The future of cardiovascular research / N. Williams & J. Anderson.

The future of cardiovascular research

An opinion survey

PRISM

Unit for Policy Research in Science and Medicine

THE FUTURE OF CARDIOVASCULAR RESEARCH

An opinion survey

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This report presents the findings of a questionnaire survey of more than 300 UK cardiovascular scientists. It forms part of a larger experimental foresight project on the future of cardiovascular research in the UK.

The survey was carried out by Nigel Williams, Leslie Rogers and Joe Anderson. We are grateful to the project steering committee; Professor A Henderson, Professor P A Poole-Wilson, Professor D Julian, Dr L H Smaje and Dr M B Davies for their guidance; Dr J Rogers and Dr M Phillips for identifying postdoctoral fellows; and Ms S Driscoll and Ms R Trevelyan for data processing and analysis. The foresight project was funded by the Wellcome Trust, the British Heart Foundation and the Medical Research Council.

This report presents the results of an opinion survey of 309 UK cardiovascular scientists on a number of issues concerning the future of the field.

The issues explored in the survey focused on the concerns of a wide range of 'stakeholders' in cardiovascular research including scientists, health managers and the industrial 'users' of academic science. Key representatives of these interest groups were interviewed about their views on the future of cardiovascular research before the survey, to develop the questions which were subsequently put to the scientific community.

Such large-scale surveys of opinion do not traditionally form part of the process of developing priorities for a research field, and this study was therefore undertaken as an experiment to assess the usefulness of such an approach. The aim was to develop a novel survey method, which might be transferable to other fields of science, to help broaden consultation in the policy-making process. This is a key goal of research foresight, a goal central to the broader project, of which this survey is one component.

The results provide some clear findings that may be helpful in developing future policies for cardiovascular research, even though consensus of opinion was not always apparent (or expected). Among the key findings were:

- A strong expectation that substantial scientific advances would be made over the next five years, leading to improved understanding in three fields of cardiovascular research, namely:

  1. the functions of the vascular endothelium

  2. the mechanisms of atherogenesis

  3. the molecular genetics of cardiovascular disease

- A widespread perception that these promising areas will only be exploited in the UK if a change is brought about in the skills profile of the present cardiovascular research community. Notably, it is felt that more molecular biology skills are needed in the field.

- Support from a majority of respondents for the establishment of a small number of multidisciplinary research centres, as opposed to a centralised national institute.

- Support also from a majority of respondents on the need for a national centre to coordinate and disseminate research results.

- Strong agreement on the need for better evaluation of new treatment technologies before introduction to clinical practice.

- A broad-based desire for initiatives to increase interdisciplinary collaboration.

More generally, this survey has revealed that it is possible to combine the interests of both users and research practitioners when reviewing policy options for a field of science.

1.1 The need for foresight studies

With the ever-rising costs of research, funding bodies are beginning to develop strategies to support various fields of science and, inevitably, priorities within these fields are becoming more explicit [1]. The development of strategies draws heavily on the work of expert committees for in-depth reviews of scientific fields. But pressures now exist which require expert committees to support their recommendations as far as possible with objective evidence and to look forward systematically at needs and opportunities.

A key pressure is the need to gather data. As the UK produces only 5 per cent of the world's output of science, and research fields are becoming more complex and fragmented, it is increasingly difficult for a small expert group to have a comprehensive overview of what is going on internationally. Also with more government and societal pressure to show the usefulness of research, the priorities likely to win the strongest support are those that take into account the views of users, in so far as they can be identified.

Foresight analysis is a term for a number of techniques that aim to address these issues. The broad goal is to obtain expert opinion on the future of a field and hard data on its status and trends, nationally and internationally. Generally it includes identifying [2]:

- national strengths and weaknesses
- consultation with users on the needs for research
- consultation with experts on the scientific opportunities
- the country's ability to exploit research findings
- the necessary skills base

Techniques of foresight analysis are well established in industry where they have been used to help develop research strategies, but a number of organisations in other countries have also used these techniques to help inform policy for academic areas of science [2]. The challenge tackled in the present foresight project was to adapt such techniques for use in UK academic science.

The purpose of the survey reported here was to carry out the key consultation component of this foresight study, by polling the opinions of a large sample of scientists on issues concerning the future of cardiovascular research in the UK that were of concern to both users and practitioners of research.

1.2 Origin of the study

The study arose from a Medical Research Council joint working group set up to review the biology of cardiovascular disorders in 1990. The group produced a well-argued case but acknowledged that future funding strategies would require broader consultation and need to be framed with reference to more comprehensive data. The joint working group of administrators and scientists decided to support a 'foresight study' as an experiment and formed the project steering group (Appendix 1).

The survey set out to gather opinions on a series of issues relevant to policy by looking forward five years. The aim was not to predict the future but rather to examine areas of research that were ripe for advance over this timescale and to collect views on funding and support structures that would most strengthen the field.

1.3 Developing a methodology

Cardiovascular research, which spans basic and clinical science, presents particular problems because of the distance between academic researchers and their funding bodies on the one hand, and the so-called users of research on the other. Because of the disease focus, it is also difficult to identify all the scientific disciplines that contribute to improved understanding of the disease and to identify experts in these fields.

The development of the methodology therefore presented a number of challenges. Firstly, it was essential that consultation was broadened beyond the scientific community to encompass the interests and views of cardiovascular research users, and that the questions posed related not only to the interests of established scientists.

Secondly, it was essential that the sample surveyed was large enough for the results to be credible and reasonably representative of the UK cardiovascular research community as a whole.

Thirdly, it was important respondents were identified using a transparent methodology.

This report:

- sets out the methods used to tackle these challenges
- presents the results of the survey
- offers a brief commentary on the policy implications of the results
- discusses the potential and limitations of this kind of survey for policy making

2.1 Broadening consultation: identifying and consulting stakeholders

To achieve the first aim of the project – to broaden consultation – a small number of 'stakeholders' in cardiovascular research was identified and interviewed. Stakeholders were defined as people who have a professional interest in the field from researchers themselves across the spectrum to 'users'. Users of research were defined as those who do not carry out research themselves but whose work is affected by the results of research. For this survey, the users included health service managers, planners and industrial scientists. The distinction between users and practitioners, however, is not clear cut; industrial researchers, for example, bridge the boundary as both users and practitioners of research.

For the stakeholder group, 21 people were identified within five categories:

- the project steering committee
- industrial cardiovascular researchers
- clinical researchers
- non-clinical researchers
- health service planners and managers

An industry database (PharmaProjects) was used to determine the pharmaceutical companies in the UK with the highest number of compounds under development in the cardiovascular area, and industrial researchers were selected as representatives of these companies.

Clinical and non-clinical researchers were selected on the basis of membership of the NHS central research and development committee, the UK Forum for Coronary Heart Disease Prevention, and on the advice of the steering committee.

The health planners and managers were selected on the basis of their known professional interest in cardiovascular research but, not surprisingly, few in the UK had this as an easily identifiable interest. The list of stakeholders interviewed is shown in Appendix 2.

2.2 Identifying the issues

Having identified a representative group of stakeholders, the next stage was to assess their main concerns about the future of cardiovascular research. This was tackled through a series of 'strategy' interviews which were structured in a systematic manner and identical in format for all interviews. The aim was to be as unbiased as possible in the questioning and to encourage interviewees to articulate their thoughts on strategic issues. The questions used were adapted from those previously used in scenario analysis at the Shell Company (see box 1).

Box one

Questions used in 'strategy interviews' with stakeholders

1) If you could talk to someone who actually knew the future of your research field, a genuine 'Delphian' as if such existed, what sort of questions might you wish to ask?
2) If things went very well in your field of research, looking at it optimistically, what sort of achievements might be possible?
3) If things do not go so well, what do you see as the pitfalls which might limit research success?
4) Looking at the ways research is now carried out, what changes might be needed to help ensure that the optimistic targets are achieved?
5) Looking back, what do you see as the most significant events which have advanced research in your field to its current state – and what have been the major disappointments?
6) Looking forward, what do you see as the most immediate and pressing actions needed to strengthen your research field?
7) If all of the constraints, financial or otherwise, could be removed, what more would you suggest should be done in addition to what has already been mentioned?

All interviews were tape-recorded and transcribed. More than 60 000 words were gathered covering more than 1000 points raised during the interviews. Each of these points was subsequently assigned to one of 11 categories which covered the broad areas expressed. Full details are given in a separate report on the pre-survey interviews[3].

2.3 Selection of respondents and questionnaire survey

Following analysis of the pre-survey interview notes the next task was to develop a questionnaire for the main survey of cardiovascular scientists. The questionnaire was divided into sections which corresponded to the 11 main categories identified. The resulting questionnaire is included as Appendix 3. The main sections covered:

- future possibilities in cardiovascular science
- future possibilities for disease intervention
- opinions on future infrastructural support
- future needs for skills

The next task was to identify 400–500 researchers to provide a minimum sample for the survey. This number was chosen to be large enough to give meaningful cell sizes, for data cross-tabulation, and hence credible results.

The largest pool of potential respondents was generated from analysis of authorship of published papers in the cardiovascular field with a UK address.

