Department of Health

Our inheritance, our future

Realising the potential of genetics in the NHS

Progress Review

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Our inheritance, our future

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Progress Review

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Ministerial foreword

When we published the 2003 genetics White Paper *Our Inheritance, Our Future*, with the ultimate aim of making full use of genetics knowledge in healthcare, we recognised that we were proposing a long-term programme of change and that it would be necessary to review progress in due course. I am delighted to present this review of the progress that has been made.

The Government has invested £70 million since 2001 in our programme, which is committed to helping the NHS to make best use of advances in genetics knowledge. This funding has provided increased capacity for NHS genetic testing laboratories and more genetics laboratory scientists and counsellors. It is supporting efforts to bring a better understanding of genetics and how it can impact on health to all healthcare staff.

Much of the new genetics knowledge has come from the parallel investment made by the Government in basic and applied research. The UK is one of the pioneers of genetics research, taking a lead role in the Human Genome Project and its application to medicine. The Government remains committed to genetics research and announced last year increased biomedical science funding of up to £1.7 billion and a new strategy for promoting health research *Best Research for Best Health*.

We've been encouraged by real improvements in the way genetics services are being used to help patients. We have also learned that there is much more to be done, as the accelerating pace of genetics knowledge increases our understanding of the causes of some diseases and our awareness of innovative therapies that can be applied.

I would like to thank personally the many dedicated NHS staff involved in bringing new genetics services to patients.

Of course, there are still challenges to understanding and applying genetics knowledge of disease throughout healthcare. The Department of Health is committed to bringing new genetics advances to bear wherever they can be used to benefit patients. We have already announced long-term funding for four major initiatives to support genetics in the wider NHS. Working within the new arrangements for patient-centred provision of effective healthcare, we will continue to work closely with our stakeholders and partners to achieve this aim.

Rt Hon Dawn Primarolo MP
Minister of State for Public Health
Department of Health

Foreword

This report summarises the review of the genetics White Paper *Our Inheritance, Our Future: Realising the potential of genetics in the NHS*, which was published in June 2003.

In order to present as full and objective a picture as possible, we asked a wide range of organisations and individuals to give their views on the impact of the work that has been done so far, together with the challenges that await us. We wanted to learn more from researchers about the state of genetics science now, its potential within healthcare, and what future priorities might be – both for government and within other sectors.

We are extremely grateful to everyone who responded to our questions, providing illuminating and valuable contributions. A full list of the respondents is provided in Annex B, but I should like to acknowledge particularly the tremendous input that has been provided by the NHS genetics service and by those who serve on the various committees, networks and groups that are shaping our programme of activities.

This review has allowed us to reflect on the considerable amount we have accomplished together. We have already reshaped and renewed some of the earlier initiatives. We will continue to work with the NHS, researchers and other stakeholders and build on the progress we have achieved so far to bring the benefits of genetics advances within the reach of every patient.

Professor David R Harper CBE
Chief Scientist and Director General for Health Improvement and Protection
Department of Health

Section one:

Realising the White Paper's commitments

Introduction

What is the purpose of the Progress Review?

The White Paper *Our Inheritance, Our Future: Realising the potential of genetics in the NHS* set out a strategy for preparing the NHS to take advantage of the application of new genetics knowledge in order to benefit patients. It set out a forward-looking and innovative plan to prepare the NHS for the future in a £50 million investment programme to develop genetics knowledge, skills and service provision within the NHS.

When the White Paper was published in June 2003, it was agreed that progress in meeting its commitments would be reviewed after three years.

Why was the White Paper commissioned?

The challenges faced in absorbing new evidence into clinical practice are not unique to genetics. However, the rapid increase in new knowledge generated by the Human Genome Project will enable us to apply genetics advances to healthcare more successfully than ever before.

The White Paper identified where extra investment and support were needed for the NHS, so that in future all opportunities to apply genetics advances beneficially to patient care can be recognised and acted on appropriately.

What are the aims of the White Paper?

The White Paper built on the announcement in April 2001 of a £30 million investment to develop specialist genetics services. It also:

- extended the scope of investment in genetics services and research and development
- recognised that, over time, the impact of genetics would be felt across the whole NHS, and identified a clear need to develop capability to harness this potential
- recognised the importance of involving the public in the continuing debate about the role of genetics developments in healthcare
- included measures to protect the public and ensure continuing public confidence in this rapidly evolving area.

How has this review been carried out?

This report summarises the progress that has been made since 2003 in delivering the White Paper's commitments. It also reflects the views of key stakeholders on what has been achieved and what future priorities, opportunities and challenges they anticipate.

You can find a list of the questions asked and a list of the organisations and individuals who responded in Annex A and Annex B respectively.

This report also reflects the findings from separate reviews of organisations that were set up to support the aims of the genetics White Paper, including:

- Genetics Knowledge Parks
- the National Genetics Education and Development Centre (NGEDC)
- National Genetics Reference Laboratories (NGRLs)
- the UK Genetic Testing Network (UKGTN).

We also took into account the views expressed by the NGEDC in a recently published paper,[1] together with the interim report of the evaluation team at Nottingham University.[2]

This report does not attempt to set out the detail of every initiative, but is intended to draw out key outcomes, objectives and overarching messages, illustrating these with case studies and relevant stakeholder comments.

