

Original Article

Scientific production of Spanish emergency physicians over the last 30 years (1975-2004). Descriptive bibliometric analysis

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ABSTRACT

Aim: Describe the biomedical research characteristics of Spanish emergency physicians from 1975 to 2004 as well as the evolution over from time.

Methods: The Science Citation Index-expanded was used in the search for documents, the presence of the word "Spain" was required in the field "address" along with any expression used to define an emergency service in Spain (in English, Spanish, Catalan, Basque, Galician). Erroneous retrieval and congress communications were excluded. For the documents included, the main bibliometric data were collected and their temporary evolution evaluated.

Results: Spanish emergency physicians signed 606 papers (20.2 per year): two thirds written in Spanish, half were original research, and most of were from emergency physicians working at hospitals. One hundred and thirty-seven centers yielded at least 1 paper and, by Autonomous Communities, Catalonia, Andalusia and Madrid showed the greatest scientific production. The average impact factor was 1.11, with an index of no citation of 45%, and indexes of in-hospital, out-hospital and international collaborative studies of 57%, 19%, and 4%, respectively. All these indexes were lower than the general biomedical investigation in Spain, although they showed a significant improvement over the last 30 years.

Conclusion: The scientific production of Spanish emergency physicians has been quantitatively and qualitatively low, although it a trend to increase has been observed in the last 30 years. Catalonia, Andalusia and Madrid were found to have the greatest investigative activity in emergency medicine.

Key Words: *Emergency medicine. Bibliometry. Research. Emergencists. Productivity.*

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RESUMEN

Producción científica de los urgenciólogos españoles durante los últimos 30 años (1975-2004).

Análisis bibliométrico descriptivo

Objetivos: Describir las características la actividad investigadora de los médicos de urgencias españoles entre 1975 y 2004, así como su evolución en el tiempo.

Material y método: Se utilizó el *Science Citation Index (SCI)-Expanded*. Para la captura de documentos se exigió la presencia en el campo "Address" de la palabra Spain y, además, cualquiera de las expresiones que identifican a un servicio-dispositivo de urgencias en nuestro país (en inglés, castellano, catalán, vasco o gallego). Se excluyeron las capturas erróneas y las comunicaciones a congresos. De los documentos finalmente incluidos se recogieron los principales datos bibliométricos y analizó su evolución temporal, así como la de los indicadores bibliométricos fundamentales.

Resultados: Los urgenciólogos españoles firmaron 606 documentos (20,2 artículos/año): dos terceras partes en castellano, la mitad documentos originales y la mayoría producidos por urgenciólogos con actividad hospitalaria. Un total de 137 centros produjeron documentos, y Cataluña, Andalucía y Madrid fueron las comunidades con mayor producción científica. El factor de impacto medio fue de 1,11, el índice de documentos no citados del 45% y los índices de cooperación intrahospitalaria, extrahospitalaria e internacional del 57%, 19% y 4%, respectivamente. Todos estos indicadores se encuentran por debajo de los índices generales de la investigación biomédica en España, si bien han mostrado mejoras progresivamente significativas durante estos últimos 30 años.

Conclusiones: La producción científica de los médicos de urgencia españoles ha sido baja cuantitativa y cualitativamente, aunque se observa una tendencia a incrementarse durante los últimos años. Cataluña, Andalucía y Madrid son las comunidades con mayor actividad investigadora en medicina de urgencias y emergencias.

Palabras clave: *Medicina de urgencias. Investigación. Bibliometría. Urgenciólogos. Productividad.*

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INTRODUCTION

It is becoming increasingly important to objectively measure the distribution, obsolescence, usage and repercussions of biomedical research carried out by individuals, research groups or the local or national medical community. During the last few decades, bibliometrics has developed to such an extent that it allows us to do this more efficiently. Moreover, its built-in, modern IT tools make the task of collecting data much easier given that years ago this same task would have taken months¹. Today it is common to use different bibliometric parameters to evaluate the curriculum of a candidate for a work post, the annual report of a research group for obtaining public grants or the investigative activity of a region or country to receive resources. Despite the fact that this system has specific limitations and is not exempt from criticism because in certain respects it is over used at times²⁻⁴, it is still considered a basic instrument for assessing the return on investment in research.

In Spain, the effort made by the Camí group to describe the comprehensive Spanish research in biomedicine and health science in the last 20 years has particularly been of note stood out⁵⁻⁸. There are already detailed studies on biomedical research and its evolution in some areas and/or medical specialisations like neuroscience⁹, nutrition and dietetics¹⁰, drug addiction¹¹, pharmacology¹², AIDS¹³, respiratory diseases¹⁴ or rare diseases¹⁵. In some cases, there is specific specialist training through MIR (the Spanish system of resident medical interns) in certain areas of medicine, whereas in other cases there is a long tradition of developing the classic training method of hospital physicians based on three main principles: patient care, teaching and research, which encourages personal development for the physician as well progress in the specialisation.

