



CEST for Life Sciences

Summary of a Collaborative Project examining

NEW GENETICS: OPPORTUNITIES AND CHALLENGES FOR THE FUTURE

CENTRE FOR EXPLOITATION OF SCIENCE AND TECHNOLOGY

**Caroline Vance, PhD
Philip Wright, PhD
Alastair Valentine Philp, PhD**

May 2001

Executive Summary

This booklet summarises the discussions from the CEST New Genetics collaborative project, which between September 1999 and December 2000 examined the commercial opportunities and social and ethical challenges arising from decoding the human genome. Participants included *Glaxo Wellcome, Nycomed Amersham, UK Human Genetics Commission, Deutsche Telekom, Siemens, IBM, UK Forensic Science Service, Enterprise Ireland, Scottish Enterprise, Industrial Development Board for Northern Ireland, National Health Service Executive, UK Department of Health, UK Office of Science & Technology, Unilever and DERA*. More details are available at <http://www.cest.org.uk/newgenetics>.

The key conclusions of the project were:

1. Genetic Medicine: genetic databases, gene discovery and genetic testing (p4)

- Genetic tests can be predictive, diagnostic or prognostic and need not be DNA based
- Different types of genetic testing have different levels of risks and benefits
- Ethical, legal and social issues, including ownership, consent and benefit sharing, are still being discussed and must be resolved

2. Pharmacogenetics: drug response profiles and personalised medicine (p4)

- Developing drug response profiles is important to pharmaceutical companies
- Pharmacogenetics has benefits for healthcare delivery
- Diverse organisations are developing an interactive medicine paradigm

3. Data Handling and Storage (p5)

- Genetic data is seen as special
- Levels of security required are attainable but total security is not
- Regulation of data ownership is an evolving field

4. Genetics, Insurance, Employment and Privacy (p5)

- Results of a genetic test are commonly not deterministic
- Regulation of use of genetic information in insurance varies among different countries
- Genetic testing in recruitment and occupational health is rare and unlikely to be useful

5. Science Communication: engaging with other parties (p6)

- The public support responsible use of genetic technologies but concern about regulation
- Dialogue on both issues and approaches needs to be built
- Advice to communicators: speak clearly when someone is listening

6. New Genetics: new opportunities (p6)

- Opportunities exist along the value chain but resolving bottlenecks such as in target validation and accelerating clinical trials represent the most valuable opportunities
- Opportunities are likely to be greatest in service provision
- Advice to entrepreneurs: treat the subject simply, build credibility through networking and avoid taking VC money for as long as possible

7. Where next for CEST and New Genetics? (p7)

- Genetics in Context: aligning strategies in life science communications
- Interactive medicine and personalised health management (iMed)

Introduction

Who is CEST?

CEST is a not-for-profit organisation. Our mission is to accelerate the positive impact of science and technology, acting as an independent hub to support innovation that benefits industry and society. We do this by facilitating collaborative groups that allow participants to explore issues by sharing perspectives. We have an extensive track record of helping divergent groups of organisations to optimise their policies and strategies. Our extensive European networks enable us to bring together groups of opinion formers that are cross-sectoral in nature and bridge the public-private divide. This leads to greater insight and helps to identify key issues, opportunities and potential blockers. More information is available at <http://www.cest.org.uk>.

The emergence of a "New Genetics"

Until recently, the application of genetics in healthcare concentrated mostly on rare single gene disorders, with counsellors advising and supporting affected individuals and their families. Most healthcare provision did not have a significant genetics dimension.

In the 'new' genetics there is recognition that many leading causes of mortality have a genetic component (for example, heart disease, cancer, stroke, chronic obstructive pulmonary disease (COPD), diabetes, kidney disease, suicide and chronic liver disease). There is also a growing realisation that resistance to even common infections such as influenza, and therefore the severity of the infections, has a genetic component. Consequently, primary healthcare professionals and specialists in disciplines other than clinical genetics will increasingly depend upon and need access to medicines and interventions that use genetics-based information and technology. To support this there will be a need to develop new ways to support healthcare providers who will use these technologies and develop new forms of counselling to deliver services such as diagnosis, risk assessment and lifestyle advice on the basis of genetic profiles. However it is important to realise that genetics is only one factor in disease aetiology: the effects of gene/environment interactions must not be understated.