You can find further information on many of the initiatives discussed in this report and a more comprehensive record of comments received on our website at: www.dh.gov.uk/genetics

"If the NHS is truly to be a world leader in genetics, then long-term investment and commitment are required." Wales Gene Park

1 Bennett C, Burton H and Farndon P (2007) Competences, education and support for new roles in cancer genetics: Outcomes from the Macmillan Pilot Projects. *Familial Cancer* **6**(2): 171–80

2 Currie G, Finn R and Martin G (2007) Spanning boundaries in pursuit of effective knowledge sharing within networks in the NHS. *Journal of Health Organization and Management* **21**(4–5): 406–17 (special issue on power and politics edited by Professor Louise Fitzgerald)

Strengthening specialised services: increasing capacity

Developments in genetics knowledge over the past 10 to 15 years have offered new opportunities to diagnose and predict disease. As a result, demand for specialist genetics services has significantly increased. In 2001, it was already clear that the NHS was unable to keep pace with this increase, and that the gap between demand and delivery would grow without targeted investment.

More tests, quicker results

To help meet patient demand for more extensive genetics services, the Department of Health has invested an additional £18 million since 2003 to expand laboratory services for genetic testing. This has funded new technology, including high throughput capacity and robotics. This has in turn presented new opportunities for collaboration between laboratories to provide services in a more streamlined and rational way. This new laboratory capacity is now fully operational.

Linked to this investment, the White Paper set out challenging standards for reporting of genetic test results:

- within three days where the result is needed urgently (for example, in prenatal diagnosis)
- within two weeks where the potential genetic mutation is already known (for example, because another family member has already been tested)
- within eight weeks for unknown mutations in a large gene.

These standards represented our best estimate at that time of what the new technology could deliver. A 2007 survey of NHS molecular laboratories by the UKGTN has shown that 62% of molecular genetics test results are now being reported to the standards recommended in the genetics White Paper.

We now have growing experience of using these systems in the NHS setting, and of how to optimise the use of these facilities to make the best use of available resources while providing high-quality and timely test results for our patients.

This practical experience suggests that it is not always possible to deliver to these standards and still make the most effective use of NHS resources. Services are instead keen to look at how best to deliver the laboratory service to ensure:

- clinically urgent tests are prioritised to support better patient care
- other tests are batched to maximise use of resources while ensuring results are available in time for the patient's next clinic appointment, where the result will be discussed.

This approach is consistent with a move away from centrally dictated targets to local decision making about how best to deliver flexible and responsive services to meet the needs of the local population.

What is clear is that the investment has been vital to laboratories' ability to expand services and improve reporting times. Overall, we know that laboratories are now delivering greater volumes of tests in much shorter timescales.

We will continue to work closely with NHS colleagues, the relevant professional bodies and patient groups to ensure that the right balance is struck between speed of service and cost effectiveness.

Equality in testing, nationwide

Together with faster access to tests, a key priority is ensuring that patients can access the same genetic tests wherever they live in the country. To meet this objective, the UKGTN was established in 2003 to support the NHS network of molecular genetics laboratories and to:

- promote equity of access to tests
- ensure services are of high quality
- evaluate the effectiveness of new genetic tests for NHS service
- influence NHS commissioning mechanisms.

The UKGTN is a collaborative group of NHS laboratories, clinical genetics specialists, patients' representatives and service commissioners. One of its key achievements has been the development of a rigorous evidence-based system for introducing new tests into NHS service that assesses both scientific validity and clinical utility. The UKGTN also maintains a website (www.ukgtn.nhs.uk/gtn/), which holds comprehensive and annually updated information on all molecular genetic tests available through the NHS in the UK, together with details of laboratories in the UK that provide each test.

This service has provided NHS service commissioners with valuable evidence about the clinical usefulness of new tests to help inform decisions about what tests to fund. This work is widely recognised by European colleagues as an important development in support of the rational introduction of genetic tests to benefit patient care. Following a successful mid-term review that confirmed the continuing need for its work, we will be funding the UKGTN through to 2009.

"The UK Genetic Testing Network has provided the vehicle for the rationalisation of genetic testing, strengthening quality assurance, has developed a system to assess the clinical validity of new tests and has provided the means for clinicians to know where and what tests are available. It is the envy of Europe."
Clinical Genetics Society

Case study: Introducing new genetic tests for renal disease

The Department of Health provided funding to Addenbrooke's Hospital in Cambridge to develop a collaborative multi-disciplinary model to integrate nephrological and genetics expertise for renal patients with inherited disorders.

As part of this work, Addenbrooke's developed a number of genetic tests that had not previously been available in the UK. Having successfully demonstrated how the tests could benefit patient care, the project team submitted four of the new tests to the UKGTN, which advises commissioners on the introduction of new genetic tests into NHS service. The UKGTN process requires evidence of:

- use (for example, diagnosis, management, risk assessment)
- clinical validity
- clinical utility
- target population
- referral pathway
- testing criteria.

These tests are now available through the NHS to patients in the UK and are listed in the NHS Directory of Molecular Genetic Testing.

In addition, two National Genetics Reference Laboratories (NGRLs) in Salisbury and Manchester have been funded since 2002. Their role is to:

- monitor the rapidly developing field of genetic testing, evaluate new technologies and develop new testing techniques
- advise other NHS molecular and cytogenetics laboratories, supporting informatics development and quality assurance.