The first source of names of cardiovascular researchers was the database of research publications: Medline. A complex set of index terms drawn from the classification scheme used by Medline, called the Medical Subjects Heading (MeSH), was constructed. This set of terms acted as a 'filter' for cardiovascular publications and was validated extensively through iteration with cardiovascular experts and the steering committee and by empirical tests on the publication lists of selected UK medical research laboratories. Full details of the procedures used to define and analyse the field are given elsewhere [4].

The filter constructed of cardiovascular index terms was applied to Medline for the years 1988–91 and captured 14 064 papers appearing in 1218 journals. The 21 157 authors (together with the order in which they appeared on the paper, address entered on the paper, bibliographic citation, and journal title) were downloaded onto a computer file and this formed the basis for selecting respondent groups 1 and 2.

Respondent group 1: most 'visible' cardiovascular researchers

The 150 most commonly occurring authors on the database were selected and listed with the total number of papers on which their names appeared. Their current address and research interests were found using a number of directories. A small number were eliminated because either they could not be located or because they helped in a pilot test of the questionnaire.

The final list comprised 119 of the most prolific publishers in UK cardiovascular research and these, not surprisingly, tended to be the heads of research groups or institutes.

Respondent group 2: sample of first authors

The second group comprised a sample of other researchers who had published cardiovascular papers during this period. The aim was to select those who had carried out the main work within research projects and who were therefore, 'hands-on', active researchers. Three criteria were used to define these respondents:

- they were the first author on the publication;
- they had published at least two papers during the period considered;
- the paper had been published in a selected set of journals considered as most important by the steering committee, and those regularly scanned for cardiovascular research by the editorial boards of the appropriate current awareness journals.

953 researchers met these criteria and 393 had a consistent, identifiable UK address on their publications. A search using a number of directories and telephone enquiries revealed the present location for 210 of these researchers and they were added to the respondent list.

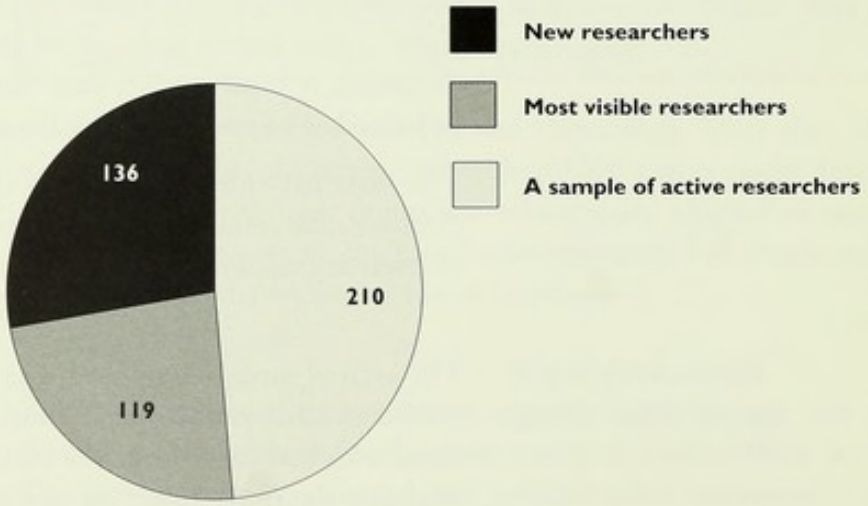
Respondent group 3: new researchers

The only researchers not drawn from the publications database were the 'new' researchers, defined as those that had won competitive postdoctoral awards either from the British Heart Foundation, Medical Research Council, or Wellcome Trust but who had not necessarily had enough research experience to have built up a publications record in the field. The total number was 102 from the BHF, 21 from the MRC and 13 from the Wellcome Trust. All BHF fellows were selected. MRC and Wellcome Trust fellows were selected on keywords used to classify their projects which were checked for relevance to cardiovascular research by scientific staff of the funding agencies.

The three respondent groups, together, consisted of 465 cardiovascular researchers (see fig.1). These were all sent a copy of the questionnaire and, following two reminders, the survey was closed after eight weeks.

Responses were analysed using the Statistical Package for the Social Sciences (SPSS/PC+). All questions were cross-tabulated by all subgroups, testing for independence using the chi-squared statistic. Those which were found not to be independent at a 5 per cent level of significance were highlighted and are referred to in the results section.

Figure one **Composition of the UK cardiovascular researcher opinion survey**



3.1 Response to the questionnaire

A total of 339 responses (73 per cent) was received by the closure date of which 309 (66 per cent) were completed adequately and therefore recorded. Respondents were reasonably evenly spread among the three subgroups; the highest rates were from the new and the most 'visible' researchers at more than 70 per cent and the lowest (53 per cent) was from the sample of active publishers who had been the most difficult to locate.

3.2 Profile of respondents

Career details

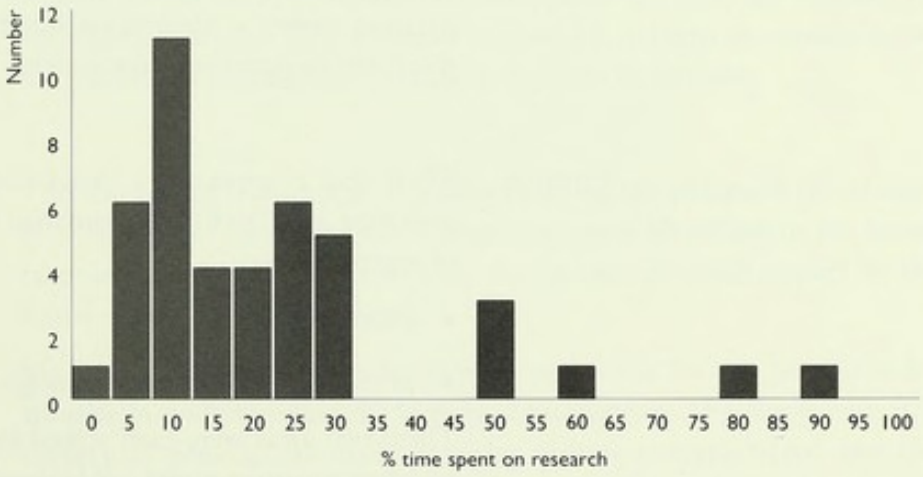
Respondents were spread across all age groups. With the inclusion of the junior research fellows supported by the funding bodies 15 per cent of respondents were under 30. Sixteen per cent of all the respondents were female and these were skewed towards the younger age groups.

The divide between the medically and non-medically qualified was almost two thirds to one third with 64 per cent of respondents recording a medical qualification. This division was less marked in the respondents' current posts with just over half holding clinical or honorary clinical posts and describing their laboratory setting as in a medical school. One third held academic posts and the rest were postdoctoral staff, industrial researchers and managers.

Time spent on research

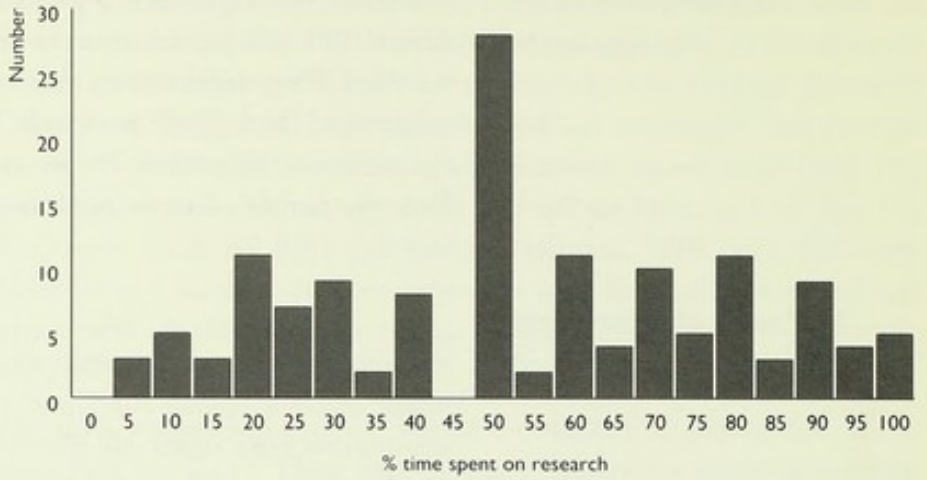
The proportion of time spent on research varied widely. Only 13 per cent of respondents claimed to spend all their time on research or essential research support activities. Division of the respondents into three subgroups by post: academic, academic (honorary clinician) and clinician (honorary academic) revealed a marked difference between them (fig.2).