Despite the homogenous patient care structures and increased patient care activity, the roles of teaching and research in emergency medicine have been limited by a lack of specialised training through MIR and at times, the hierarchic dependency on other superior structures. This implies added difficulties for the development of research work¹⁶. This study we will essentially analyses two aspects. Firstly, it describes the main bibliometric characteristics of the research work carried out by Spanish emergency physicians during the last 30 years (1974-2004) and the evolution of this research. Secondly, it determines whether there are any differences between the biomedical research of emergency physicians working in hospital emergency departments or in independent out-hospital emergency departments compared with the research of those who work in an emergency department that hierarchically depends on another different department.

MATERIAL AND METHOD

The bibliometric search tool used was the *Web of Knowledge*[®] (version 3.0) program from the *Institute for Science Information* (ISI) and the database used was the *Science Citation Index (SCI)- Expanded*. The database was consulted during the month of February 2006. The period of time analysed was 30 years (from 1974 to 2004) and for some of the analyses the years were grouped together in five year periods since we were able to assume that scientific production during the first half of the study were quite low.

The following search strategy was designed in order to find the documents produced by the Spanish emergency physicians. The presence of the word "Spain" in the "Address" field was considered mandatory (SCI always records the name of the country in English) as well as any of the following expressions which identify an emergency department/medical service in Spain (in this case SCI recognises the authors' affiliation in the same language in which the document is written): urgencias, urgencies, urxencias, larrialdia, larrialdia, emergentziak, emergencies, emergencias, emerxencias, emergency, 061, SAMUR, 1006, SUC, SEMSA, SERCAM, 112, DEIAK or EPES.

Of the documents initially identified, the following which fulfilled the exclusion criteria were rejected: congress communications (*Meeting Abstract*), incorrect finds (for example: Andorra is sometimes included as part of Spain, the number 112 as part of the street number and not as part of an emergency medical service), the appearance of "España" and "Urgencias" (in any of the defined expressions) in different authors' affiliations but without the authors fulfilling both requirements at the same time or the author recording "España" and "Urgencias" in the address only and not in their affiliation (the system that searches by "Address" performs that search indiscriminately both in the affiliation field and in the correspondence address).

A descriptive study of all the documents that were finally included was carried out and the main bibliometric data was collected. In cases lacking sufficient information, the article was evaluated manually. The following information was finally put into a table which included: year of publication, issue number, impact factor (IF) of the publication, country of the editor of the publication (national or foreign), type of document (original, clinical notes, letter to the director, revised version), the language of the document, medical centre, province and autonomous community of the first emergency physician who has signed the document and the order of the authors (primary author, secondary author), if the emergency physician was affiliated with a university, his main work (in-

hospital, out-hospital, primary care, public organisms, scientific societies), if any collaboration has taken place with other emergency departments/medical services and/or other hospitals (and if this hospital was in the same autonomous community, a different one or in a different country), if they collaborated with other emergency departments/medical services and the number of citations the article received. The article was assigned to the medical centre of the first emergency physician who signed it, however if emergency physicians from other centres had collaborated, the province and autonomous community of the other emergency physicians that had signed the article was recorded. A two-fold strategy was employed to determine the focus of the research carried out by the Spanish emergency physicians. On one hand, the SCI area of classification for the article was recorded and if it had been classified under more than one area it was recorded as multidisciplinary. On the other hand, the documents were also classified according to the index of one of the main emergency medicine text books "*Tintinalli's Textbook of Emergency Medicine*"¹⁷ which was slightly modified. Documents which fitted into more than one category were also classified as multidisciplinary.

Finally, the bibliometric aspects of the research of the Spanish emergency physicians working in centres/medical services with independent emergency departments and those of the research of physicians whose emergency department depended on another department or specialisation (internal medicine, intensive care medicine, paediatrics, traumatology, surgery, laboratory or other departments) were compared in order to highlight any differences. To do this, an independent emergency department was considered when the authors affiliation did not indicate that they belonged to any other department or

area. In the remaining cases, the emergency department was considered to be dependent.

We used the mean and standard deviation to present the quantitative variables in the statistical analysis. We used the percentage value for qualitative variables, and for comparing groups we used Students t or chi-square distributions, respectively (with the linear trend test for ordinal variables). In the latter case, if the values calculated in any of the boxes were below 5, the Fisher exact test was used. The categories were grouped together beforehand and converted into dichotomic variables if the table was larger than 2x2. Some of the bibliometric data was adjusted according to the population (number of inhabitants, information from 2002) or economic development (gross national product, GNP, referring to 2002) of the autonomous community. A linear progression test was used to evaluate the evolution of the publications over time. Differences were considered statistically significant if the p value was below 0.05.

RESULTS

During the study period, a total of 606 documents signed by physicians associated with emergency medical services or departments were published, representing a yearly average of 20.2 articles and showing a clear pattern of upward progression, especially from 1995 onwards (Figure 1).

