

Science and innovation: working towards a ten-year investment framework

Set out below is the Academy of Medical Sciences' response to the Treasury/DTI/DfES consultation document: 'Science and innovation: working towards a ten-year investment framework'. This response was prepared on behalf of the Academy by a working group chaired by Academy Vice-President Sir John Skehel, FRS, FMedSci in consultation with the Academy Fellowship. It is endorsed by the Academy's Council and the Council of Heads of Medical Schools.

FOREWORD

The Academy welcomes the initiative to develop a ten-year investment framework for science and innovation in the UK and the opportunity to work in partnership with government and key stakeholders to take it forward.

We welcomed the announcement of the increase in funding for NHS research and development (R&D). We agree wholeheartedly that medical research is a key priority for UK science over the next decade and we look forward to developing a research-rich environment within the UK health services, in combination with support for biomedical research excellence in academia and industry.

In the short time available during this consultation, the Academy has convened a working group, conducted a brief survey of its Fellowship, drawn upon its previous publications and held a 'scoping' meeting in partnership with the Council of Heads of Medical Schools to provide evidence for its response.

EXECUTIVE SUMMARY

Q1: Are these the right areas for the Government and its partners to target over the next ten years? What are the underlying components of success in these areas and what roles do Government and other funders of the science base need to play in achieving these aims?

The Academy broadly supports the proposed aims but wishes to emphasise the international dimension of scientific research. International collaboration from the globalisation of research will present significant opportunities and challenges to science in the UK over the next ten years. Newly emerging economies, such as China and India, whose R&D costs are a fraction of those of the UK, will present fierce competition.

UK SCIENCE: PERFORMANCE AND IMPACT ON INNOVATION

Q2: Which strengths of the UK science base could be further developed; what are the weaker areas that need to be addressed; and what are the risks to the UK's

continued production of internationally competitive levels of research? What criteria should the Government use to help determine its overall commitment to science?

Initially the Academy would like to emphasize that this is an era of great opportunity in basic biomedical research – a traditional area of UK excellence. This must be sustained by a strong and flexible scientific infrastructure. We also recognize the pressing need to support clinical research so that recent advances in basic science can be translated into diagnostics and treatments that will benefit patients. (See the Academy's 'Strengthening Clinical Research' report.)

A policy for strategic funding of research priorities must build on strengths while remedying weaknesses, where these are of importance to the UK.

Research across the continuum, from basic to clinical, in the major health areas, such as the seven important causes of morbidity and mortality identified in the 'Strengthening Clinical Research' report, present significant chances. Specifically several areas of research have emerged from recent deliberations as immediate opportunities:

- *Neuroscience: as the UK population ages the incidence of neurological diseases such as Alzheimer's, stroke and Parkinson's is likely to increase. (See the Academy's 'Restoring Neurological Function' report.) A case can also be made for increasing investment in research into human behaviour, for example addiction. The social costs of addiction are high, yet there is very little UK research funding, by contrast with the USA. (See the Academy's 'Calling Time' report.)*
- *Infectious disease: emerging and re-emerging infectious diseases present significant threats to the future health of the UK population. (See the Academy's 'Academic Bacteriology in the 21st century' and 'SARS' reports.)*

These areas are illustrative examples but the Academy would not recommend compiling a comprehensive list. We welcome the Government's desire to develop a longer-term perspective on R&D priorities but warn against being too prescriptive. Long-term socio-political trends such as the aging population, environmental change or the diseases of affluence might be identified as foci for research and the Academy advocates continuing discussion of research priorities - bringing stakeholders together to look at the process by which resources are invested in research. This has already been attempted in the Foresight process and we remain enthusiastic about the value of sharing perspectives on priorities across the research, user and policy-making communities.

The main criterion for research funding is the pursuit of excellence. In benchmarking investment the UK should continue to be overall at least equivalent to its global competitors. But scientific performance is not only about research funding. It is also about the research environment. R&D is highly dependent on trained people and therefore one important criteria for overall commitment should be the ability to attract people to research careers. Important aspects of this are issues of research training, careers and education: these are covered in detail in the Academy responses to questions ten and 11. In addition, support for research must be achieved through flexible regulation and other framework measures. Without an appropriate regulatory environment funding cannot be used effectively.

