SPECIAL ARTICLE

Imbalance Between the Supply and Demand for Cardiologists in Spain. Analysis of the Current Situation, Future Prospects, and Possible Solutions

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Planning cardiology provision in Spain requires knowledge of the resources available and the demand, both now and in the future. In this report, we present the results of a study carried out by the Spanish Society of Cardiology on the availability of and demand for cardiologists in the country. The current situation is characterized by an imbalance of around 14% between the number of active cardiologists and the estimated number required. The demographic distribution of cardiologists shows that they are predominantly male and middle-aged. Expectations are that the situation will get worse until the year 2020. To correct this imbalance, alternative forms of training or clinical department organization, or both, are required. Some possible alternatives are presented in the final part of this document, as proposals for open discussion.

Key words: *Cardiologists. Planning. Supply. Demand.*

Desequilibrio entre la oferta y las necesidades de cardiólogos en España. Análisis de la situación actual, previsiones futuras y propuestas de solución

La planificación de la cardiología en España requiere el conocimiento de los recursos disponibles y las necesidades, no sólo presentes, sino también futuras. En el presente informe se recogen los resultados de un estudio llevado a cabo por la Sociedad Española de Cardiología sobre la necesidad y la disponibilidad de cardiólogos. La situación actual en España presenta un desequilibrio entre el número de cardiólogos en activo y los que serían necesarios, desequilibrio que oscila en torno al 14%. La pirámide poblacional refleja una población envejecida y mayoritariamente masculina. Las previsiones futuras indican que la situación empeorará desde ahora hasta el año 2020. La corrección de este desequilibrio requiere el desarrollo de alternativas diferentes de las actuales en formación y/o organización de los servicios asistenciales. Algunas de estas alternativas se recogen en la parte final de este documento, en forma de propuestas abiertas al debate.

Palabras clave: *Cardiólogos. Planificación. Oferta. Demanda.*

INTRODUCTION

Cardiovascular diseases are still the leading cause of death in Spain and also represent an important cause of morbidity and invalidity.[1] This situation does not seem set to change much in the future; in fact, it may get worse if the growth in the prevalence of some risk factors (obesity, diabetes) does not slow down.[2] It is also true that medical science has made spectacular advances in recent years. Not only has cardiology been involved in such changes, it has often been at the forefront of progress. These advances have introduced into clinical practice an impressive battery of diagnostic tests and therapeutic options, which, without doubt, will help to alleviate the effects of cardiovascular disease. Society too has undergone changes, not only in its demographic profile but also in the expectations and demands of the public. This makes for a complex situation that requires new strategies to be drawn up and more efficient use of those resources best suited for dealing with cardiovascular disease. Such strategies should take into account not only the current situation, but should also try to anticipate future needs.

Document drafted by the Working Group on Cardiologists in Spain. This Working Group was set up by a mandate from the Executive Committee of the Spanish Society of Cardiology with the sole aim of producing the present document.

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Although many different types of health professional are involved in the fight against cardiovascular diseases, the cardiologist is still a cornerstone of investigation and clinical practice. Therefore, any analysis of needs and resources must take into account the availability and requirements of appropriately trained cardiologists given that the relationship between resources and cardiologists will play a leading part in shaping the health care models for cardiovascular disease. At the same time, prediction of possible scenarios may help the adoption of measures to successfully provide for these future needs.

The Spanish Society of Cardiology (SEC), in accordance with its role as a reference in the fight against cardiovascular diseases, understands that it has the responsibility to provide data that help clarify the current situation and that allow the most appropriate approaches for the future to be chosen.

In 2003, the SEC commissioned a study on the current supply and demand for cardiologists in Spain, including predictions for the coming years. The study was done by Beatriz González Valcárcel and Patricia Barber, who belong to the Group for Health Economics Research of Las Palmas University, Spain.[3] After receiving the final report, the Executive Committee of the SEC decided to set up a working group to draft a document, based on the report, that included possible actions to deal with the predictions made therein. This group, whose members are presented at the beginning of this article, included members of the National Cardiology Commission (for Internal Physicians and Residents) of the Spanish National Board of Medical Specialties under the auspices of the Ministry of Health and Consumer Affairs, J.M. Cruz, the past president of this commission and the person who proposed the study, and the authors of the aforementioned report. Dr. E. de Teresa coordinated this working group and was responsible for drafting this document, which summarizes the results of the report drawn up by the Group for Health Economics Research of Las Palmas University, Spain, and discusses possible future actions. The document aims to serve as a framework to establish a broad debate about the future of cardiology.

PREDICTING THE FUTURE-AN ARDUOUS TASK

Any prediction of the needs of health professionals is fraught with a number of problems, especially when those predictions look beyond the short term. In 1965, for example, the Commission on Heart Disease, Cancer, and Stroke, set up by the then United States President, L.B. Johnson, concluded that the country would be faced with a critical shortage of cardiologists.[4] Years later, in 1981, a report by the Graduate Medical Education National Advisory Committee in the United States of America predicted the opposite and concluded that there would be a 94% excess of cardiologists by the year 1990.[5] When 1990 arrived, this excess never materialized. Shortly afterwards in 1993, the American College of Cardiology sponsored the 25th Bethesda Conference on the "Future needs in human resources for cardiovascular health care." The conclusions of the resulting 54-page document were that the United States of America had too many cardiologists, that this excess was going to be accentuated by existing American private and public health policies, and that, consequently, the number of cardiologists in training should be reduced. The excess, according to the document, occurred mainly in the field of interventional cardiology.[6] As a result, the number of cardiology residents decreased by between 11% and 13%. Finally, the 35th Bethesda Conference, whose results were published in 2004, concluded that the United States of America was faced with a serious and growing shortage of cardiologists.[7]

These shifts, not only in the actual situation but also in the analysis, reveal how difficult it is to predict future scenarios for an activity that is subject to many influences, some of which are changing rapidly. These problems also illustrate the risks of making sudden corrections to the supply of new cardiologists given that the effects-because specialist training takes a long time-are felt many years later when the circumstances may have changed substantially.

NEED AND AVAILABILITY OF CARDIOLOGISTS IN SPAIN: CURRENT SITUATION, PROSPECTS, AND RECOMMENDATIONS FOR HUMAN RESOURCE POLICIES

This section briefly covers the report commissioned by the SEC. The full document is available from the SEC web page.[3]

The labor market for health professionals is characterized in that supply cannot be self-regulating because of stronger intervention from the public sector than in other markets and because the market must be able to adapt quickly to accommodate changes arising from new technologies, which in turn are becoming increasingly specialized (overspecialization). The labor market for health professionals operates against a backdrop of continually increasing demand for health care, both in quantity (extent of development, longevity, access, etc) and quality (development, technologies, etc).