Figure two

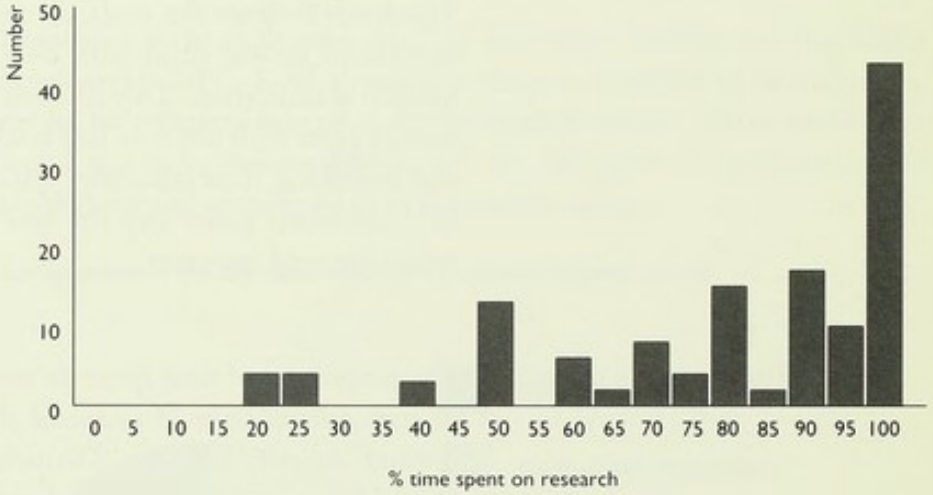


Clinician, honorary academic

Academic, honorary clinician



Academic



Most of those who held purely academic posts spent more than half their time on research. In contrast, those who held posts with a clinical position, either as their main function, or as honorary positions, spent much less of their time on research.

Expertise

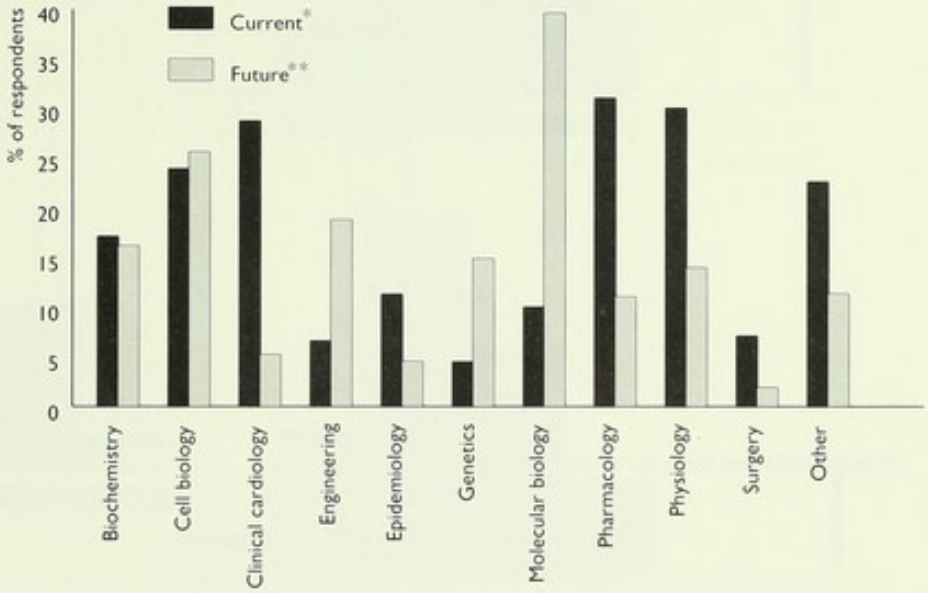
There was, as expected, a broad range of expertise amongst respondents who were asked to list no more than three main areas. The two main areas of expertise were:

- pharmacology
- physiology and electrophysiology

These two areas were each scored by almost a third of respondents. Just less than a quarter scored cell biology as a main area of expertise. Just over a third scored clinical expertise; 28 per cent scoring clinical cardiology and diagnosis and 8 per cent surgery. Amongst the 22 per cent claiming other skills, pathology, immunology and nutrition were the most frequently mentioned. Only 10 per cent claimed expertise in molecular biology and less than 5 per cent scored genetics. Epidemiology was scored by 11 per cent of respondents and engineering and instrumentation by 6.5 per cent.

Respondents were asked what expertise not presently available to them they would anticipate to be of most value to them for future research plans. The results of this question were compared to the present availability of skills listed earlier in the questionnaire (fig.3).

Figure three **Current expertise amongst respondents and anticipated additional needs**



*Respondents were asked to score not more than three areas from the list as their main areas of expertise

**Respondents were asked what expertise from the list not available to them now would be most valuable for their future research plans

The most striking result was that 40 per cent said they would need molecular biology expertise in contrast to 10 per cent of respondents who claimed they already had expertise in this area. In addition, more than a quarter of respondents anticipated a need for additional skills in cell biology.

Almost 20 per cent of respondents anticipated the need for engineering and instrumentation skills presently unavailable to them in contrast to the 6.5 per cent of respondents who claim expertise in this area.

3.3 Potential for scientific advances

The aim of this section was to gather views on the prospects for advance in a number of research areas. These areas were identified in the initial interviews as the ones likely to have the greatest potential impact on the future of cardiovascular research.

More than half the respondents were optimistic on the prospects for advance in understanding the biological mechanisms of atherogenesis, the molecular genetics of cardiovascular disease susceptibility, and the functions of the vascular endothelium (fig.4). Research on the vascular endothelium was seen as particularly ripe for advance, with almost 70 per cent of respondents scoring prospects for advance as good and only 3 per cent scoring them as poor.

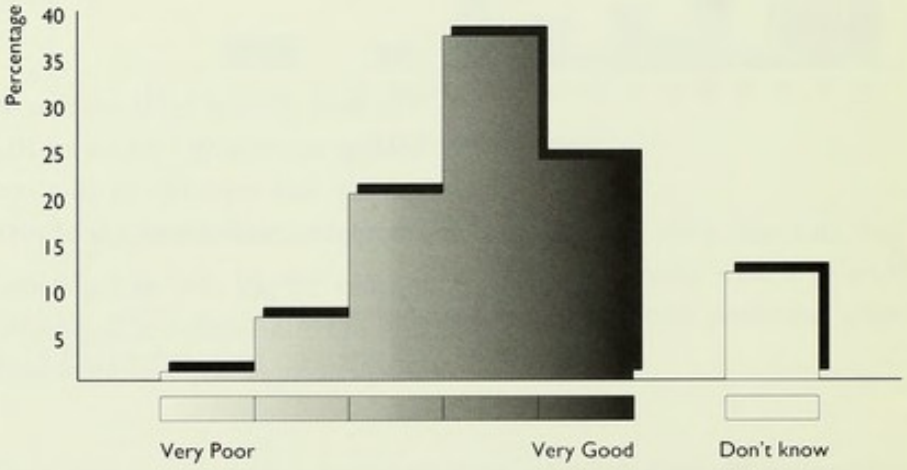
As expected, given the range of respondents' expertise and interests, opinion was broadly spread on a number of questions. On the question of

prospects for advance in understanding the mechanisms of angiogenesis, for example, 25 per cent of respondents answered 'don't know'. On analysis of subgroups by stated expertise, epidemiologists gave the highest rate of 'don't knows' on this question with cell biologists giving the lowest rate. Overall, the prospects for advance in angiogenesis were seen to be good.

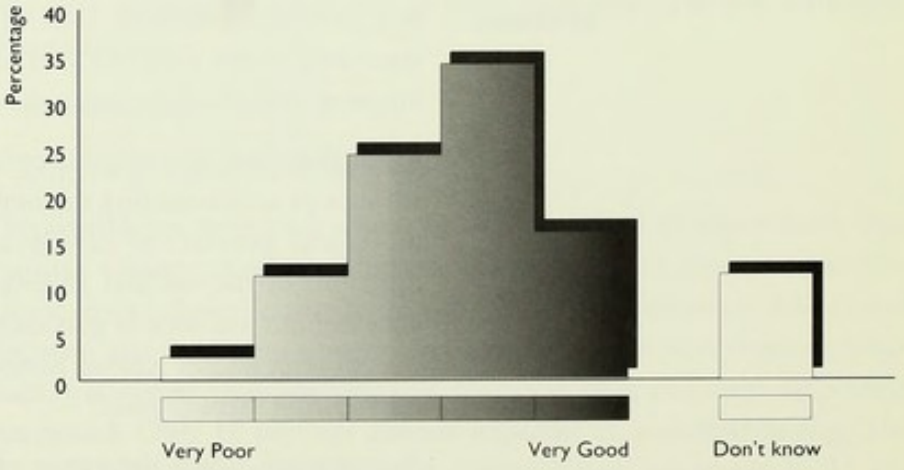
Figure four **What do you see as the prospects for advancing understanding in the following areas over the next five years**

Functions of the vascular endothelium

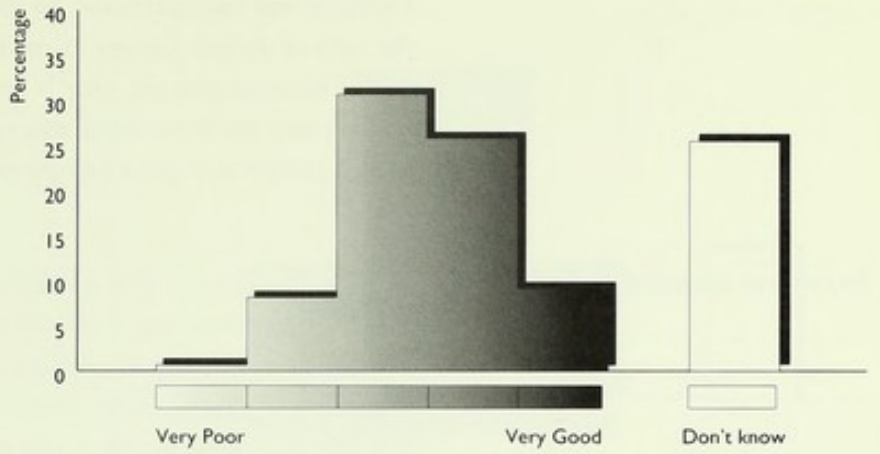
The biological mechanisms of atherogenesis