The Structure of the Programme

The programme consisted of eight meetings:

- Launch/ setting the agenda
- Briefing: Kari Stefansson, Decode Genetics
- Visit to the Wellcome Trust to explore genomics, structural and functional genomics and public perceptions
- Visit to Deutsche Telekom's future centre and exploration of data issues
- Visit to Glaxo Wellcome and investigation of pharmacogenetics and predictive medicine
- Workshop on genetics, insurance, employment and privacy
- Panel discussion on communicating genetics
- New Genetics: new opportunities

In addition to the consortium participants, representatives from Pfizer, Roche, Swiss Re, the Association of British Insurers, the Wellcome Trust, The Genetics and Insurance Research Centre, The Recruitment Society, People, Science and Policy, The Guardian, Bio NRW, 3I, Merlin Biosciences, Tepnel Bioscience, the Office of the Data Protection Commissioner and Citigate Westminster attended single meetings where their input was especially appropriate and valuable.

Summary of conclusions from the programme

Genetic Medicine: genetic databases, gene discovery and genetic testing

Genetic tests can be predictive (uncover susceptibility), diagnostic (identification of infectious agents or sub-fractionation of existing diseases to enable more efficient clinical intervention) or prognostic (predicting response to drugs). Different types of genetic testing have different levels of risks and benefits and since genetic testing is a broad and evolving field, regulation must be proportionate. We must understand the limitations of a genetic approach to medicine and not underestimate the contributions that environmental and gene/environment effects make.

When considering genetic databases, ethical, legal and social issues, including ownership, consent and benefit sharing, must be resolved. Individuals do not own their DNA but have control over it. The rights that must be protected are therefore personal rather than property rights

There is an increasing demand for evidence-based medicine. Genetic testing is one way of providing evidence for causes or contributory factors to many conditions. With the completion of the draft phase of the human genome project the potential for increased genetic testing is clear. However as we heard at our closing meeting "*the clinical relevance of the human genome project is evolving but far from being established*". Quality assurance is also a major cause for concern: accuracy in reporting-out was found by one recent survey to be less than 95%.

Today the possibility of taking a drop of blood from a newborn baby, putting it on a microchip and simultaneously discovering the baby's pre-disposition to various conditions is a dream. However within 25 years this will have passed from dream to reality. We have that time to fully understand the limitations of the approach, to think about whether such testing will always generate useful information that people want to have, and to decide how such private and sensitive information can be kept from unauthorised third parties. But we must engage in public discussions of these questions now.

It seems likely that genetics will cease to be a medical specialty and will become as core a technique as biochemical testing currently is in modern medicine. Specialists will still be required to conduct the tests and perform specialist interpretation but the level of genetic knowledge in all healthcare professions will have to be enhanced. Increased automation will drive down costs per test but in the short term a therapeutic gap may remain for some conditions, where patients can be diagnosed but no treatment yet offered. In such a circumstance there will be much debate about whether testing is justified. However in time therapeutic solutions should follow. Counselling will continue to be very important, particularly in allowing people to make lifestyle choices based on probabilistic risk assessments derived from multigene profiling.

Pharmacogenetics, drug response profiles and personalised medicine

Pharmacogenetics is the study of how genetics affects response to drugs in individual patients. This approach is a way of avoiding adverse drug reaction events and having better targeted drugs that actually benefit the patients they are prescribed to. In this way it will be possible to achieve better value from the drug bill. However, drug response is commonly affected by the products of multiple genes so pan-genomic approaches are required. Additionally the adverse events caused by drug/drug interactions and mis-administration of drugs will not be conquered by pharmacogenetics. A pharmacogenetic approach may however be a way to find drugs for orphan diseases or markets for orphan drugs.