The characteristics of the documents are shown in Table 1. Two thirds of the articles were published in Spanish, around half of these were original documents and most of the scientific activity was produced by emergency physicians with

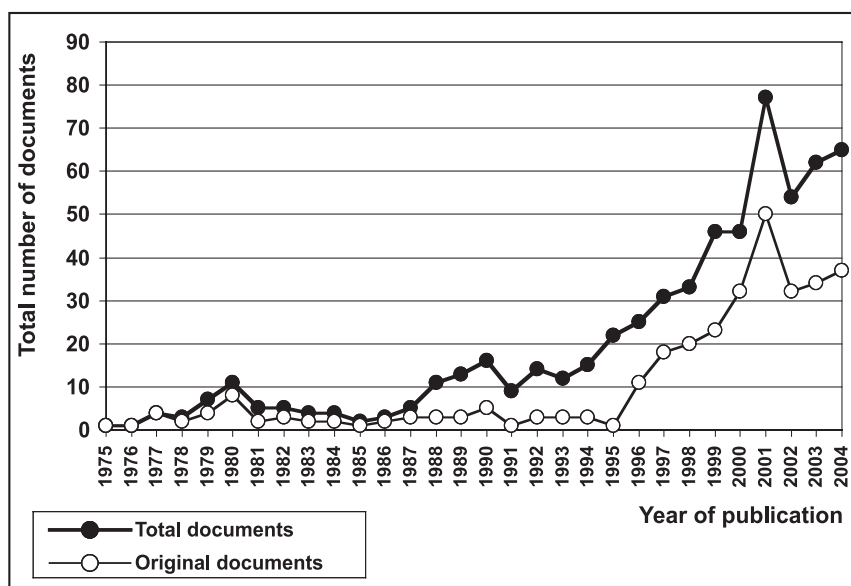


Figure 1. Number of documents published annually by emergency physicians.



a hospital background. In two thirds of the documents, the emergency physicians had signed and stated that they belonged to an independent emergency department. In the remaining third of the documents the department depended on other departments, specially intensive care and internal medicine. Of the 23 international collaborations established, 14 were with the United States, 4 with France, 2 with the United Kingdom, 2 with Germany and 1 with Argentina.

Catalonia, Andalusia and the autonomous community of Madrid in this order, were the regions with greatest scientific production (Table 2). This was demonstrated both in the number of documents as well as in the accumulated impact factor (IF), although, when adjusted according to socioeconomic indicators (population, GDP), Cantabria and the autonomous community of La Rioja also figured among the top three autonomous communities with better scores for some indicators. Twenty-eight documents were the result of collaborations between different emergency departments and, consequently, the authors included emergency physicians from different medical centres other than that of the first emergency physician who signed the document. The additional medical centres were from Andalusia (n=23), Catalonia (n=11), the autonomous community of Madrid (n=2), the autonomous community of Valencia (n=2), the Basque Country (n=2) and Navarre (n=1). The mean IF of the documents was 1.11 and the number of documents that had never been cited was 45.0%. The Balearic Islands and the Basque Country, respectively, were the leading autonomous communities in these indicators. These indicators have improved significantly over the whole period from 1974-2004 and similarly, the rate of in-hospital and out-hospital/national and international collaboration has also risen and reached averages of 57%, 19% and 4%, respectively (Figure 2).

A total of 137 centres, medical services or organisations produced documents; the Hospital Clínic in Barcelona stands out as the clear leader with 13.2%, more than double its closest rival (Table 3). The analysis of the distribution of documents by publication (Table 4) shows that there are two core publications, *Medicina Clínica* and *Revista Clínica* which contain more than half of all the articles published. The first publications specifically about emergency medicine (*American Journal of Emergency Medicine* and *Journals of Emergency Medicine*) appear further down in the list in ninth and tenth place and the group of publications that deal specifically with this subject only contributed a total of 25 documents (4.1% of the total).

The SCI classified the highest number of documents into the following categories; internal and general medicine, intensive care medicine and the cardiovascular system, since al-

TABLE 1. Main characteristics of the documents produced by Spanish emergency physicians

Number of authors [mean (SD)]	4.93 (2.62)
Citations received [mean (SD)]	3.02 (7.77)
Language the article is written in [number (%)]	
-Spanish	394 (65.0)
-English	210 (34.6)
-French	1 (0.2)
-German	1 (0.2)
Editor of the publication [number (%)]	
-national	403 (66.5)
-foreign	203 (33.5)
Type of document [number (%)]	
-article	314 (51.8)
-letter	214 (35.3)
-editorial	37 (6.1)
-note	26 (4.3)
-revision	15 (2.5)
Order of the authors [number (%)]	
-primary author	434 (71.6)
-secondary author	172 (28.4)
Emergency physician's work	
-hospital related	575 (94.9)
-out-hospital emergencies	21 (3.5)
-administration	6 (1.0)
-primary care emergency centres	2 (0.3)
-medical organisation	2 (0.3)
Definition of the emergency centre [number (%)]	
-independent	404 (66.7)
-dependent on intensive care department	91 (15.0)
-dependent on internal medicine department	45 (7.4)
-dependent on surgery	21 (3.5)
-dependent on paediatrics	18 (3.0)
-dependent on traumatology	7 (1.2)
-dependent on other departments	6 (1.0)
Emergency physician university affiliation [number (%)]	
-no	515 (85.0)
-yes	91 (15.0)
Collaboration with other hospital departments [number (%)]	
-no	232 (40.7)
-yes	341 (59.3)
Collaboration with other Spanish centres in the same autonomous community [number (%)]	
-no	500 (82.5)
-sí	106 (17.5)
Collaboration with other Spanish centres in other autonomous communities [number (%)]	
-no	575 (94.9)
-yes	31 (5.1)
Collaboration with centres in other countries [number (%)]	
-no	583 (96.2)
-yes	23 (3.8)
Collaboration with other emergency departments/medical services [number (%)]	
-no	578 (95.4)
-yes	28 (4.6)