The NGRLs have now been reviewed by an independent panel. The review confirmed the value of their role, and as a result of its recommendations the Department of Health has awarded new contracts that will take the NGRLs through to 2012. Detail of their work programmes is available through the NGRLs' website: www.ngrl.org.uk/Pages/index.htm

Building genetics into mainstream services: boosting capability

The genetics White Paper recognised that over time the relevance of genetics across other medical specialties would become increasingly clear to clinicians and others working outside the genetics specialty. Strengthening specialist services is the first step in ensuring that NHS users can access accurate information and advice about the relevance of genetic testing to a variety of medical conditions.

Specialist genetics services will continue to play a leading role in diffusing new genetics advances across the spectrum of medical care. It will also be essential to encourage the take-up of genetics technology through service development so that other clinical services can explore ways of using genetics knowledge to help patients with inherited conditions and their families. An example might be by linking specialised genetics centres to other clinical services, such as cancer care.

The White Paper identified a need for central support to encourage the development of new patient pathways and types of service in areas of mainstream service planning. This is particularly important where the relevance and future potential of genetics are not yet well understood. Because genetics knowledge and technology are developing very fast, this kind of new service development needs to be underpinned by educational support for healthcare professionals and training to prepare them for new roles.

Pilot projects to develop new services and skills

In order to rationalise care for patients at risk of inherited disease, four pilot programmes have explored the development of patient pathways spanning primary care, secondary specialties and genetics services.

One programme was set up in partnership with Macmillan Cancer Care Support[3] to develop and test new patient pathways designed to give easier access to genetics services for both concerned individuals and healthcare professionals in cancer services. Many people with relatives suffering from cancer, or who have cancer themselves, worry that other family members might be at increased risk of developing cancer. Some types of cancer are inherited, and if the gene or genes that cause this can be identified, this allows people to assess their cancer risk more accurately, take preventative action and, where possible, reassure themselves and their families.

3 Eeles R, Purland G, Maher J and Evans DG (2007) Delivering cancer genetics services – new ways of working. *Familial Cancer* **6**(2): 163–7

The Macmillan partnership pilot demonstrated that non-specialist NHS staff who are appropriately trained and supported can effectively provide people with genetics services such as taking details of family history and assessing their risk of having a cancer-causing gene.

To help bring specialist genetics advice into mainstream NHS services, ten service development pilots have been set up. These give patients who are being treated for genetically based diseases in such specialties as cardiology and ophthalmology, together with their relatives, direct access to genetic testing advice in their specialty outpatient clinic.

In a further pilot project, ten GPs with a special interest (GPwSI) worked locally with primary care teams to raise awareness of genetics services, including new antenatal and newborn screening programmes. Some of these teams are now preparing to provide community-based genetics advice for primary care.

The London IDEAS Knowledge Park led a pilot project to implement and evaluate cascade testing in the families of individuals affected by familial hypercholesterolaemia (FH). FH is an inherited predisposition to have high levels of cholesterol and those affected have a high risk of developing coronary heart disease, often from a young age. The pilot sites were selected to give a geographical spread, to cover multi-ethnic and socioeconomic groupings, and to include large single clinics and consortia of small clinics.

The pilot highlighted the organisational challenges of developing an effective service to identify family members with FH, and it made a number of recommendations for how services should be developed in the future, and on the possible role of DNA testing. The report of the project, *Recommendations to the Department of Health from the Steering Group of the DH FH Cascade Testing Audit Project,* and other details of the project are available at: www.fhcascade.org.uk. A linked research project looking at the utility of DNA testing, in addition to cholesterol levels in the blood stream, for identifying individuals with FH will report later in 2008.

An evaluation of all these pilot activities is being carried out by Nottingham University, which will submit its final report in autumn 2008. Interim results suggest that effective clinical leadership is crucial in setting up these new services, which proved to be a complex and challenging process. This may be because, perhaps for the first time, these service pathways have to span primary, secondary and tertiary care, and involve two or more clinical specialties and laboratories.

In addition, within screening, new initiatives are under way, as follows.

- The criteria for national screening programmes have been expanded to take account of family issues and consent processes when the condition that is being screened is genetically determined.
- As part of the Fetal Anomaly Screening Programme, Down's syndrome screening is offered in almost all maternity units to women of all ages.
- Roll-out of newborn hearing screening is now complete and offered to all babies and 99% of newborn babies are screened.
- Newborn screening for sickle cell is now fully implemented and covers the whole of England and is already identifying approximately 300 babies a year who would be at risk of death unless treated promptly. Antenatal screening for sickle cell and thalassaemia is expected to be rolled out in all trusts by spring 2008.
- Roll-out of newborn cystic fibrosis screening is now complete. A new national programme to screen for medium-chain acyl-CoA dehydrogenase deficiency was announced in February 2007 and is currently now being rolled out.
- The Human Genetics Commission (HGC) and UK National Screening Committee (NSC) were asked to consider the possible implications of genetic profiling of newborn children. Their report *Profiling the newborn: a prospective gene technology?* was published in March 2005. It concluded that genetic profiling of newborns was unlikely to be a practical or acceptable practice for the foreseeable future.

Case study: Teesside Cancer Family History Service (CFHS)

This service was set up in 2004 with funding from the Department of Health's Macmillan Cancer Care Support Familial Cancer Programme. It aimed to provide a more efficient and accurate genetic risk assessment for families affected by cancer within the Cancer Care Alliance network, which covers a population of about one million.