Predictive medicine adds value by integrating novel diagnostics (to detect disease) with appropriate therapeutic interventions (to treat disease). Sub-fractionation of existing diseases using molecular

diagnostics will enable swifter, more precise and hopefully more effective clinical intervention. However if it takes around 15 years to bring a drug that will be used with a genetic test to market (as it did in the case of herceptin) how can the diagnostic test company be "*kept afloat*" until the drug is actually available? This will require more collaborative working and partnership between companies. Routine genome mapping may take 20 years to be common but pharmacogenetic testing for receptors is already coupled with herceptin treatment for breast cancer. Many more applications will be available within 5 years.

Data handling and storage

As more and more genetic data must be managed and there is enhanced utility from combining datasets there will be increasing demand for secure storage and transmission systems over public networks and in compatible formats. Data compression routines may be required to allow easier portability. Consent for specified uses of personal data will remain the cornerstone of achieving responsible curation. The risks of hacking can be minimised but are unlikely to be overcome completely. However the financial benefits of hacking will not approach those to be gained from cracking bank codes and so incentives to pry will be lower.

The technology solutions to meet most of these constraints already exist, with the current big ICT companies hard at work on refinements, and there are probably few new niches for specialist contractors. There may be some role however for trusted third parties as data custodians or for specialist, licensed information practitioners who enjoy defined access privileges.

Genetics, insurance, employment and privacy

As more genetic tests become available there will be more pressure to use them to predict which individuals represent greater risk to insurers and employers. However genetics is commonly less deterministic than we think and the additional information obtained from such tests is unlikely in many cases to be very useful for insurance purposes. This is because most conditions are dependent on multiple genetic factors as well as environmental ones. In other words the genetic test results will not predict with certainty whether conditions will develop: rather they will only give rough probability scores. Comprehensive gene profiles coupled with extensive lifestyle evaluation may represent a way to more precisely define risk but other than for underwriting very large policies the additional costs of this work and the fragmentation of the market this will encourage, will outweigh likely protection from losses.

In cases where genetic tests do provide certainty (rare single gene defects) the adverse selection risk to insurers is unlikely to represent a major financial loading in the life insurance market. In smaller markets with larger policies (critical and long-term care insurance) adverse selection may be more of an issue. In any event, there is highly unlikely to be any new uninsurable "genetic underclass".

In employment settings the current best practice of removing environmental risk from all employees, rather than removing a subset of workers, who test adversely, should persist. Human rights law, the Data Protection Act and the duty of care implied by a decision to test will make companies think carefully before applying genetic tests. Testing of new recruits is a less certain area but the benefits of testing are still to be resolved, unlikely to be many and the costs will, at least initially, be very high. Perhaps such testing will be first seen in screening appointees to senior management positions (for example as part of their medical exam to check for susceptibility to heart attacks on the job).

Science communication: engaging with other parties

Opinion research indicates that the public are interested in science and do not hold it in low esteem. 88% of people think scientists make a positive contribution to society. Medical applications (except cloning) are viewed more favourably than genetic modification in agricultural biotechnology. Social and ethical objections to biosciences get confused. Folk in the UK are pragmatic in their personal responses to biotechnology, asking "*what does it mean to me and mine?*" Other recent research shows that most people see science as making our lives healthier, easier and more comfortable. However the pace of change is viewed as too fast for the government to regulate properly. Genetics is viewed as mysterious and, because of the belief that it is immutable and determinist, is seen as scary. If the over-hyping of the "*awesome power of genetics*" can be recognised and diffused, maybe the fear will also be diminished.