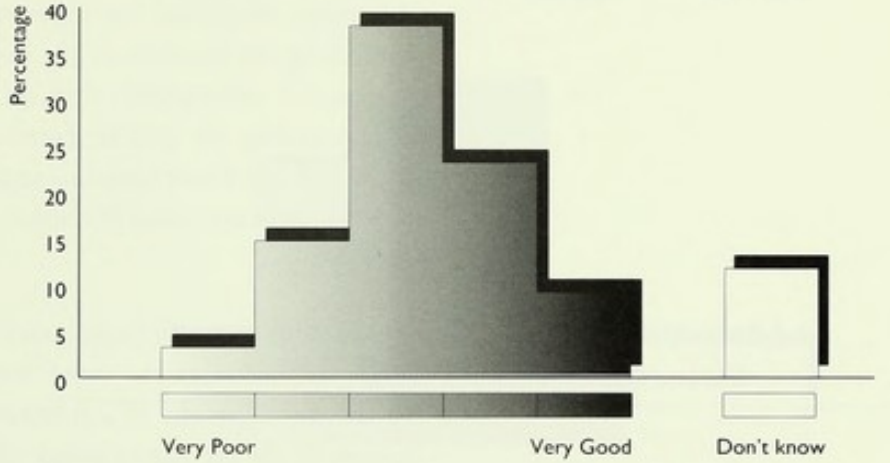
The molecular genetics of cardiovascular disease susceptibility



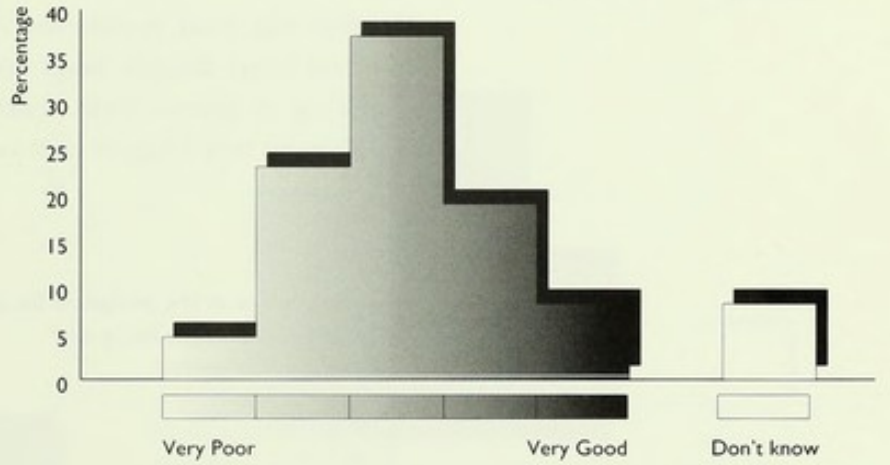
The mechanisms of angiogenesis



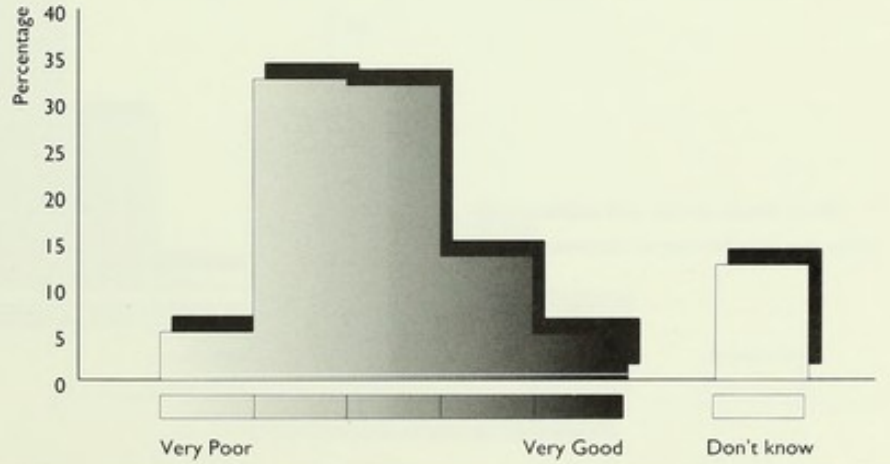
The biological mechanisms in hypertension



The role of dietary factors in cardiovascular disease



The role of non-dietary environmental risk factors in cardiovascular disease



Opinion was less optimistic on the prospects for advance in understanding the role of dietary factors in cardiovascular disease and, in contrast to the results for angiogenesis, only 8 per cent scored 'don't know'. On the role of non-dietary environmental risk factors almost 40 per cent of respondents scored prospects as poor or very poor over the next 5 years.

Important advances over the next 5–10 years

In order to ensure that all important potential areas of advance were identified, and not just those offered on the questionnaire, respondents were given the opportunity to state in an open question what they saw as the most important scientific advances over the slightly longer timescale of 5–10 years. The question drew a wide range of responses but, overall, the most frequent comments reinforced the responses to the closed questions. Advances in unravelling the functions of the vascular endothelium and understanding the processes of atherogenesis featured most strongly, together with progress on understanding the genetic factors in cardiovascular disease. Advances in organ and cell transplantation and gene therapy, over this longer timescale, were the areas next most frequently cited.

3.4 Potential for different disease interventions

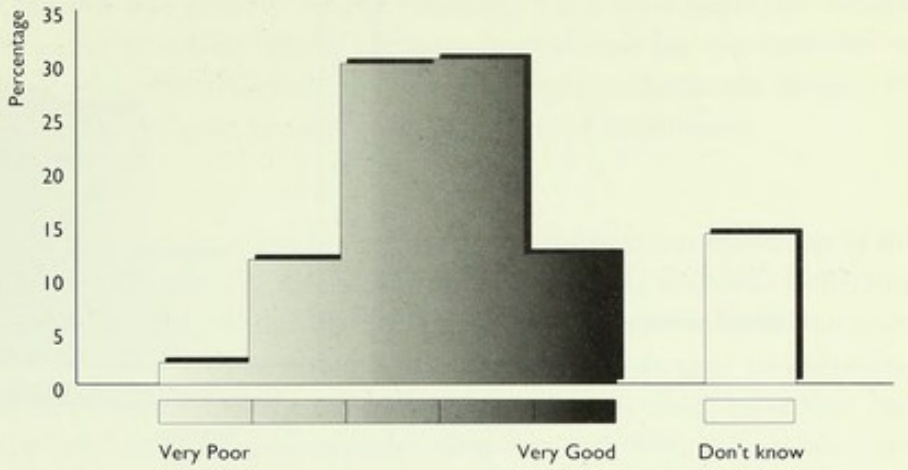
To consider more strategic aspects, for example, applying the results of cardiovascular research, views were also sought on prospects for advance on the development of a number of possible interventions that were of interest to the pre-survey group (fig.5).

Opinion was most positive on the development of new drugs to treat coronary heart disease, heart failure and the development of effective screening of disease risks. Forty per cent of respondents saw good prospects for new drugs to treat and reduce the risk of heart disease.

Figure five **What do you see as the prospects for advance in the feasibility of developing the following over the next five years?**

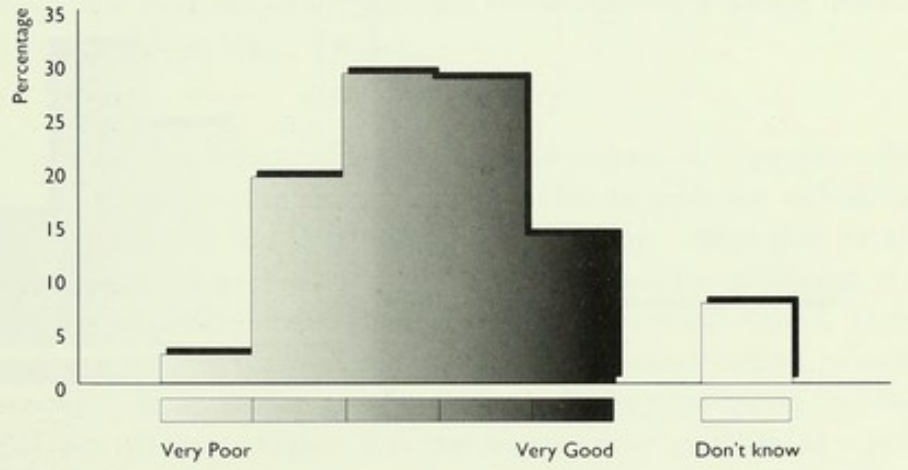
New drugs which will substantially improve treatment of coronary heart disease