In order to meet the needs of patients more effectively, a new role of genetic risk assessment practitioner (GRAP) was created to work with patients who have a moderate risk of developing cancer. Within the pilot area, patients assessed as high risk were referred to the genetics cancer specialist to discuss the possibility of genetic testing, while patients with a moderate risk were cared for by GRAPs, who organised additional cancer screening and provided extra monitoring and advice on prevention.

In the 30 months of the pilot study, the Cancer Family History Service (CFHS) received over 2,600 referrals, two-thirds from cancer clinics. In most cases, referrals were much more accurate than previously, as the GRAPs worked with an improved risk assessment model and were able to collect more accurate family history information.

A collaborative breast cancer audit showed that, before the new service was introduced, some 30% of women who were undergoing regular extra mammography screening were wrongly thought to be at increased risk. Cancer genetics specialist Dr Paul Brennan, who led the project, said: "We are proud that we have successfully managed change in a large clinical network. We have established a novel, efficient service and can demonstrate its benefit in a number of ways. We have broken the boundaries between primary, secondary and tertiary care."

Case study: Poole Familial Cancer Project

In 2001, Poole Primary Care Trust set up a unique Community Cancer Nursing Service (CCNS) comprising five cancer specialist nurses experienced in working within the community. This team works with 28 GP practices, the hospital cancer services and palliative care teams to provide a comprehensive care service to the people of Poole.

Until now, risk from specific genes was assessed by specialist genetics services. Poole's nearest genetics service is based in Southampton. As more people became aware of the risk of cancer, many who were worried, but not at very high risk, were being referred. GPs did not know how to identify patients at highest risk. In addition, many families struggled to produce accurate cancer history details to help the clinic with risk assessment. These two factors meant that waiting times rose to unacceptable levels.

With funding from the Department of Health/Macmillan Familial Cancer Programme, the Poole CCNS worked with a genetics counsellor from Southampton General Hospital to develop the skills and knowledge required to:

- provide risk assessment in cases referred by GPs
- help patients gather information about family illness history
- explain the risk assessment process.

Patients greatly appreciated this new personal and sympathetic local service. In the first few months, a small number of people were found to be at high risk. However, many more patients found that their risk was no greater than that of the general population. This helped reassure many worried individuals and families and reduced pressure on the specialist genetics clinic.

Case study: Oxford Ophthalmic Genetics Service

There are many genetic eye diseases, some causing developmental or structural abnormalities of the eyes and others causing progressive visual loss, in childhood or later in life. Some occur as isolated ocular problems, while others are part of a broader pattern of problems. Some genetic eye diseases arise for the first time in one individual, while in other cases there may be a family history. Importantly, ophthalmic diseases are a considerable cause of morbidity, often accompanied by psychological and social stresses.

Frequently asked questions by those attending eye genetics clinics include:

- What is the diagnosis?
- What is the prognosis?
- Why did this happen?
- Will this affect other people in the family – my children or my siblings?
- What can I do to prevent this happening again in my family?

Some of these questions are best addressed by an ophthalmologist with expertise in eye diseases, while some can be answered by a geneticist with expertise in genetics counselling and testing.

Now that we know more about the molecular basis of ophthalmic genetic diseases, genetics counselling and testing are becoming increasingly relevant in treating and preventing these conditions. This means that healthcare professionals on the front line of care need extra genetics training.

The Oxford Ophthalmic Genetics Service is one of a handful of specialty outpatient services that offer combined ophthalmic and genetics services for patients with genetic eye diseases. From October 2004, an ophthalmic genetics counsellor joined the Oxford team, funded by the Department of Health.

In this pilot project, patients referred to the service were assessed by an optometrist and their personal histories were analysed. Information about diagnosis, genetic testing, prognosis and further investigation was clearly explained to each patient, and a written summary was then sent to both the patient and their GP.

The counsellor was then able to support the family through any genetic testing process and ensure that the patient was given all the necessary information about learning to live with a visual disability.

Patients have responded well to this integrated service, especially the range of advice and support offered by the ophthalmic genetics counsellor.

Spreading knowledge across the NHS

Incorporating genetics knowledge into everyday health practice is a key element of the White Paper's commitments. Approximately £2 million has already been invested in educational support to the NHS to achieve this aim. In particular the National Genetics Education and Development Centre (NGEDC) has been established in Birmingham to look at the genetics educational needs of health professionals who are not genetics specialists and to work with the relevant professional and regulatory bodies to get genetics incorporated into curricula and continuing professional development to meet those needs.

The programme includes the following elements.

- The NGEDC is working with Skills for Health to develop a competence framework for health professionals working outside specialist genetics departments.
- The NGEDC is also working with the medical Royal Colleges to incorporate genetics into the new curricula for junior doctors' training.
- The web-based National Library for Health now has a genetics portal, which allows health professionals to access information about genetics and clinical practice from the workplace.
- A fellowship fund has allowed young health professionals to travel abroad with the aim of bringing back to the NHS relevant skills in genetics healthcare, research and new laboratory technology. In addition, eminent genetics scientists have visited the UK and contributed to genetics policy development and public health research programmes.

Many respondents have commented on the key importance of education in preparing the NHS for the wider use of genetics knowledge in healthcare. The work already undertaken by the NGEDC has clearly shown the huge need here. We have confirmed extension of the current contract with the NGEDC to the full five years. This takes our funding for this vital underpinning work through to August 2009.

"We believe that continued education and training of the healthcare workforce should be a priority area and would encourage the Government to maintain its commitment to integrating genetics into the health service." Wellcome Trust

Generating new knowledge and applications

Keeping up the pace of advances in genetics – and identifying new ways to apply genetics knowledge at a practical level – is crucial to the aim of making best use of evolving genetics technology.