It is important to appreciate that research can be adversely affected by legislation specifically designed to regulate it, or as an unintended consequence of other

legislation (e.g.: the Human Tissue Bill or Data Protection Act). The Government should scrutinize and manage regulation at both UK and EU levels and work in consultation with stakeholders in order to ensure clarification and minimization of any impact on research.

Q3: In which key technology-based sectors does the UK have the potential to maintain and grow internationally competitive value added over the coming decade? What are the barriers to capitalising on our strengths and addressing areas of relative weakness in business innovation and R&D? How can investment in the UK science base and Government support for business R&D best contribute to that growth?

The Academy wishes to emphasize that the key technology-based sectors in the UK are not homogenous. Aerospace is different from computing which is different from pharmaceuticals. The Academy is well placed to comment about the pharmaceuticals and biotechnology industries, and our response focuses on these sectors.

The Academy recognizes that business R&D is crucial to the UK technology sector in order to maintain and foster internationally competitive added value, as well as to fulfil the Academy's mission of translating advances in medical science into benefits for patients. In spring 2003, the Academy launched its Forum, a body designed to promote and increase the interaction of academic and industrial biomedical scientists and other groups committed to improvements in healthcare through research. The Forum is an active network comprising a diverse array of constituents that adds strategic value by building on what is distinctive about the Academy: its impartiality, focus on research excellence and interdisciplinary nature. Originally the Forum was nucleated by the pharmaceutical and biotechnology industries but there are plans to expand the initiative to encompass medical devices and other healthcare sectors. Further details of specific Forum activities and how they relate to the Government's ten-year plan to invest in science and innovation are discussed in the Academy's responses to questions 11 and 13.

The success of the Forum and other initiatives demonstrates the importance of facilitating the interaction and communication between industry, academia and others. In addition, it shows the catalytic role organizations such as the Academy can play in capitalizing on the strengths and addressing the areas of weakness in UK innovation and R&D. The Academy aspires to a growing role in these respects over the next decade.

The Academy also welcomes the recent efforts by others to address issues for UK health and wealth creation. For example, the 'Bioscience 2015' report by the Biosciences Innovation Growth Team (BIGT) addressed issues across a broad front, that were important to key technology-based sectors in the UK.

Q4: In order to inform decisions on the future investment framework, and building on the Research Councils' extensive consultations with stakeholders, in what areas are there opportunities for the UK research base to excel and contribute to the economy and society, which might form the basis of future strategic research programmes over the next ten years?

Currently, the Academy is focusing on the strategic importance of clinical trials and experimental medicine as discussed in our response to question 15. We reiterate our previous point that in order to develop research opportunities more broadly the process underpinning research needs to be well resourced and subject to continuing evaluation. In addition, we emphasize the importance of maintaining interdisciplinary

interactions across the Research Councils and elsewhere. Many of the issues discussed in question four are also addressed in the Academy's responses to questions one to three.

MANAGEMENT OF THE SCIENCE BASE

Q5: In the light of the changes to be made to the next RAE, how can funding mechanisms build on existing resources and research assessment reforms to reward excellence and underpin sustainability?

The Academy has previously commented on the planned shape of the next Research Assessment Exercise (RAE). For the future, we recommend that radical alternatives be entertained. For example, it would be helpful to know if a similar result could be achieved with metrics alone. If performance indicators were to be employed, should grant income be the only metric?

To begin to address these issues the Academy proposes a rigorous, quantitative and independent exercise using both retrospective and prospective data to identify, by multivariate analysis, what combination of indicator metrics most closely matches RAE peer-review conclusions. The results from this modelling could serve as the evidence-base for future decisions on alternative systems. However, it is also important to consider the outcomes and impact of research in the longer term to augment the measurement of immediate research outputs. Much needs to be done to develop indicators of research outcomes across different fields of research and demonstrate the degree of 'payback' to research funders. Accordingly, the Academy is now considering how best to work with other biomedical research stakeholders to progress coherent approaches to evaluating and communicating research outcomes and impact.

