emergency physicians in prehospital emergency care (e.g. Austria, Germany).

Level 2: Hybrid medical model = mainly prehospital emergency care by emergency physicians, but a few regions (or remote areas) in the country where prehospital emergency care is provided by non-medical staff (e.g. Denmark).

Level 3: Hybrid non-medical model= mainly non-medical staff in prehospital emergency care, but few regions in the country where prehospital emergency care is provided by emergency physicians (e.g. United Kingdom, Sweden, Norway).

Level 4: AA model= Anglo-American model= only non-medical staff in preclinical emergency care (e.g. Ireland).

(Non-physician staff= rescue nurses, emergency medicine technicians, paramedics).

EMS = Emergency Medical Services, AA = Anglo-American, FG = Franco-German, pEP= prehospital emergency physician.

### Physician participation in European emergency medical services

Thirty out of the 32 (94%) European countries participating in the study employ physicians in prehospital emergency medical services. In 29 (97%) countries (all except Iceland) physicians work in ground response vehicles and in 26 (87%) countries (all except Bulgaria, Latvia, Lithuania, and Malta) in helicopter emergency medical systems (HEMS). In 17 out of 32 countries (53%), general practitioners are also involved in prehospital emergency care and can be contacted or alerted by ambulance dispatch centers.

### System organization and physician utilization throughout Europe

There are distinct design differences between European prehospital care models concerning the implementation of physician response into ambulance systems.

In the 32 countries in question, EMS systems were described as Franco-German in 27 (84%), as Hybrid in 17 (53%), and as Anglo-American in 14 (44%). In 17 (53%) countries, multiple archetypical classifications were considered appropriate; in 9 (28%) countries, all three archetypes were reported or selected to be employed at least regionally.

Highest absolute numbers of physician-staffed EMS systems were found in Germany ( $n \approx 1200$ ) and France ( $n \approx 540$ ).

The mean number of inhabitants cared for per each physician-staffed EMS system varies considerably between European countries [17 466 to 6 604 023, mean (SD) 539 776 ( $\pm 1 367 799$ )] as does the mean area covered by each physician-staffed EMS system [51 km<sup>2</sup> to 80 km<sup>2</sup>, mean (SD) 7 128 ( $\pm 13 542$ ) km<sup>2</sup>].

These mean values allow for calculation of the so-called “physician utilization index” and comparison of physician utilization in respective countries presented in Table 1. Rankings and derived classifications are presented in Figure 2, Figure 4 and Figure 5.

Based on the different Physician Utilization Tiers (Figure 3), a clustering of tier 1 is evident in Central Europe with the external exception of Bulgaria. Tier 2 classification can be identified around the inner core (with offshoots to Greece, Estonia and Portugal) and tier 3 are dedicated to the Nordic countries and peripheral European countries such as Iceland, United Kingdom and Italy.

### Discussion

Most European countries employ a comprehensive network of physician response systems in their respective emergency medical systems. However, there are still notable differences in system designs and intensity of physician utilization between different geographic areas, countries, and regions. Clear-cut distinctions between systems may therefore be inadequate to represent today’s emergency medical systems throughout the continent.

