

Developing and testing of search filters for the new European Union Member States' research

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Abstract

Background: To develop and apply search filters retrieving the scientific output (SO) after 2000 focusing on Public Health (PH) of the new European Union (EU) Member States after the 2004 and 2007 enlargements.

Methods: Twelve geographical filters (GFs) were designed and applied to retrieve references added since 2001 in MEDLINE (accessed through PUBMED) and originated in the new EU countries. The PH area was accessed using Medical Subject Heading terms. The filters were evaluated through a manual check and the agreement/non-agreement percentages were calculated.

Results: A number of 99 912 articles revealing the total SO and 6502 articles focusing on PH were retrieved. More than 66% were published abroad and more than 80% in English. The evaluation revealed an average agreement percentage of 98.97%. The results were compared with those obtained by using simple search strategies.

Conclusions: Twelve GFs applied to MEDLINE retrieved references belonging to twelve countries for a specific period of time. The evaluation of the GFs through the manual check demonstrated effectiveness of these filters. Complementary studies would be advisable to focus on the development of search filters to retrieve complete and accurate information.

Key Messages

Implications for Practice

- Knowing the scientific output of countries is a strategic tool in developing future scientific politics.
- Analysing the research situation in a specific area is vital for knowing its status into the scientific output of a country.
- Evaluation of search filters for construction, applicability and effectiveness is needed.
- Correct retrieval of information by using search filters is fundamental to demonstrate filters' effectiveness and provide precise search tools.
- Guidance for researchers on the utilisation of search filters is useful to enhance the accuracy of searches.

Implications for Policy

- The high number of publications requires development in the search strategies area.
- Development, use and/or improvement of search filters are needed in the sphere of search strategies.
- Employment and combination of various types of search filters to retrieve specific information is essential.

Introduction

The use of search filters in scientific literature becomes a useful tool particularly taking into account the annual increase of scientific publications.

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For example Bautista Cabello *et al.*¹ observed in his 2006 study that each year, the MEDLINE database alone includes 560 000 new articles and the central register of the Cochrane Collaboration adds 20 000 trials annually. Search filters can be helpful in retrieving specific information, are gaining popularity and the importance afforded to them as a retrieval tool is reflected by their incorporation as 'Clinical Queries' into the search interface of one of the largest and freely available medical databases, PUBMED.² In some specific areas and exemplified in the MEDLINE database, it was evidenced that the usage of specific search filters are a reliable and valid searching method.³ Geographical search filters were defined as search tools created with the purpose of identifying information according to geographical location.⁴ Revealing the Swedish supremacy among the other European Union (EU) countries in MEDLINE publications between 1990 and 1998, some studies focused on the geographical aspect in this area for the past decade.⁵ In 2004 and 2007, the expanding process of the EU continued assimilating twelve more Member States: Cyprus, the Czech Republic, Hungary, Estonia, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia in 2004, and Bulgaria and Romania in 2007, becoming the EU-27. The study of the research evolution in the new EU members, particularly focusing on the field of Public Health (PH), is even more justified given that several of these countries started painful reform in the early 1990s after the fall of the communist governments.⁶ Bulgaria and Romania, the last two countries included in the EU – where a lower life expectancy at birth was revealed in comparison with the other EU countries – are to receive substantial financial help and one of the challenges posed is the PH community.⁷

The aim of this study was to develop and apply geographical filters (GFs) for new Member States of the EU after the 2004 and 2007 enlargement, and to determine their scientific output (SO) characteristics after 2000, globally and in the field of PH.

Methods

The search strategy proposed in this article followed in order (i) the construction of twelve GFs, for each of the twelve countries that joined the EU

in 2004 and 2007 (Table 1), (ii) the application of Medical Subject Heading (MeSH) terms available in PUBMED database to focus on the PH field and (iii) the evaluation of filter performance by checking the results obtained by means of a manual check. Taking into account that no data was found regarding the topic approached in this article, the study focused on the research situation (in the PH field) of the new EU Member States beginning in 2001 and spanning the date of the search (roughly an 8-year interval of time comprising the beginning of the 21st century until the day of the search) aiming to provide preliminary data for future comparative studies and/or to contribute to the search strategy research improvement. This interval of time is of even more importance, considering that it includes both times of EU enlargement (2004 and 2007) and possible consequent changes perhaps in the political, economical and other possible fields.

