Public health research literature on infectious diseases: coverage and gaps in Europe

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Background: In this study, bibliometric methods were used to investigate prevention and control of infectious diseases (IDs). The aim was to gain an overall view of published research on IDs in Europe as part of the collaborative study SPHERE (Strengthening Public Health Research in Europe).

Methods: A framework for research on IDs and public health was developed with definitions, keywords, inclusion and exclusion criteria. A detailed web search strategy based on the framework was designed, piloted and refined. The PubMed electronic database was searched for ‘infectious diseases’ as a whole, and for several subtopic areas, across July 1995 and June 2005. Numbers of publications by year, country, population and Gross Domestic Product were calculated.

Results: Nearly 21,000 publications on the main topic and sub-topics were found, with a progressive increase particularly since 2000. There was a marked heterogeneity between countries. France, Italy, The Netherlands, Spain, Germany, Switzerland, Sweden, UK and Belgium were the most prolific, and Eastern European countries less so. ‘Vaccine-preventable diseases’, ‘Sexually transmitted diseases’, ‘Drug-resistant infections’, ‘Insect–arthropod-related diseases’ and ‘Childhood diseases’ were the main fields of scientific production. Research on ‘Epidemiology and Surveillance’ appeared, in general, to be better represented than research on ‘Prevention and Control’.

Discussion: This is the first time such a broad approach has been used to describe public health research on IDs across Europe. A priority should be cooperation between European states where there is little or no, scientific production. Bibliometrics has limitations, but is of value to indicate a general pattern.

Keywords: Europe, infectious diseases, public health, scientific research

S
ome of the best results in medicine, during the last few decades, concern prevention and control of infectious diseases (IDs), to which both vaccines and antibiotics have contributed.¹² Globally, some important IDs, have been eradicated, e.g. smallpox, and for others, e.g. polio, diphtheria, measles and tetanus,²⁻⁵ there is a clear possibility of eradication or optimal control. Children’s health has improved, mainly due to well-planned vaccination strategies, and targeted national immunization schedules.⁶

However, many problems remain. HIV infection, micro-organism multi-resistance to antibiotics and anti-virals and the possibility of the next pandemic of influenza currently face public health policy makers.⁷⁻⁹ Dramatic changes in the demographic composition of populations, due to mass migration, changing work relationships, tourism and ‘globalization’, have impacted on social and cultural values and also ID epidemiology.¹⁰ Inequalities within and between countries have been growing, as also have the use and cost of health care.¹¹⁻¹² Significant economic benefits can be achieved by improving population health,¹³ and a more dynamic approach to the prevention and control of IDs will contribute to improving general health status.

Recent developments have resulted in effective new instruments for prevention, e.g. new vaccines against meningitis, chicken pox, HPV and rotavirus infections, and diagnosis and treatment, e.g. new drugs such as HAART for HIV infection, antibiotics for non-susceptible strains.¹⁴⁻¹⁶ This study was undertaken to gain an overview of research on ID control and prevention as part of the collaborative study SPHERE (Strengthening Public Health Research in Europe). We reviewed published public health research literature covering the European Economic Area (EEA). Our objectives were to describe production of scientific articles, and the temporal trend over the past 10 years; define the main research areas; compare scientific production between European countries.

Methods

We searched PubMed from 1 July 1995 to 6 March 2005¹⁷ for papers by authors in the EEA, considered both together and by each single country. Author’s address or affiliation was used as a proxy for country of production. We identified search term ‘infectious diseases’ as our general topic, and also selected subtopics and two main research areas (see diagram, Appendix 1).

The general topic keyword was ‘Infectious diseases’. Subtopics were chosen from the Centres for Diseases Control and Prevention classification¹⁸ and listed in nine groups: ‘Sexually transmitted diseases’, ‘Animal-related diseases’, ‘Bioterrorism agents and Diseases’, ‘Childhood diseases’, ‘Drug-resistant infections’, ‘Emerging infectious diseases’, ‘Food-related diseases’, ‘Occupational risk in healthcare’ and ‘Insects or arthropod-related diseases’. A further subtopic was also included ‘Vaccine-preventable diseases’ (with ‘Vaccine’ used as keyword). In addition, a PubMed search was undertaken for one ‘specific disease’ within a main subtopic (i.e. HIV for the subtopic STDs).

All results for topics and sub topics were allocated to research area ‘Epidemiology and Surveillance’ or ‘Prevention and Control’, and were described for the sexually transmitted diseases subtopic as number of published articles both for Europe as a whole and by single state. Crude rates were also calculated in relation to the size of the population of each Member State and GDP.
Results
Approximately 21,000 published articles were found in our study. Figure 1 shows their distribution by country: France, Italy, The Netherlands, Spain, Germany, Switzerland, Sweden, UK and Belgium were the most prolific, with an overall production ranging from 3898 to 899 articles.