Objectives

To compare the current reality and trends in provisions for cardiology in Spain with needs. The elements of this comparison are:

1. Provisions (supply). Human resources currently available and those available in the future. Expected changes according to different hypotheses for the future and according to different options of public intervention in the market.

2. Needs (demand). To assess the needs, it is also necessary to lay down some assumptions about what professionals are responsible for what tasks and about regulation in the workplace. Alternatively, the needs can be established by comparison with other similar countries with supposedly good provision (benchmarking method), or using an epidemiological profile of the population and application of standard workloads generated by such a population.

The specific objectives of the study were:

1. To estimate the current deficit or excess of cardiologists in Spain for a reference date corresponding to the year of the study, 2004, with a confidence interval that takes into account the elements of uncertainty in the model, including errors in measuring the data.

2. To provide a dynamic, year-on-year, estimate of the deficit or excess for 2004-20.

3. To propose recommendations for policies or interventions to control variables to minimize the imbalances between supply and demand (that is, between needs and provisions).

Evaluation of the Current Situation

Supply: Availability of Cardiologists in Spain

In this section, we provide numbers for the population of cardiologists in Spain in the reference year (2004), discuss the reliability of the data available, and present the age pyramid on which our simulation of the future dynamics of this population is based.

Data Sources and Problems Associated With These Sources

There are no "official" figures for the total number of practicing cardiologists (with an official qualification who are working as cardiologists or who are prepared to do so). Basically, there are 3 information sources for the number of specialists, and an additional information source for cardiologists in training. The Ministry of Health and Consumer Affairs drafted and published a survey of specialists in the resident training system through to 1990, and since then has recorded the number newly qualified resident physicians each year.[8] Professional bodies and their General Council of the Association of Spanish Professional Medical Bodies have data on members who are accredited with the qualification of cardiologist, but there is no way of knowing which of these have retired, which have several different specialist qualifications, and which are currently not practicing or have never practiced as cardiologists. The SEC is an alternative source with a register of its members. Although this underestimates the size of the population because membership is voluntary, the register provides realistic information on sex, age, and place of residence and work. The SEC also has surveys of specific working conditions of the cardiologists.[9]

TABLE 1. **Discrepancies in the Sources for Total Number of Cardiologists in Spain in 2004**

Source	Total Number of Cardiologists	Number of Cardiologists of Working Age (<65 Years)
SEC*	1903	1537
ASPMD†	2287	
CESM Study 2005‡	–	1713
Cardiology Resources Study 1999§	–	1177

*Members of the Spanish Society of Cardiology in October 2004.[12]
†Members of the Association of Spanish Professional Medical Bodies with specialist qualification in 2005. Source: ASPMD.[11]
‡tAmaya C, García MA. Demografía Médica en España. Fundación CESM; 2005.
§Study of the resources of the Spanish National Health System performed by the Spanish Society of Cardiology. The data only include cardiologists employed as specialists in the Spanish National Health System, excluding resident physicians in training.[14]

The different sources provide a different number of qualified cardiologists (Table 1). Legislation which became law in December 2003 lowered the age of retirement of health professionals from 70 years to 65 years and established the need to explicitly request a voluntary extension to the working life, up to a limit of 70 years.[10] The request for such an extension was to be assessed according to physical and intellectual capacity and health care needs (article 26). Table 1 presents the number of cardiologists under 65 years of age, that is, potentially active.[11-14]

The figure from the Association of Spanish Professional Medical Bodies represents an upper limit because it includes member cardiologists who are now retired and classifies as cardiologists physicians who, prior to the introduction of the current resident training system, registered for more than one specialty (including cardiology) but who have never practiced and never will. The figure for the study of resources in cardiology only includes cardiologists who work in the public health system (specialist care).

In February 1996, the General Council of the Association of Spanish Professional Medical Bodies had 1904 member cardiologists registered in Spain. In January 2005, there were 2287 member cardiologists.[11] This corresponds to an increase of 20%, considerably greater than Spanish population growth over the same period (7%). According to the

TABLE 2. **Number of Cardiologists in Europe, the United States of America, and Canada**

Country	Number in 2002 per 100 000 inhabitants	Percentage Increase in 1990-2002
Ireland	0.7	
Turkey	1.2	140%
Finland	2.1	110%
United Kingdom	3.1	158%
Slovakia	3.6	
Germany	3.7	
Czech Republic	3.9	290%
Denmark	4.1	86%
Netherlands	4.2	5%
Switzerland	5.5	57%
Latvia	5.7	27%
United States of America*	6	
Portugal	7	49%
Luxembourg	7.4	
Belgium	8.6	91%
Iceland*	8.6	
France	9.6	19%
Lithuania	9.6	20%
Estonia	9.8	72%
Bulgaria	10.4	
Cyprus*	11.2	
Greece*	21.7	

*Figure for year 2000.
Source: Eurostat.[15]

figures from the SEC registry, the number of cardiologists in October 2004 was 1903, of whom 1537 were under 65 years of age.[12] The number of cardiologists of working age per 100 000 inhabitants in Spain varies from 3.6 to 4.0 according to the source. Regardless of the source used, there are relatively few cardiologists in Spain compared to other European countries[15] (Table 2).

Population of Cardiologists: Number and Profile of Cardiologists Belonging to the Spanish Society of Cardiology

An analysis of the database of SEC members should represent a true reflection of the profile and demographic structure of cardiologists in Spain, with the necessary provisos arising from the discussion in the previous section about discrepancies between data sources. The database contains the age, sex, and place of residence and work of 1903 cardiologists, and also whether they are practicing and, if so, whether they work in the private sector.

The mean age of SEC members is 55 years, but this age decreases to 51 years if we include only those aged under 65 years. One out of every 5 members is over 65 years. The age pyramid clearly shows that the age distribution is centered between 50 years and 60 years and reflects the high proportion of members aged over 65 years. Despite more women becoming qualified and also more women specializing in cardiology, only 15.3% of members on the SEC database are women. The proportion of female cardiologists bears an inverse relationship to age (Table 3). In the last 2 rounds of applications for the resident training program (2002-03 and 2003-04), the percentages of women who started training to become a cardiologist was 46.5% and 42%, respectively.

TABLE 3. **Percentage of Female Cardiologists With Respect to the Total Number of Cardiologists Belonging to the Spanish Society for Cardiology, by Age Range (2004)**

Age, Y	Percentage
30-34	31.7
35-39	28.6
40-44	23.2
45-49	16.6
50-54	16.1
55-59	9.7
60-64	6.0
65-69	0.8

Age Pyramid of Cardiologists in Spain

We only took into account potentially active physicians and therefore excluded those aged over 65 years, who represent 17.4% of the SEC membership.