TABLE 2. Indicators of scientific production by autonomous community

	Number of doc. (rank)	% of total doc.	Number of doc./ 10 ⁶ pop. (rank)	Number of doc./ 10 ⁶ € GDP (rank)	AIF (rank)	% of total AIF	AIF/10 ⁶ pop. (rank)	AIF/10 ⁶ € GDP (rank)	Average IF per doc. (rank)	% of doc. not quote
Andalusia	139 (2 ^o)	22.9	17.9 (3 ^o)	1380 (1 ^o)	162.2 (2 ^o)	24.2	21.1 (3 ^o)	1610 (3 ^o)	1.17 (5 ^o)	47.5 (8 ^o)
Aragon	6 (13 ^o)	1.0	4.8 (14 ^o)	244 (14 ^o)	2.3 (16 ^o)	0.3	1.8 (18 ^o)	98 (18 ^o)	0.38 (18 ^o)	83.3 (15 ^o)
Asturias	13 (8 ^o)	2.1	12.1 (6 ^o)	780 (4 ^o)	8.5 (10 ^o)	1.3	7.9 (11 ^o)	510 (11 ^o)	0.65 (14 ^o)	61.5 (13 ^o)
Balearic Islands	3 (16 ^o)	0.5	3.1 (18 ^o)	142 (18 ^o)	18.4 (8 ^o)	2.7	19.3 (5 ^o)	871 (5 ^o)	6.12 (1 ^o)	33.3 (3 ^o)
Canary Islands	19 (6 ^o)	3.1	9.9 (7 ^o)	585 (8 ^o)	21.9 (6 ^o)	3.3	11.4 (8 ^o)	674 (7 ^o)	1.15 (7 ^o)	57.9 (12 ^o)
Cantabria	7 (11 ^o)	1.2	12.6 (5 ^o)	717 (6 ^o)	18.3 (9 ^o)	2.7	33.0 (2 ^o)	1874 (1 ^o)	2.61 (2 ^o)	28.6 (2 ^o)
Castile-La Mancha	9 (9 ^o)	1.5	4.9 (13 ^o)	288 (13 ^o)	4.9 (14 ^o)	0.7	2.7 (16 ^o)	157 (15 ^o)	0.54 (17 ^o)	33.3 (3 ^o)
Castile and León	9 (9 ^o)	1.5	3.6 (17 ^o)	212 (17 ^o)	6.0 (11 ^o)	0.9	2.4 (17 ^o)	141 (17 ^o)	0.67 (13 ^o)	55.6 (1 ^o)
Catalonia	196 (1 ^o)	32.3	28.8 (1 ^o)	1332 (2 ^o)	239.7 (1 ^o)	35.7	35.2 (1 ^o)	1629 (2 ^o)	1.22 (4 ^o)	36.2 (6 ^o)
Autonomous cities of Ceuta and Melilla	1 (18 ^o)	0.2	7.0 (9 ^o)	458 (10 ^o)	1.3 (18 ^o)	0.2	9.2 (9 ^o)	595 (8 ^o)	1.35 (3 ^o)	100 (17 ^o)
Autonomous community of Madrid	100 (3 ^o)	16.5	17.2 (4 ^o)	688 (7 ^o)	86.4 (3 ^o)	12.9	14.9 (7 ^o)	594 (9 ^o)	0.86 (11 ^o)	49.0 (9 ^o)
Autonomous community of Murcia	5 (15 ^o)	0.8	3.8 (15 ^o)	243 (15 ^o)	5.5 (13 ^o)	0.8	4.3 (13 ^o)	267 (12 ^o)	1.11 (9 ^o)	40.0 (7 ^o)
Autonomous community of Rioja	6 (13 ^o)	1.0	20.4 (2 ^o)	990 (3 ^o)	5.6 (12 ^o)	0.8	19.1 (6 ^o)	924 (4 ^o)	0.93 (10 ^o)	33.3 (3 ^o)
Autonomous community of Valencia	28 (5 ^o)	4.6	6.2 (11 ^o)	355 (11 ^o)	20.7 (7 ^o)	3.1	4.6 (12 ^o)	262 (13 ^o)	0.74 (12 ^o)	53.6 (10 ^o)
Extremadura	7 (11 ^o)	1.2	3.7 (16 ^o)	315 (12 ^o)	4.5 (15 ^o)	0.7	4.2 (14 ^o)	202 (14 ^o)	0.64 (16 ^o)	85.7 (16 ^o)
Galicia	19 (6 ^o)	3.1	6.9 (10 ^o)	480 (9 ^o)	22.2 (5 ^o)	3.3	8.1 (10 ^o)	561 (10 ^o)	1.17 (5 ^o)	68.4 (14 ^o)
Navarre	3 (16 ^o)	0.5	5.1 (12 ^o)	223 (16 ^o)	2.0 (17 ^o)	0.3	3.4 (15 ^o)	149 (16 ^o)	0.65 (14 ^o)	100 (17 ^o)
Basque Country	36 (4 ^o)	5.9	9.0 (8 ^o)	749 (5 ^o)	41.1 (4 ^o)	6.1	19.4 (4 ^o)	855 (6 ^o)	1.14 (8 ^o)	27.8 (1 ^o)
TOTAL	606	100.0	14.0	867	671.4	100	15.5	961	1.11	45.0