Our general keyword ‘Infectious diseases’ identified relatively few articles. In 1995, 64 articles were identified rising to 228 in 2005. The yearly production of these ‘Infectious diseases’ articles was always more for ‘Epidemiology and Surveillance’ than ‘Prevention and Control’ over the entire period monitored: 46 vs 18, 72 vs 32 and 161 vs 67 published articles per year in 1995, 2000 and 2005, respectively.

Total number of articles for all subtopics are shown in table 1. ‘Vaccine-preventable diseases’ showed the largest number, followed by ‘Sexually transmitted diseases’. For all subtopics, with the exception of ‘Vaccine-preventable diseases’, the crude number of articles on ‘Epidemiology and Surveillance’ area was higher than that on ‘Prevention and Control’.

Among the subtopics, ‘Sexually transmitted diseases’, ‘Drug-resistant infections’, ‘Insects or arthropod-related diseases’ and ‘Childhood diseases’ emerged as the main fields of scientific production over the 10-year period.

We assessed the results as totals for each country, and by population and GDP. Data related to the search ‘Epidemiology and Surveillance’ are reported in figures 2 and 3. Switzerland, Iceland, Luxemburg, Denmark, The Netherlands, Sweden, Norway, Finland, Belgium, France and Ireland showed the largest research production when considered by population, with a production of 50 or more articles per million inhabitants. Also, the general category of ‘Infectious Diseases’, showed a similar country distribution (data not shown).

For the variable GDP, Estonia, Switzerland, The Netherlands, Iceland, Sweden, Finland and Denmark had the highest production, publishing 4000 or more articles per trillion US dollars of GDP.

Our specific disease-based search on HIV yielded 4881 articles, with those related to ‘Epidemiology and Surveillance’ and ‘Prevention and Control’ totalling 3327 and 1554, respectively. Switzerland, Luxemburg, Denmark, The Netherlands, Norway, Spain, France, Sweden, Italy and Belgium produced 10 or more articles per million inhabitants on ‘Epidemiology and Surveillance’ and ‘HIV’, and Estonia, Switzerland, Spain, The Netherlands, Denmark, Lithuania, Italy, France and Luxemburg produced more than 500 articles per trillion US dollars of GDP as for ‘STDs’.

Discussion
Before analysing our data, it is worthwhile underlining some limits of our methodological approach to the present research: the use of a single means of web search (PubMed), the difference in sensitivity of the selected keywords used, together with the fact that selection of articles was made only for ‘all type’ publications, without stratifying results according to impact factor. Despite these shortcomings, some results of our study appear to be of interest and worthy of further discussion.

![Figure 1](https://via.placeholder.com/150)

**Figure 1** Overall scientific production (crude number of published papers) on selected topic and subtopics, by EU Countries, during the study period

**Table 1** Published papers on “Epidemiology and Surveillance” and “Prevention and Control” AND subtopics investigated, during the study period, in ‘overall Europe’

<table>
<thead>
<tr>
<th>Subtopics</th>
<th>Sexually transmitted diseases</th>
<th>Drug-resistant infections</th>
<th>Bioterrorism</th>
<th>Occupational risk in healthcare</th>
<th>Animal borne diseases</th>
<th>Food-related diseases</th>
<th>Childhood diseases</th>
<th>Emerging infectious diseases</th>
<th>Insects-arthropods-related diseases</th>
<th>Vaccine-preventable diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidemiology and Surveillance</td>
<td>3114</td>
<td>1184</td>
<td>36</td>
<td>102</td>
<td>181</td>
<td>222</td>
<td>557</td>
<td>113</td>
<td>561</td>
<td>1810</td>
</tr>
<tr>
<td>Prevention and Control</td>
<td>1499</td>
<td>349</td>
<td>61</td>
<td>77</td>
<td>55</td>
<td>133</td>
<td>139</td>
<td>47</td>
<td>383</td>
<td>4433</td>
</tr>
<tr>
<td>Total published papers</td>
<td>4613</td>
<td>1533</td>
<td>97</td>
<td>179</td>
<td>236</td>
<td>357</td>
<td>694</td>
<td>160</td>
<td>944</td>
<td>6243</td>
</tr>
</tbody>
</table>
The EEA has been demonstrated to be an important producer of public health research on IDs. Starting from 1995, production of literature has shown a progressive increase, particularly since 2000, reaching a peak in the last year of the study period. This trend can be considered real, in our opinion: since the aforementioned methodological limits were present throughout the study period. Developments in basic and applied research, particularly in biotechnology, molecular epidemiology and genetics, may explain this trend. We are aware that numerous new vaccines and pharmacological molecules and diagnostic tests applied to IDs have been studied in the recent past: their availability and routine use in health-care practices have significantly changed the natural history and general epidemiology of several diseases. Conjugate pneumococcal and meningococcal vaccines and those against chicken pox, in the field of prevention, anti-virals and antibiotics for multi-resistant micro-organisms, new molecular techniques, such as polymerase chain reaction and genetic sequencing are important examples of improvements in this research field.16,19–22

We observed a wide heterogeneity in scientific production on IDs in Europe. This became immediately apparent from our first web searches: both analysing data generally and by specific subtopic, large differences between country article production emerged. This is consistent with results from other SPHERE research groups: public health research is proportionate to health needs at a geographic level.