To establish the age pyramid in 2004, we applied the age distribution of the SEC members to the total number of members of the Association of Spanish Professional Medical Bodies, subtracting 17.4% to account for those who, supposedly, have passed the legal age for retirement.

From these data, and following the procedure described, we estimated the total number of potentially active physicians (<65 years) in 2004 to be 1926 cardiologists.

The estimated age pyramid for the reference year 2004 (Figure 1) shows an ageing population of cardiologists, in which 39% are aged between 50 years and 59 years and only 21% are under 40 years (Table 4). More than half (51%) are aged over 50 years. Given that the age of retirement has dropped to 65 years, around 669 specialists (more than a third of the total, 33.2%) will retire in the coming 10 years. As shown in Figure 1, the population has aged slightly since 1996.

Future Supply of Cardiologists: Recent Changes and the Current Number of Resident Cardiologists in Training

The main function of the resident training program is to train specialist physicians in a range of fields in

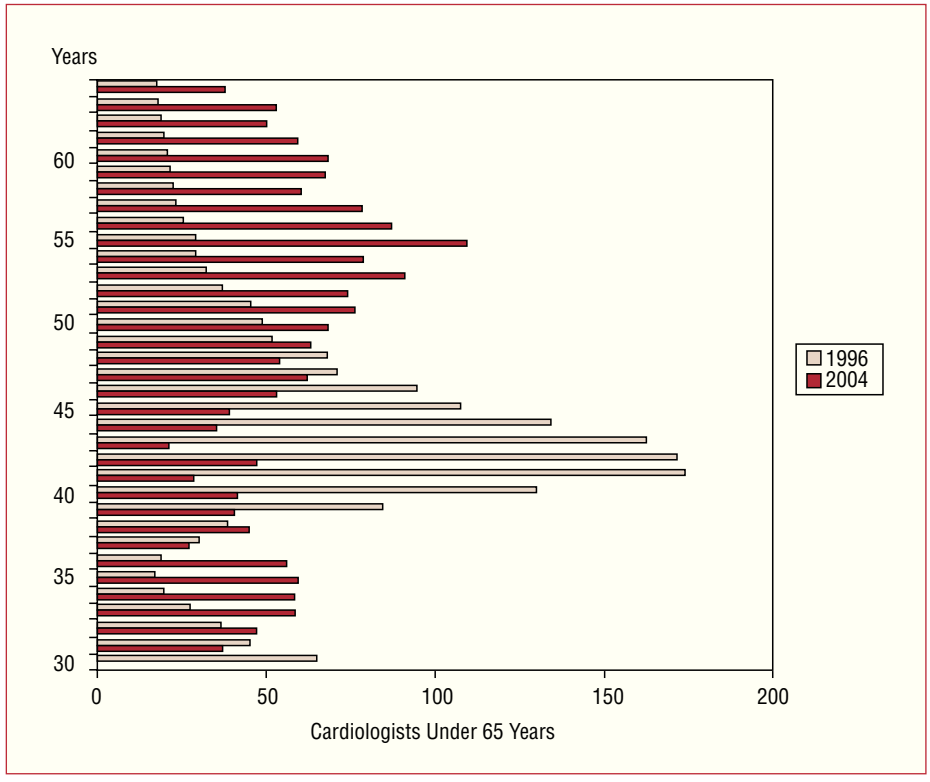

Figure 1. Age pyramid of Spanish cardiologists up to 65 years of age. The absolute numbers for each age group are presented along the x-axis and the age groups are shown on the y-axis. Data drawn up from the law governing health professionals,[10] Association of Spanish Professional Medical Bodies,[11] and the Spanish Society of Cardiology.[12]

sufficient numbers to meet Spain's needs. The training of physicians is affected by education, health, and labor policies, and so represents a particularly attractive and complex topic.

In the 2002-03 round of applications, a total of 5417 resident positions were awarded compared to 5661 in the 2003-04 round of applications. Of the positions awarded in 2003 to 2004, 2%, that is 114, corresponded to the specialty of cardiology.[16]

The percentage growth in the number of training positions advertised in the specialties of cardiology and cardiovascular surgery through to 1996 was 17.52% and 142%, respectively, whereas the increase over the same period in the total number of training positions on offer was 24.97%. This increase is 69.16% if we include family and community medicine. In this period, cardiology has been one of the specialties with the lowest increase in training positions advertised and its relative share has also declined. In the 1997-98 round of applications, with family and community medicine included, 2.9% of the training positions were in the specialty of cardiology, whereas in the last round of applications in 2003 to 2004, that share was 2%. If we exclude family medicine, the corresponding shares were 3.2% and 3%, respectively. Cardiology is one of the preferred specialties when choosing a resident training position, occupying third place in the last 2 rounds of applications, with a median ranking of 318 in 2003 to 2004 and 284 in 2002 to 2003, and a relatively narrow distribution.[16]

TABLE 4. **Age Distribution of Cardiologists in Spain, 2004**

Age, Y	Number in 2004	Percentage in 2004
30-34	200	9.9
35-39	227	11.2
40-44	172	8.5
45-49	271	13.4
50-54	387	19.2
55-59	401	19.9
60-64	268	13.3
Total	1926	100

Cardiology is an eminently "male" specialty, but it is following the same trends as the rest of the medical profession; indeed, 40% of the new cardiologists in training are women.

Labor Market: Employment of Cardiologists in Spain

The National Survey of Cardiology Resources from 1991 to 1992[9] was sent to 127 hospitals, of which, 94 responded. Cardiologists tended to be concentrated in large hospitals (in fact, none of the hospitals that responded to the survey had fewer than 200 beds). Overall, 37% of the hospitals had more than 700 beds and 35% had between 400 and 700 beds. In 1992,

these 94 hospitals employed 700 cardiologists (plus 173 residents), an increase of 7% with respect to the previous year. More than half of the cardiologists (54%) worked in hospitals with more than 700 beds. These hospitals also accounted for 73% of the cardiology residents. The hospitals with between 200 and 400 beds employed only 17.6% of the cardiologists and 5% of the residents.

The concentration of human resources in large hospitals is becoming less marked. As subspecialization becomes more widespread in medical practice, community hospitals tend to assign beds to cardiology and employ at least one cardiologist, even if he or she works within the internal medicine service.

In 1997 to 1998, 3% of the physicians in the public hospital system were cardiologists.[14] Of these, 8.7% were under 34 years old.

More than a quarter of the cardiologists who were members of the SEC worked in hospitals with more than 20 cardiologists, but a considerable number of professionals (more than 10%) were the only representatives of their specialty in the hospital where they worked. Medium-sized community hospitals are hiring cardiologists and this trend is expected to become more marked.

Demand and Need: How Many Cardiologists Are Required?