To meet the White Paper's commitments on generating new genetics knowledge and applications, the following programmes were set up.

- The Department of Health, the then Department of Trade and Industry and the National Assembly for Wales set up an initiative to bring together diverse groups of experts working to anticipate and inform the future of genetics in healthcare. This led to the creation of six Genetics Knowledge Parks (GKPs) in Cambridge, Cardiff, London, Newcastle, Oxford and the North West.

  The work of these organisations involved:

  – research and development including developing new diagnostic testing and screening
  – policy development on ethical, social and legal issues
  – supporting professional education and public engagement
  – commercial collaborations to develop new technologies.

  The GKP concept has demonstrated the need for multi-disciplinary working in complex areas that have the potential to improve health and quality of life for future generations.

- A new NHS Chair in Pharmacogenetics and a supporting research team have been funded to increase research capacity and knowledge in this important field. This position will also provide national leadership and have a role in disseminating understanding of new developments in pharmacogenetics. The new team is based at the University of Liverpool. The Department of Health is providing £3 million over five years to fund this development.
- In addition, £4 million has been invested to support pharmacogenetics research on existing medicines. Six projects focused on areas where pharmacogenetics will have the greatest influence and use, investigating medicines in common use and associated with severe adverse side effects, or where efficacy can be significantly reduced by genetic-related toxicity. Details of the funded projects are at: www.genres.org.uk. Areas covered include variability in response to warfarin, and adverse side effects in the use of antimicrobial drugs.

- Approximately £1.5 million has also been invested in health services research. Service users helped to design the programme. It looks at issues relevant to how new services involving genetics should be developed, tackling two main areas:
  - the organisation, management and delivery of services
  - aspects of patient, public and societal attitudes and behaviour that should be taken into account when designing them.

  Details of the projects funded can be found at: www.dh.gov.uk/genetics. Areas covered include communication issues and the use of family history to assess risk.

Supporting novel and safe gene therapy research

As part of its drive to generate new knowledge and applications, the Department of Health has funded research into gene therapy, including the following new trials and research programmes.

- A novel exploratory gene therapy trial is under way for patients living with Duchenne muscular dystrophy, a rare, single-gene disorder affecting boys, with onset in early childhood. There is currently no effective treatment.
- A second trial is being conducted for young people suffering from a form of inherited eye disease. Again, no effective treatments exist for this single-gene disorder.
- A gene therapy trial for cystic fibrosis, the UK's most common inheritable single-gene disorder, is likely to begin in 2008. Cystic fibrosis was one of the first diseases to be tackled by gene therapy and the new trial will build on previous experiences.
- Several laboratory research projects have been funded to help researchers understand the risks of adverse side effects, and should help the development of safer gene therapies with fewer side effects. This is particularly important in applications where there needs to be a long-term beneficial effect, such as in children with single-gene disorders. The importance of such safety research was exemplified when, in December 2007, it was reported that one of the ten boys on a gene therapy clinical trial for a rare immunodeficiency had developed leukaemia following gene therapy.

A £4 million commitment for the purchase of gene therapy vectors has enabled several clinical teams to begin key studies. Two trials have already begun for myeloma (a form of blood cancer) at Southampton General Hospital, and a new trial is due to begin in 2008 for leukaemia at King's College Hospital, London. A further two clinical trials received funding in late 2007. These are for leukaemia at the Royal Free and University College Hospital, London, and for a novel strategy to combat graft-versus-host disease following haploidentical stem cell transplantation at Great Ormond Street Hospital. During 2008, other trials are expected to start too, drawing support from the commitment.

Case study: First clinical trial of gene therapy for childhood blindness

In May 2007, University College London's Institute of Ophthalmology and Moorfields Eye Hospital began a trial to test a revolutionary treatment for blindness in children, funded by the Department of Health. The trial is the first of its kind and could have a significant impact on future treatments for eye disease.

The trial involves adults and children who suffer from a form of Leber's congenital amaurosis, a type of inherited retinal degeneration. This disease causes progressive deterioration in vision, due to an abnormality in a gene called RPE65. This defect prevents normal function of the retina, the light-sensitive layer of cells at the back of the eye, resulting in severely impaired vision from a very young age.

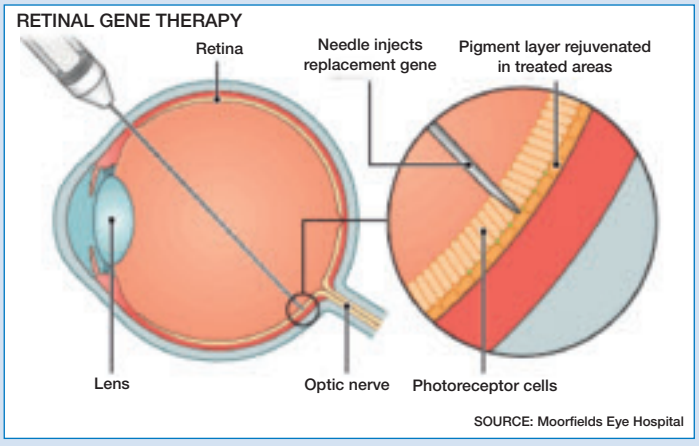
The new technique involves inserting healthy copies of the gene into the cells of the retina to help them function normally. Restoring the activity in these cells should restore vision.

