

Advanced life support units in Spain: the situation in 2008

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Objective: To determine the number of emergency advanced life support teams currently operating in Spain, their locations, the proportion of the population served, the population density, and the territorial extension covered in the different autonomous communities.

Method: Descriptive study of the Spanish situation as of January 1, 2009. Public information sources were used to identify the number and locations of advanced life support teams. The data gathered were complemented with information obtained by interviewing the staff of hospital emergency departments and dispatch centers. The concept of advanced life support team was defined and the study was limited to teams providing initial care. Population and territorial extension data were taken from the latest official census published by the Spanish National Institute of Statistics in December 2008.

Results: We identified 362 teams meeting the defined criteria; 327 use road transport ambulances and 35 use helicopter ambulances. We found advanced life support teams operating at a ratio of 1 to 127 308 inhabitants (0.78/100 000 population), with ratios varying from 1 to 63 000 (1.58/100 000 population) to 1 to 232 000 (0.43/100 000 population). Geographically, we found 1 team for every 1400 km² (7.2/10 000 km²) on the average, with a range of 1 unit for every 129 km² (77.2/10 000 km²) to 1 unit for every 5200 km² (1.9/10 000 km²). Density averaged 12 persons per square kilometer attended by a unit, with a range in density of 1 to 31 per square kilometer attended.

Conclusions: 1) There is considerable disparity between different Spanish autonomous communities with regard to use of advanced life support units, the territorial extension covered, populations served, and density. 2) The differences in coverage by life support units are unrelated to population, territory, or population density. 3) The differences can be attributed to disparity in criteria applied when planning and to factors related to geography and climate, communication infrastructure or other unstudied variables. [Emergencias 2009;21:269-275]

Key words: Advanced life support units. Emergency medicine. Spain.

Introduction

The 1980s and early 90s saw the appearance of the outpatient services of Emergency Medical Services (EMS) at several places in Spain, with different areas of assistance and different dependencies. Examples include the Fire Brigades of Seville and Barcelona in 1980, Helicopter Health Service of Aragon in 1980¹, Zaragoza Fire Brigade in 1983, SAMU Castellón in 1985, Emergencias Ciudad Real in 1987 in Helicopter Health Service in 1988, 061 Madrid in 1990 or SAMUR Madrid, and SAMU Valencia in 1991². Each were

pioneering services in their setting and of those that survived the early years, many have continued as a model for others. The progressive introduction of these services in our territory, their configuration and the different aspects of their activity have been studied since before their inception to date³⁻¹⁷.

One element common to all, an essential for outpatient medical care in Spain, was the introduction of mobile medicalized advanced life support units (ALSU) as the first links in the chain of care, able to provide the type of assistance until then only offered by hospitals. Since then, the

widespread development of EMS has resulted in the presence of this type of resource throughout the territory to the point that the whole EMS is now identified with their ALSU (an informal survey conducted by the authors and others in 2004, among a population of 107 firefighters, police and patients in three autonomous communities, found that 78% viewed the EMS as the ALSU in their community, and took the other elements of the system for granted). Today the presence of the ALSU (Mobile ICU) vehicles is part of the daily life of the population, and of social policy proposals or television series or documentaries, and an EMS is inconceivable without them. However, few studies have estimated the actual number of units in Spain, and none updated.

A brief study in 1996¹⁸, referring to the previous year, reported a total of 89 operational ALSU, of which 64 were operating almost continuously.

The well-known review published in this Journal by Pacheco et al² in 1998 found 123 ALSU in operation, although their activity schedule and staffing was variable. And in the SEMES Congress held in Cadiz 2001, one communication specifically devoted to the ALSU for emergencies identified 175 vehicles in permanent use¹⁹.

With the constant growth of ALSU, it therefore seems important to determine the state our current situation. Knowledge of external resources and especially of adjacent territories is useful in a country like Spain with distances of up to 6,000 km between the Autonomous Communities (ACs) (personal estimate based on territorial limits using the software utilities of Google Earth V.4.3) and therefore between different EMS. Thus, the objectives of this study were to determine the number of ALSU currently operating in Spain assigned to primary emergencies; their distribution; and to establish their proportions in the population, the extent and population density of the ACs to which they belong.