Where one specialty ends and another begins. The assignment of the professional duties of the cardiologists is a key aspect when quantifying the future needs for specialists. The distribution of professional duties changes over time and from place to place. For example, in Canada, half of the patients admitted to hospital for congestive heart failure are attended by a general or family physician, and 65% of the patients admitted to hospital for acute myocardial infarction (AMI) are treated by a cardiologists.[17] In Canada, 12% of the patients seek medical attention in general clinics for cardiovascular disease and undiagnosed chest pain.[18] In Spain, the medical culture tends to favor specialization and burdens the cardiologists with greater responsibility, although, as in other countries, internists attend to more than 50% of hospital patients with heart failure, particularly if they are elderly with other concurrent diseases. On the other hand, a coronary service run by a specialist other than a cardiologist is not unheard of, even in large hospitals.

The division of duties among specialties also depends of course on the availability of professionals. So although it might be desirable that, for example, interventionist cardiologists attend cases of stroke,[19] this is often not possible because of the lack of such professionals. The exact definition of the training needs of professionals implicated in attending cardiovascular patients is a complex topic that changes over time.

Faced with the need for teamwork in the cardiovascular field, there is a trend towards subspecialization (general cardiologists, interventionists, and electrophysiologists in the USA). Recently, the SEC set in motion the process to set up qualifications in electrophysiology and arrhythmias and in catheterization and interventional cardiology. The European Society of Cardiology has subsequently followed suit. As the profession becomes more subdivided, there will be a tendency towards a heightened perceived need for more professionals because a minimum number of each subspecialist will be required in each clinical unit. At the other extreme, active collaboration between cardiologists and family physicians is encouraged to help manage the cardiovascular problems of the patients.

In search of references for the number of cardiologists. It is an extremely complex task to establish how many cardiologists are needed. Too few cardiologists is of course not desirable, but neither is too many, as the use of invasive cardiac procedures and cardiac catheterization is largely dependent on the availability of cardiovascular resources (catheterization laboratories). This is reflected in a number of studies on the variability of medical practice, such as the study by Wennberg et al[20] for example. The Organization for Economic Cooperation and Development (OECD) has found that usage of interventional cardiac procedures varies greatly from country to country and follows different trends. The position of Spain in the ranking of usage is relatively low, although the growth in the number of these techniques used has been spectacular over the last decade.[21] Within Spain, variation from autonomous region to autonomous region is also noteworthy-2.5 more angioplasty procedures are performed in the autonomous region with most procedures compared to the one with least.[22,23]

The number of cardiac procedures in Spain might be expected to increase until it comes in to line with other countries. In 2002, Spain was the third from the bottom of a ranking of 22 countries according to the number of coronary angioplasty procedures and the country that performed the least number of coronary bypass grafts (out of 19 countries).[21] Both cardiologists and cardiovascular surgeons would have more work to do if the number of procedures in Spain was more in line with other members of the OECD. According to the Integral Plan for Ischemic Heart Disease, patients with coronary artery disease should have access to cardiac rehabilitation programs-another sign of the need for cardiologists is the fact that access is limited to only 2% to 3% of such patients.

On the other hand, treatment of myocardial infarction by a cardiologist is associated with a 17% decrease in in-hospital mortality in the United States of

America.[24] Sufficient empirical evidence has accumulated to suggest that the availability of cardiologists in a zone is significantly associated with greater usage of angioplasty procedures, catheterization, or coronary stenting[25] and that cardiologists and other physicians (mainly internists) differ in their clinical practice.[26,27] Moreover, better health outcomes have been reported (greater survival after myocardial infarction,[28] lower in-hospital mortality[29]) for patients treated by cardiologists than for those attended by other physicians. These differences have also been reported in Europe. The cardiologists who treat patients with congestive heart failure seem to adhere more closely to clinical guidelines.[30] A study in Germany highlights the advantages of having cardiologists on hand because postinfarction mortality is lower in hospitals with a cardiology department compared to those that lack such a service.[31] In Spain, cardiologists resort to interventions shown to be useful more often than other specialists, both for acute coronary syndrome[32] and heart failure,[33] and adhere more closely to clinical guidelines.

Reference standard. From the arguments presented above, it follows that the appropriate number of cardiologists depends on the how professional duties are defined and the "need" for cardiology services in order to improve the health of the population. Some exercises in planning human resources set an optimum or desired number for comparison (benchmarking). Thus, the planning office of Ontario, Canada, sets the number in the region with best coverage (3.8 per 100 000 inhabitants) as the goal to aim for.[17]

In both the United States of America and Canada, general practitioners and internists take on many of the professional responsibilities and tasks that, in Spain, would correspond to cardiologists. Therefore, the American reference values should not be applied to Spain. In fact, as has been observed, almost all European countries exceed the optimum number for North America. This is probably not because there is an excess of cardiologists in other countries, but because they have more extensive clinical duties.

Evaluation according to "needs" criteria. The technical definition of need is the capacity of patients or population to benefit from the possibilities offered by medicine to improve their state of health, lengthen their lives, or improve their quality of life. The need for cardiologists is therefore dependent on normative criteria (how much can cardiologists do and how long does it take?) The Integral Plan for Ischemic Heart Disease has found a number of large areas in which the health system could be improved to reduce mortality and improve the state of health of patients with cardiovascular diseases.[21] Many of these areas represent technically feasible options that would need more professionals. However, the number of cardiologists required is not evaluated or quantified in the Plan.

Ever since the 1970s, epidemiological studies have investigated unnecessarily early and avoidable deaths where the health system could assign more resources or better use existing resources. The list of causes of such deaths includes:

– Cerebrovascular disease and hypertension (35-64 years), codes ICD-9: 430-438, 401-405.
– Ischemic heart disease (all ages), codes ICD-9: 410-414.
– Rheumatic heart disease (5-44 years), codes ICD-9: 393-398.

The mortality rate for ischemic heart disease per 100 000 inhabitants varies from 67.9 to 178.7 in men and from 35.3 to 97.4 in women according to Spanish autonomous region.[34] Nationally, this rate has dropped in the last 10 years, although an increase has been reported in 7 autonomous regions. Some cardiovascular risk factors, such as high concentrations of cholesterol, increased smoking among women, and high-calorie diets might lead to an increase in this type of mortality in the coming years.

Although it might seem paradoxical, the need for cardiologists tends to increase when the health system manages to lower cardiovascular mortality (deaths due to unexpected infarction avoided thanks to rapid action). This is because someone who has suffered an infarction becomes a cardiology patient for the rest of his or her life so and the decreases in mortality go hand in hand with an increased prevalence of cardiovascular conditions. These problems tend to occur after a certain age and ageing of the Spanish population will therefore be a factor that increases the need for cardiologists.