The Academy also wishes to emphasize that it does not advocate homogeneity across the higher education sector. Research is not the only output that can measure the success of an institution.

Q6: What are the main barriers or challenges to the achievement of a sustainable public research base in the medium term? What further action could the Government take, in partnership with universities and other funders of research, to create robust incentives on all parties to work together to deliver greater financial sustainability of the UK's research base?

In the Academy's 'Strengthening Clinical Research' report we describes how partnership between universities, government and other research funders can ensure a sustainable public research-base in the medium-term. The Academy welcomes government initiatives for disease-specific clinical research networks. Through participation in the Department of Health's 'Research for Patient Benefits' working party and subsequent reports such as 'Restoring Neurological Function', which exemplify the principle of disease specific clinical research networks, the Academy continues to pursue the goal of partnership in research.

We note also that an important recent development in this area is the establishment of the Wellcome Trust Millennium Clinical Research Centres. The Academy supports this initiative and its progressive expansion, and agrees that increased communication and collaboration between the multi-skilled Centres will maximize their impact.

The specific role of charities as research funders is discussed in more detail in the Academy's response to question 14.

Q7: How could funding for universities provided by Government and other funders create stronger incentives for the effective creation management and usage of the research base infrastructure over the next decade?

The Academy warmly acknowledges that Government action to reverse long-standing deficits in research infrastructure through JIF and SRIF initiatives has helped significantly. It is important to continue government support for research infrastructure and to ensure funding is also available for smaller items of equipment. In addition, there is now a need to address infrastructure running costs and we ask that Government recognizes this as a priority.

Q8: What is the optimal means of developing access to large research facilities at national and international level? How should funding of large facilities be prioritised?

Access should be subject to review by a committee representative of the scientific community. Prioritisation of funding should come after genuine consultation.

KNOWLEDGE TRANSFER AND THE LAMBERT REVIEW

Q9: The Lambert Review was based on extensive consultation during 2003. Reactions to the analysis and proposals set out by the Lambert review, and in particular to the Government's proposed response, are very welcome.

The Academy recognises the importance of the issues raised in the Lambert review regarding the cultural differences across academic and industry sectors. Medical researchers often experience career structure difficulties when returning to the NHS after working in industry or the medical charities. With regard to the clinical research domain we recommend the promotion of mobility and understanding across universities and companies, for example, by extending training schemes analogous to the biomedical Cooperative Awards in Science and Engineering (CASE) for PhD students to post-docs at fellowship level.

Universities that conduct medical research must also have in place effective means for knowledge transfer. The Scottish proof-of-concept grants and Intermediary Technology Institutes provide good examples.

EDUCATION, SKILLS AND PUBLIC ENGAGEMENT WITH SCIENCE

Q10: Following the 2002 review by Sir Gareth Roberts of the supply of scientists and engineers and the Government's response, what is the emerging evidence on the prospects for the supply and demand of science, technology, engineering and mathematics skills? What further steps could the Government take to ensure that the supply of these skills is responsive to the demands of the economy over the coming decade? How could women and other low participatory groups be more encouraged to pursue higher education in science, technology, engineering and mathematics and to pursue careers in these areas?

The Academy agrees that there is a broad range of issues across education, from primary to higher, to be addressed and that the teaching of science in schools is of particular importance. For the purposes of this consultation the Academy focuses on higher education and, in particular, on the training of clinician and non-clinical

scientists, areas of recruitment in which the Academy has much experience.

Government recognition of clinical research as a key priority, along with subsequent funding increases, highlights the critical role clinician scientists have in the future of UK science. The Academy has previously recommended a range of actions to ensure the appropriate supply and career development of a cohort of clinician scientists. (See the Academy's 'Tenure-Track Clinician Scientist', 'Implementing the Clinician Scientist Scheme', 'Clinical Academic Medicine in Jeopardy' and 'Strengthening Clinical Research' reports.) These recommendations include:

- funding additional clinician scientist posts;*
- clinician scientists should have protected research time;*
- clinical researchers employed at universities should have their work adequately recognised by research assessment systems.*

The Academy is also concerned about non-clinical scientists on short-term contracts in medical research, highlighted in the 2002 Academy report 'Non-clinical Scientists on Short Term Contracts'. Key issues include: job insecurity, lack of adequate career structures, advice, recognition and status. Academy recommendations have covered: employment codes; recurring contracts; the right to apply for grants in researcher's own names; employer recognition and training; and responsiveness by contractors to improved terms and conditions.