To detect the SO after 2000, the search has taken into account all of the records added to MEDLINE, beginning with the year 2001 (by using the option 'Limits – Dates') until the day of the search. The search was carried out on 15 January 2009 for each country individually, seeking out all the articles: of which the major topic was PH, had originated in one of the twelve new countries of the EU, and have been added to MEDLINE since 2001. All the information was extracted from MEDLINE accessed through PUBMED, the leading

Table 1 New European Union Member States according to the year of adhesion in alphabetical order

Year of adhesion	New European Union Member States
2004	Cyprus Czech Republic Estonia Hungary Latvia Lithuania Malta Poland Slovakia Slovenia
2007	Bulgaria Romania

online public database of biomedical literature.⁸ Boolean operators 'OR', 'AND' and 'NOT' were used to construct/combine the search strategies.

The construction of the geographical filter

The following countries were considered for the construction of the GFs: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia (which joined the EU in 2004) and Bulgaria and Romania (joined the EU in 2007). According to these countries, twelve GFs were elaborated, following a similar strategy by each one and comprising a total number of 4970 words (33 397 characters with no space in between). The complete name(s) of the countries were initially identified and then included in the filter translated into the native language (in those cases in which the native alphabet corresponded to the alphabet recognised by the database) and in English, German, French, Spanish, Portuguese and Italian. In those cases in which the translation in several languages revealed similar words, only one term was included. Except for cases where the number of town inhabitants or municipalities was very small, the filter included also the twelve countries' main cities, towns or municipalities, provinces, counties or districts; this was carried out for each individual country by searching, comparing and verifying the information on the Internet. This has been done to retrieve possible affiliations not mentioning the name of the country/countries but specific place/s located in the country/countries. When constructing the Cypriot GF, the entire surface of this island – which is divided into a Northern and a Southern part with six districts⁹ covering the entire island – was taken into account; this is because the whole of the island is in the EU.¹⁰ The affiliation Tag '[ad]' was added to all the terms included in the filter, which were joined by using Boolean operators.

During the construction of the GFs, they were constantly tested and in case of incorrect retrieval by confusion of terms in the GFs, (e.g. parts of addresses or name of centres in other countries) other term of the non-relevant article affiliations retrieved were added to the GF by using the Boolean operator 'NOT'.

The 'subject'/thematic filter

With the aim being able to detect the SO in the field of PH, the MeSH Database was accessed and the MeSH Major topic term 'Public Health' and its sub-terms were selected (and combined by using the Boolean operator 'OR') to obtain all publications of which the major topic was PH as proposed in this article, thus obtaining references with a high degree of efficiency.¹¹ The search strategy obtained was added to the GF with the Boolean operator 'AND'. Table 2 reveals the complete 'subject'/thematic filter developed and used in this article. The complete GF is shown in the Appendix A.

As a secondary search tool, the Tag for 'publication place' was used to divide the research production published in a national or international context. A country's name added to this Tag was then crossed with the geographical and thematic filters by means of the Boolean operator 'AND'.

The searches were carried out for English and/or the countries' native languages by using the language option permitted by the database search system. To detect bilingual publications, the 'language' Tag was added to the languages which were then combined with the Boolean operator 'AND' and added to the rest of the filter with the Boolean operator 'AND' [i.e. (English[la] AND 'native language'[la]) AND 'GF']. The articles were categorised according to 'English,' 'Native language,' and the references in other languages were classified into 'other language'. Aiming to illustrate the number of PH papers published per head of population, such as other studies focused on this aspect in a dermatological context,¹² a coefficient of SO (CSO) was calculated for each

Table 2 The complete 'subject'/thematic filter developed

'Subject'/Thematic filter
"Public Health"[Majr] OR "Public Health Nursing"[Majr] OR "Students, Public Health"[Majr] OR "Public Health Practice"[Majr] OR "Schools, Public Health"[Majr] OR "United States Public Health Service"[Majr] OR "Public Health Informatics"[Majr] OR "Education, Public Health Professional"[Majr] OR "Public Health Dentistry"[Majr] OR "Public Health Administration"[Majr] OR "American Public Health Association"[Majr] OR "Environment and Public Health"[Majr] OR "Population Surveillance"[Majr]

country by dividing the number of articles by the number of inhabitants of the country and multiplying the result by 100 000. The population of the countries was considered according to the World Health Organisation data.¹³

The evaluation of the geographical filter

The data set for evaluation consisted of all the articles (6502): of which PH was the major topic in the field (detected by using the thematic filter) written in any language by any author, added to MEDLINE from 2001 until the day of the search and originated in the twelve countries that joined the EU in 2004 and 2007 (detected by using the GFs).