Evaluation by benchmarking: what is the optimum reference number? In this study, the basic model considers the following numbers of cardiologists necessary for every 100 000 inhabitants (basic scenario), divided into 4 age groups:

– 0-14 years, 1 cardiologist.
– 15-44 years, 4 cardiologists.
– 45-64 years, 7 cardiologists.
– ≥65 years, 9 cardiologists.

These figures are assigned in accordance with the precedents for Spain and for other countries after comparing morbidity, the use of resources, and human resources available. These numbers are those that were inputted into the basic simulation model. We also performed a sensitivity analysis by varying the

benchmarks. The parameters of the model are set so that it runs automatically on changing the benchmarks.

Evaluation by demand indicators: waiting lists and access to services. Demand is the expression of the need felt by the public who use the health services. Medications are becoming more widely used in society, and cardiovascular drugs are no exception. This is reflected in national health surveys-comparison of the last 2, from 1993 and 2001, shows a significant increase in the perceived cardiovascular disease in all Spanish autonomous regions except Valencia and Castile-León (where it decreased) and in the Canary Isles and Navarre (which showed no significant changes).[34] There are factors that "catalyze" demand in Spain and in other countries. A recent report by the American Society of Cardiology[6] described catalysts in demand for cardiologists in the coming decades in the United States of America. The list, presented below, is applicable to Spain, except for the point referring to the disappearance in the United States of America of the role of the "gatekeeper" in general clinics (catalyst number 4 of the list):

1. Elderly population, with more chronic diseases, that lives longer.

2. Epidemics of obesity and noninsulin dependent diabetes that enhance cardiovascular problems.

3. Improved outcomes for patients when attended by a cardiologist.

4. Disappearance of the model of indirect access to the specialist (only with referral by the family physician) and improved access to the cardiologist.

5. Better informed population with growing health care expectations.

6. More women aware that they are more likely to die of cardiovascular disease than cancer.

7. Continuous innovations in procedures and techniques, which spread rapidly.

8. Growing use of cardiovascular screening tests, which in turn lead to more tests and procedures.

9. Progressive subspecialization among cardiologists, so increasing the number of referrals from within the specialty.

An indirect indicator of the current imbalance between supply and demand is the number of cardiology positions that are advertised. In March 2005, there were 17 cardiology positions advertised on the web site of the Spanish Society of Cardiology that were unfilled.[35] In February 2006, this number had risen to 41, although the number of unfilled positions was actually much higher because the web site is by no means exhaustive. In 2004, 40% of the hospitals in the United States of America with more than 100 beds were seeking to hire cardiologists, and half of these recognized having difficulties to find qualified personnel.[6]

Waiting lists are another sign or indicator of the imbalance between supply and demand, but there is a problem associated with using them to quantify the deficit in resources: providers (cardiology services) can readily manipulate them. Waiting lists are the main reason for dissatisfaction among the public and they have got longer in recent years.[22] After a report issued by the national ombudsman at the end of 2002 which made recommendations on waiting lists in the Spanish National Health System, the state has regulated and guaranteed waiting times (Act 605/2003, Spanish Official Gazette dated May 23, 2003), with measures introduced to ensure that information about waiting lists in the health system is reliable. As a result, the criteria, indicators, and requirements for information on waiting lists in some autonomous regions have started to become standardized, and it could be expected that the demand for cardiologists increases dramatically in the short term as a result. According to the state figures for waiting lists, somewhat more than 400 000 patients were awaiting surgery on December 31, 2003.[36]

The demand (and need) for resources depends to a large extent on demographic changes and the ageing process. In our reference year (2004), drugs to treat cardiovascular diseases were mainly consumed by patients aged over 65 years.[37]

Evaluation of the Deficit/Excess of Cardiologists in Spain in 2004

In 2004, there were 1926 potentially active cardiologists in Spain, whereas 2185 would be needed according to our estimates based on the benchmark criteria discussed above.

In 2004, Spain had 259 cardiologists less than the number necessary, that is, the number of practicing cardiologists would have to be increased by 13.4%.

Future Prospects: Simulation Model

Factors That Influence Change: Hypothesis of the Dynamics of Supply and Demand Through to 2020

As with all dynamic simulation models, future changes in the variables included in the model depend in turn on dynamic changes in other elements of the model.

The hypothesized changes are those that ultimately will determine to a large extent the quality of the results obtained. For this reason, in this study, the most plausible hypotheses were used in that we erred on the side of caution and tried to avoid excessive errors. Thus, when other preferably official predictive models (such as those of the Spanish National Institute of Statistics for the population) were available, the hypothesized changes in these models was