However, the situation is more complex than appears from analysing only crude numbers of published articles. Analysing our results on the basis of both State population and GDP, a different scenario seems to emerge, particularly for the variable GDP: Eastern European countries seem to acquire more importance.

With regard to our subtopics, we found 4613 published articles for ‘Sexually transmitted diseases’, 4881 for ‘HIV’ and 6243 for ‘Vaccine’ subtopics, respectively: far more than that obtained through the first web search using ‘Infectious diseases’ when 1201 articles were collected. As previously stressed, this confirms methodological limits in our research, depending upon the sensitivity of each keyword used. Yet, the balance of scientific production by country, for this subtopic, these are similar to those found for ‘Infectious diseases’: France, Italy, Spain, The Netherlands, Switzerland, Germany, Sweden, Belgium and UK are still the largest European producers. Comments on data from the country population size and GDP analysis do not differ from those previously outlined.

With regard to heterogeneity of production observed across Europe, with different results emerging from the analysis for each specific item, no definite conclusions can be drawn. A first priority should be cooperation to help those Member States with no scientific production as well as a need to harmonize research in Europe.

Another general trend emerges: the research area ‘Epidemiology and Surveillance’ seems to be more frequent.
than that ‘Prevention and Control’. This could reflect a need, during the last few years, of Governments of developed countries to establish the frequency of the main important IDs, in order to better plan and organize health care policies. The lack, both of a deeper analysis on the contents of our articles and, especially, of the separation of observational from experimental studies in our search do not permit to draw definitive conclusions on this item yet.

On the other hand, it may be that public health research focuses too much attention on descriptive research and not enough on the active-interventional approach. In this respect, it seems that European public health policy makers need to focus attention and efforts in the future on optimization of research production in the ‘Prevention and Control’ setting. The only exception was the subtopic ‘Vaccine-preventable diseases’, where ‘Prevention and Control’ was more frequent than ‘Epidemiology and Surveillance’. This is not unexpected: vaccines are primary instruments in the prevention of many infectious diseases.

Finally, some comments on results regarding the subtopics investigated.

‘Vaccine-preventable diseases’, ‘Sexually transmitted diseases’, ‘Drug-resistant infections’, ‘Insects or arthropod-related diseases’ and ‘Childhood diseases’ emerged as the main fields of scientific production. These groups of diseases focus on the main public health problems in EU Countries, with good results being demonstrated, in recent years, in terms of prevention, diagnosis and treatment. Some subtopics, such as ‘Bioterrorism’, ‘Emerging infectious diseases’ and ‘Occupational risk in healthcare’ appeared from our search to be areas in which public health research output should be significantly increased. We need to respond to the impacts of globalization, and the changing world political scenario and also to offer greater safety from infections to healthcare workers. The experience of SARS, the potential next influenza pandemic, and old diseases that are re-emerging (e.g. tuberculosis), justify more attention focused on the subtopic ‘Emerging infectious diseases’. ‘Animal-borne infections’ was not a very sensitive keyword for our purpose, but as this is an area of scientific concern, further investigations should be made.

In balancing these demands, it is also important for public health research to ensure that existing problems are tackled without being ‘distracted’ by potential threats.

Conclusions

Today, it is recognized that both evidence-based medicine and prevention require a well-structured scientific approach to design effective public health interventions.25 The present study is the first, to our knowledge, to describe, with a broad approach, the state of public health research on IDs in Europe. Even if the bibliometric methodology used may some limitations and results could, in some way, be biased, we believe that SPHERE represents a useful tool, both for scientists and public health policy makers, to plan and organize research on IDs, with clear implications for future EU (and other) funded programmes in Europe.

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Conflict of interest: None declared.

Key points

- Starting from 1995, there has been a progressive increase in the production of literature, particularly starting from 2000, to reach a peak in the last year of the study period.
- A marked heterogeneity exists in Europe concerning scientific production on IDs: this phenomenon concerns both the number of papers published by each Country and the specific fields of the research.
- “Vaccine-preventable diseases”, “Sexually-transmitted diseases”, “Drug-resistant infections”, “Insect-arthropod-related diseases” and “Childhood diseases” were the main fields of scientific production.
- Is clearly evident that a first priority is to cooperate to help States with no, or a very low, scientific production and that there is a real need to harmonize research throughout Europe.
- It is essential for further studies to better focus on the real state of the art of research on IDs in the EU, possibly with a more analytic approach than biobibliometrics.

References

Appendix 1. General scheme used for the web search strategy

![Search Strategy Diagram]

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