Method

We performed a descriptive study of the situation in Spain as at 1 January 2009. To identify the number and location of ALSU, we used public sources of information such as websites, reports of the Ministries of Health or memoranda of EMS²⁰⁻³⁵. The information has been completed and verbally checked with that offered by the staff of Emergency Coordination centres at the autonomic or provincial level.

ALSU are understood to be emergency ground

or air vehicles, equipped with their own material to perform advanced life support tasks, and with permanent emergency expert staff including at least one physician and a registered nurse.

The presence of emergency experts is assumed for any health emergency vehicle, but is not unique to ALSU. It applies to both patient transport and rapid intervention vehicles that meet the above conditions. The specific ownership of each vehicle has not been taken into consideration; the only requirements for inclusion in this study were that the vehicle met the above conditions, was immediately operational and permanently available to the centres that coordinate health emergencies.

Of the ALS units meeting the above conditions, the study only included those devoted primarily to emergencies, and excluded inter-hospital transport units and "multipurpose" helicopters whose use is not entirely health-related. Both may occasionally perform emergency tasks, but their intended use is essentially different.

For population data we used the Official Census for 2008, the latest publication of the National Institute of Statistics³⁶. The extension each AC was taken as that documented by this official institute³⁷.

The proportion of ALSU with respect to the population is expressed in two ways: as the average number of people per ALSU, and the number of ALSU per 100,000 inhabitants. The proportion of ALSU with respect to AC area is expressed as the average square km covered by each unit, and the number of ALSU per 10,000 square km. The proportions of population density is expressed as the number of people per square kilometer and per ALSU. All the proportions are established for the total number of ALSU in each area, with land and air ALSU reported separately when appropriate. Apart from the averages throughout Spain and for each AC in particular, in some cases we obtained indicators for mainland Spain and island communities, or the territories of Ceuta and Melilla were excluded for dimensional reasons with respect to the remaining territory.

Results

We identified 362 ALSU, of which 327 were land vehicles and 35 aircraft. Table 1 lists data by ACs, and Figure 1 shows distribution by territory.

As regards the proportion of ALSU per total population, we found an average 127,508 inhabitants per ALSU, with extremes ranging from

63,187 per ALSU in Aragon to 232,014 per ALSU in Galicia (Table 2). Expressed as demographic indexes, the Spanish average was 0.78 ALSU per 100,000 population, with territorial differences from 0.43 to 1.58 (Figure 2).

In the section on geographical extension, we found an overall average of one ALSU per 1398 square km, with wide differences ranging from 129 square km to 5,204 square km in Extremadura. On separating mainland from island areas, we found that the mainland had one ALSU per 1450 square km, which exceeds the national average, while the island territories had one ALSU per < 600 square km (Table 3).

With respect to geographical indexes, the overall average was about 7.2 units per 10,000 square km, varying from 1.9 to 77.2 units (Figure 2). Notably, both averages and geographic indexes for Ceuta and Melilla were substantially different from the rest of the country.

Table 4 shows the proportion of ALSU according to population density, ie the number of inhabitants per square kilometer served by each ALSU. The average for all the ACs was estimated as 11.7 persons per km and ALSU, with extremes ranging from 31 in the Balearic Islands and 1 for Castilla-La Mancha, Aragon and Leon (Figure 2).

Discussion

It may strike the reader that with such a profusion of data, the usual comparative statistical analysis is not presented in this study. The reason is simple. To determine whether the proportion of ALSU vehicles in a community deviates significantly from the average or not is purely numerical data, which add nothing to the existing proportion, which is what this descriptive study sought to establish. Moreover, the AC regions do not seem to be comparable realities in terms of their geography, topography, or their population densities. For comparative purposes, all these factors and others would have to be taken into account, which may be the aim of future studies, but to compare them without these factors could lead to inappropriate conclusions. An example: if we took the proportion of ALSU per square km in the community of Madrid as the optimum model, Extremadura would need 322 ALSU to match that proportion.