First, the filter performance was evaluated by manually checking all the results (affiliations) provided after the application of the GFs. The manual check was undertaken by one of the authors based on information presented in the affiliation field of the database record. The manual check classified the articles into 'relevant' and 'non-relevant.' Relevant articles were those written in any language and by any author(s) and in which the affiliation section mentioned place/s located in one of the countries included in the study. The articles in which the affiliation section revealed place/s belonging to any other country/countries (retrieved by coincidence of terms) were categorised as 'non-relevant.' The filters for each country were checked individually and agreement and non-agreement percentages were established; the average was calculated.

Second, a country-by-country search was performed by using simple filters (SFs) constructed including only the names of the countries in English and the native language, added to the affiliation Tag and combined with the Boolean operator 'OR'. In some cases, 'confusing' terms were excluded by using the Boolean operator 'NOT' and when the names of the countries were similar in English and the native language, only one term was included. Examples of SFs are shown in the Table 3. The search was also carried out in the field of PH by using the thematic filter. The results were also checked manually according to the same inclusion/exclusion rules, articles were classified into 'relevant' and 'non-relevant' categories; agreement and non-agreement percentages were also calcu-

Table 3 Examples of simple filters (SFs)

Simple filters (examples)
Cyprus: (cyprus[ad] OR (kypros[ad] NOT australia[ad] NOT dunedin[ad]) OR kypriaki[ad] OR kibris[ad])
Czech Republic: ("czech republic"[ad] OR cesk*[ad] OR czechia[ad])
Estonia: (estonia[ad] OR eesti[ad])
Hungary: (hungary[ad] OR magyarorszag[ad])
Latvia: (latvia[ad] OR latvija[ad])
Lithuania: (lithuania[ad] OR lietuva[ad])
Malta: (malta[ad] NOT italy[ad])
Poland: (poland[ad] OR polska[ad])
Slovakia: (slovakia[ad] OR "slovak republic"[ad] OR slovensk*[ad])
Slovenia: (slovenia[ad] OR slovenija[ad])
Bulgaria: (bulgaria[ad] OR balgariya[ad])
Romania: romania[ad]

lated. The results obtained by using the GFs were compared with those detected by using the SFs.

Results

By using GFs this study detected research situation on an approximately 8-year period of time in the 21st century in MEDLINE, of the new EU Member States with respect to their global SO and focusing on the field of PH, and relating language and place of publication. The application of the GFs provided a total of 99 912 references. Of those, 66 421 (66.48%) originated in the twelve new EU countries. Given the possible relation between the SO found in MEDLINE and the number of journals indexed for this database for information purposes only, the 2008 List of Journals Indexed (LJI)¹⁴ was checked. In the case of Cyprus, Estonia, Latvia and Malta, no journals were currently indexed for MEDLINE so no data was found relating their national environment. All SO detected for these countries was published abroad. For the other eight countries, 33 491 (33.52%) articles were published in their national context, where most of the countries published in the native language or English, except for: Romania (1.25% articles were published in other languages, mainly Hungarian and French); the Czech Republic (0.63% articles were published in other languages, mainly Slovak); Hungary (0.13% articles were published in other languages) and Poland (0.01% articles were published in other languages). Three hundred and sixty bilingual articles

almost in totality (99.17%) publishing in their national environment were found as follows: Poland (80.28%), Lithuania (14.72%), Slovakia (2.22%), Hungary (1.67%) and the Czech Republic (1.11%). Table 4 (Appendix B) shows the number of Journals MEDLINE indexed in 2008 and the distribution of articles by country, SO, language and place of publication.

The combination of geographical and thematic filters permitted the retrieval of the articles in the field of PH, in which Soteriades and Falagas¹⁵ found that Eastern Europe provided 0.7% of the worldwide SO between 1995 and 2003, meanwhile most of the production came from the USA (60.6%) and Western Europe (26.3%). A total of 6502 (6.51%) references originated in the twelve countries included in this study and treating some PH subject as a major topic were found, mostly written in English (80.18%) and more than half (67.38%) which were published abroad. The distribution of the articles by country, SO and year is shown in the Table 5 (Appendix B) and the distribution of the articles by country, SO and language

and place of publication is shown in Table 6 (Appendix B).