**Table 4.** List of questionnaires sent out, questionnaires returned, and respondents

Country	Questionnaires sent out (n = 68)	Questionnaires received (n = 34)	Names of the persons providing the information
Austria	1	1	Prof. Gerhard Prause* Medical University of Graz.
Belgium	1	1	Prof. Said Hachimi-Idrissi* University of Ghent, Belgium.
Bulgaria	1	1	Dr. Boyko Penkov** Deputy Minister of Health.
Croatia	1	1	Sanja Predavec** Ministry of Health.
Cyprus	1	1	Riana Constantinou** State Health Services.
Czechia	2	1	Dr. Ondrej Franek* Prague Dispatch Medical Director.
Denmark	3	2	Prof. Erika Frischknecht Christensen* Aalborg University Hospital. Prof. Leif Rognas* Aarhus University Hospital.
Estonia	1	1	Dr. Veronika Reinhard* Tartu University Hospital.
Finland	2	1	Dr. Lasse Raatiniemi* Oulu University Hospital.
France	1	1	Prof. Frederic Lapostolle* University Sorbonne Paris.
Germany	2	1	Prof. Jochen Hinkelbein* Prof. Bernd Böttiger* University of Cologne.
Greece	2	1	Prof. Athanasios Chalkias* University of Thessaly.
Hungary	1	1	Dr. Csató Gábor* National Ambulance Service.
Ireland	1	1	Dr. Shane Knox National Ambulance Service/University College Cork.
Italy	2	1	Dr. Guido Francesco Villa* Azienda Regionale Emergenza/Urgenza, Milano.
Latvia	3	2	Inga Karlivane** State Emergency Medical Service of Latvia. Maira Sudraba* Head of the Latvian Medical Association.
Lithuania	3	1	Dr. Linas Darginavicius* Lithuanian University of Health Sciences Hospital.
Luxembourg	1	1	Dr. Pascal Stammel* Grand-Ducal Fire and Rescue Corps.
Malta	1	1	Dr. Jonathan Joslin* Mater Dei Hospital.
Netherlands	2	1	Dr. Victor Viersen* University Hospital Amsterdam.
Poland	3	1	Prof. Juliusz Jakubaszko* Medical Academy of Wrocław.
Portugal	1	1	Dr. Vitor Almeida* College of Competence in Emergency Medicine.
Romania	1	1†	Dr. Raed Arafat** Secretary of State.
Slovakia	5	0	–
Slovenia	3	1	Dr. Gregor Prosen* Center for Emergency Medicine, Maribor.
Spain	1	1	Prof. Sendoa Ballesteros-Peña* University of the Basque Country; Bilbao-Basurto Healthcare Organization.
Sweden	5	2	Dr. Frida Meyer* Linköping University Ulf Andersson* University of Borås.
Iceland	1	1	Dr. Hjalti Már Björnsson** Landspítali - The National University Hospital of Iceland.
Liechtenstein	3	0	–
Norway	5	1	Prof. Andreas Krüger* St. Olav University Hospital.
Switzerland	3	1	Dr. Barbara Schild* Swiss Society of Emergency and Rescue Medicine.
United Kingdom	5	2	Dr. Michael Eichinger* Medical University of Graz. Dr. Matthew Mak* Royal London Hospital.

\*Expert in the field, i.e. lead role in emergency medicine and/or publication activity in the field of emergency medicine.

\*\*Official of the respective ministry of health or in charge of emergency medical services.

†Data could not be used or explicit data were not provided even upon request.

High or exclusive reliance on physician personnel for prehospital provision of advanced medical care can be seen in Central Europe, the historic birthplace of the “Franco-German” archetype of EMS systems. On the other hand, Ireland and Cyprus have been found to be the only European countries in which physicians are mainly not employed in prehospital emergency care; these would be the only representative of the archetypical “Anglo-American” system.

More commonly today, however, medical response systems are used in conjunction with non-medical personnel units to respond to cases of severe trauma or life-threatening illness on an immediate basis. Harmsen et al. refer to this model as a “Hybrid” of paramedic-based and physician-supported systems,<sup>4</sup> this concept seems to be widespread in Europe today. Even in the United Kingdom, which in part lends its name to the eponymous “Anglo-American” model, physicians are now employed in

EMS with helicopters in addition to a well-developed paramedic system.

Other countries, in which prehospital physician participation is completely or at least mostly limited to air rescue operations include Northern European countries primarily, especially Sweden, the Netherlands, Iceland, Finland, and Norway. This type of physician involvement in EMS seems to occur mainly in countries where the scope of practice of non-physician ambulance personnel already encompasses advanced emergency care.

Jones et al. had already reported approximate numbers of HEMS systems in the European Union from a questionnaire-based study.<sup>6</sup> The figures in our study differ markedly from ours. We suspect that this is due, on the one hand, to the fact that our figures only include medically staffed HEMS and, on the other hand, to the fact that our information was mainly obtained from official sources.

