The Worshipful Company of World Traders

The XIth World Traders' Tacitus Lecture

Delivered at the Guildhall in the City of London on

11th February 1998

by

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Health and Wealth from Molecules

Alderman Martin, Master, Lords, distinguished guests, ladies and gentleman.

May I first of all express my thanks to the Company of World Traders for inviting me to add my name to the list of lecturers in the Tacitus series. And, to be giving this lecture in such magnificent surroundings makes this evening particularly special for me.

Cornelius Tacitus of course was a Roman historian, senator and famous orator, who was renowned for his terse, albeit sententious, style of communication. Since I have just 45 minutes or so to cover such an enormous subject area, I will, in line with this lecture's namesake, try to adopt a sententious style, but also ensure that I do not, at any time, resort to a terse approach! Nevertheless you will, I am sure, appreciate that on the subject involving my Company which is currently making headlines, for the present, I am required to remain uncharacteristically TACITURN!

Health and Wealth from Molecules

The health and wealth that has been achieved to date from molecules, and the tremendous potential that molecules have to deliver much greater progress in the future, will be subject of this evening's lecture. And I must clarify that for the purpose of my talk, I am defining a molecule as the new medicines that the biopharmaceutical industry develops and brings to the market. This is a fair definition since it is precisely the role that pharmaceutical and biotechnology companies have in society. No-one else fulfils this role or is likely to.

The pharmaceutical industry has been in existence for just over 100 years yet in that relatively short period of time, it has delivered significant benefits to the world.

Health Benefits

The benefit that springs immediately to mind is of course the improvement of health.

The average life expectancy at the beginning of this century was just 49 years. By 1920 it had risen to 54 years and today it is over 76 years, with further increases forecast as we enter the 21st Century. In fact, for every four years since 1965, one additional year has been added to life expectancy at birth.

Much of this increase has been due to the control of infectious diseases that we hardly think about now such as smallpox, diphtheria and typhoid fever.

Around the world, the past century has seen startling improvements in health.

Smallpox has been eliminated, diphtheria and polio are on the verge of extinction and as you can see, there have been successes with many other diseases too.

Together with the introduction of public health measures, this impressive picture is the result of astounding discoveries of new medicines and vaccines throughout this century, which have successfully eradicated disease, relieved suffering and saved millions of lives.

For decades, tuberculosis was a major killer in developed countries.

Some of us may recall that patients were merely sent to sanatoriums to "wait out" the disease, and to be isolated from uninfected individuals since little else could be done. Then during World War II, physicians and researchers developed antibiotics that dramatically reduced the worldwide incidence of TB.

Unfortunately you may be aware that the disease is on the increase once again as a result of the emergence of drug-resistant tuberculosis bacteria in all countries of the world.

Familiar to all of you is penicillin, one of the best-known antibiotics and a remarkable drug which helped eradicate or control some of the world's worst infectious diseases.

For the first time, it was possible to really influence the course of disease. People could go to a pharmacist for medicines to help treat and control a host of infectious diseases such as pneumonia, diphtheria, spinal meningitis and scarlet fever.

We should all take pride that many improved medicines and vaccines have emerged from pharmaceutical companies in Britain, indeed British laboratories can currently boast 5 out of the world's current top 20 medicines.

And it is not just in medicines and vaccines that we have excelled, British doctors and scientists pioneered many other important developments including the invention of the body scanner and the pharmacological approach to drug design.

The key success factors behind this performance are the value of the NHS as a "clinical test bed", a drugs pricing regimen which recognized the need to reward pharmaceutical companies for long-term investments and of course our strong science base – in addition to medicine, Britain has a long and proud heritage in science, engineering and technology stretching back to the Industrial Revolution.

Economic Benefits

But this lecture is not just about health – it incorporates the creation of wealth too. So before reviewing how, in the future, the industry will be even more successful in fighting disease, I would like to spend a few minutes on the economic benefits of the industry and specifically, how the UK based industry has benefited the British economy.

Let's start by looking at the world pharmaceutical market.

With total sales over £165 billion, geographical analysis illustrates that 82% of the industry's business comes from North America, Europe and Japan.

As an aside, it is worth noting that the remaining 18% of the world pharmaceutical market comes from the emerging markets which are growing very strongly and offer tremendous potential well into the next century.