The highest number of articles was found in the case of Poland, the country in which a parametric system for assessing the quality of research and based on the impact factor of scientific journals, has been introduced.¹⁶ Poland is followed by the Czech Republic and Hungary; however, according to the CSO, which calculated the changing order, Slovenia holds the highest number of references, followed by the Czech Republic and Hungary (Fig. 1). In the field of PH, the first three classified are also Poland, the Czech Republic and Hungary; but according to the CSO, the order becomes Slovenia, Estonia and the Czech Republic (Fig. 2). Poland and Slovenia hold the highest number of articles according to the SO respectively CSO but in any case the Czech Republic is the only country that holds a position among the first three classified countries. Calculating the PH SO as percentage of total SO per country, Estonia holds the highest position, followed by Malta and Lithuania (Table 6, Appendix B).

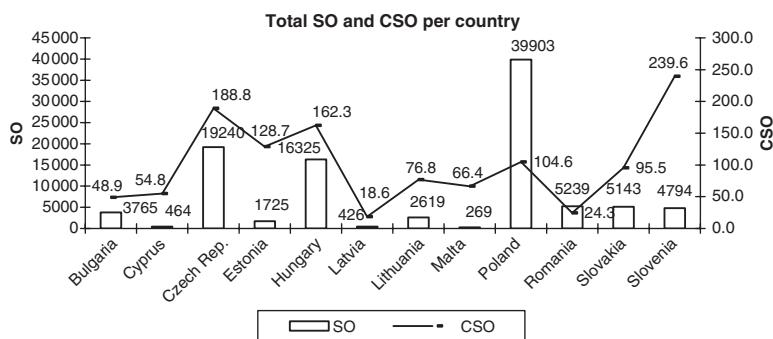


Figure 1 Total scientific output (SO) and coefficient of SO per country

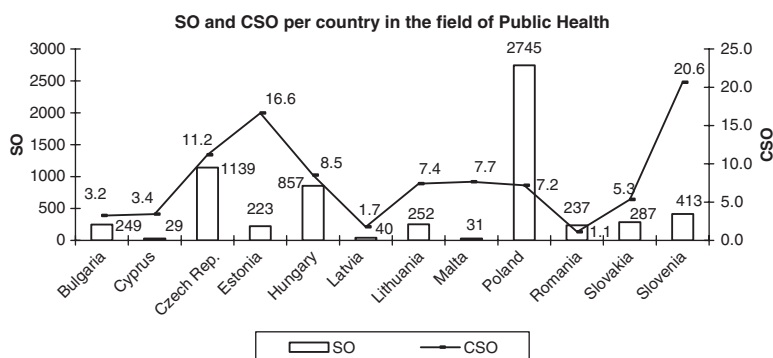


Figure 2 Scientific output (SO) and coefficient of SO per country in the field of public health

Evaluation of the GFs was carried out on a data set of 6502 articles by checking the affiliation mentioned in the database records retrieved, through a manual check; this was obtained after the application of the filters. Each country was checked individually. A number of 6445 (99.12%) references were classified as relevant and 57 (0.88%) as non-relevant. The average agreement percentage was 98.97%, the maximum (100%) in the case of Cyprus, Latvia and Malta, and the minimum (95.98%) in the case of Bulgaria (Table 7, Appendix B). The retrieval of non-relevant articles was owed to the use of words similar to the geographical terms used to construct the filter in the: (i) local part (usually authors' name) or domain name of the electronic mail included in the affiliation field, (ii) research centre's address and (iii) part of the research centres' name. All the coincidences and their frequency and causes by country are shown in Table 8 (Appendix B).

The SFs provided a total of 5155 references of which the manual check classified 5147 (99.84%) of them as relevant and eight (0.16%) as non-relevant. The average agreement percentage was 99.96%. The SFs demonstrated an agreement percentage that was 0.99% higher than the GFs' one, but did not retrieve 1298 relevant references. All relevant articles retrieved by the SFs were encompassed by the number of relevant references retrieved by the GFs and all eight non-relevant references retrieved by the SFs were encompassed into the total of 57 non-relevant articles retrieved by the GFs. According to this data, despite the fact that the agreement percentage was slightly lower, the higher retrieval of relevant references was evident, and so the advantages and effectiveness of the GFs was concluded. In all the cases except Malta, the GFs retrieved a higher number of articles than the SFs (Table 7, Appendix B).