doc.: documents; pop.: population information refers to 2002; GNP: gross national product (information refers to 2002); AIF: accumulated impact factor (to calculate the AIF we used the IF from 2004 published by the *Journal Citation Index*).

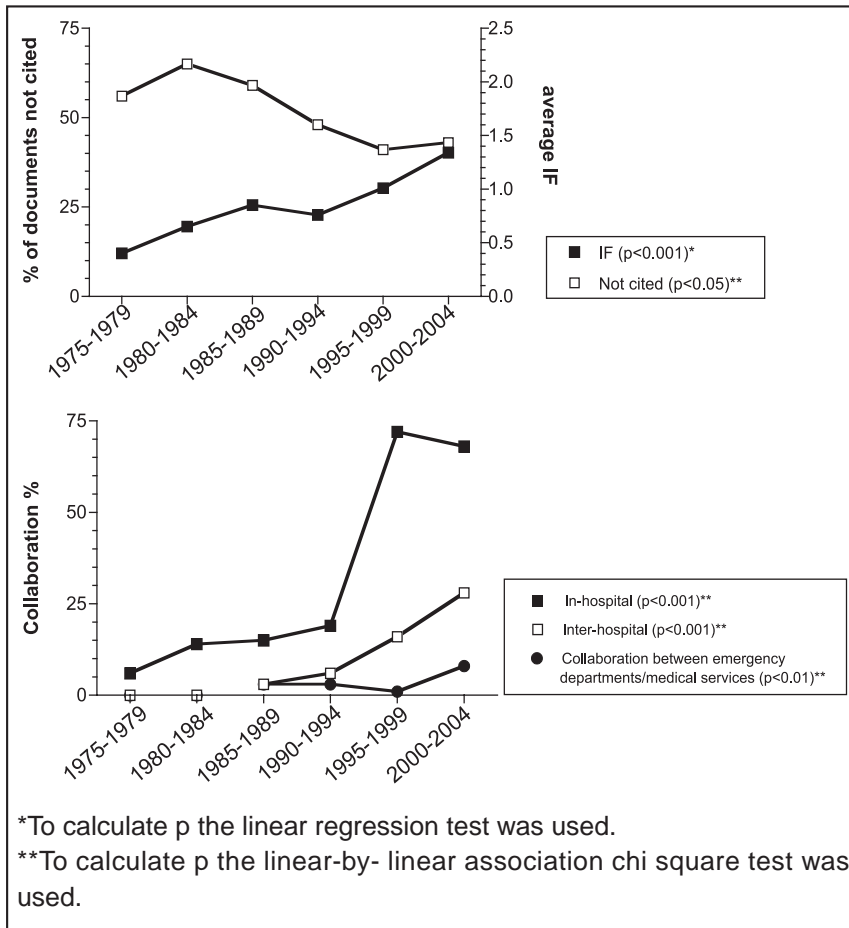


Figure 2. Evolution over 5 year periods of the impact factor (IF) and the number of documents not cited (superior) and the different collaboration rates (inferior) for the documents produced by Spanish emergency physicians.

most two thirds of documents contained one of these three categories (Table 5). The classification based on the specific list of emergency-related topics (*Tintinalli's Textbook of Emergency Medicine*) allowed a more varied distribution of the research areas in a more varied way and in this case, the areas of toxicology and pharmacology, infectious diseases, cardiovascular diseases and the organisation of emergency departments accumulated the largest number of documents (280, 46.2%).

On analysing scientific production according to whether the emergency department was independent or not, we observed that emergency physicians that were associated with independent emergency departments progressively increased their contributions during this period (Figure 3). Moreover, with regards to those depending on other departments, the first emergency physicians published significantly more work in Spanish (68.1% vs. 58.9% respectively; $p < 0.05$) and in publications belonging to a Spanish publisher (69.3% vs. 60.9% respectively; $p < 0.05$), whilst it was less common for their articles to be original (48.0% vs. 59.4% respectively; $p = 0.01$) and signed as the first author (67.2% vs. 80.1% res-

pectively; $p = 0.001$). Finally, in all areas of research, toxicology and pharmacology and the organisation of the emergency department were significantly more predominant among the emergency physicians of independent emergency departments (Table 6).