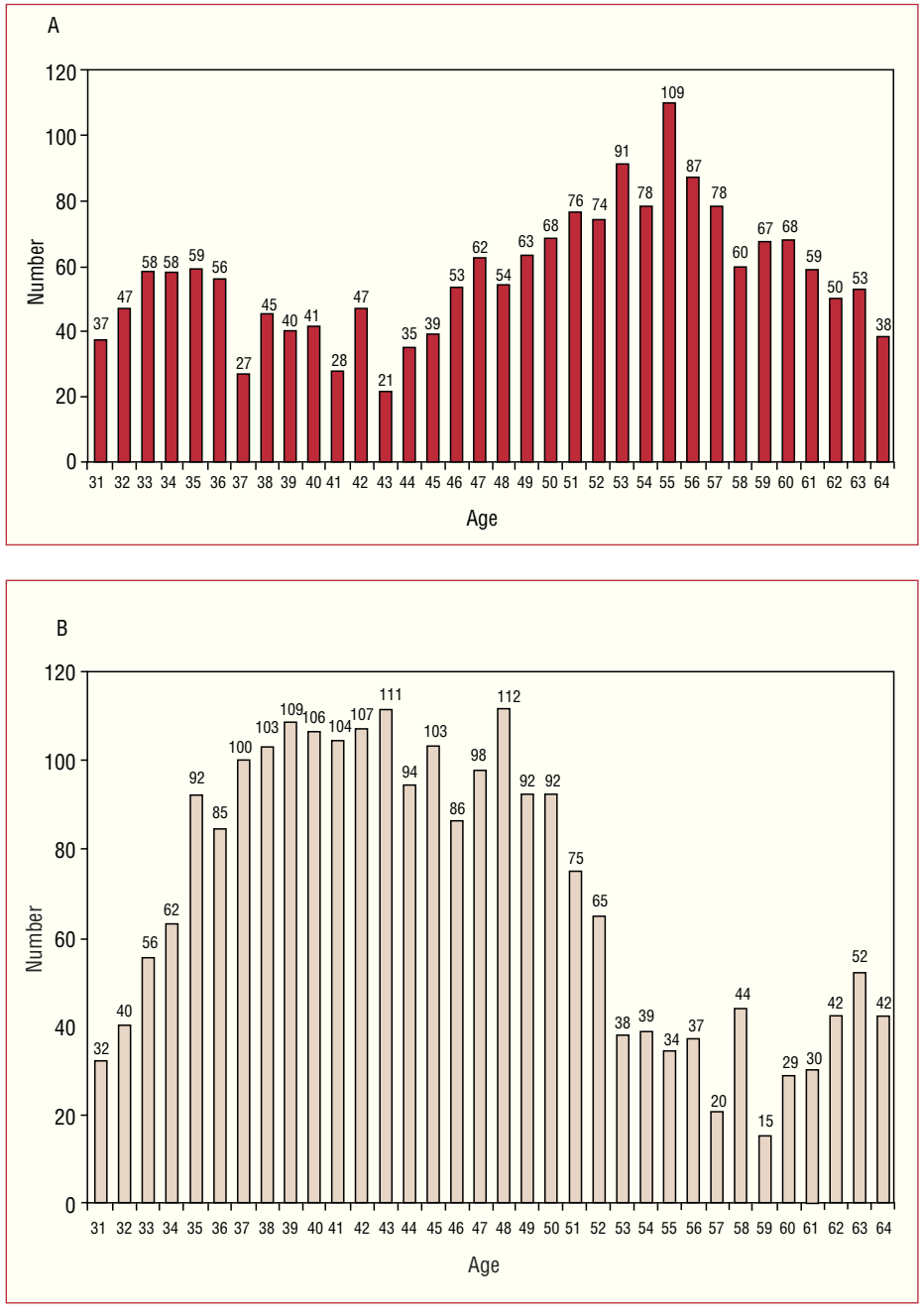

Figure 2. Age pyramid of Spanish cardiologists up to 65 years. A: 2004. B: prediction for 2020.

incorporated, and when no such models were available, hypotheses were established based on past behavior of the variable in question. Nobody can ignore the impact that immigration is having on the Spanish population. In fact, a look at the predictions for the population made by several studies in recent years shows that the future population has been consistently underestimated. The foreign population living in Spain has gone from 1.6% in 1998 to 6.24% in 2003 according to the electoral role for 2003, and to 8% according to the electoral role for 2005[38]; in the last 5 years, the number of foreigners living in Spain has increased 4-fold. However, the arrival of foreigners has not only affected the overall number of people but also the age structure and regional distribution. The incoming population is generally young, with a mean age of 44.5 years for those from the European Union, but around 30 years for those from South America, Africa, and East Europe.

Obviously, the estimates for demand and need are determined by changes in the population and so depend on the quality of the predictions of population growth. The hypothesized changes in the population in our model correspond to those made by the National Institute of Statistics but, given that the extent of immigration is uncertain, an alternative scenario has

Figure 3. Age pyramid of Spanish cardiologists up to 65 years, according to sex. A: 2004. B: prediction for 2020.

been drawn up in which immigrants arrive in Spain in similar numbers to the last 5 years.

For indicators such as mortality, natality, emigration, etc, we opted to maintain the overall structure of the population so as to err on the side of caution, although a subsequent sensitivity analysis could be performed to see how the results change on varying these values.

Simulation Model: Results of the Basic Model Through to 2020

Supply. The age distribution of the cardiologists will undergo substantial changes in the coming 15 years (Figure 2A and B). The current top-heavy age pyramid will give way to one with a wider base corresponding to more young cardiologists. This will be due to 2 factors: *a)* the resident training program will incorporate new young cardiologists at a rate of more than 100 per year, which is higher than the retirement rate, and *b)* through to 2020, 1119 professionals will retire, that is, 58% of the current cardiologist, because they will have passed the mandatory retirement age of 65 years.

The estimated number of cardiologists in 2020 is 2348, 22% more than in 2004. Of these, 1092 will be women (46.5%) compared to the current percentage of women of 19.1%. Female cardiologists will have a younger age profile than male ones. In some age groups, there will be more female cardiologists than male ones (Figure 3A and B).

Demand/need. The first catalyst factor in the demand and need for cardiologists is demographic.

According to the population model, which extrapolates demographic trends from the past and takes into account the large numbers of young immigrants arriving in Spain, in 2020 the Spanish population will be 51 364 417.[3] The current composition of the Spanish population and that in 2020 by broad age groups is shown in Table 5. Each age group will of course have its own corresponding needs for cardiologists.

This demographic pattern that determines the need for cardiologists, according to the benchmarks discussed earlier, is essentially subject to growth in the birth rate and the arrival of immigrants under 44 years of age.

In the next 15 years, and in accordance with the benchmarks established for the basic model (1/100 000 inhabitants for subjects under 14 years of age, 4 /100 000 inhabitants for subjects between 15 and 44 years of age, 7/100 000 inhabitants for those aged between 45 and 64 years, and 9/100 000 inhabitants for those aged over 65 years), the need for cardiologists will increase by 512 professionals (from 2179 that would be required in 2004 to 2691 that would been needed in 2020, an increase in need of 23%).

TABLE 5. **Spanish Population in 2004 and 2020, by Age**

	2004		2020	
	Number	Percentage	Number	Percentage
0-14	6 043 479	14	7 947 193	15
15-44	19 792 999	46	20 285 032	39
45-64	9 603 966	22	14 098 865	27
>65	7 276 620	17	9 033 325	18
	42 717 064	100	51 364 415	100

The Deficit of Cardiologists in Spain, 2004-20

The deficit in professionals, which was 253 cardiologists in 2004, will widen each year until reaching 343 in 2020. Expressed as a percentage, the current deficit is 13% and will increase to 14.5% in 2020.

The supply of professionals will increase by 422 over the period covered by the model, corresponding to a growth in supply of 22%, whereas the growth in demand will be 512 professionals, an increase of 23%. The current deficit will increase by 35% (from 253 to 343 professionals) (Figure 4). The annual cumulative increase in the number of resident training positions offered will need to be 4% (in order to offer 215 training positions in 2020, that is, almost twice the current training capacity) to reach an equilibrium in 2020. But if immigration increases in the coming 15 years at the same rate as it has done in the 5 preceding years, the current deficit in cardiologists will double in the same period from 253 to 502. And if the training