New drugs which will substantially improve treatment of cardiac failure



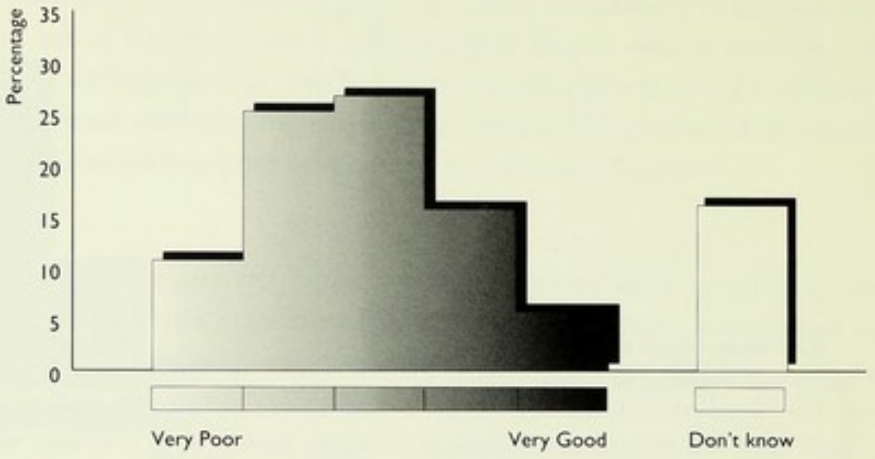
New drugs which will substantially reduce the risk of coronary heart disease

Effective screening of an individual's cardiovascular disease risks



Public health or dietary measures which will substantially reduce the risk of coronary heart disease

Artificial hearts and heart-assist devices



Manipulation of cardiac cells to treat heart failure

Heart transplants to humans from animal donors

In the pre-survey interviews there was considerable controversy on the development or desirability of animal-derived heart transplants, artificial hearts or heart-assist devices. The questionnaire survey revealed that prospects for the development of heart transplants from animal donors was seen as poor over the next five years by more than half the respondents although several said that their views would have been more positive over a longer timescale.

Likewise the prospects for advance in the feasibility of developing artificial hearts or heart-assist devices was seen as poor overall but on subgroup analysis newer researchers (those who had been carrying out research for fewer than 10 years) were significantly more positive ($p < 0.05$).

Opinion was gloomy on the prospects for public health or dietary measures to reduce risks of coronary heart disease but the feasibility of developing effective screening of an individual's cardiovascular disease risk were scored as good by more than 40 per cent of respondents.

3.5 Anticipated skills needs

Respondents were asked for their views on the future contribution of the different biomedical disciplines to cardiovascular research. Reflecting molecular and cellular developments within cardiovascular research, around two thirds of respondents expected the strongest contributions from molecular biology, cell biology, and pharmacology. More than half saw genetics as featuring strongly. More than two thirds (68 per cent) saw molecular biology as making a key contribution to the future of the field but, as noted earlier, only 10 per cent of respondents said that they had expertise in this area.

3.6 Strengthening the field

View on current UK strengths

Respondents were asked for their view on the international standing of UK cardiovascular research. Both UK clinical and basic research was compared favourably with the world's best but basic research was seen as slightly weaker than clinical research. Analysis of the response by subgroup revealed that clinical cardiologists scored basic research significantly weaker whereas non-clinical researchers scored it significantly stronger than the group as a whole ($p < 0.05$). But in answer to the open questions many respondents wrote that there was insufficient basic high-quality cardiovascular research being done in the UK.

Options for strengthening the infrastructure

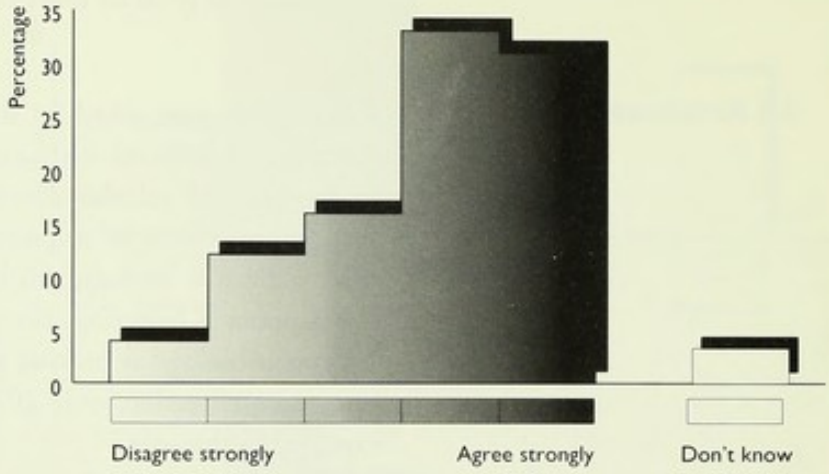
Three options which emerged from the pre-survey interviews for providing additional infrastructural support for the field were included in the questionnaire (fig 6). There was strong support – more than 65 per cent agreeing or agreeing strongly – with the suggested establishment of a small number of multidisciplinary cardiovascular research centres. There was also majority support for the funding of topic-oriented projects among existing research groups, although the number opposed to this (25 per cent) was higher. But the suggestion of establishing a new national centre for cardiovascular research drew an overall negative response.

Responses to two open questions on how UK cardiovascular research could best be improved and how an additional £10 million could best be spent were dominated by infrastructural issues.

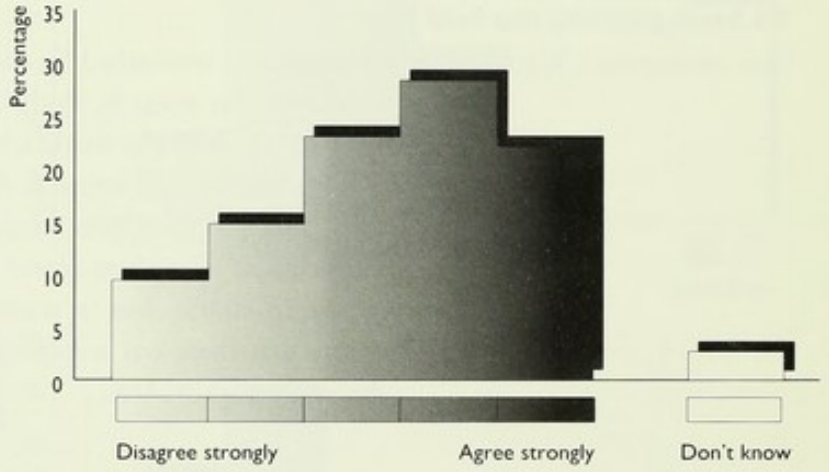
The key concern was interdisciplinarity. It was seen, almost without exception, as a desirable goal and in need of developing or strengthening. Related to this there was also widespread concern about the perceived divide between basic and clinical research and clinically and non-clinically qualified staff, and the need for more good quality basic research.

Figure six **If extra financial support for cardiovascular research above present levels was made available by the various funding bodies, what is your opinion of the following suggestions for strengthening UK cardiovascular research?**

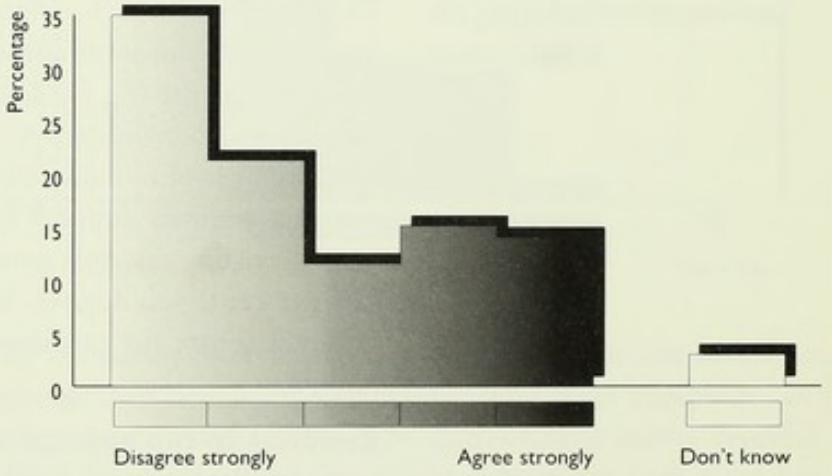
'Set up a small number of cardiovascular research centres of sufficient size to mount multidisciplinary programmes at each centre'



'Fund multicentred, topic-oriented programmes among existing groups'



'Establish a national institute for cardiovascular research'



Another approach, suggested by several respondents, was to identify clearly the current strongest groups and increase their funding to build them into multidisciplinary cardiovascular research centres.

Possible models from industry were also offered and the following examples illustrate the comments received:

'Create strategic alliances between small research teams by funding collaborative projects that would utilize the various strengths and facilities that each team possesses'

'Set up a basic/clinical collaborating research fund to support projects designed to overcome the communication gap. It should be organised to respond swiftly to good proposals, the emphasis being on salaries for identified and keen link researchers'

'Fund adequately resourced and patient-based research units that would have enough multidisciplinary expertise to cut across traditional specialist boundaries and provide excellence in research methodologies and outputs'

Many respondents pointed out that emphasis on molecular approaches could help break down the barriers between clinical and basic research and help tackle the mismatch, in molecular biology, between the availability of present skills and anticipated needs.

