Analysis of Scientific Research on Diagnostic Imaging in Collaboration between European Union Countries and Between European and other Worldwide Countries

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Background

Developing of new technologies on diagnostic imaging have been gradually assuming importance in scientific research and clinical practice, being common today for scientists to conduct scientific research in collaboration with their colleagues from different institutions and disciplines. Until April 2004, the European Union (EU) was a union of fifteen independent states (EU-15) based on the European Communities and founded to enhance political, economic and social co-operation. Since May 2004, ten countries have joined the European Union (EU-25). With these considerations in mind, we performed a study aimed at three different points: to evaluate the importance of diagnostic imaging research in collaboration between the different countries in the EU-15 according to the number of papers published in scientific journals during 1999-2003; to analyse the increase of radiological productivity originating from the ten countries that have joined the EU in 2004; and to identify the scientific collaboration in research articles on diagnostic imaging published in collaboration between the UE-15 countries and the USA, China, Japan, Russia, Canada, Australia and New Zealand. Format

Methodology

In order to measure radiological productivity and collaboration, we considered all peer-reviewed articles, including original papers and reviews, published in biomedical journals indexed in the Science Citation Index (SCI) database between 1999 and 2003. International journals grouped by ISI in the "Radiology, Nuclear Medicine and Medical Imaging" category were considered of radiological interest. The total number of articles ("thematic search") was obtained by scanning the field "topic" of the *ISI Web of Knowledge* (which includes the title of the paper, summary and key words), with a total of 104 terms related to diagnostic imaging techniques, including both acronymic (e.g. "MRI") and truncated terms (e. g. arteriograp*). These 104 terms were obtained by means of a specific search profile in the MeSH Heading "Diagnostic Imaging" from the 2004 Edition of the National Library of Medicine's controlled vocabulary thesaurus. Countries research was performed in the field "address" (AD), which includes the institutional affiliations of all authors of scientific papers, in order to facilitate the analysis of the collaboration between the different institutions. Measures of radiological productivity of each country (related to the number of papers published in each one) was obtained by combining the results of the thematic search with those of each one of the different countries. Specific search profiles that combined pairs of countries for each year of the analysed period were performed to identify the collaboration between the different countries. To count the documents of each country a complete assignment was done. For example, if there was a document that was published by three different countries, the assignment for each of the three countries was n=1.

Results and Discussion

During 1999-2003, there were a total of 143,805 research articles on diagnostic imaging originated from the EU-15 with differences according to the different years of the analyzed period, being 2003 the year with the highest number (n = 31,173; 22%) of papers. The highest number of papers was produced by Germany (n = 31,637; 22%), United Kingdom (27,323; 19%), and France (23,001; 16%). The number of articles published between 1999 and 2003, originating from the 10 countries joining to the European Union in 2004 was 6669 (4.4% of the total radiological productivity of the EU-25), Poland having the highest number of articles (n = 2875, 43% of productivity from the ten new countries and 2% of total productivity from the EU-25). The number of papers published in collaboration between the different countries of the EU-15 was 44,186 (30.7%), with a progressive increase of the

number of papers published during the analysed period. Countries with the highest number of published articles in collaboration were the United Kingdom (n = 7788; 17.6%), Germany (7257; 16.4%) and France (5921; 13.4%). Nevertheless, comparing absolute and relative productivity of articles in collaboration, Ireland (72%), Portugal (68%) and Denmark (57%) had the highest percentage of papers, whereas the United Kingdom (28,%), France (25%) and Germany (23%) had the lowest number of published articles in collaboration. Furthermore, our results suggests that the EU-15 countries tend to establish their collaborations with institutions from the United Kingdom and Germany, followed by collaborations with institutions from neighbouring countries. Interestingly, some countries showed a higher number of published articles in collaboration with their neighbouring countries (e.g. Belgium and France; Spain and France; Luxembourg and Belgium; and Finland and Sweden). Productivity of the joining 10 new countries to the European Union was 3614 articles (7.5% of total EU-25 productivity), having Poland, Czech Republic and Hungary the highest number of articles (n = 1327, 2.7%; n = 704, 1.5%; and n = 672, 1.4%, respectively). These countries tend to collaborate mainly with Germany and France. Excluding the radiological productivity of Austria, Denmark, Ireland, Luxemburg and Portugal, most papers originated from the remaining EU-15 countries were published in collaboration with the USA. The most productive non-EU countries of our sample were USA, Australia, Canada, China, Japan, New Zealand and Russia, the USA having a total of 107,235 diagnostic imaging articles published between 1999 and 2003. Excepting Russia and Japan, which tend to collaborate mainly with Germany, the United Kingdom was the EU country with the highest number of articles in collaboration with these non-EU countries.

Conclusions

The present study shows that radiological research in the EU-15 is the most active and productive in the world, followed by the USA. Several EU-15 countries have an extensive collaboration with the rest of European Union countries, chiefly with the United Kingdom and Germany. Collaboration with other non-EU countries in our series was established mainly with the USA. There were a relevant collaboration between the different European countries and their neighboring countries. Radiological productivity of the joining 10 new countries to the European Union is increasing steadily and can be a relevant part of EU radiological research in the future.

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