DISCUSSION

This study analyses the main characteristics of the scientific production carried out from 1975 to 2004 by a group of physicians with the common objective of developing their work in patient care in emergency departments and medical services. The results allow us to observe for the first time and in detail what kind of research work Spanish emergency physicians have been undertaking. Altogether it can be seen that this production has been relatively low and of poor quality, although an important increase in the number of documents has been observed in the last decade. We should highlight the fact that whether an emergency department is independent or dependent on other departments affects the characteristics of the scientific produc-

TABLE 3. Detailed scientific production of the centres which have contributed 5 or more documents signed by emergency physicians

	Number of documents	% of the total (n=606)
Hospital Clínic, Barcelona	80	13.2
University Hospital Virgen del Rocío Seville	38	6.3
Clínica Puerta de Hierro, Madrid	23	3.8
Hospital Mútua, Terrassa	21	3.5
University Hospital Virgen de las Nieves, Granada	20	3.3
Hospital Sant Pau, Barcelona	17	2.8
University Hospital Reina Sofía, Córdoba	17	2.8
Hospital de Poniente, Almería	17	2.8
Hospital Germans Trias i Pujol, Badalona	15	2.5
University Hospital Gregorio Marañón, Madrid	13	2.1
University Hospital Ramón y Cajal, Madrid	13	2.1
University Hospital, Santiago de Compostela	13	2.1
University Hospital of the Canary Islands, Tenerife	11	1.8
Hospital de Basurto	11	1.8
Hospital La Paz, Madrid	10	1.7
Fundación Jiménez Díaz, Madrid	10	1.7
Hospital del Mar, Barcelona	9	1.5
Hospital de Las Cruces, Bilbao	9	1.5
Hospital Arnau de Villanova, Lleida	8	1.3
Hospital Clínico Universitario San Carlos, Madrid	8	1.3
SEM, Madrid	7	1.2
Hospital Juan Ramón Jiménez, Huelva	7	1.2
Hospital Doce de Octubre, Madrid	6	1.0
Hospital Campo Arañuelo, Navalmodal	6	1.0
University Hospital Valme, Sevilla	6	1.0
Hospital San Millán y San Pedro, Logroño	6	1.0
Hospital Doctor Peset, Valencia	6	1.0
Hospital Carlos Haya, Málaga	6	1.0
SEM, Barcelona	6	1.0
Hospital de Mataró	5	0.8
Hospital Virgen de la Victoria, Málaga	5	0.8
Hospital Universitario de Bellvitge, L'Hospitalet de Llobregat	5	0.8
Hospital Txagorritxu, Vitoria	5	0.8
University Hospital Clínico, Valencia	5	0.8
Hospital Marqués de Valdecilla, Santander	5	0.8
3 centres with 4 documents	12	2.0
11 centres with 3 documents	33	5.4
24 centres with 2 documents	48	7.9
64 centres with 1 document	64	10.6
Total	606	100.0

TABLE 4. Summary of the publications which have published 5 or more documents signed by Spanish emergency physicians

	Number of documents	% of the total (n=606)
<i>Medicina Clínica</i>	238	39.3
<i>Revista Clínica Española</i>	83	13.7
<i>Revista Española de Enfermedades del Aparato Digestivo</i>	18	3.0
<i>Revista Española de Cardiología</i>	17	2.8
Intensive Care Medicine	16	2.6
<i>Revista de Neurología</i>	15	2.5
Critical Care Medicine	9	1.5
<i>Enfermedades Infecciosas y Microbiología Clínica</i>	9	1.5
American Journal of Emergency Medicine	8	1.3
Annals of Emergency Medicine	8	1.3
Annals of Pharmacotherapy	8	1.3
Resuscitation	7	1.2
Chest	6	1.0
European Journal of Clinical Microbiology and Infectious Diseases	5	0.8
The Lancet	5	0.8
3 publications with 4 documents	12	2.0
7 publications with 3 documents	21	3.5
22 publications with 2 documents	44	7.2
77 publications with 1 document	77	12.7
Total	606	100.0

tion of the physician working in either type of department to a certain extent.

Although it is difficult to find bibliometric studies that use exactly the same methodology, there are a series of scales which pinpoint the scientific production of emergency physicians within the global context of Spanish biomedical productivity. In relation to the intrinsic characteristics of the documents and using the report on comprehensive Spanish research on biomedicine and health science between 1990 and 1993⁷ as a benchmark, it can be seen that during this period, emergency physicians produced less research work in English (9.8% vs. 92.4% for global productivity), fewer original documents (23.5% vs. 67.9%), there was also less inter-hospital collaboration (7.8% vs. 52.1%) and less international collaboration (3.9% vs. 17.8%). At the same time there was an increase in the number of signatures per document (5.0 compared to 4.5). On the one hand, it is worth noting that most research work in emergency medicine comes from a hospital background, which contributes almost 95% of documents despite emergency medicine having high levels of out-hospital activity and patient care. On the other hand, university participation is minimal (emergency physicians had university affiliation in only 15%