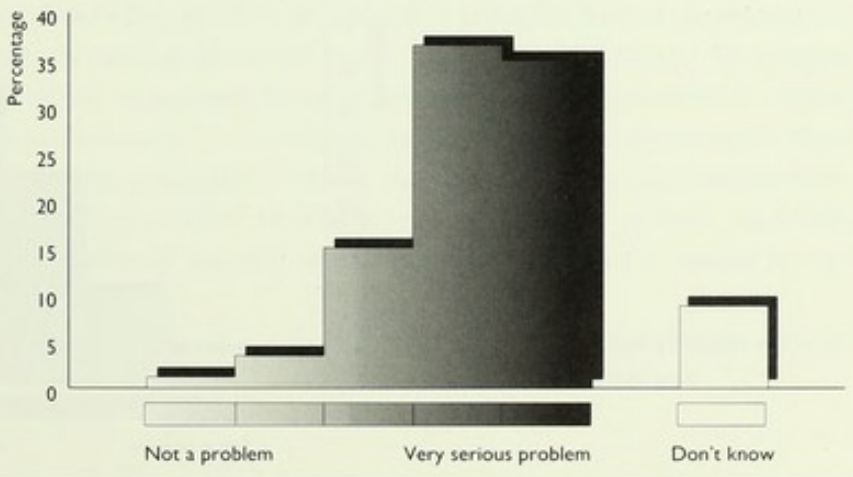
Many respondents, especially clinical researchers, argued that funding bodies should develop more explicit strategies for funding cardiovascular research and control more firmly those topics funded within this field.

Improving careers

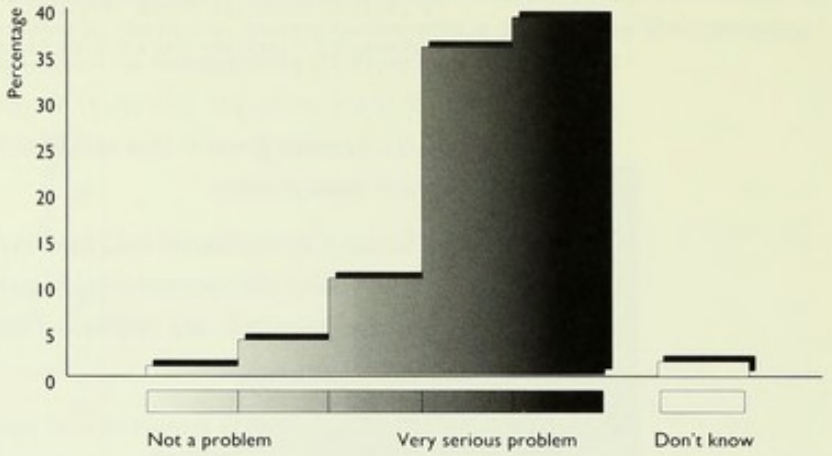
A number of questions concerning staffing and careers were asked. Most of these issues were not specific to the field of cardiovascular research but as they were identified as major blocks by several of the pre-survey group, opinion on these issues was canvassed in the questionnaire (fig.7). Five out the seven perceived problems posed were endorsed by more than half the respondents, and on two issues – the lack of career opportunities for non-clinical researchers in clinical research and short-term project funding – more than 70 per cent agreed that these were problems. On subgroup analysis the provision of training for clinical researchers was seen particularly as a problem by the clinical cardiologists.

Figure seven **The following staffing problems have been identified in cardiovascular research. Please give your opinions on these problems**

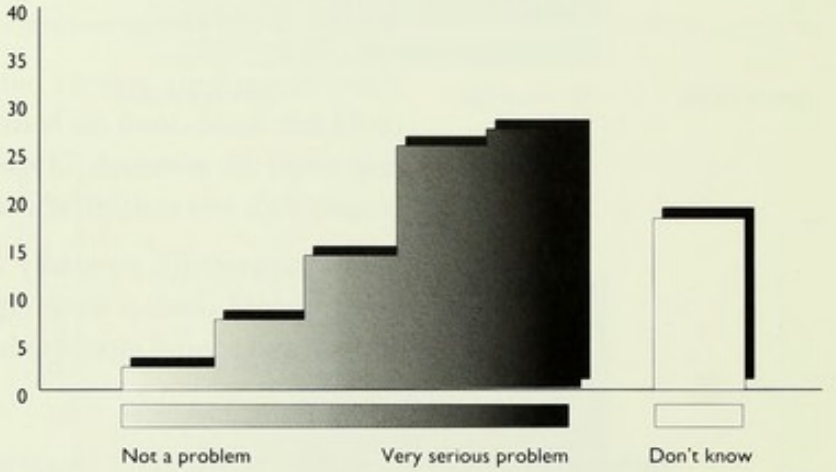
Lack of career opportunities for non-clinical researchers in clinical research



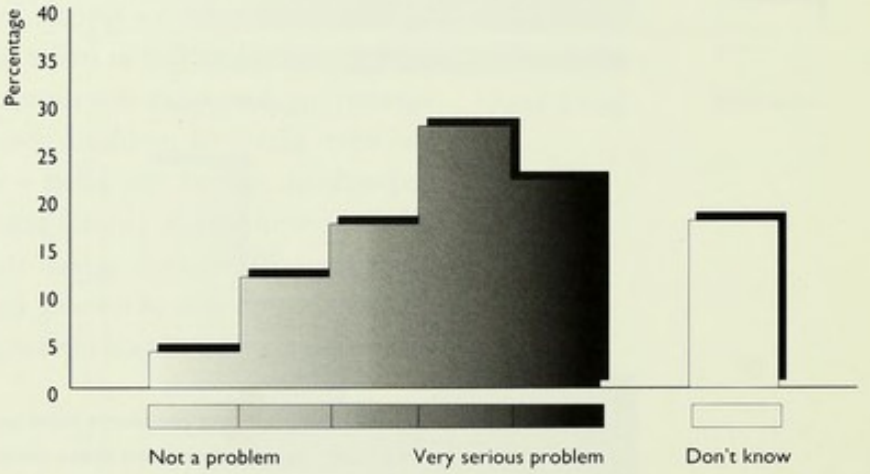
Short-term project funding



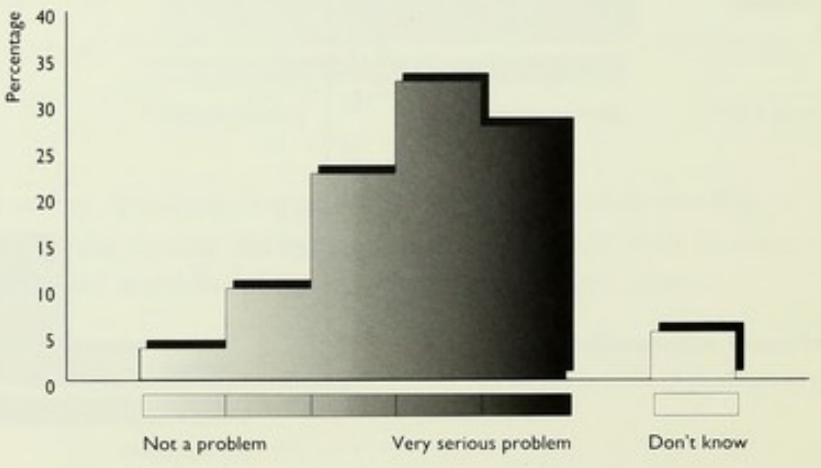
Competition between research and NHS clinical practice



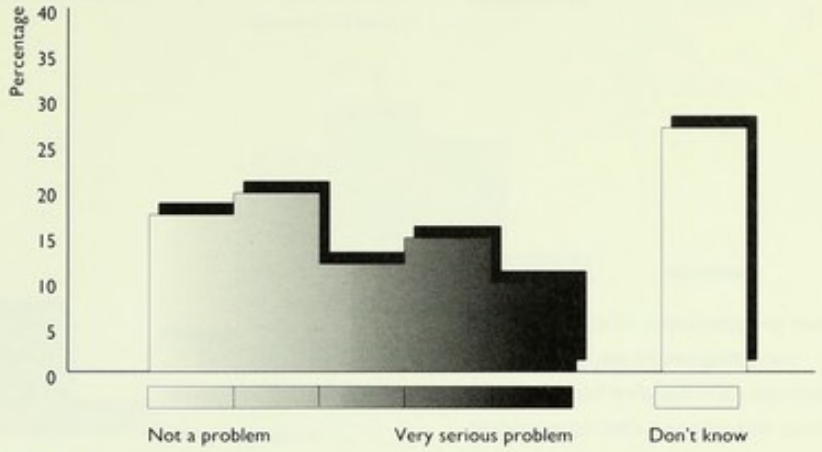
The provision of training for clinical researchers



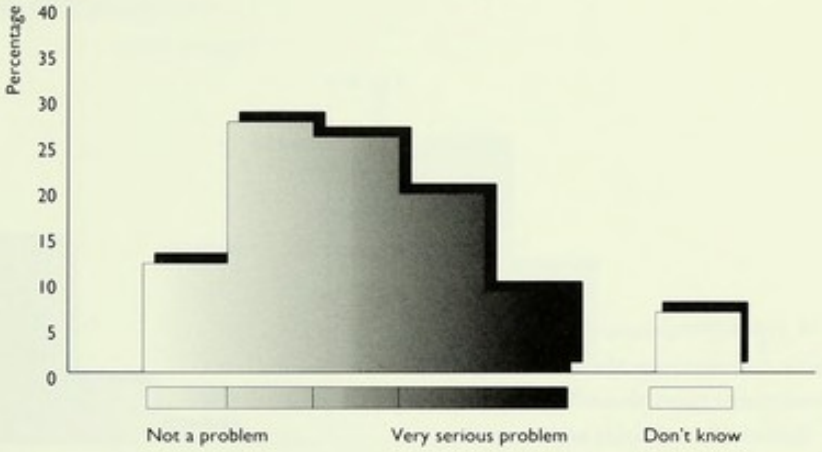
The salary disparity between clinical and non-clinical staff



Competition between research and private practice



Competition for researchers with other fields, for example cancer



Although the salary disparity between clinical and non-clinical staff was scored more as a problem by the non-clinical respondents, more than half of the clinically qualified respondents also identified it as a problem.