The team conducting the trial is led by Professor Robin Ali. Professor Ali said: "We have been developing gene therapy for eye disease for almost 15 years, but until now we have been evaluating the technology only in the laboratory. Testing it for the first time in patients is very important and exciting, and represents a huge step towards establishing gene therapy for the treatment of many different eye conditions."

A faulty gene in the pigment layer prevents the photoreceptor cells from detecting light.

The needle is inserted through the eye and into the retina.

- The replacement gene is injected between the two layers of cells that make up the retina.
- Once treated, the cells in the pigment layer are restored and can support the photoreceptor cells to detect light normally.
- The photoreceptor cells can now send nerve impulses to the optic nerve for transmitting to the brain.



Ensuring public confidence

The potential use and misuse of genetics knowledge is something that rightly concerns both healthcare professionals and the public. The White Paper set out a series of commitments to engage with major areas of public concern, including:

- discrimination on the basis of a genetic predisposition to an illness
- use of genetic testing for reproductive purposes
- the safety of gene therapy
- the supply of genetic tests directly to the public.

The White Paper committed to funding a variety of activities designed to communicate with the general public on genetics issues and stimulate debate. These following activities were included:

- The Department of Health and the then Department of Trade and Industry produced two CDs, which were cover-mounted on the *Sunday Times* in November 2003. These CDs were designed to give readers information about genetics in an easily digestible format, including articles, images and animations, as well as interviews with leading scientists. Since publication, copies of the CDs have been sent on request to schools worldwide.[4]
- The Department of Health has also funded production of the booklet *A Guide to Genetics* by the Progress Educational Trust (www.progress.org.uk).

The Human Genetics Commission

The White Paper also emphasised the importance of providing reliable sources of advice and reassurance to the public, and the work of the Human Genetics Commission (HGC) is particularly important here. Established in 2000, the Commission provides a valuable forum for discussing the ethical, legal and social implications of genetics. Their report on the use of genetic information was invaluable in informing the White Paper. They have also provided advice on issues such as genetic profiling of babies, genetic testing and pregnancy, research and uses of genetic information in non-medical settings (see box on next page). It continues to pioneer new methods of engaging with people affected by genetic conditions.

4 The CD titles are '1: My Life: Window On Life' and '2: My World: Window On Life'

Human Genetics Commission publications 2000–07

Consultations

Public Attitudes to Human Genetic Information (March 2000)

Whose Hands on your Genes? (November 2000)

Consultation on Genetic Testing Services Supplied Direct to the Public (July 2002)

Choosing the Future (July 2004)

Reports

Protection of Genetic Information: An international comparison (September 2000)

Outcome of the Public Consultation on Pre-implantation Genetic Diagnosis (joint report with the Human Fertilisation and Embryology Authority) (November 2001)

Inside Information: Balancing interests in the use of genetic data (May 2002)

Genes Direct: Ensuring the effective oversight of genetic tests supplied direct to the public (March 2003)

Choosing the Future: Genetic and reproductive decision-making (July 2004)

Profiling the Newborn: A prospective gene technology? (March 2005)

Making Babies: Reproductive decisions and genetic technologies (January 2006)

Annual reports

Five

Genetic information and the insurance industry

One of the biggest concerns for the public is how the insurance industry may use genetic information. The Government has acted on these concerns by maintaining and extending the safeguards against misuse of genetic information, which were spelt out in the White Paper.

The moratorium on the use of genetic test results by insurers has been extended until 2011 and is supplemented by a detailed concordat between the Government and the Association of British Insurers. This specifies the limits within which genetic results may be used for insurance purposes.

The new agreement also sets out a number of issues that have been resolved since the moratorium began, including clauses stating that insurers will not request genetic testing be done in order to buy insurance and will not seek access to the results of tests carried out as part of research. Details of the concordat and moratorium are at: www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4105905

Genetic information – the rights of employers, employees and the public

The use of genetic test information by employers is covered by the Information Commissioner's statutory code on employment. This sets out in detail the requirements of the Data Protection Act 1998 and the restrictions on the use of genetic information that were recommended by the HGC.

It is now an offence, as set out in the Human Tissue Act 2005, to hold DNA for the purposes of analysis without the consent of the person from whom the sample was obtained.

"The Department of Health must take into consideration the public concerns and expectations of the applications of genetics technology, including issues of consent, confidentiality and reliability." Royal Society

Section two:

Where next?

Maintaining momentum in a changing NHS landscape: a summary of responses from stakeholders

This section of the report gives an overview of stakeholders' responses to our questions (see Annexes A and B).

It aims to give a balanced view of how healthcare experts view the progress that has been made so far on meeting the White Paper's commitments, and what else they feel remains to be done. It is not a comprehensive record of all the responses received. These are available under the genetics White Paper review at: www.dh.gov.uk/genetics

Progress so far

Stakeholders have welcomed the Department of Health's capacity-building investment in genetics, and consider that it has provided useful services for patients, given better access to quality assured genetic tests and is appreciated by the hard-pressed specialist services.

The following achievements and developments are seen as key.