TABLE 5. Summary of the areas of scientific production in which Spanish emergency physicians have published 10 or more articles

	Number of documents	% of the total (n=606)
Science Citation Index classification	606	100.0
– general and internal medicine	293	48.3
– intensive care medicine	38	6.3
– cardiovascular system	37	6.1
– toxicology	25	4.1
– pharmacology and pharmacy	24	4.0
– infectious diseases	23	3.8
– gastroenterology and hepatology	22	3.6
– medical laboratory technology	16	2.6
– surgery	14	2.3
– paediatrics	10	1.7
– other (10 categories with less than 10 documents)	30	5.0
– multidisciplinary	74	12.2
Classification according to the index of Tintinalli's Textbook of Emergency Medicine	606	100.0
– toxicology and pharmacology	84	13.9
– infectious diseases	76	12.5
– cardiovascular diseases	62	10.2
– organisation of the emergency department	58	9.6
– gastrointestinal emergencies	54	8.9
– pulmonary emergencies	34	5.6
– neurology	24	4.0
– urgent pre-hospital care and care during catastrophes	21	3.5
– renal and genitourinary disorders	18	3.0
– oncological and haematological emergencies	16	2.6
– cardiopulmonary resuscitation and techniques	14	2.3
– environment related injurie	10	1.7
– traumatology and bone, tendon and joint pathology	10	1.7
– other (11 categories with less than 10 documents)	35	5.8
– multidisciplinary	85	14.0

of documents) and is much lower when we consider the overall context of Spanish research in which university participation reaches around 50% of the total of all documents⁷. Here, the lack of university professorships and/or subjects related to emergency medicine in Spanish faculties of medicine may explain this in part. Although the research areas were varied, that internal and general medicine predominated when the research was categorised according to the SCI. This is probably due to the fact that approximately half of the physicians working in the emergency department have a background in internal medicine or family and community medicine and therefore, much of their research work falls under this classification. However,

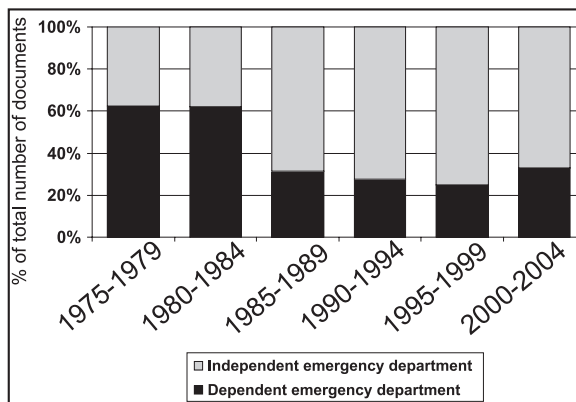


Figure 3. The evolution of the relative contribution of documents during the period 1975-2004 according to the type of emergency department.

when the research was categorised according to the more specific list of topics related to emergency medicine, the areas of interest of the Spanish emergency physicians seem to be more varied.

Even though the autonomous community of Madrid leads in productivity in most of bibliometric studies^{6,8,13,15}, in the case of emergency medicine, Catalan and Andalusian emergency physicians contribute the most. The Hospital Clínic in Barcelona is at the top of the list of centres and this seems to occur in many other areas of biomedical research in Spain^{8,13,14}. However, it is worth pointing out that the map of centres with the most activity in emergency medicine is rather different to the map of Spanish hospital biomedical research activity in a broader context. Consequently, four out of the ten first centres on the list of productivity in emergency medicine (Hospital Mútua in Terrassa, University Hospital Virgen de las Nieves in Granada, University Hospital Reina Sofía in Córdoba and Hospital de Poniente in Almería) occupy these positions despite the fact that the centres do not figure in the list of the top 20 centres with research activity in biomedicine and health sciences in Spain between 1994 and 2002⁸. For this reason they deserve extra merit given that, in a hospital with little research activity, the opportunities for emergency physicians to participate in joint projects involving other areas or specialisations in their centres are scarce.

Although the quantification of biomedical research is relatively easy nowadays, the quality of a publication is always much more difficult to evaluate. Directly applying the IF (used specifically to measure the repercussion of scientific publications) to a particular article is a frequent, albeit well known, mistake within the scientific community¹⁻³. Nonetheless, this, Camí J et al⁷ have quantified the IF of Spanish biomedical research during the period of 1990-1993 within the different areas recognised by the SCI. If we make these calculations using the same methodology over the same period of time for the publi-

TABLE 6. Comparison of some of the characteristics of the scientific productivity carried out by emergency physicians with independent or dependent emergency departments