3.7 Exploiting the results of cardiovascular research

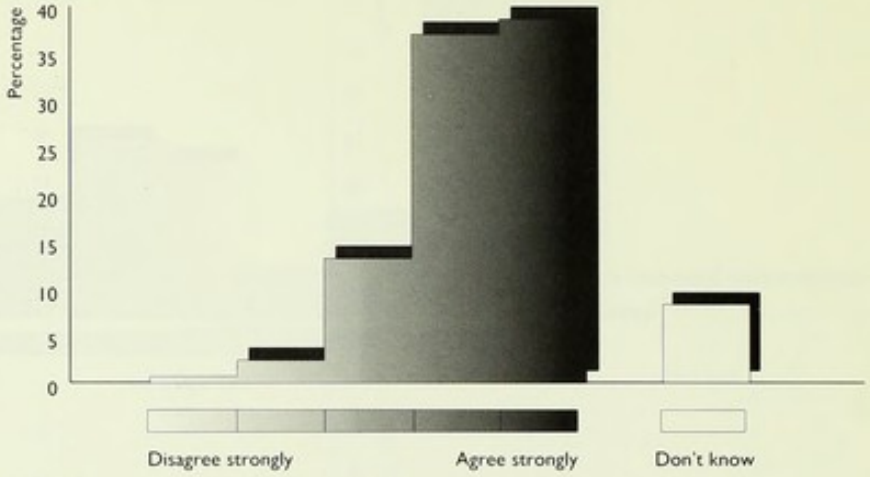
There was particularly strong support for clear programmes to evaluate new diagnostic and treatment technologies before they enter widespread clinical practice (fig.8). Overall more than three quarters of respondents endorsed this concern and subgroup analysis revealed an even higher proportion, 83 per cent, of the clinical cardiologists agreed with this statement.

The only suggestion to solicit a narrowly overall negative response was that of including funds with a research grant for further dissemination of results beyond publication in the professional literature. In contrast a majority of respondents were in favour of the establishment of a national information centre to coordinate and disseminate cardiovascular research results, with particularly strong support among younger researchers. It could be concluded that researchers support further and better dissemination of research results but do not believe it should be up to them to do it.

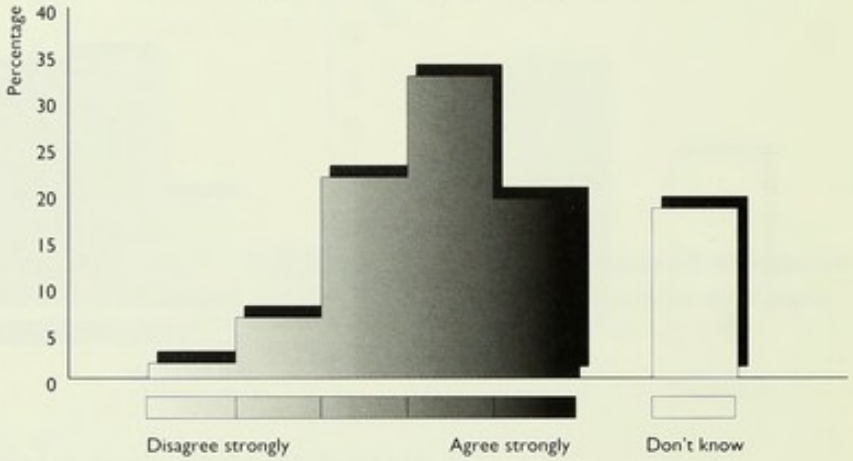
Figure eight

Extent of agreement with statements concerning the evaluation and utilization of research results

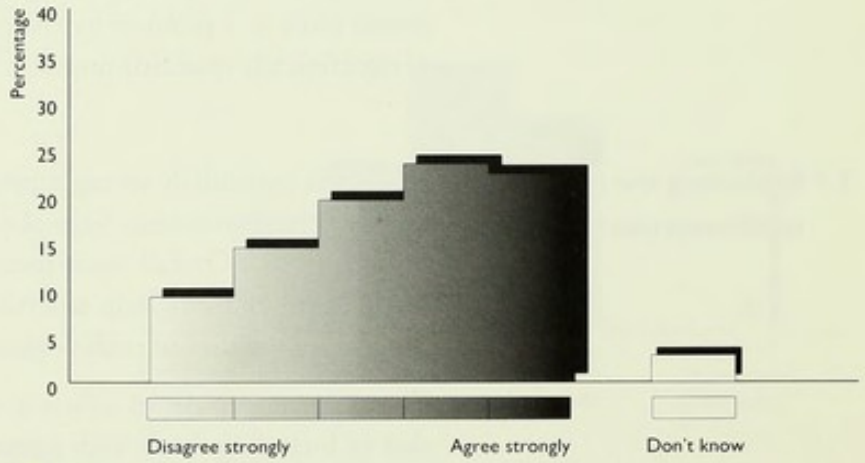
'Clear programmes of evaluation of new diagnostic and treatment technologies are needed before these get into widespread clinical practice'



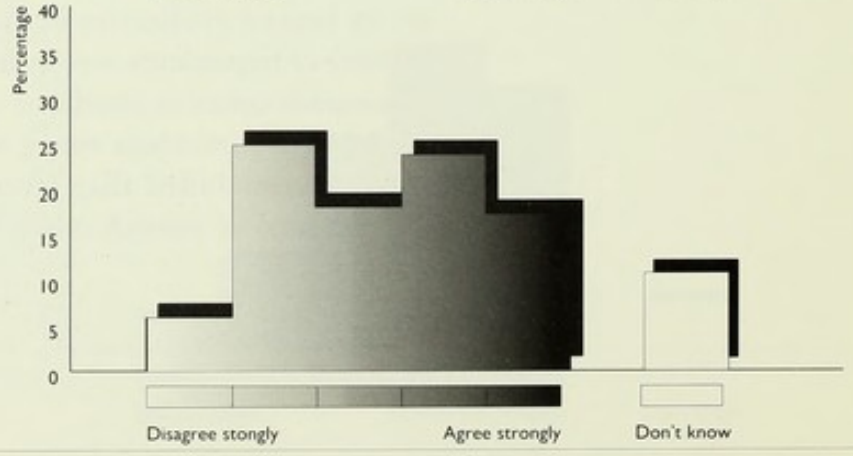
'A greater measure of potential resource consequence than just drug or treatment costs should be made before clinical trials are set up'



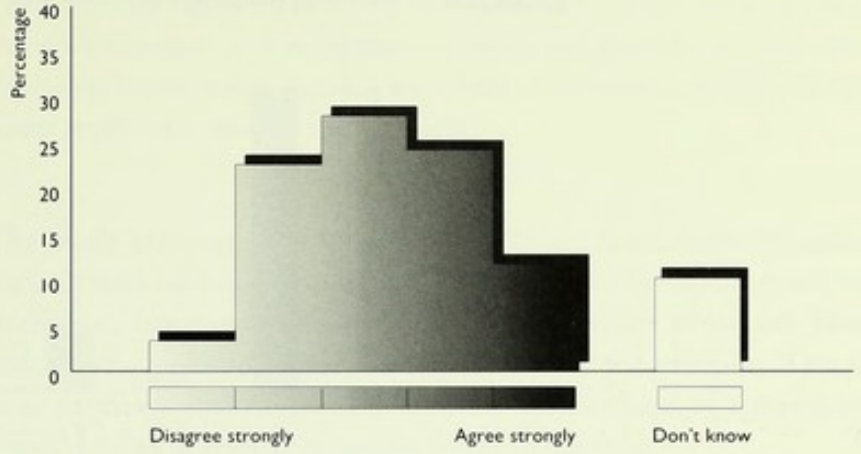
'A national information centre should be established to coordinate and disseminate cardiovascular research results'