More recently, Academy Fellows have noted a decline in the number of undergraduate students going on to do PhD's. One reason for this might be the burden of student debt making modestly paid jobs in academia unviable. Increases in science funding and postgraduate salaries could alleviate this problem.

The Academy stresses that interdisciplinarity should pervade biomedical research, training and education across the continuum from basic through to health services research. Team-work is also of paramount importance as no individual can possess every skill.

Q11: Do UK business leaders and managers have the necessary skills and knowledge to exploit new technology and research to maximum effect? Where are the areas of greatest weakness and opportunity in terms of sector size of enterprise and level of management? What can and should be done to bridge the gap?

The Academy would like to reiterate the point that it is important not to generalize across UK business. Once again the Academy focuses on the pharmaceutical and biotechnology sectors with which it is most familiar.

Leadership and management is not just about skills and training. UK business leaders and managers, as well as medical scientists, would also benefit from increasingly close contact between academe and industry. The Academy's Forum provides just such an opportunity where knowledge, perspectives and experience can be exchanged. See question three for further details.

Q12: What should the role of Government be in improving the interaction between science and society? Are there areas where Government could improve the promotion of science in society? How can we improve public confidence in the Government's use of science? What should we be aiming to achieve in this area in the next ten years?

We welcome the increasing commitment of government and parliament to science through the appointment of chief scientists in every government department and the continuing visibility of the Science and Technology Select Committees.

A crucial component in the success of scientific research is public confidence. The House of Lords Science and Technology Committee 2000 enquiry into Science and Society identified a crisis in public trust. Public values and attitudes must be heeded and dialogue should replace the 'public understanding' emphasis.

Many of the public are often unfamiliar with how scientific research leads to innovation. Trust is therefore essential between the researcher and public. Public engagement is thus requisite not only to restore confidence in research but also to build support for research funding, increase participation in the research process, reinforce the importance of basic research in understanding the causes of disease, promote innovation and generate commitment to new research opportunities. There should also be greater emphasis by researchers and government on the uncertainties inherent in scientific enquiry.

One successful example of scientific public engagement in the UK is stem cell research, where users and society generated informed debate with a realistic understanding of a high-risk business to ensure this research could be supported. Another success story was the Human Fertilisation and Embryology Authority that built confidence and trust in the regulation of a controversial area.

In contrast, lack of engagement and transparency during the preparation of the Human Tissue Bill has imperilled crucial biomedical research. (See the Academy Statement on the Human Tissue Bill and Supplemental Paper.)

A particular issue in UK biomedical science is animal research and the Academy welcomes continued government support for this area.

PARTNERSHIP FUNDING

Q13: What is the outlook for business investment in R&D over the next decade? How can business investment contribute to the success of a ten-year framework for science and innovation?

As previously discussed, the Academy wishes to emphasise the heterogeneous nature of UK commercial science and focuses its attention on the pharmaceutical and biotechnology sectors when responding.

When working with academia, industry makes a distinction between funding of contract research, where full economic costs are paid as overheads, and collaborative research, where sharing of intellectual contributions merit more equitable distribution of costs. Government needs to understand this plurality of objectives and funding needs when developing its strategy for external funding of university research, see question 14.

Companies have welcomed recent initiatives concerning R&D tax credits. The Academy believes it is important to collect evidence to measure the impact of these policy initiatives and to ensure the definition of R&D covers all companies, for example in relation to SMART or other government funded awards for small and medium sized enterprises (SMEs) and their impact on the ability to obtain tax credits.

Q14: What are the research aspirations and funding plans of the medical charities over the coming next decade? How best can Government and charity funders work together to enhance the impact of their complementary research efforts on national and global health outcomes and contribute to the development and maintenance of a sustainable UK science base?