Based on the calculated density of emergency physicians per inhabitant and area in the respective coun-

**Table 5.** Comparison of European prehospital emergency care systems based solely on information retrieved from systematic review of available literature

Country	FG	HY	AA	Physician response systems (n)	Ground-based PRS (n)	Physician-staffed HEMS (n)	Population (n)	Area (km <sup>2</sup> )	Population density (Km <sup>2</sup> )	Inhabitants cared for per EMS system (km <sup>2</sup> )	Area covered per EMS system (km <sup>2</sup> )	EMS per population density	GPs involved in EMS (yes/no)
Austria							8901064	83879	106				
Belgium							11549888	30528	378				
Bulgaria							6951482	110370	63				
Croatia <sup>7</sup>	X						4105493	56594	73				Yes
Cyprus <sup>16</sup>			X			0	888005	9251	96				No
Czechia <sup>6</sup>						10	10693939	78868	136				Yes
Denmark <sup>8,9</sup>						4	5822763	42924	136				Yes
Estonia							1328976	45227	29				
Finland <sup>6,9,10</sup>		X	X			6	5525292	338440	16				
France <sup>6,11</sup>						63	67098824	633187	106				Yes
Germany <sup>12</sup>	X						83166711	357376	233				No
Greece <sup>6,13,*</sup>	X	X	X	85	77	8	10709739	132049	81	125997	1554	1.05	
Hungary <sup>6,14</sup>	X					7	9769526	93011	105				
Iceland							355620	102775	3				
Ireland <sup>15,16</sup>			X	0			4963839	69797	71				No
Italy <sup>6,17</sup>						33.47	60244639	302073	199				
Latvia <sup>6</sup>						0	1907675	64573	30				
Liechtenstein							38111	160	238				
Lithuania <sup>18,**</sup>	X	X	X	12	7	5	2794090	65286	43	232841	5441	0.28	
Luxembourg <sup>6</sup>						3	626108	2586	242				
Malta <sup>6</sup>	X					0	514564	315	1631				
Netherlands <sup>4,6,19</sup>		X	X	4	4	4	17407585	41540	419	4351896	10385	0.01	Yes
Norway <sup>20,21,22,***</sup>	X		X			12	5323933	385178	14				Yes
Poland <sup>23</sup>	X	X			378		37958138	312679	121				
Portugal <sup>6</sup>						7	10295909	92226	112				
Romania <sup>6</sup>						6	19317984	238391	81				
Slovakia <sup>6</sup>						7	5457873	49035	111				
Slovenia <sup>6</sup>						3	2095861	20273	103				
Spain <sup>6</sup>						29	46659302	505994	92				
Sweden <sup>22</sup>		X				6	10327589	438574	24				
Switzerland <sup>6</sup>	X					40	8508898	41285	206				
United Kingdom							66040229	242495	272				

\*16 motorcycles available, but not specified whether staffed with doctors.

\*\*5 Mobile Intensive Care Units (MICU) for adults and 2 for pediatric patients; 5 large military helicopters are available for SAR (search and rescue); Military helicopter emergency service (HEMS) are also available for civil emergencies.

\*\*\*12 HEMS bases.

AA=Anglo-American model, EMS= emergency medical service, FG = Franco-German model, GP = general practitioner, HEMS = helicopter emergency medical service, HY=hybrid model, km2= square kilometer, n=number, PRS= physicians response system.