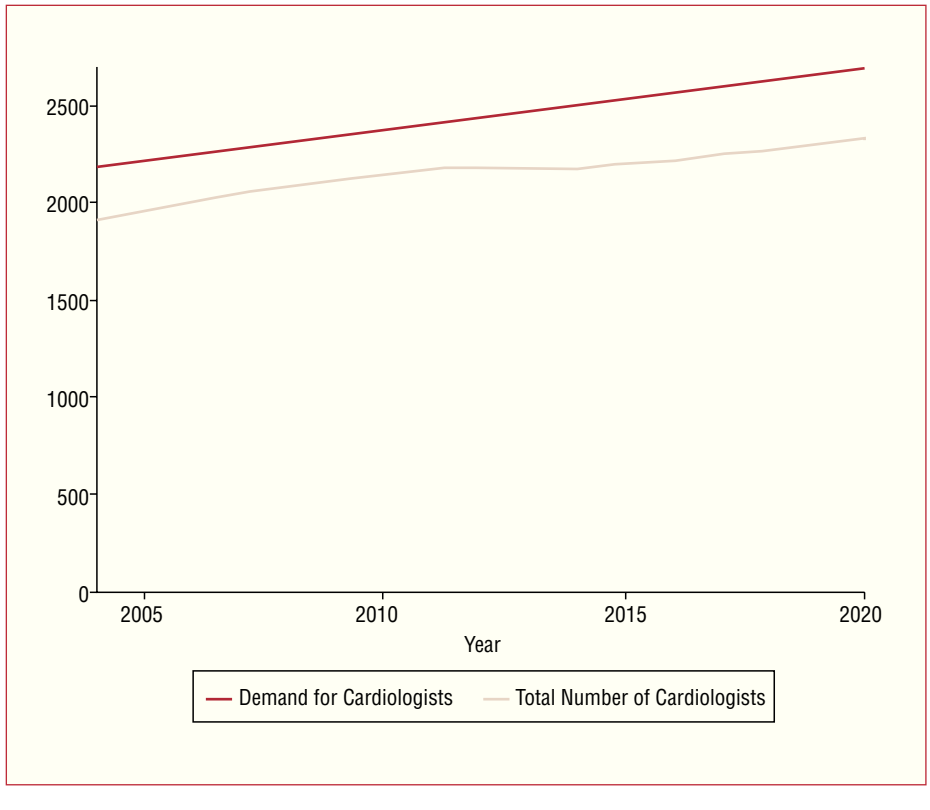

Figure 4. Supply and demand of cardiologists in Spain, 2004-20.

period is increased by 1 year, the deficit in 2020, which was 14% in the basic model, will be as high as 19.5%. In terms of absolute numbers, 439 more cardiologists will be required in 2020.

Synthesis, Discussion, and Recommendations

In 2004, there were 1926 potentially active cardiologists in Spain whereas, according to our estimates based on the benchmarks discussed earlier, 2185 would be needed. Spain has 253 fewer cardiologists than needed, that is, the number of practicing cardiologists would need to increase by 13.4%. In 2020, the deficit will be 14.5%. The need for cardiologists will increase by 512 professionals (from the 2179 that would be needed in 2004 to 2691 that would be required in 2020, an increase of 23% in the need).

In order to balance the number of cardiologists needed in 2020 with the expected demand, the annual cumulative increase in the number of resident training positions offered for cardiology would need to be 4% (so that 215 positions are awarded in 2020, that is, almost double the current training capacity).

POSSIBLE LINES OF ACTION IN THE FUTURE

Although all such prospective analyses have their limitations, particularly when the predictions are subject to many influences-some of which cannot even be conceived at present-it seems clear that the present deficit in cardiologists will tend to worsen in the immediate future. The following sections summarize some of the possible actions that can be taken to address this situation.

Reduction in the Demand

A decrease in the demand for cardiologists in the near future in order to better align demand with current availability would require a decrease in the incidence and prevalence of cardiovascular diseases. As has already been discussed earlier, a simple decrease in mortality among patients with cardiovascular disease does not reduce the need for visits to the cardiologist. In fact, such a need may even increase because patients whose life has been saved become chronic patients who require continued specialist care. It would therefore be necessary to prevent cardiovascular disease in the first place, which is essentially the goal of preventative medicine. Although advances in this field have been impressive, it is hard to be optimistic. Prevention within the population should not depend on greater intake of medication but rather on extensive changes in lifestyle. However, many of the habits inherent in our western lifestyle that need to be modified are closely linked to the current model of western society-stress, haste, lack of exercise, and poor eating habits are not going to disappear overnight. And like Jason's battle with the 7-headed hydra, the threat from cardiovascular disease reacts to improvement in one risk factor (smoking habits) with new challenges such as obesity and diabetes. In any case, even in the best case scenario, partial success in cardiovascular prevention will not lead to eradication of the disease but only delay its presentation. In a society with an ever increasing life expectancy, the demand for cardiologists is not likely to decrease.

Increase in the Supply of Cardiologists

To bolster the supply of cardiologists, the first and most immediate option would be to increase the number trained by the current resident training program. In some countries, such as the United States of America, physicians in training, particularly those that belong to certain groups such as women and foreigners, are less interested in becoming cardiologists. This is not the case in Spain, where demand for cardiology among those who enter the resident training program is high, and so the capacity to meet demand is derived from the limitations of the system itself. The availability of training positions in the system was 118 in 2004, according to a survey of the centers recognized for specialist training in this field and the number of positions that each can accept. Of these positions, 114 were advertised nationally in the round of applications. The National Cardiology Commission of the Spanish National Board of Medical Specialties under the auspices of the Ministry of Health, when consulted, had recommended-as it does every year-that all positions available were advertised.[39] But even if this request had been met, this increase would have been insufficient to cover not only future needs but also current ones. According to the simulation model used, more than 200 positions would need to be offered in 2020, which represents an annual cumulative increase of 4% from the present time. This would require the number of recognized hospitals and/or the number of residents per hospitals to be increased. The legislation for recognition of teaching hospitals is very strict[40] and requires a series of conditions that the hospital and the cardiology service itself have to meet. It is therefore unlikely that hospitals, apart from those already recognized, will easily obtain recognition. This same legislation covers the requirements for extending the number of residents per hospital in order to guarantee full training with sufficient practical experience in techniques and procedures. With this legislation, it is also unlikely that the number of positions in most of the hospitals can be increased. Clearly, a move towards more resident

cardiologists in training would require a change in the current legislation.

If this alternative were insufficient to improve supply, some of the other alternatives presented below would need to be considered.

