Spanish scientific productivity and equipment in magnetic resonance from a regional and European perspective

ANGEL PESTAÑA, SEBASTIAN CERDÁN
Instituto de Investigaciones Biomédicas "Alberto Sols", CSIC-UAM, Madrid (Spain)

The aim of this work was to provide a rational frame for the design of scientific policies in MR infrastructure implementation. To this end, we have investigated the relationships between MR instruments, their scientific productivity or medical performance and several socio-economic, R&D or health care indicators in a Spanish and European context. The distribution of MR spectroscopy instruments among Spanish Autonomous Communities suggests that the allocation policy resulted from a compromise between the pull of demand based on regional strength in R&D activities and the push of convergence criteria to bring underdeveloped regions up to a national standard. On the whole, the average value for Spanish MR spectroscopy equipment (1.6 units per TRDP) was within the average value of 1.7 found in 6 European countries. The scientific productivity of these spectrometers in Spain (10.3 publications per unit), compares with the ratio (12.4) found in the United Kingdom and was above the six countries' average (8.3). Larger differences in productivity were observed between Spanish Autonomous Communities, suggesting the existence of important laguna in the distributive side of the allocation policy. Consistent with its socio-sanitary importance, the regional distribution of MR imaging equipment in Spain correlated with the number of sanitary personnel and regional population or wealth. The average number of installed units per million inhabitants in Spain (3.3) is very close to the average found in five European countries and the diagnostic procedures per installed units are close to the 5 countries' average values of 340/year. However, the scientific productivity of MR imaging equipment in Spain (1.6 publications per installed unit in the five year period) was very low as compared with other European countries (3.7 on average). Higher diagnostic demand or lower publication pressures could explain these differences equally well. Our results suggest that increases in scientific productivity and medical performance of MR instrumentation in Spanish Autonomous Communities may not necessarily involve a net increase in the number of MR instruments but rather, improvements in the global socio-economic throughputs derived from the organisation of R&D and medical service policies.

Introduction

Nuclear Magnetic Resonance methods have undergone spectacular development since their discovery in 1946 (Bloch, 1946; Purcell, 1946). What was initially considered as an esoteric technique of exclusive interest to physicists, developed progressively into a combination of methods that today have enormous impact on
chemistry, biology and medicine. Initial applications of MR to chemistry and biology began in the fifties with the characterisation of the most important MR parameters and the publication of the first spectra from biological macromolecules (Kardeszsky, 1981). The first biomedical MR applications to intact cell and tissue metabolism and the first MR image appeared in the early seventies (Eakin, 1972; Lauterbur, 1973; Hold, 1974). Since then, MR methods have become necessary in most basic research institutions and mandatory in well-equipped hospitals. Increased demand for MR technologies (Service, 1998) by scientists and physicians has fostered an increased production of NMR instruments and considerably widened an initially small market. As a result, public investment in MR instrumentation has increased, but objective criteria to evaluate the relationship between equipment needs, investment costs, scientific productivity or medical benefits derived from this type of instrumentation remain as unresolved aspects in the design of scientific and medical policies for high technology infrastructure. The present paper addresses these topics in detail in Spain as an example, but also provides information for European perspective.

We estimated the number of MR instruments, their distribution in different Spanish autonomous communities or institutions in Spain and in different European countries, in order to establish statistical correlations with their scientific and medical productivity as measured by bibliometric criteria and sociomedical indices. To our knowledge the results provide the first frame to evaluate the scientific and medical performance of MR instrumentation and could aid in the design of rational policies for the implementation of high technology instrumentation in European countries.

Material and methods

Spanish publications on or use of MR methods, in the period 1992–1996, were retrieved from Chemical Abstracts (CHA) and MedLine (ML) with a search for the keywords “NMR” or “Magnetic Resonance”. A total of 1240 documents were recovered from CHA and 425 from ML. A revision of the ML documents identified 248 (58.3%) that specifically corresponded to MR-imaging. A similar search identified NMR and MR-imaging documents that had originated in the Western European countries (UE+EFTA) during 1992–1996.

The MR publications from Spain (n=1665) were imported to a database (FileMaker, Claris Software, Mo, USA), from which 111 duplicated documents were deleted, leaving a total of 1554 records. These documents were manually assigned to research centres and institutional affiliation of the authors (universities, hospitals, CSIC – Spanish Research Council – and other public or private research centres) and