- The UK is recognised as a world leader in embedding scientific advances in genetics into healthcare, supporting health professionals and dealing with ethical and social issues.
- New genes have been identified that cause variants of common diseases such as type 2 diabetes. These have the potential to generate new treatments for people with these genetic variations.
- Genetic testing will become more widespread and useful in a wider range of clinical situations to determine the best management of disease. It is important that all healthcare professionals using or paying for these tests understand and are kept up to date about the role of genetics in clinical practice.
- New laboratory technologies are developing rapidly. Microarrays offer new diagnostic possibilities in areas such as learning disabilities and cancer. New sequencing techniques reveal variants such as copy number polymorphisms in a range of diseases. The study of these could lead to a better understanding of the link between environment and genetic make-up in the individual's risk of developing chronic diseases such as heart disease or diabetes.

- Investment in pharmacogenetics research will lead to a better understanding of drug metabolism and, in the next 5 to 10 years, it could provide new information on some adverse drug reactions. Such research will have a substantial impact on finding new indications for conventional drugs and developing novel treatments.

"Continued capital investment will be necessary to ensure that NHS laboratories have the means to afford new diagnostic technology and the associated consumables." Wellcome Trust

What more needs to be done?

Our respondents identified the following areas of genetics technology as being likely to demand further action in the future.

- The analysis of free foetal DNA is likely to raise many new ethical issues. For example, the ability to analyse foetal characteristics from just a maternal blood sample, which could be taken without medical supervision, would make prenatal testing much easier – not only for genetic disorders in the absence of counselling, but even for unmonitored sex selection.
- Incorporating genetics education into professional education at all levels remains a priority and needs continuing support. More education in healthcare ethics is particularly important.
- More research is needed in genomics, proteomics and transcriptomics. This is important for further understanding the mechanisms that underlie disease and is likely to lead to new and effective treatments.
- Further epidemiological research is important for an understanding of the significance of new discoveries about the existence and effects of polymorphisms (common variations in genetic make-up). This research will provide information on the influence of genetic variations on the risk of common chronic conditions and will become increasingly important to people making choices to reduce their risk of these diseases. Research may also lead to the development of new treatments and prevention strategies.
- Health professionals need better access to information about genetic conditions, information management support and support to incorporate genetics advances into their practices.
- Continued public sector support for gene therapy development may be necessary to provide more experience in treating very rare genetic conditions and to get the technology right. It may also be important to support innovation in treatments for these very rare diseases where the market forces are so weak that there is little or no incentive for pharmaceutical or biotechnology industries to invest.

"Education in genetics has trailed behind the enormous scientific and technical advances in this field and the Royal Society strongly believes that the teaching of genetics to doctors, pharmacists and nurses at undergraduate, postgraduate and continuing medical education levels must be increased as a matter of urgency." Royal Society

"Many of the themes of the White Paper remain current; it is important that several current initiatives continue to be funded as there has been insufficient time for them to deliver the maximum potential. Service development projects, the Pharmacogenetics Programme, UKGTN and the education centre are amongst these." Royal College of Physicians

"There is a very real need to ensure that professionals and the public understand the science and the ethical issues involved… Unless professionals understand the issues then the public will not get the service it deserves." Sir Kenneth Calman

"There is [still] a need to 'mainstream' and de-specialise genetics, and to incorporate it into care pathways. In particular, there needs to be a better understanding of genetic risk and its assessment, across both primary and secondary care." British Medical Association

"Gene therapy 'bespoke' treatments for ultra-orphan conditions may prove unlikely to reach the status of a 'licensed medicine' due to practicalities around continual refinement of the product and the fact that the small number of patients involved may render collecting sufficient data for licensing impracticable. These obstacles to licensing are somewhat exacerbated by the fact that these trials have historically failed to attract commercial funding." NICE

Future challenges and opportunities

The review of the genetics White Paper has confirmed that the long-term aim of embedding genetics technology and know-how into NHS service and clinical practice remains important. Much has been achieved in a relatively short period, but we are only at the beginning of the process.

Healthcare professionals, researchers and the medical charities are increasingly recognising that human genetics will have a far-reaching impact on our understanding of the causes of disease and our ability to develop new treatments. A consistent theme in respondents' comments has been that many of the White Paper's aims will require a longer timeframe than three to four years to become an inherent part of NHS ways of working. Meanwhile, the pace of advances in genetics continues to increase, and the demand from patients for a National Health Service able to use this knowledge effectively continues to grow.

The review has shown that the NHS remains at the forefront internationally of the application of genetics knowledge to healthcare. The Department of Health will continue to work closely with all the relevant stakeholders to embed good genetics practice in the NHS and to address any remaining areas of uncertainty. This will include issues such as:

- how the NHS reforms can improve access to genetics advice integrated with existing and new services
- how new laboratory technologies can be commissioned
- how to support the National Genetics Education and Development Centre and other bodies to provide education in genetics for all healthcare staff from their basic training and throughout their careers
- how increasing knowledge about genetic influences on common chronic diseases can be used effectively to aid prevention
- how to address ethical and societal concerns about new technological developments.

As more is learnt about the genetic basis of disease and clinical and laboratory genetics expertise increases still further, genetic tests and treatments will need to be embedded more widely in the NHS. This will involve developing commissioning frameworks that can span different parts of the NHS. In delivering on these commitments, it is essential to have full professional and public engagement.

Together we will continue to build on the foundation of a world-leading NHS genetics service to provide real health benefits from properly applied genetics knowledge.