The Academy has previously responded in detail to the Higher Education Funding Council for England (HEFCE) Review of Research Funding consultation, to express its considerable concern that higher education institutions have to provide full economic cost recovery for charity-funded research. We consider that it is still necessary for Government to entertain alternative options so as to strengthen the partnership between charities and Higher Education and there should be commitment to clarify issues through the Funders Forum. We are particularly concerned that the proposed removal of charities from the QR funding formula would eliminate the support from public funds for charity commissioned research. We also feel that the removal of numbers of research assistants from the QR funding formula would mean that larger teams of researchers that are often required for current research would be financially disadvantaged.

Q15: Are there ways in which Government support for medical research – in terms of both institutions and the distribution of funding - could be better structured in order to maximise the benefits of investment from partners in industry and the medical charities? What should Government and the NHS be doing over the ten years of the science and innovation framework to ensure successful partnership working in medical science in the long term?

The Academy identified a number of weaknesses in UK medical research in its 'Strengthening Clinical Research' report. These include:

- *lack of appropriate facilities and infrastructure;*
- *lack of appropriately trained clinical scientists and career structure to support them;*
- *inadequate funding support for experimental medicine and all types of clinical trials;*
- *a failure to utilize the opportunity provided by a National Health Service to generate high quality clinical data for such studies;*
- *the increasingly complex and bureaucratic legal and ethical frameworks in the UK and EU.*

To address these weaknesses, as described in our answers to previous questions, the Academy recommends the creation of a National Network for Clinical Research, new OST funding via the MRC for clinical research, improved career structures and incentives for those undertaking clinical research, an improved regulatory environment and increased NHS funding for R&D. Of course, we also need to ensure the effective investment of extra funds where there is a case to be made for external audit and overview.

The Academy welcomed both the formation of the 'Research for Patient Benefits' working party and the increased funding for clinical research that characterised the initial government response to the Academy report. However, there remains much to do and the Academy stands ready to work in partnership with Government and other key stakeholders to achieve these goals. A recent Wellcome Trust report on Public Health Science raised concerns that the organisation and ethos of some NHS Trusts have made it difficult for clinical scientists to develop research-driven clinics designed

to improve methods of treatment and patterns of patient care. Many Trusts provide disincentives for clinicians to participate in research with rigid clinical training programmes. Reorganisation in the Department of Health may endanger long-term strategic funding. It is critically important that the focus on funding clinical trials is accompanied by increased resources for experimental medicine, as recommended previously by the Academy.

Most 'clinical research' in the NHS is undertaken by University clinical academic researchers who also provide leadership within the NHS. The relationship between Universities and the NHS is crucial to the successful exploitation of medical research, yet current arrangements serve to restrict partnership and diminish the medical research capacity of the UK. For example, the NHS and universities may compete for commercial research funding and clinical academics may be prevented from undertaking research because of inappropriate clinical service commitments.

In light of this the Academy wishes to emphasize the pivotal role of Medical Schools, who have the potential to make arrangements that could bridge the gap between higher education institutions and the NHS. In Scotland for example, all Universities with Medical Schools must have a Memorandum of Understanding regarding their relationship with the NHS. In Glasgow specifically there is a Joint Liaison Board with sub-groups dealing with issues like workforce planning, estates and finances.

Q16: In light of the second Wanless Report, where are the weaknesses in public health research capacity? How can we improve the links between academics and deliverers of public health, to ensure a strong evidence base both on causality and on effective, well-targeted interventions? How should the roles of the various research bodies be better coordinated in relation to public health, to ensure the public health research requirements are met in a structured and coherent way?

The Academy will respond to the Wanless Report via the Department of Health's 'Choosing Health?' consultation and will provide a copy of that response to the Treasury/DTI/DfES upon completion. We will identify key issues for primary care and epidemiology research relating to research structures, current constraints on research and issues for data handling. In addition we will address issues such as the relevant RAE biases, evaluation of community-based interventions and the determination of disease causality so as to allow implementation of appropriate public health interventions.