**Table 6.** Comparison of different emergency medical services on the basis of expert feedback

Country	FG	HY	AA	Physician response systems (n)	Ground-based PRS (n)	Physician-staffed HEMS (n)	Population (n)	Area (km <sup>2</sup> )	Population density (Km <sup>2</sup> )	Inhabitants cared for per EMS system	Area covered per EMS system (km <sup>2</sup> )	EMS per population density	GPs involved in EMS (yes/no)	Physician Utilization Tier
Austria*	X			160	120	40	8901064	83879	106	55632	524	1.51	Yes	I
Belgium	X			39	36	3	11549888	30528	378	296151	783	0.10	No	I
Bulgaria		X		398	398	0	6951482	110370	63	17466	277	6.32	Yes	II
Croatia	X			705	700	5	4105493	56594	73	5823	80	9.72	Yes	I
Cyprus			X	0	0	0	888005	9251	96				No	IV
Czechia	X			190	180	10	10693939	78868	136	56284	415	1.40	No	I
Denmark	X	X		29	25	4	5822763	42924	136	200785	1480	0.21	Yes	I
Estonia	X			20	20		1328976	45227	29	66449	2261	0.68	No	I
Finland	X	X	X	10	5 (4-6)	5	5525292	338440	16	552529	33844	0.61	Yes	I-III
France	X			540	500	40	67098824	633187	106	124257	1173	5.10	No	I
Germany	X			1195	1100	95	83166711	357376	233	69596	299	5.14	No	I
Greece		X		80	77	3	10709739	132049	81				Yes	IV
Hungary	X			59	52	7	9769526	93011	105	165585	1576	0.56	Yes	I
Iceland**		X	X	2	0	2	355620	102775	3	177810	51388	0.58	Yes	II
Ireland			X	0	0	0	4963839	69797	71				No	IV
Italy				n/a	n/a	20	60244639	302073	199				No	I
Latvia	X			16	16	0	1907675	64573	30	119230	4036	0.54	No	I
Liechtenstein							38111	160	238					
Lithuania	X	X	X	14	13-14	0	2794090	65286	43	199578	4663	0.33	Yes	III
Luxembourg	X			5	5	0	626108	2586	242	125222	517	0.02		
Malta	X	X		2	2	0	514564	315	1631	257282	158	0.00	No	III
Netherlands†	X			4	4	4	17407585	41540	419	4351896	10385	0.01	No	III
Norway‡		X		23	4	19	5323933	385178	14	231475	16747	1.66	Yes	III
Poland		X		320	300	20	37958138	312679	121	118619	977	2.64	Yes	II
Portugal	X	X	X	50	46	4	10295909	92226	112	205918	1845	0.45	No	II
Romania							19317984	238391	81					
Slovakia							5457873	49035	111					
Slovenia	X	X	X	62	60	2	2095861	20273	103	33804	327	0.60	Yes	II
Spain	X	X	X	330	330		46659302	505994	92	141392	1533	3.59	Yes	III
Sweden§		X	X	9	3	6	10327589	438574	24	1147510	48730	0.38	Yes	III
Switzerland		X			n/a	17	8508898	41285	206				Yes	II
United Kingdom	X	X	X	10	1	9	66040229	242495	272	6604023	24250	0.04	No	III

\*Number of HEMS varies according to season.

†1 fixed wing ambulance.

‡HEMS staff can deploy via helicopter or vehicles.

§6 from 13 HEMS are big SAR (search and rescue) helicopters.

¶not all emergency medical resources are available or staffed with a physician 24/7.

AA=Anglo-American model, EMS= emergency medical service, FG = Franco-German model, GP = general practitioner, HEMS = helicopter emergency medical service, HY=hybrid model, km2= square kilometer, n=number, PRS= physicians response system.