The proportion of population per ALSU (inhabitants/ALSU) usually reflects the potential volume of patients they attend. A high index reflects

Table 1. Quantitative distribution of Emergency advanced life support units (ALSU) by Autonomous Communities (ACs)

Acs	Total ALSU	Land ALSU	Air ALSU
Andalusia	41	36	5
Aragon	21	19	2
Asturias	7	6	1
Cantabria	4	4	—
Castilla-La Mancha	28	24	4
Castilla-Leon	27	23	4
Cataluña	52	48	4
Com. Valenciana	47	44	3
Basque Country	11	10	1
Extremadura	8	6	2
Galicia	12	10	2
Balearic Islands	7	6	1
Canary Islands	14	12	2
La Rioja	3	3	—
Madrid	62	60	2
Murcia	11	10	1
Navarra	5	4	1
Ceuta	1	1	—
Melilla	1	1	—
Total	362	327	35

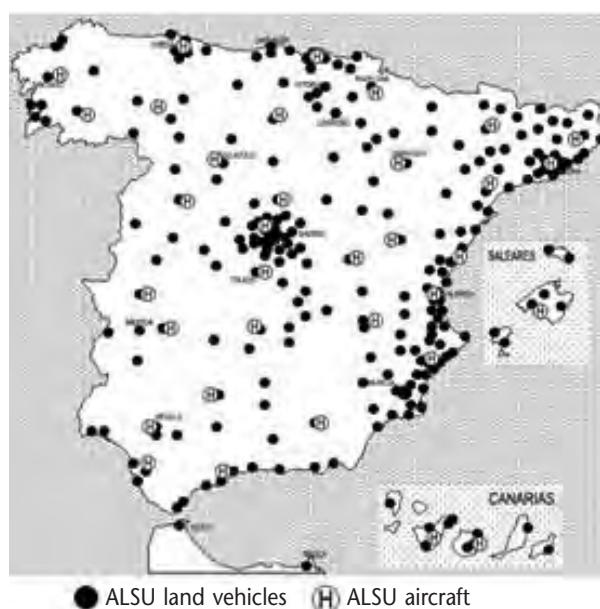


Figure 1. Geographic distribution of advanced life support units (ALSU) in Spain.

greater likelihood of simultaneous emergencies occurring in the same population. The logical solution is to have a sufficient number of ALSU to cover these situations, taking into account the relative incidence of common emergencies within that population (eg acute coronary syndrome, severe multiple trauma patient, stroke, respiratory failure), as well as other resources available for attending emergencies.

We were unable to establish a direct relationship between proportions of total and land ALSU per population and the population of ACs. In oth-

Table 2. Proportion of advanced life support units (ALSU) per population of the Autonomous Communities (ACs)

Acs	Population	Pop/ALSU	Pop/IALSU	Pop/aALSU
Andalusia	8,202,220	200,054	227,839	1,640,444
Aragon	1,326,918	63,187	69,838	663,459
Asturias	1,080,138	154,305	180,023	1,080,138
Cantabria	582,138	145,535	145,535	–
Castilla-La Mancha	2,043,100	72,968	85,129	510,775
Castilla-Leon	2,557,330	94,716	111,188	639,333
Cataluña	7,364,078	141,617	153,418	1,841,020
Com, Valenciana	5,029,601	107,013	114,309	1,676,534
Basque country	2,157,112	196,101	215,711	2,157,112
Extremadura	1,097,744	137,218	182,957	548,872
Galicia	2,784,169	232,014	278,417	1,392,045
Balearic Islands	1,072,844	153,263	178,807	1,072,844
Canary Islands	2,075,968	148,283	172,997	1,037,984
La Rioja	317,501	105,834	105,834	–
Madrid	6,271,638	101,155	104,527	3,135,819
Murcia	1,426,109	129,646	142,611	1,426,109
Navarra	620,377	124,075	155,094	620,377
Ceuta	77,389	77,389	77,389	–
Melilla	71,448	71,448	71,448	–
Spain	46,157,822	127,508	141,155	1,318,975

IALSU: land ALSU. aALSU: aircraft ALSU.

er words, it cannot be said that the most populated ACs have higher rates of population per ALSU, or that less populated ACs have lower indexes. This statement is less categorically correct if indexes of population per helicopter ALSU, where there was a slight tendency for the more populated regions to have a higher population per helicopter. But neither was this an absolute trend, since neither the community with lowest index was the least populated, nor vice-versa. Nor could we substantiate the opposite hypothesis, namely, that there was an inverse relationship between the indices and population of ACs (the larger the population, the lower the proportion).