"Increased knowledge of genetics and genomics in the long term will impact substantially on the way in which we understand and treat disease; the impact on healthcare is just beginning and will not be dramatic over a short timescale. Instead, new diagnostic treatments and new disease classifications will emerge with increasing frequency but will not change the basics of clinical care overnight."
Royal Society

Annex A: List of questions for stakeholders

For clinical associations and patient groups

1. In your view, what have been the main achievements to date from the commitments in the White Paper? In particular, have there been any benefits (direct or indirect) for patients?
2. We are keen to obtain up-to-date views on forthcoming developments in genetics science and technology. Are you aware of any that might:
   - make a substantial difference to health outcomes
   - lead to major new demand or cost pressures
   - challenge existing capacity, ways of working, configuration of services or information flows?
3. Are there any social, ethical or regulatory issues that need new or additional work, and who would be best placed to take that forward?
4. Much work has been done by many parties already, but what should the future priorities be for:
   - government
   - other sectors such as the NHS, professional bodies and higher education

   which would forward our aim of facilitating appropriate uptake of genetics knowledge and technology as it becomes available?

For key stakeholders and policy makers

1. Could you describe briefly the current and future potential for genetics in healthcare as you see it, either generally and/or in specific areas?
2. Are there any areas of development (such as the role of genetics in multifactorial disease, pharmacogenetics, gene therapy, but also any other areas you would like to mention) that show particular potential to improve healthcare or, conversely, present new risks or other concerns?
3. Are you able to comment on likely timescales?
4. Much work has been done by many parties already, but what should the future priorities be for government to enable appropriate uptake of genetics knowledge and technology in healthcare?
5. What should the future priorities be for other sectors, such as the NHS, professional bodies and the higher education sector, to forward this aim?

For professional bodies (non-genetics)

1. Is genetics within healthcare already relevant to your members, and if so, how? Do you anticipate that it will become more relevant?
2. Are there any areas of development that show particular potential to improve healthcare or, conversely, present new risks or other concerns?

3. What plans does your organisation have to anticipate genetics developments? How might we work with you on some or all of these?
4. Much work has been done by many parties already, but what should the future priorities be for government to enable appropriate uptake of genetics knowledge and technology in healthcare?
5. What should the future priorities be for other sectors, such as the NHS, professional bodies and the higher education sector, to forward this aim?

For genetics reference laboratories

1. In your view, what have been the main achievements to date from the commitments in the White Paper? In particular, have there been any benefits (direct or indirect) for patients?
2. Are you aware of any current or forthcoming developments in genetics – for example, new technologies or new gene–disease associations – that might:
   - make a substantial difference to health outcomes
   - lead to major new demand or cost pressures, and/or
   - necessitate major change in services, for example reconfiguration of laboratory services?

For science and research institutions

1. Could you describe briefly the current and future potential for genetics in healthcare as you see it?
2. What level of impact do you envisage, and over what kind of timescale:
   - generally
   - in specific areas (such as the role of genetics in multifactorial disease, pharmacogenetics, gene therapy, but also any other areas you would like to discuss)?
3. Are you aware of any areas within current or planned research (in genetics or in related areas such as proteomics) that show particular potential to improve healthcare or, conversely, present new risks or other concerns?
4. What should the future priorities be for government to allow the UK to remain at the leading edge in enabling appropriate uptake of genetics knowledge and technology in healthcare?
5. What should the future priorities be for other sectors to forward this aim?
6. Do you have any suggestions for future priorities for:
   - government
   - others (such as the NHS, academia, professional bodies or higher education)

   which would forward our aim of facilitating appropriate uptake of genetics knowledge and technology as it becomes available?

Annex B: List of respondents

Responses were received from the following organisations and individuals:

Professional bodies (non-genetics)
Amicus (Community Practitioners' and Health Visitors' Association)
British Dietetic Association
British Medical Association
Royal College of General Practitioners
Royal College of Nursing
Royal College of Physicians
Royal Pharmaceutical Society of Great Britain

Major research and academic bodies
Biotechnology and Biological Sciences Research Council
Diabetes UK
Economic and Social Research Council
Kidney Research UK
Medical Research Council
Royal Society
Wellcome Trust

NHS bodies
Meeting of all Specialised Commissioning Groups**
National Institute for Health and Clinical Excellence
South Specialised Commissioning Group

Committees hosted by the Department of Health
Advisory Group on Genetics Research
Commission on Human Medicines
Gene Therapy Advisory Committee*
Genetics and Insurance Committee*
Human Genetics Commission*
National Screening Committee (Foetal, Maternal and Child Health Subcommittee)*

Specialised genetics bodies
Association of Clinical Cytogeneticists
Association of Genetic Nurses and Counsellors
British Society for Human Genetics**
Clinical Genetics Society
Clinical Molecular Genetics Society
Joint Committee on Medical Genetics*
The two National Genetics Reference Laboratories (Manchester and Wessex)
UK Genetic Testing Network Steering Group

Patient/public interest bodies
Breakthrough Breast Cancer
Contact-a-Family
Genetic Interest Group*
Macmillan Cancer Support

Genetics Knowledge Parks
Oxford Genetics Knowledge Park
Public Health Genetics Unit
Wales Gene Park

Key individuals in the science field
Professor Charles Coutelle, Imperial College
Professor Sir Charles George, former President of the British Medical Association
Professor Sir Kenneth Calman, University of Durham
Professor Sir Muir Gray, Director of National Screening Programmes
Sir John Sulston, Wellcome Trust

Other
Individual clinical geneticists and heads of NHS genetics laboratories
Researchers from White Paper-funded research projects

*Meeting or conference attended by member of NHS Genetics Team
**Meeting or conference attended but no written response received

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