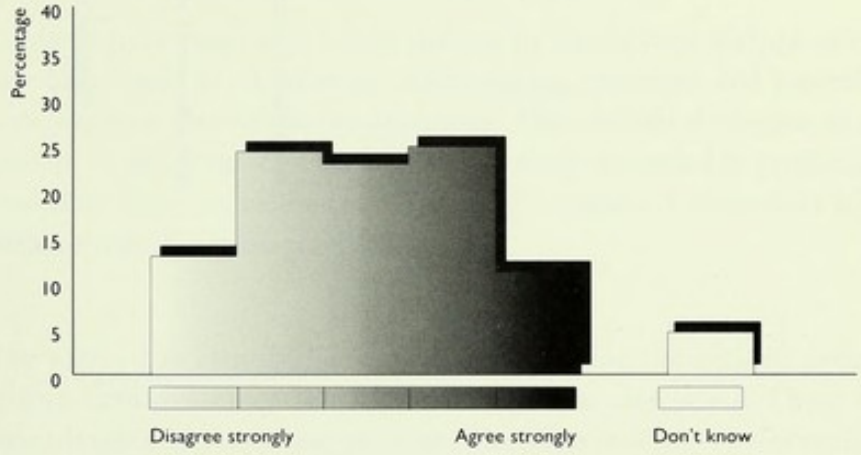
'In cardiovascular research there has been much naive application of basic science that has not been properly validated'



'The results of biomedical research are not being applied adequately in clinical practice'



'Additional funds for dissemination of results beyond publication in the professional journals should be included in a grant'



Responses to the open question on how UK cardiovascular research could be improved also featured many suggestions for improved evaluation, dissemination and information. The following comments illustrate the suggestions received:

'Set up a cardiovascular research group to take a pro-active role in disseminating new information and techniques and encouraging collaboration between existing groups.'

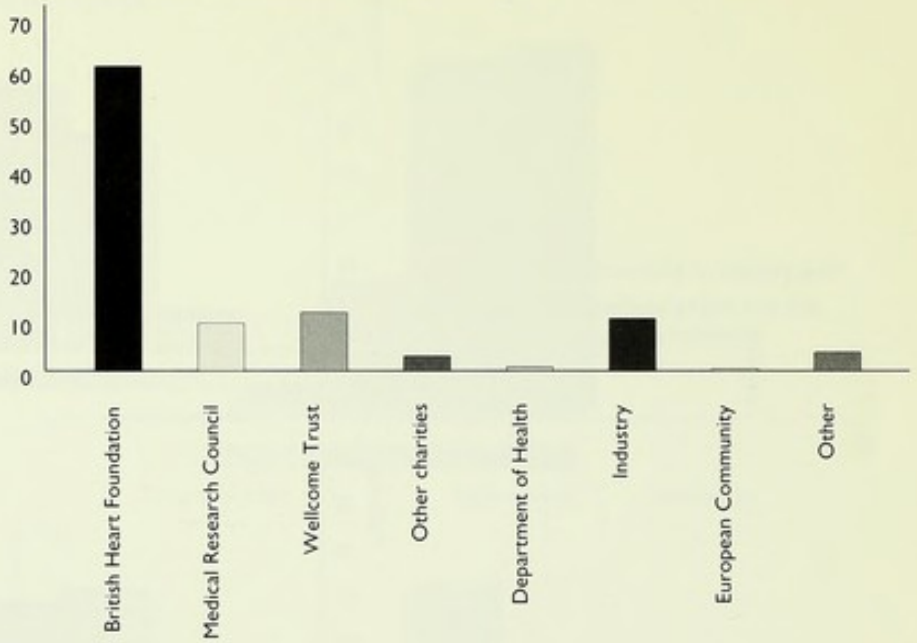
'Encourage and develop links with European centres - a coordinated database of current research and interests in European centres would be valuable.'

Other proposals for fostering collaboration and better dissemination of research included meetings programmes, symposia and workshops which focused on a topic and brought together researchers from many disciplines. This was seen as being particularly useful by young investigators.

3.8 Funding choices

The first choice of respondents for research funds is shown below (fig.9). The British Heart Foundation was the first source of funds for more than 60 per cent of respondents. But the interests of funding bodies were widely perceived to differ and many respondents said their first choice was determined by the nature of the project.

Figure nine **Where do you go as a first choice for research funds?**



The aim of this survey was to test new methods of consultation to support the work of expert review committees and more generally to help inform debate on future policy options for a field of scientific research. The field under study was cardiovascular research.

4.1 Aims and approaches used

The study attempted to identify users of academic/basic biomedical research and take account of their interests. The methods aimed to be systematic, transparent and reproducible in an effort to consult broadly and identify issues to include in a questionnaire for scientists. This two-stage approach was adopted to combine the concerns of research users with the views of researchers on the future of the field.

Cardiovascular research is a field defined by disease area and the science that contributes to advances in understanding, treatment and prevention is drawn from many different disciplines. This presents difficulties in any attempt to poll scientific expertise but the study succeeded in producing a workable, objective method for obtaining a sample of researchers active within a multidisciplinary field.

4.2 Key findings

Areas of scientific promise and disease interventions

The survey has identified scientific areas showing the greatest promise within cardiovascular research over the next five years. There was considerable expectation amongst the respondents of unravelling molecular and cellular details of the vascular endothelium, and critical processes associated with atherogenesis.

The strategic potential of such advances, particularly in the development of new drugs, was also shown in the survey, with more than 40 per cent of respondents scoring prospects as good for the development of new drugs to treat coronary heart disease. Such potential developments may also tie in with the expected improvements in individual screening for cardiovascular disease risks. For example, molecular genetic analysis of risk factors is already suggesting potentially new uses for established drugs, such as the angiotensin-converting enzyme (ACE) inhibitors [5,6].

In contrast, the pessimistic views of respondents on prospects for developing public health and dietary measures to reduce the risks of cardiovascular disease may have reflected the widely held view, among the pre-survey group and others [7], of a need for better public uptake of current advice on issues such as smoking and diet. Social and ethical factors, also raised in the pre-survey interviews, may have influenced pessimism over the development of artificial hearts and heart-assist devices recorded in the survey.

Skills for the future

The survey has also revealed the skills respondents believe are needed for development of the field. Molecular biology, cell biology and instrumentation development were seen as the areas of greatest current

need. But there were also concerns that a broad base of skills needs to be maintained to exploit developments in molecular biology in the longer term.

Infrastructure for the future

There was strong support for initiatives to develop multidisciplinary collaboration as one of the best ways to strengthen the field. The preference was for smaller, more flexible approaches rather than developing a national institute. There was, however, majority support for a national centre to coordinate and disseminate research information which was a concern of health service managers and planners in the pre-survey interviews.

4.3 The consultation process

Its potential

The survey has shown that it is possible to identify a number of key concerns within a research community about the future through structured consultation.

Although opinions were broadly spread on some issues, clear signals were obtained from a large sample of researchers on what they believe is possible in their field scientifically and what is desirable for strengthening it.

The survey also revealed areas of concern shared by practitioners of research and users of the results. For example, the need for better evaluation of new treatments and technologies before widespread introduction into practice, was a concern shared by scientists reponding to the questionnaire, as well as health service managers and planners consulted before the survey.

Its limitations

The methods used, however, have revealed some limitations.

Firstly, it was inappropriate for research users to address questions of scientific opportunity and potential in the same questionnaire as was used for polling the opinions of researchers. The conclusion drawn from this is, at least in foresight surveys of academic science, that users and researchers have to be consulted separately, in a two-stage process.

Secondly, it was not possible to identify research users as systematically as was the case with identifying researchers.

Thirdly, by starting with a disease definition there was likely to be some bias towards the selection of more clinically oriented researchers by concentrating on research publications as the defining tool.

Fourthly, respondents' opinions on potential scientific developments may have differed if the questionnaire had looked at timescales longer than 5 years. For example, as several respondents stated, their views would been different on the potential for gene transfer, developmental issues, immunology and animal-derived transplants if the time horizon considered had been 10 years.

Finally, the potential impact of future advances in other fields of science which do not currently contribute to cardiovascular research was not explicitly considered because of the difficulty of systematically identifying appropriate experts in all potentially relevant fields.

Although it is important to be aware of the limitations of opinion surveys, the techniques of consultation and respondent selection used in this survey are, in principle, transferable to foresight studies in other fields of academic science, where systematic reviews of opinion within research communities are desired.

1 For example, Medical Research Council Scientific Strategy; MRC, London, 1993; Science and Engineering Research Council Coporate Plan; SERC, Swindon, 1993 and Agricultural Food Research Council Corporate Plan, AFRC, Swindon, 1993.

2 Martin, B R and Irvine, J Research Foresight. Pinter, London, 1989.

3 The Future of Cardiovascular Research: Summary of the pre-survey interviews for the PRISM Cardiovascular Research Foresight Exercise. 1992. The Wellcome Trust, London.

4 Rogers, L A and Anderson, J 'New approach to defining a multi-disciplinary field of science: the case of cardiovascular biology', Scientometrics 28, 61–77, 1993.

5 Cambien, F et al 'Deletion polymorphism in the gene for angiotensin-converting enzyme is a potent risk factor for myocardial infarction' Nature 359, 641–644, 1992.

6 Kurtz, T W 'The ACE of hearts' Nature 359, 588–589, 1992.

7 Scott, J MRC Annual Report. pp 32–40, 1992.

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