Moreover, it should be noted that there are certain factors that may undermine the results of this section. For example, if a service uses its ALSU only or mainly within the isochrone 20 (and that procedure is currently applied in several ACs^{20, 29}) while out of it other resources of the system are used, the proportion of the population served is lower than it would be by simple application of the mathematical formula of proportion. A special case, which deserves independent study, is that seasonal populations of certain communities (eg.Valencia, Andalusia and Galicia), experience significant variation of population in holiday periods, and sometimes implement facilities only for these periods.

The indexes on geographic extension (square km²/ALSU), unlike previous ones, tended to reflect the remoteness or proximity of any point in the territory covered. Thus, a high index per ALSU

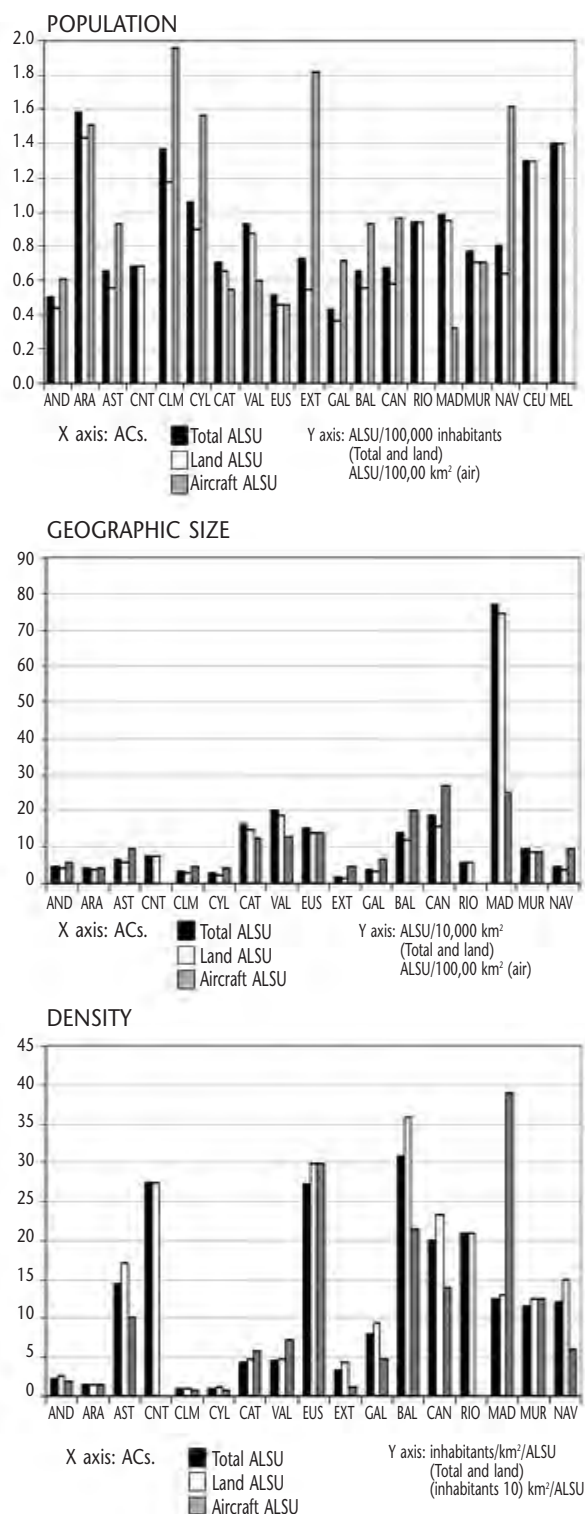


Figure 2. In the different Autonomous Communities, indexes of advanced life support units (ALSU) by population (upper), geographic size (middle) and population density (lower). AND Andalusia; ARA Aragon; AST Asturias; CNT Cantabria; CLM Castilla-La Mancha; CYL Castilla y Leon; CAT Catalunya; VAL Valencia; EUS Euskadi (Basque country); EXT Extremadura; GAL Galicia; BAL Balearic Islands; CAN Canary Islands; RIO La Rioja; MAD Madrid; MUR Murcia; NAV Navarra; CEU Ceuta; MEL Melilla.