Table 7. Comparison of European prehospital emergency care systems

Country	Franco-German	Hybrid	Anglo-American	Physician response systems (PRS) (n)	Ground-based PRS (n)	Physician-staffed HEMS (n)	Population (n)	Area (km <sup>2</sup> )	Physician Utilization Index [x 10 <sup>12</sup> ]	Physician Utilization Tier	Inhabitants cared for per EMS system	Inhabitants per EMS Tier	Area covered per EMS system (km <sup>2</sup> )	Area per EMS Tier	GP's involved in EMS (yes/no)
Austria*	X			160	120	40	8901064	83879	34304	I	55632	I	524	I	Yes
Belgium	X			39	36	3	11549888	30528	4312	II	296151	III	783	II	No
Bulgaria	X	X	X	398	398	0	6951482	110370	206693	I	17466	I	277	I	No
Croatia <sup>7</sup>	X			212	207	5	4105493	56594	193397	I	19366	I	267	I	Yes
Cyprus <sup>1,6</sup>			X	0	0	0	888005	9251	0	IV	-	IV	-	IV	No
Czechia <sup>6</sup>	X			190	180	10	10693939	78868	42812	I	56284	I	415	I	No
Denmark <sup>8,9</sup>	X	X		30	25	4	5822763	42924	3600	II	194092	II	1431	II	Yes
Estonia	X			21	20	1	1328976	45227	7336	II	63285	I	2154	III	No
Finland <sup>6,9,10</sup>	X	X	X	11	5	6	5525292	338440	65	III	502299	III	30767	III	Yes
France <sup>6,11</sup>	X			540	500	40	67098824	633187	6861	II	124257	II	1173	II	Yes
Germany <sup>12</sup>	X			1200	1100	98	83166711	357376	48419	I	69306	I	298	I	No
Greece <sup>6,13</sup>	X	X	X	80	77	3	10709739	132049	4524	II	133872	II	1651	II	Yes
Hungary <sup>6,14</sup>	X			59	52	7	9769526	93011	3832	II	165585	II	1576	II	Yes
Iceland		X	X	2	0	2	355620	102775	109	III	177810	II	51388	III	Yes
Ireland <sup>1,5,16</sup>			X	0	0	0	4963839	69797	0	IV	-	IV	-	IV	No
Italy <sup>6,17</sup>	X			221	174	47	60244639	302073	2684	III	272600	III	1367	II	No
Latvia <sup>6</sup>	X			16	16	0	1907675	64573	2078	III	119230	II	4036	III	No
Liechtenstein <sup>†</sup>	X			2	1	1	38111	160	655961	I	19056	I	80	I	n/a
Lithuania <sup>18</sup>	X	X	X	14	14	0	2794090	65286	1075	III	199578	III	4663	III	Yes
Luxembourg <sup>6</sup>	X			8	5	3	626108	2586	39558	I	78264	I	323	I	No
Malta <sup>6</sup>	X	X	X	2	2	0	514564	315	24600	I	257282	III	158	I	No
Netherlands <sup>6,15,19,20</sup>	X	X	X	4	4	4	17407585	41540	22	III	4351896	III	10385	III	Yes
Norway <sup>20,21,22,‡</sup>	X	X	X	23	4	19	5323933	385178	258	III	231475	III	16747	III	Yes
Poland <sup>23</sup>	X	X	X	398	378	20	37958138	312679	13340	II	95372	II	786	II	Yes
Portugal <sup>6</sup>	X	X	X	53	46	7	10295909	92226	2958	II	194262	II	1740	II	No
Romania <sup>6,†</sup>	X	X	X	46	40	6	19317984	238391	460	III	419956	III	5182	III	Yes
Slovakia <sup>6,†</sup>	X			125	118	7	5457873	49035	58425	I	43663	I	392	I	No
Slovenia <sup>6</sup>	X	X	X	63	60	3	2095861	20273	93351	I	33268	I	322	I	Yes
Spain <sup>6</sup>	X	X	X	359	330	29	46659302	505994	5550	II	129970	II	1409	II	Yes
Sweden <sup>22,§</sup>	X	X	X	9	3	6	10327589	43574	18	III	1147510	III	48730	III	Yes
Switzerland <sup>1,6</sup>	X	X	X	70	30	40	8508898	41285	13943	II	121556	II	590	II	Yes
United Kingdom	X	X	X	10	1	9	66040229	242495	6	III	6604023	III	24250	III	No

\*Number of HEMS varies according to season.

\*\*HEMS staff can deploy via helicopter or vehicles.

†Assumed values based on number of federal states or individual Internet search.

‡12 HEMS bases, one base with two helicopters, additional 6 SAR (search and rescue) helicopter; § not all emergency medical resources are available or staffed with a physician 24/7.

AA=Anglo-American model, EMS= emergency medical service, FG = Franco-German model, GP = general practitioner, HEMS = helicopter emergency medical service, HY=hybrid model, km2= square kilometer, n=number, PRS= physicians response system.