Additionally, reduced deference, a distrust of authority and an increased public feeling of exclusion, inevitability and disempowerment leads to more critical comment, which must be countered. Organisations have to be proactive in laying out in a clear concise way the benefits to society that their approach delivers. They also need to place genetics in context by comparison with other influences (e.g. use of agrochemicals when talking about agbiotech and the effects of the environment when talking about genetic predispositions). If biotechnology is to realise its promise for health and wealth generation in the next 25 years, audiences must be engaged, misinformation countered and publics understood. We need to understand who builds trust (proxy groups) and talk to them. Companies need to build common positions with other organisations active in their area and engage detractors to understand their concerns with a view to addressing them. Collaboration may be useful in reducing individual risk and CEST is currently exploring a joint initiative - Genetics in Context - that will complement individual communication endeavours (see page7)

Specific advice:

- Do not underestimate the public's intelligence, do not overestimate their knowledge
- Make time to interact and debate. "*True dialogue needs time for people to think*".
- "*Say it clearly, when someone is listening, using language we can all understand*"
- Celebrity endorsements make a difference

Opportunities

Few opportunities remain to be exploited in hardware or software for genomics. The pace of development is too fast to make investment in genomic technology profitable but proteomics and structural genomics are growth areas. Bottlenecks represent areas for improvement and therefore opportunities: the major bottleneck and therefore opportunity cluster in drug discovery is target validation. Another bottleneck is in getting drugs through clinical trials. Pharmacogenetics may allow more information to be gleaned from fewer people and this would streamline drug approval and represent immediate added value. However companies working on elucidating drug targets, making drugs or developing pharmacogenetic tests also represent a high risk for investment.

More personal responsibility for own health, wellness and appearance will generate more demand for convenient, reliable over-the-counter diagnostics. However new genetics will also drive an expansion in the need for counselling, probably by a new group of professionals. Opportunities already exist to provide information management tools and high quality education programmes for the public and for healthcare professionals. There will also be many easily exploited opportunities in marketing, PR and net-mediated consumer-led healthcare.

Where is CEST going next?

As the New Genetics programme concluded, two topics emerged among the participants as worthy of further study:

Genetics in Context: Aligning Strategies in Life Science Communications

This programme is focussing on issues surrounding the communications of genetics and life sciences: the aim being to understand how genetics can be placed in context. The key objectives are to promote and share experiences of the effective communication of the benefits, as well as the limitations, of genetics and other life sciences to deliver innovative products and services.

Earlier this year CEST was commissioned by its members to undertake a scoping study of practices and strategies in life science communication. The main aim of the study was to identify whether such practices and strategies could be enhanced by working with others who are tackling similar issues. One of the main points that arose was that many organisations are involved in communicating aspects of genetics and other life science issues from their own perspectives, initiatives are often fragmented and can appear inconsistent to external observers. Specific areas that may benefit from collaboration include:

- Messages: What topics are shared interests?
- Consistency of language: what is "genetic modification"; what makes genetics "special"; what is a "genetic test"?
- Audiences: Who do we need/ want to build dialogue with?
- Channels: How do we reach our target groups?
- Targets/Audit: How do we know we are making a difference?

Interactive medicine and personalised health management (iMed)

The convergence of biotechnology (in the form of genetic profiles and pre-symptomatic tests) with information and communication technologies (which permit swifter transmission of medical information) will allow a more interactive patient-centred mode of medicine, which we call iMed. Adoption of these technologies should also allow patients to play a richer role in managing their personal health, and streamline patient contact with healthcare systems. If hospitalisations can be minimised by following a “test and predict, then avoid or treat” approach rather than the currently reactive paradigm, considerable savings could accrue, both in specialists’ time and bed occupancy costs.

Over the last few months we have undertaken a consultation to gather an understanding of the economic and strategic issues determining thinking in interactive and predictive medicine, and in particular to identify outstanding issues that must be addressed if the potential is to be realised. We will present our findings at a meeting in mid June whose main purpose is to explore how the iMed vision can be made real by working with others with common interests.

The perspectives from participants at that meeting will enable us to validate/refine these early research results and allow us (collectively) to establish which issues or areas are of the greatest shared importance. This will allow all of us to decide where attention should now be focussed, and where a CEST-brokered collaborative programme would be a helpful addition to current initiatives.

To learn more about either of these new projects:

Contact Alastair Valentine Philp (alastair.philp@cest.org.uk; +44 (0) 20 73 54 99 42)