Table 3. Proportion of advanced life support units (ALSU) by geographic size (extension) of Autonomous Communities (ACs)

Acs	Extension	Km ² /ALSU	Km ² /IALSU	Km ² /aALSU
Andalusia	87,598	2,137	2,433	17,512
Aragon	47,720	2,272	2,512	23,860
Asturias	10,604	1,515	1,767	10,604
Cantabria	5,321	1,330	1,330	–
Castilla-La Mancha	79,462	2,838	3,311	19,866
Castilla-Leon	94,225	3,490	4,097	23,556
Cataluña	32,113	618	669	8,028
Com. Valencia	23,255	495	529	7,752
Basque Country	7,235	658	724	7,235
Extremadura	41,635	5,204	6,939	20,818
Galicia	29,574	2,465	2,957	14,787
Balearic Islands	4,992	713	832	4,992
Canary Islands	7,447	532	621	3,724
La Rioja	5,045	1,682	1,682	–
Madrid	8,028	129	134	4,014
Murcia	11,313	1,028	1,131	11,313
Navarra	10,390	2,079	2,598	10,390
Ceuta	19	19	19	–
Melilla	13	13	13	–
Total	505,957	1,398	1,547	14,456
Total without CE + ME	505,925	1,405	1,557	14,455
Total Peninsular	493,486	1,456	1,607	14,421
Total Islands	12,439	592	691	4,146

IALSU: land ALSU. aALSU: aircraft ALSU CE: Ceuta, ME: Melilla.

means a higher probability that in a given emergency the appropriate ALSU is further away and therefore will take longer to get to the point where it is needed. The indexes should be closer to what each service deems as acceptable access times.

In this area, there is no clear relationship, direct or inverse, between the index and the extension of the ACs. There is a tendency for the geographically larger communities to have higher extension indexes and vice-versa, but this cannot be generalized because there are conflicting data in both cases. The relationship seems clearer for the aircraft ALSU in the larger ACs. Another aspect is the location of several ALSU in close proximity in the same area, usually in densely populated areas, which happens in all big cities, and this can distort the results pertaining to their communities.

The only clear relationship that could be established in this section occurred on grouping the territory into mainland versus island areas. In this case it appears that the peninsular ALSU tend to cover three times greater distance than the island ALSU, and the trend continues in both total and ground or air units. However, despite the obvious trend of averages, there are two mainland communities that offer lower rates per ALSU than the island rates, and two others with similar rates.

Finally, the density indexes (number of inhabitant/square km²/ALSU) reflect the probability that when an emergency arises in a particular popula-

Table 4. Proportion of advanced life support units (ALSU) by population density of Autonomous Communities (ACs)

Acs	Pop/Km ²	Pop/Km ² /ALSU	Pop/Km ² /IALSU	Pop/Km ² /aALSU
Andalusia	94	2	3	19
Aragon	28	1	1	14
Asturias	102	15	17	102
Cantabria	109	27	27	–
Castilla-La Mancha	26	1	1	6
Castilla-Leon	27	1	1	7
Cataluña	229	4	5	57
Com. Valencia	216	5	5	72
Basque Country	298	27	30	298
Extremadura	26	3	4	13
Galicia	94	8	9	47
Balearic Islands	215	31	36	215
Canary Islands	279	20	23	139
La Rioja	63	21	21	–
Madrid	781	13	13	391
Murcia	126	12	13	126
Navarra	60	11	15	60
Ceuta	4,073	4,073	19	–
Melilla	5,496	5,496	13	–
Total	91	0.3	0.3	3
ACs Average		11.7	13.8	93

IALSU: land ALSU. aALSU: aircraft ALSU.

tion, the ALSU responsible for attending it is busy with another. Sometimes this is used as an index of service overload or as indicative of the dispersion of the population to be attended. Even then, we found no relationship between AC population density and their relative indexes.