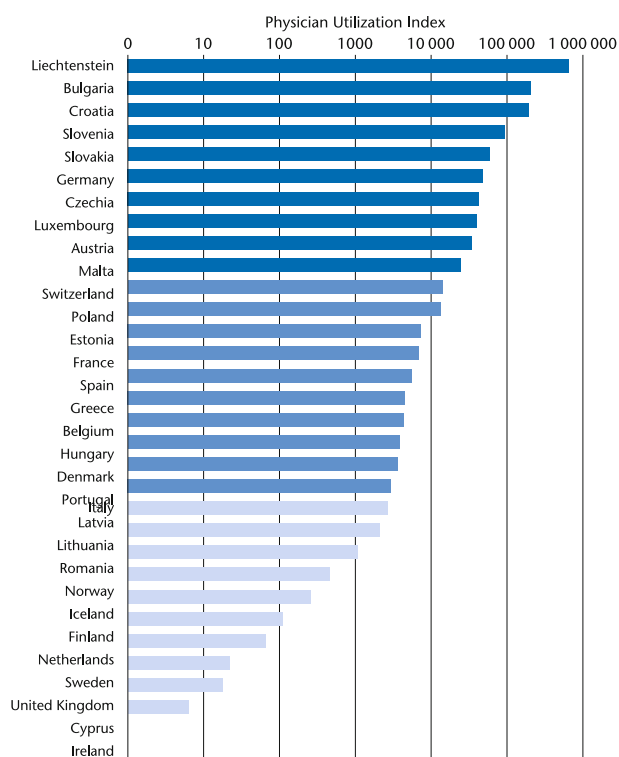


Figure 2. Countries ranked by physician utilization index.

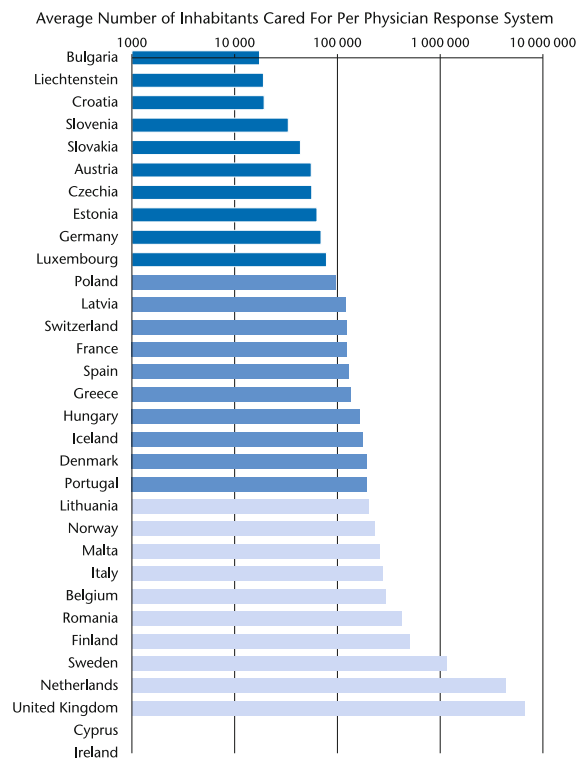


Figure 4. Countries ranked by average number of inhabitants cared for per physician response system; x-axis on logarithmic scale.