Increase in the Number of Cardiologists by Training Systems Other Than the Current One

This option includes the establishment of the requirements for the training of general clinical cardiologists. Working Group no. 8 of the 35th Bethesda Conference[41] started by defining the different types of cardiologist, in accordance with the subspecialties that we are familiar with at present and with others that will appear in the near future (for example, the cardiologist who concentrates on magnetic resonance imaging/computed tomography). The general clinical cardiologist is, according to this working group, someone who is dedicated to the diagnosis, treatment, and prevention of cardiovascular diseases. He or she is essentially responsible for hospitalized patients and outpatients and is in contact with the physicians who refer the patients to a specialist. This person should be able to interpret and perform electrocardiograms, exercise tests, Holter monitoring, and transthoracic echocardiography. Such a cardiologist can undergo short track training, which would reduce the length of training in the American system from 6 years (3 years of internal medicine plus 3 years of cardiology) to 5 years (2 years of internal medicine, one transition year, and 2 years of cardiology). In the Spanish system, training could consist of one year of internal medicine plus 2 years of mainly clinical cardiology, which of course would need to be spent in recognized cardiology services. This same common program of 2 years of clinical cardiology could also be considered as part of the training of family physicians. The Spanish health system has sufficient capacity to absorb the training of this type of specialist, given that the number of cardiology residents that can be trained at present is limited by the need to have a minimum experience in terms of number of invasive tests and other tests performed. This type of cardiology could provide a platform for subspecialization through optional and additional training periods that would have to be defined. The foreseeable problem with this approach is that clinical cardiology has to be seen as an attractive option for physicians in training. This problem goes beyond the scenarios considered in this analysis although it represents a real problem for cardiology. Young physicians in training are fascinated by the attractive options offered by technically complex medicine such as electrophysiology and catheterization in the case of cardiology. On the other hand, the practice of cardiology in the public system is burdened with overcrowding and physicians have limited amounts of time to deal with the patients, whether in hospital or an outpatient clinic. Because of these factors, many young cardiologists do not think of clinical cardiology as their first option. To try and overcome this perception, it is necessary to remind physicians in training that patient considerations should be at the heart of the medical professional. The clinic, which integrates much of what cardiovascular medicine has to offer the patients, plays a central role in attending to patient needs.

TABLE 6. **Comparison of Salaries of Physicians in Different Countries of the European Union***

Country	Mean Gross Annual Salary*, Euro	Range
Spain	37 500 (+20% retainer)	35 000-45 000
Portugal	55 000	40 000-70 000
United Kingdom	122 500	95 000-150 000
Germany	65 000	NA
France	70 000	NA
Italy	55 000	NA

*NA indicates not available.
*Equivalent to an associate physician in the Spanish National Health System with 5 years experience in the position.
Taken from the *Diario Médico*[42] and Pay scales.[43]

Importation of Cardiologists Trained Outside Spain

Any cardiologist who wishes to practice in Spain, at least within the Spanish National Health System, requires official recognition of the cardiology qualification obtained outside Spain. The legislation for this recognition requires the duration and content of the respective programs to be equivalent to the Spanish ones. When the programs are not fully equivalent but there are no large discrepancies, it is possible to take an examination. In 2004, the National Cardiology Commission examined the applications of 23 cardiologists from Argentina (n=10), Germany (n=4), Cuba (n=3), Romania (n=2), Venezuela (n=2), Mexico (n=1), and Uruguay (n=1). Of these, 6 received a favorable decision. At present, there are 36 applicants waiting to take the theoretical and practical examination foreseen for those cases in which there are no substantial differences between the content and duration of the training followed in the country of origin and the current program in Spain. The current legislation that regulates the recognition of qualifications of specialist physicians from member states of the European Union, presented in Act 1171/2003, dated September 12, 2003, that modifies article 12bis of Act 1691/1989, dated December 29, 1989, foresees automatic equivalence of cardiology qualifications in the 15 member states. But a glance at

the origin of the applications received last year suggests that future immigration is unlikely to come from the European Union. The reason for this is the working conditions. The mean salary of an associate cardiologist in the Spanish health system is around €37 500 (plus 20% retainer fee), which is below that of other European countries with similar socioeconomic conditions such as the United Kingdom and Portugal[42,43] (Table 6). Both the United Kingdom and Portugal are net importers of qualified medical manpower, and at present, there are 1688 Spanish members in Portugal and 1084 in the United Kingdom, according to data from the General Council of the Association of Spanish Professional Medical Bodies (through to February 2005).

Modification of the Structure of Cardiology Services by Incorporating Noncardiologists

Cardiology, like other current fields of medicine, is an exercise in teamwork, and the importance of teamwork is evident in clinical services, such as cardiology. From the point of view of health professionals, the team is currently made up of cardiologists and nurses, each with their own well defined duties. University hospitals also have a temporary contribution from the personnel in training, including cardiology residents and residents from other specialties who spend time learning about cardiology. The present lack of cardiologists on the one hand and the integrated approach to patients with multiple illnesses on the other may stimulate a search for more imaginative alternatives. Under the supervision of cardiologists, internists and family physicians could form part of the team. After a period of adaptation, they could carry out some of the mainly clinical functions which are currently the reserve of cardiologists in the cardiology services but which are no different to those conducted by internists or general practitioners in cardiovascular patients in other services. Such an approach contrasts with what happens when cardiovascular patients are attended in noncardiology services. Questions of divisions of professional duties aside, polyvalent services (internal medicine or intensive medicine) undeniably see a wide range of patients, so each physician spends little time with cardiovascular patients. In the proposed alternative, however, noncardiologists who form part of the cardiology services would dedicate themselves almost exclusively to attending patients with heart disease, with close support from cardiologists. The proposal would be complemented with the incorporation of nonmedical technicians for specific tasks. A clear example of this is echocardiography. In countries such as the United States of America, scans are recorded by technicians and interpreted by physicians, and so the performance of the physicians, measured in terms of the number of scans, is very high. Such an approach is already the norm in some hospitals in Spain, where nurses are responsible for recording the scans. If such an approach were to become more widespread, the type of training, qualification, and duties of the different types of technician would need to be regulated. Finally, such an integrated team approach should not be limited to the clinical services of large hospitals. The integration of the cardiology resources of small hospitals could also be pooled into one large regional cardiology service, so facilitating rotation of personnel and coordination of referrals.

If these alternatives, or indeed other alternatives yet to be considered, are not taken up, the outlook for cardiovascular patients could be bleak. If there are too few cardiologists, they would be restricted to performing certain techniques which, because of their technical nature, need to be performed by a specialist. Care of the patients would then fall on noncardiologists. This is not in the best interests of the patients, and it would also be negative for cardiology as such, because cardiologists should be providing support for the clinicians who attend the patients. The other possibility would be to select a limited the number of patients to be attended by a cardiologist. Once again, this would not be in the best interests of the patients because it would create 2 different levels in the quality of care.

SUMMARY

The current situation in Spain shows an imbalance between the number of practicing cardiologists and those that would be necessary. This imbalance is approximately 14%. The age pyramid reflects an ageing population of mainly male cardiologists. Predictions for the future indicate that the situation will get worse through to the year 2020. Correction of this imbalance requires other sources of training to be developed and/or reorganization of the health care services. Some of these alternatives are presented in the final part of this document, in the form of proposals to stimulate debate.

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