Considering the above, if as a rule each AC index is unrelated to its population size or density, it seems logical that the differences between them are due either to differences of approach in the planning of services or to other variables not studied in this work, such as topography or transport routes.

From a practical standpoint, these data should serve to point to specific goals.

Being below average in only one of the indexes (population number, geographical extension or population density) may reflect a characteristic of the territory. However, being always below average should encourage reorganization of the service to meet more ambitious objectives. It would seem advisable that ACs with similar characteristics, and adjacent regions, unite their efforts so that their respective EMS could achieve similar results. Those EMS with better than average results should be encouraged to aim at improving other aspects of quality, or the type and location of their future strategic ALSU to cover the weakest points.

Although the data obtained here are of considerable importance, we should bear in mind that this study did not include all the possible fac-

tors influencing the distribution of ALSU, which suggests that there are further lines of future research.

Now the question arises: is it desirable that all ACs should have similar proportions of ALSU with respect to their population data and geographic extension? On the one hand, it is only reasonable that the entire population in Spanish territory should have similar emergency resources and, as far as ALSU are concerned, significant differences were found. But then, emergency resources are not limited to ALSU; there are other elements that comprise the system and play their specific role: 24h call centers (emergency centres for emergency primary care), home care units or basic life support units, among others. And therefore it should not be surprising that, faced similar problems, different communities may use different resources to solve them. At the end of the day, we should not forget that the primary goal of EMS is to provide effective medical care to the population they serve, wherever they operate, using the means at their disposal.

Addendum

This article is an updated version to 1st January 2009 of a paper presented at the XX National Congress of the Spanish Medical Emergencies Society held in Salamanca in June 2008, a summary of which is published in the records of the Congress.

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Unidades de soporte vital avanzado en España 2008. Mapa de situación

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Objetivo: Determinar el número de unidades de soporte vital avanzado (USVA) dedicadas a emergencias que operan en España, su distribución y su relación con la población, la densidad de población y la extensión de las comunidades autónomas.

Método: Estudio descriptivo a 1 de enero de 2009. Para el número y localización de las USVA se han utilizado fuentes públicas de información, y se completó con los datos obtenidos de personal de esos servicios y de los centros de coordinación. Se ha definido el concepto de USVA y se ha delimitado el estudio a las dedicadas a servicios primarios. Los datos de población y extensión se han tomado del último Censo Oficial del Instituto Nacional de Estadística (Diciembre 2008).

Resultados: Se han identificado un total de 362 USVA: 327 terrestres y 35 helicópteros medicalizados. Existe una USVA por cada 127.308 habitantes (0,78 USVA/100.000 hab.), con variaciones desde una cada 63.000 (1,58 USVA/100.000 hab.) hasta una por cada 232.000 (0,43 USVA/100.000 hab.). En el aspecto geográfico, hay un promedio de una unidad de SVA por cada 1.400 Km² (7,2 USVA/10.000 Km²), con extremos de 1 USVA por cada 129 Km² (77,2 USVA/10.000 Km²) y una USVA cada 5.200 Km² (1,9 USVA/10.000 Km²). Por cuanto se refiere a la distribución por densidad de población, tenemos un promedio de 12 habitantes por Km² y unidad, con extremos entre 1 y 31 habitantes.

Conclusiones: Hay una notable disparidad entre las comunidades autónomas en cuanto a los índices relativos de USVA sobre su extensión, población y densidad de población. Las variaciones entre índices encontrados no guardan relación con la población, extensión y densidad de población de cada comunidad. Las diferencias citadas pueden atribuirse a disparidad de criterios en la planificación y a factores, geográficos, climatológicos, de vías de comunicación, o de otro tipo no estudiadas aquí. [Emergencias 2009;21:269-275]

Palabras clave: Unidades de Soporte Vital Avanzado. Emergencias España.