	Total number of documents (n = 606)	Independent emergency departments (n = 404)	Dependent emergency departments (n = 202)	P*
Number of authors [mean (SD)]	4.93 (2.62)	4.8 (2.7)	5.2 (2.4)	0.05
Impact Factor [mean (SD)]	1.11 (1.73)	1.02 (1.65)	1.27 (1.89)	0.06
Citations received [mean (SD)]	3.02 (7.8)	3.4 (8.8)	2.8 (7.6)	0.23
Documents not quoted [number (%)]	273 (45.0)	189 (46.8)	84 (41.6)	0.22
Articles published in Spanish [number (%)]	394 (65.0)	275 (68.1)	119 (59.8)	<0.05
Publications from Spanish publishers [number (%)]	403 (66.5)	280 (69.3)	123 (60.9)	<0.05
Original articles [number (%)]	314 (51.8)	194 (48.0)	120 (59.4)	0.01
First author [number (%)]	434 (71.6)	271 (67.2)	161 (80.1)	0.001
Hospital activity of the emergency physician [number (%)]	575 (94.9)	379 (93.8)	194 (97.0)	0.34
University affiliation of the emergency physician [number (%)]	91 (15.0)	58 (14.4)	33 (16.4)	0.50
Collaboration with other departments of the same hospital [number (%)]	341 (59.3)	232 (57.6)	109 (54.5)	0.47
Collaboration with other Spanish centres of the same autonomous community [number (%)]	106 (17.5)	67 (16.6)	39 (19.4)	0.40
Collaboration with other Spanish centres from a different autonomous community [number (%)]	31 (5.1)	23 (5.7)	8 (4.0)	0.37
Collaboration with other centres from a different country [number (%)]	23 (3.8)	11 (5.5)	12 (3.0)	0.13
Collaboration with other emergency departments/medical services [number (%)]	28 (4.6)	17 (4.2)	11 (5.5)	0.49
Documents on toxicology and pharmacology [number (%)]	84 (13.9)	69 (17.1)	15 (7.4)	<0.001
Documents on the organisation of emergency departments [number (%)]	58 (9.6)	51 (12.6)	7 (3.5)	<0.01
Documents on urgent pre-hospital care and care during catastrophes [number (%)]	11 (1.8)	10 (24.8)	1 (0.5)	0.11

*In order to compare groups all the qualitative variables have been changed into dichotomic variables.

cations of Spanish emergency physicians, the result would place them in 50th place (0.794 points), just ahead of ENT, orthopaedics/traumatology, dentistry, veterinary science, parasitology, mycology, experimental psychology, forensic medicine, rehabilitation and nursing. The number of citations that a particular article receives can improve the qualitative estimate, although this may also be affected by factors that are extrinsic to the quality of the article itself, such as the visibility of the publication, language and its IF. Consequently, the number of documents on biomedicine and health science not cited was 26.6% for the period 1994-2004⁸, and for the same period (information was gathered 3 years later in the former example) this number was 40.4% for emergency physicians, suggesting that the quality of the articles written by emergency physicians is poor.

During the last decades the number of independent emergency departments with structure a separate from the remaining hospital departments has risen. This increase can be attributed to the fact that since 1985 these departments have made a greater contribution to biomedical research: 67% in the last five-year period studied. However, this research is in a statistically significant for a local community (national publications in Spanish), with a lower percentage of original documents in publications with an inferior IF and a higher number of documents not cited. This suggests that the quality of the research even today is below that of the emergency departments that are

dependent on other departments. One argument in favour of independent departments is that we have observed that in some areas of research that are very specific to emergency medicine such as toxicology and pharmacology, the organisation of emergency departments or urgent pre-hospital care and care during catastrophes are much more frequently made by them.

This study has been a number of limitations which should be mentioned. Some are related to the methodology. The databases are biased towards basic science and English language publications (especially since there is no indexed publication specifically about emergency medicine in Spanish) and, moreover, the classification ability of the database also decreases when the size of the item analysed is reduced (as may be the case for certain centres or authors). The search strategy used in this study only allowed identification of the physicians who identified themselves in their affiliations as physicians who belonged to a particular emergency department. This meant that all research carried out by physicians that did not record these circumstances but, nonetheless, worked in emergency departments was not included. As a result, a significant percentage of documents may have been omitted given that if a professional works temporarily in the emergency department, it is understandable that they may not want to associate themselves with that department, especially if the emergency department is not independent. Additionally, the fact that the pu-



blication *EMERGENCIAS* is, there fore, not included in the main bibliometric indices and as a result emergency physicians do not have an indexed publication about their specialisation in their own country represents an enormous obstacle in terms of showcasing the research work that these professionals carry out.

Another set of limitations also arise as a result of circumstances Spanish emergency physician. At present, emergency medicine is not a recognised specialisation in Spain (unlike in the United States, Canada, Australia, the United Kingdom and Ireland). From a research perspective, this creates certain limitations such as, for example, the fact that research work is not carried out in a structured way as occurs in most of Spanish

emergency departments and medical services. The fundamental cause of this is due to the high percentage of daily work time being dedicated to patient care and the shortages and instability that have affected the workforce until recently. Rationalisation and stabilisation of the workforce and more specific acknowledgement of this work would contribute enormously to improving the investigation carried out by emergency departments and to increasing the specific knowledge related to emergency medicine and emergencies and finally, improve the care provided to the patients.

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