Discussion

This study determined the SO of the twelve new Member States that joined the EU in 2004 and 2007, focusing on the field of PH, by using GFs and retrieving the references added to MEDLINE over a period of approximately 8 years. According to the SO detected Poland holds the highest number of articles, followed by the Czech Republic

and Hungary. This order may be related to the fact that in the same order, these countries have the highest number of journals indexed for MEDLINE in 2008. According to the number of inhabitants, the SO of Slovenia is notable, a country with one journal indexed for MEDLINE in 2008 and where the infrastructure of PH was amended and refurbished but a thorough reconstruction has not taken place.¹⁷

In the global SO, about 4.4 times more English publications were found than native language publications. In the PH field, an approximately similar situation was observed. The use of English in scientific research is frequent in the worldwide literature and in the field of PH, Clarke *et al.*¹⁸ revealed in a study that in a European context only 3.5% of the publications were written in a non-English language, with German being the most common. Kevelaitis and Grabauskas¹⁹ revealed that between 2001 and 2006, despite the fact that the native language was more frequent in a prestigious Lithuanian medical journal, a decline in the use of this language and an evident increase of English as language of publication was noted. An interesting aspect to look at with regard to the language used is the publication in foreign language into a national publishing framework. Only three countries used foreign language(s) to publish in their national context, the Czech Republic and Romania with 44 articles each, and Hungary with five articles written in German. In the Czech case, the foreign language used was Slovak, which is explained by the fact that before 1993 the Czech Republic and Slovakia formed only one country. In Romania, of the total 44 articles written in a foreign language, 77.22% were in Hungarian and 22.73% were in French.

The retrieval of a higher number of articles than those retrieved through the SFs revealed the advantages and the strength of the GFs constructed, suggesting the use of such filters to obtain higher relevance rates. However, taking into account the difference of relevant and non-relevant records retrieved by the GFs and SFs, 6445 vs. 5147; 57 vs. 8 respectively (Table 7, Appendix B), it could be stated in statistical terms that the GFs are characterised by 'recall' and the SFs by 'precision'. Limitation of the GFs constructed may be the possible non-inclusion in the filters of terms

corresponding to some other locations of research centres, in other words, raising the concern with regard to the difficult retrieval of references of which an affiliation field does not include (enough) information to enable their identification and retrieval. The construction of GFs is based on being able to detect specific information in the section 'affiliation'. Looking at it from this direction, a situation in which the obtaining of richer information can be limited is represented by the fact that the GFs detect only the affiliation of the first author.¹¹

The evaluation of the GFs through the manual check demonstrated effectiveness of these filters. The higher retrieval of non-relevant articles was in the case of Poland, followed by Bulgaria, Romania, Hungary, Slovenia, the Czech Republic, Lithuania, Slovakia and Estonia. No non-relevant articles were retrieved in the case of Cyprus, Latvia and Malta, but on the other hand it is useful to mention that the lack of journals indexed in MEDLINE of these countries as well as in the case of Estonia, suggests that alternative sources would need to be searched. The causes of non-relevant retrievals were related to similarities between the terms used in the GFs and the terms of the local part/domain name of the authors' electronic mail included in the affiliation field (most cause found in this study), terms of the research centres' address or terms of the research centres' name. In some cases these coincidences may be avoided, i.e., if a term of the electronic mail corresponds to the last name of the author, this term may be added to the filter with the 'author' Tag and excluded with the Boolean operator 'NOT'. However, there is the risk that another author (with the same name) of a relevant article may be also excluded. In the other cases of coincidences when confusion is with the part of the addresses or name of centres in other countries, those articles can be detected by adding to the GF another term included in the non-relevant article affiliation, as had been done in the filters presented in this article where confusion was detected.

In the field of bibliometrics and PH, Sanson-Fischer *et al.*²⁰ and Soteriades and Falagas¹⁵ carried out studies including geographical descriptions of the PH research, focusing also on specific sub-categories. In the area of bibliometrics and search strategies, there are studies analysing different

databases and describing specific type of search filters.^{21,22} Other bibliometric studies identified SO in the field of the oral health, clinical biochemistry or dermatology^{23–25} and some others focused on geographical aspects.^{5,26–28}

By using geographical search filters this article presented research condition (global SO and looking at from a PH direction) after 2000 until January 2009 in MEDLINE, of the new EU Member States revealing important data about these countries. It is worth mentioning, however, that the results of the search in this study especially with regard to recent years, may vary with the date of the search depending on the probable time needed by the database to update the records. Relating language and place of publication characteristics, the employment and/or combination of filters such as those constructed and used in this article can be useful in carrying out and/or developing bibliometric analysis and in finding specific information for researchers. The results of this article are tentative and complementary studies are advisable to focus on the development of search strategies particularly search filters retrieving precise and accurate information.

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Declaration of conflict of interest

None.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix A. Geographical filters (GFs) of the twelve new Member States of the European Union.

Appendix B. Tables 4–8.

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