The future of medicine

Centralised health and genetic databases promise to increase quality of health care while lowering costs. But to get there, many legal and social obstacles will have to be overcome to prevent abuse

When people in ancient Greece needed advice on their future, they usually turned to local forecasting institutions, a popular and respected service at that time. The most famous amongst these was the Oracle of Delphi, where gods, demigods and celebrities listened to a priestess describing their future in twisted words. The only problem with the oracle's predictions was that they were often not clearly comprehensible and so it was the priests' task to translate the priestess's words. Although the Oracle of Delphi closed its business a long time ago, the possibility of predicting the future has continued to fascinate mankind, as can be seen in the unbroken belief in palm readers, tarot cards or analysts' predictions of the NASDAQ.

Today, we are witnessing the building of the modern version of the Oracle of Delphi. The combination of genomics, genetic diagnosis technologies and powerful computers promises not less than to eradicate all leading causes of death in the First World that we have not yet found a cure for. 'Personalised', 'genetic' or 'molecular medicine', as it has been dubbed, has become the battle cry to describe the future of health care (Papavassiliou, 2001). No wonder this venture has drawn considerable interest from private enterprises and governments, as well as patient organisations. But the path to a bright future where cancer, coronary heart disease, obesity or Alzheimer's disease will be eliminated is littered with legal, organisational and social obstacles.

Personalised medicine is becoming possible now that the information from the Human Genome Project, which will eventually identify all human genes and their functions, is pouring in. At the same time, epidemiology (classical as well as on a molecular basis), genetic and medical research are clarifying the role that certain genes and their variations play in the pathogenesis of the most important diseases. The physical part of personalised medicine, however, will be an extensive database that contains all the genetic and health data for every individual from a country that decides to embark on such an endeavour.

So far, only two countries, Iceland and Estonia, have begun large-scale efforts to establish a health and genetics database of their citizens. Both countries are able to do so because they have two advantages that ease such an undertaking. With 1.42 million citizens in Estonia and 280 000 in Iceland, their populations are small enough for their data to be easily recorded and stored. Furthermore, in Iceland, the majority come from a homogeneous genetic background with good historical data, which makes genetics research easier. The final result, a health database linked to a genetic database, is similar, but Iceland and Estonia have chosen different paths. The Icelandic government entrusted deCODE, a private company, to establish a national health database since the same company had already created an extensive genetic database of Iceland's population. In Estonia, the government established the independent, non-profit-making Estonian Genome Project Foundation to create and manage the database. On 24 April 2001, the supervisory board elected Toomas Vilosius, Chairman of the Social Affairs Committee of the Estonian Parliament, as chairman, and established an ethics committee. Both enterprises plan to finance their undertaking either by selling these data directly to pharmaceutical companies or by identifying genes that are involved in disease pathogenesis. deCODE has already demonstrated the power of its databases by identifying several genes involved in Alzheimer's disease, stroke and osteoporosis, among others.

But apart from the identification of disease-associated genes, the compilation of a genetic and health database will have benefits for patients and is expected to improve the efficiency of health care dramatically. Simply making health data accessible to all doctors within a nation could result in dramatic improvements in emergency care. For example, a doctor in an emergency room could check via a computer terminal whether the unconscious victim of a car accident has complications that could turn into life-threatening conditions. He could thus learn whether his patient has diabetes or is allergic to penicillin and plan his treatment accordingly.

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A centralised health database also has the potential to increase overall health by reducing the risk of lifestyle diseases, such as diabetes, high blood pressure or coronary heart disease. By analysing the genetic and health knowledge from the database, primary care physicians will be able to draft an individual risk assessment for their patients and develop drug regimens or advise on lifestyle changes. Thus, the proponents of national health and genetic databases maintain that the benefits for society are too large to be ignored.

With health care becoming an explosively increasing budget factor—the USA and Germany are already spending 13% of their GDP on it—First World countries will have to look into ways to control costs without impeding quality. According to Andres Metspalu of the University of Tartu, and one of the founders of the Estonian Genome Project, genetic medicine will be one avenue to follow. Although the project has created a stir in the country, mainly over ethical questions, physicians think it could make better use of existing health care budgets. 'If we know the genetic markers [for drug response], we could plan better treatments', Jaanus Pikani, Director of the University Hospital in Tartu, Estonia, said, referring to his country's establishment of a national health and genetic database, 'so we won't waste money on unnecessary treatments'.