SCIENCE AND RESEARCH ACROSS GOVERNMENT

Q17: What are the public service objectives and priorities for science and research over the next decade to contribute to policy development service delivery and the wider economy? How can the wealth creation potential of investments in R&D across different Government programmes be increased?

Q18: How can Government best secure greater synergies between research funding, investment and strategies across different public programmes, and link the Government's overall objectives for research outputs with the capabilities in the UK science base?

To address questions 17 and 18 better review procedures and measures of research output and impact are required, see the Academy's response to question five.

The Academy welcomes the commitment to increasing collaboration across government for the health and wealth of the nation, exemplified by the convening of

the 'Research for Patient Benefits' working party and this consultation.

As well as supporting research and innovation directly through funding and creating a suitable research environment, government can stimulate innovation through the goods and services it procures. For example, the Department of Health could more rapidly deploy new medicines with proven efficacy across the NHS, thus rewarding innovation.

We believe that the scientific community would benefit from a better understanding of how government uses research and handles advice from expert groups. There is also renewed opportunity to ensure coordination across government in terms of scientific research and innovation through the leadership role of the re-formed Council for Science and Technology.

Q19: How can the Government and the Regional Development Agencies and their equivalents in the Devolved Administrations help integrate funding of science research on a predominantly national basis with development and delivery of regional economic strategies? In particular how can Government and RDAs strengthen partnership working to facilitate more effective knowledge transfer and research collaboration?

The Academy welcomes discussion at the local level but recommends that there must be coherence across the various local science and innovation strategies to fulfil national priorities. The need to treat patients and train doctors across all regions requires clinical research to be supported in a broad manner.

The Academy has geographical strength across the UK and would welcome further involvement in strategy development across the devolved administrations and in the regions. We look forward to the Government response to the House of Lords Science and Technology Select Committee report on 'Science and the RDAs'.

Q20: Are there barriers facing business and the science base in effective engagement with EU research programmes? How can the UK more effectively influence and benefit from EU research funding and policies? In what ways can action at Community level add value to UK science and innovation policies? How can national and community funding complement each other more effectively?

At the EU level, as at the UK level, there is the same need for coherence in research funding and other policies to underpin a flexible and supportive environment for research and innovation. Weaknesses at the EU level have been much discussed; in terms of improving the EU R&D funding mechanisms, there is particular need in the UK:

- for the biomedical research community to play a stronger strategic role in participating in Framework Programme 6 so as to position the UK as partner of choice in key areas and to steer developments in standards, research tools, services, technology platforms and policy;*
- to continue to explain to the Commission the importance of simplifying procedures for the funding and management of projects and to facilitate company participation irrespective of size (rather than assuming that SMEs are the only source of innovation);*
- share our view that there is value in simplified schemes for supporting students and fellows across Europe;*

- *to be more proactive in sharing information on critical success factors for UK (industry and academia) participation and to provide advance information and support on funding opportunities and consortium development;*
- *to conduct open consultation on issues (process and content) for Framework Programme 7 and the European Research Council across all of the research community and to develop proposals for change based on evidence, particularly in the level of bureaucracy.*

Some of these points have been discussed extensively elsewhere (e.g. House of Commons Science & Technology Committee Report 2003). What is now needed is for UK Government to identify its priorities for the Presidency in 2005 so as to take leadership in driving a more strategic, coordinated approach to EU research and innovation.

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The Academy of Medical Sciences
10 Carlton House Terrace
London SW1Y 5AH

Tel.: ++44 (0) 20 7969 5288
Fax.: ++44 (0) 20 7969 5298

E-mail: apollo@acmedsci.ac.uk
Web: www.acmedsci.ac.uk

Registered charity no.: 1070618
Registered company no.: 3520281

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WORKING GROUP MEMBERSHIP

Sir John Skehel, FRS, FMedSci (Chair)
Academy of Medical Sciences

Professor Guy Dodson, FRS, FMedSci
MRC National Institute for Medical Research

Dr Barry Furr, FMedSci
AstraZeneca

Professor Peter Goodfellow, FRS, FMedSci
GlaxoSmithKline

Dr Melanie Lee, FMedSci
Celltech

Professor Stephen Smith, FMedSci
University of Glasgow

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