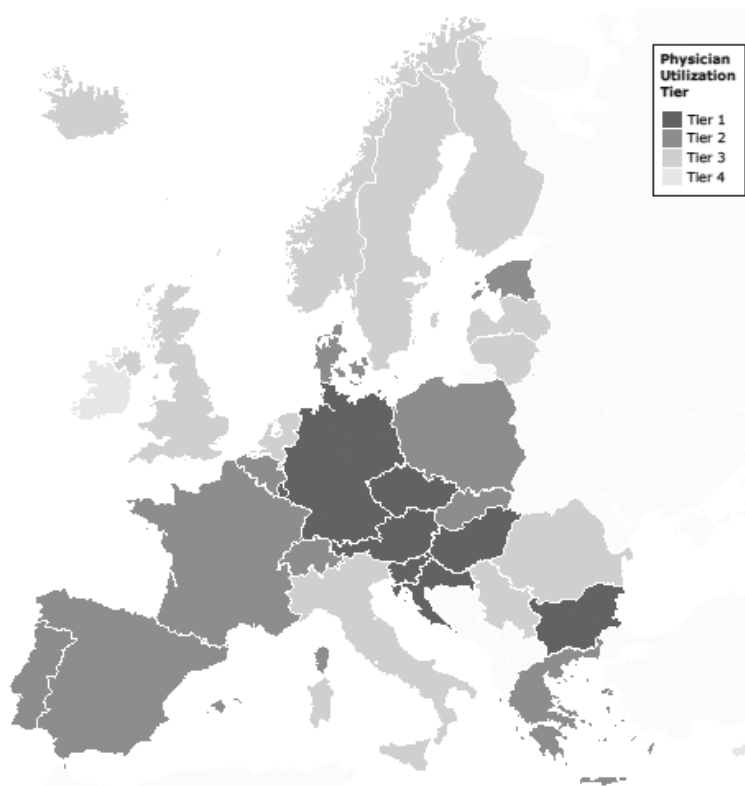
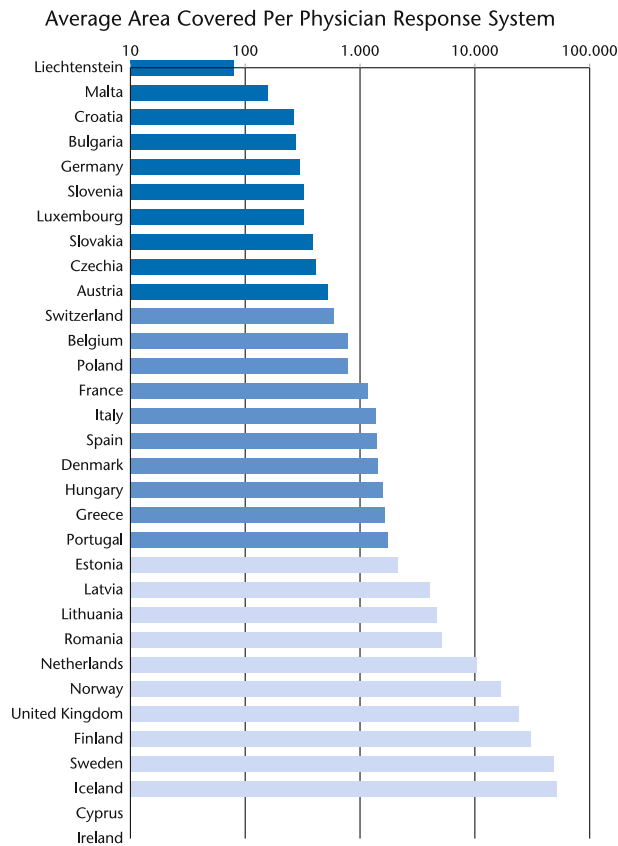


Figure 3. Overview of physician utilization tiers in Europe.



**Figure 5.** Countries ranked by average area [in square kilometers] covered per physician response system; x-axis on logarithmic scale.

tries, we show that the utilization of prehospital physicians still varies considerably across Europe. A classification based on the density of prehospital medical services provided, the so-called “physician utilization levels”, allows an objective comparison between countries, as it reflects country-specific situations much more accurately than the archetypal denominators used to date (Franco-German, hybrid, Anglo-American).

The question of which system is more beneficial for treated patients and societies as a whole is beyond the scope of this article. The potential advantages and disadvantages.

Few countries can provide accurate information on the number of emergency medical resources. In addition, there are often specific seasonal differences, e.g., some countries deploy additional emergency helicopters for the care of winter sportsmen during the winter season; this variation could not be taken into account, in these cases average values were assumed. In addition, specifically for HEMS, daytime and nighttime availability is not taken into account in this analysis. We have assumed that the indicated number of HEMS represents helicopter availability during the day.

If throughout the direct communication with the country representatives there were figures that differed from those in the scientific articles on the subject, the figures reported by the country representatives were

preferred (except in some exceptional cases) because we consider them to be more up to date.

In conclusion, there are notable differences in system designs and in the intensity of physician utilization between the different geographical areas, countries and regions of Europe. Several archetypal models (Franco-German, hybrid and Anglo-American) exist simultaneously in all European countries. This classification therefore seems obsolete. The classification we propose, based on the density of the emergency physician system, may provide a better insight into the treatment in each emergency medical system. On the basis of this new classification, qualitative questions and comparisons of the different medically staffed EMS systems in Europe can be better addressed in the future.

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