This positive expectation is shared by most sufferers of severe inherited and multifactorial diseases, according to Alastair Kent, Director of the Genetics Interest Group, an alliance of British charities that supports patients and families affected by inherited disorders. 'We are likely to see better prescribing, which will increase the efficacy of drugs that are existing and decrease the side effects', he said. Furthermore, genetic testing could improve diagnosis for those with a family history of a disease. Kent named bowel cancer as an example, a disease that is traditionally diagnosed by colonography, a procedure he described as 'painful and humiliating'. Moreover, most people with a family history of cancer or an inherited disease are usually very interested in taking a genetic test to ascertain their risk of developing the disease.

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But not everybody welcomes personalised medicine with the same enthusiasm as doctors and those with an increased risk of inherited diseases. The idea of having their health records and, even worse, their genetic data stored in a central database scares many people in the First World, who already feel insufficiently protected against intrusions into their private lives. And many ethicists and doctors agree, as the possibilities for abuse are numerous. Health insurers might increase premiums for people with a high number of risk factors. Employers might decide against applicants or even lay off workers if their genetic make-up indicates that they have a higher risk of developing job-related ailments. Life insurance companies might refuse to insure people who have a higher chance of stroke, heart failure or cancer. Physicians fear that storing health and genetic data might impede medical practice and biomedical research when patients refuse to disclose this information if they do not trust their physicians to use it in their best interest. 'So that trust we have is essential for our practice', James Appleyard, a British paediatrician and chairman of the World Medical Association's (WMA) working group on patient confidentiality and health databases, said, 'and if we operate in an unsafe or abusive system, we will not be able to operate efficiently'.

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When it comes to behavioural traits, critics also fear social discrimination lurking. 'The problem with genetic information is that it is not certain and the question is how far do you discriminate?', WMA's Appleyard said about genes that are linked to psychiatric illnesses. Moreover, some researchers, and others too, still think that genes might control traits such as intelligence, sexual orientation, substance abuse or criminal behaviour. If everyone's genetic data became available, discrimination on race, religion or sex might very well be replaced by discrimination on genetic markers. The movie, GATTACA, gave a frightening impression of what might happen if the use of genetic data gets out of hand.

Despite the potential threats, in general Appleyard welcomes this development. 'I don't find it negative at all because our motivation as doctors is to use it for our patients', he said, adding, 'we just want to make sure that it's secure'. The WMA's working group that he chairs is actually working to establish ethical guidelines that can serve as a blueprint for lawmakers when they draft laws to regulate the use of health and genetic databases. Appleyard expects those to be available after the group's next meeting in October. 'The fundamental principles we have basically agreed upon', he said, 'it's the language that is now being discussed'.

In Iceland and Estonia, both governments got their share of criticism when they gave the go-ahead for a national health database. deCODE's project provoked a fierce debate in Iceland and around the world, swirling around questions of privacy, data protection, genetic counselling and the involvement of private enterprises in national health systems, which, at a smaller level, was repeated in Estonia. For the moment, the critics seem to be quiescent. But, since Metspalu expects that the Icelandic and the Estonian approach may serve as a pilot project for larger countries to follow suit, it is just a matter of time before another government has to face the same debate. And not every citizen will eagerly embrace the idea of having his genes being stored in a database, as the Icelanders and Estonians do. 'In a country like Germany with a different history, not everybody will be willing to volunteer so easily', Kent said.

Particularly in the USA, with its privatised health care system, people fear being discriminated against by health care providers. This system is indeed an obstacle to a national genome project, according to Pikani, because people will be afraid of negative effects when their genetic risk factors become exposed. Only a few states currently protect their citizens from genetic discrimination, and a similar federal bill has been shuttling back and forth for years between various committees and subcommittees in Congress. Another bill to protect patients' privacy, proposed under the Clinton administration, is facing heavy criticism from private health care providers. Furthermore, it is not very likely that overall health care in the USA would improve even if the government established a national health database. 'You can have the genome and determine all the risks you have, but it will never go anywhere [without treatment]', Ruby Senie, Clinical Professor at Columbia University's School of Public Health, said. She cited the

particular case that the US government pays for breast cancer screening while some health care providers deny coverage for a mastectomy after a positive diagnosis. Senie has already experienced this fear, as it is more difficult for her to find volunteers for her breast cancer studies than for her collaborators in Canada and Australia.

In Europe, abuse of genetic data by governments or private enterprises might not seem so much of a problem. The European Convention on Biomedicine, endorsed by 39 countries, attempts to prohibit 'any form of discrimination against a person on grounds of his or her genetic heritage' (McGleenan, 2000). Also, in this regard, the Estonian approach is regarded as the preferable choice to manage a central health database. 'We're quite comfortable with this', WMA's Appleyard said about the independent and non-profit-making Estonian Genome Project Foundation, 'that is much better in principle than the Icelandic approach'.

But life insurance companies might want to demand genetic tests from their customers to protect themselves against adverse selection when people with a negative test result purchase large amounts of insurance. For instance, the Insurance Federation, representing Irish insurance companies, announced on 1 May that anyone seeking life insurance over £300 000 (381 000 Euro) will have to make the results from genetic tests available to the insurance company. Critics fear that life insurers might even demand genetic tests in the future and then increase premiums or even refuse to insure people with certain risk factors. However, people seeking life insurance already have to disclose risky lifestyles such as smoking or health problems such as high blood pressure or diabetes. As Jennifer Hoban, Life Assurance Manager of the Insurance Federation, explained on 'Morning Ireland', it is a legal requirement for an individual to be honest about her or his medical history.

Centralised health and genetic databases might give fresh ammunition to those who want to punish people with a high-risk lifestyle. Will someone who does not smoke and who exercises regularly tolerate higher health insurance premiums to finance the treatment of lung cancer or obesity? On the other hand, will governments, challenged with increasing health care costs, decide to crack down on lifestyles deemed dangerous? 'Yes, there will be pressure, and yes, there will be some alternation of lifestyle but only modest', Arthur Caplan, Director of the Center for Bioethics at the University of Pennsylvania, expects. 'Actually, everyone could change all their bad behaviour now since it is all likely to be a risk factor regardless of one's genes […]. I doubt there will be a huge social stigma on lifestyle since sin is so widely distributed that it is very difficult for one person or group to get too enthusiastic about criticising the "bad" behaviour of another person or group. For every obese person there is another who smokes, or has unprotected sex, or speeds in their car, or does not get enough sleep, or uses addictive drugs, or fails to wash their hands enough, etc., etc., etc.'

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Thus, personalised medicine could even be an argument for the USA to return to national health coverage. 'Genetics may leave some rich and middle class Americans potentially uninsured, they will not like this fact and will have the political clout to get a guaranteed minimum of health care made available to all', Caplan thinks. 'Moreover', he added, 'insurance companies do not want to become victims of adverse selection, so they too have a stake in making sure that minimal coverage is available to all'.

But ensuring sufficient legal protection or minimum health care might not be enough for people to embrace centralised health and genetic databases. To make an informed choice, citizens must know about the benefits and the drawbacks. Furthermore, it is the nature of a health risk itself that is still misunderstood by many people. A 10-fold increase of getting bowel cancer might sound dramatic at first, but is actually low if the basic risk is only 1 in 50 million. Unfortunately, this incorrect picture of health risks is often perpetuated by the press, who like to report dramatic-sounding risk increases but fail to compare these to the basic risk of the population. 'The key is education as in everywhere', Metspalu said. And as an understanding of inherited risk factors is at the heart of personalised medicine, proponents such as Metspalu and Pikani see an absolute need for people to know more about genetics and health risks. Consequently, the Estonian Genome Project has started to use the media to educate its population about genetics, and initiated a debate in the national newspapers on the risks and benefits of personalised medicine.

So far, personalised medicine is still a long way from realising its promise of improved health care. But even if the legal, technological and social problems prove to be too forbidding, Metspalu and Pikani already see a positive outcome from Estonia's undertaking. 'Even if this project doesn't work, we have achieved that the Estonian population is much more educated', Pikani said.

References

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