Within the developed markets, North America is dominant – contributing 37% of the world's sales compared with only 3% from the UK.

Despite this, the UK plays a major role. Three of the top 20 pharmaceutical companies are British and we clearly lead Europe in the "so-called" biotechnology sector. Whether classified by some as being part of the pharmaceutical or biotechnology sector, all of these companies belong to one industry – one that searches for new ways to treat important diseases, produces medicines for the world and indeed sells them to the world.

The economic benefits to the British economy are substantial, in fact a couple of years ago, a document from the Office of Health Economics estimated that if the resources, people and capital used in the industry today were to be put to other uses, the UK would be worse off by some £2 billion per year.

Let's have a look at these benefits in a little more detail – I have classified them under 4 main areas:

- Investment into R&D
- Value of exports
- Employment
- and shareholder value

First, investment into R&D.

The industry invests huge sums of money in research and development into new treatments for diseases such as AIDS, heart disease, problems associated with the central nervous system and many many more serious and common conditions.

The importance of the pharmaceutical sector in UK R&D is illustrated in the latest DTI scoreboard. The three pharmaceutical companies: Glaxo Wellcome with £1.2 billion, SmithKline Beecham and Zeneca occupy the top 3 places in the league table of R&D expenditure by company.

Between us, the 3 companies spent over £2.5 billion on R&D in 1996 which is over £6.8 million every day and accounts for at least one third of the total R&D undertaken in the UK.

Second, the value of pharmaceutical exports.

In 1996 this was over £5 billion – equivalent to more than £70,000 per employee – and after North Sea oil, the pharmaceutical industry is Britain's second most successful exporter, with a trade surplus of over £2 billion in 1996.

Third, employment where not only the figures are significant, but they reflect the provision of high quality jobs for people with high academic qualifications.

The industry employs approximately 75,000 people, and is probably responsible for employing an additional 250,000 people in related companies.

At Glaxo Wellcome in the UK, our 16,000 strong workforce has a particularly impressive academic profile. Forty three percent of staff hold a first or post-graduate degree and a further 14.5% hold other qualifications and certificates at diploma level.

And finally the fourth benefit, the creation of shareholder value.

Taking Glaxo Wellcome as an example again. Over the last 12 months our share price rose by over 50%, such that our market capitalisation increased from £33.6 bn to £51.5 billion, creating nearly£18 bn of additional value – a figure equivalent to the current value of Marks and Spencer.

That value is to the benefit of Glaxo Wellcome shareholders, whether they are professional fund managers such as pension funds, insurance companies or individual private holders.

A large part (50%) of the £1,600 billion invested by fund managers in this country is in UK equities. And the pharmaceutical industry currently accounts for 10% (with Glaxo Wellcome accounting for 4.6%) of the value of all UK equities.

So clearly the creation of shareholder value in the pharmaceutical sector has a very meaningful impact on the value of all managed funds in the UK. That means knock-on benefits too, for example, pension scheme members, unit trust holders and others in the country not necessarily directly connected with the pharmaceutical industry.

That concluded a very brief reflection of what has been achieved in the past. Now we can look forward to even greater success in the future, since progress continually expands the range of options for tomorrow.

The search for new medicines has entered an era of unprecedented opportunity, offering new insights and opportunities for the research-based pharmaceutical industry to fight health problems that have so far eluded treatment.

Furthermore we look forward to producing medicines of value which will bring about wealth through additional ways to those outlined above. This is critical in the light of the economic forces which are increasingly driving the structure of the pharmaceutical industry – forces that have been seen in the pressure on the share of GNP spent on health and the need to meet the various challenges of value for money.

Up until recently in many situations around the world, you had a patient, a doctor and a payor. The patient would go to the doctor, the doctor would prescribe, and the payor would pay, and each party did not really bother each other too much. But then government budgets tightened and as a consequence, public healthcare systems came under increasing pressure. Regardless of whether healthcare provision is through the private or public sector, every market has seen aggressive cost-containment strategies. Even in the US where private medicine is dominant, the cost of publicly-funded programmes is a big issue.

Third Generation Pharmaceutical Research and Development

So what is being done within the industry to ensure we harness new science and technology and ultimately deliver medicines of value?

This can be summarized by what we call "the third generation pharmaceutical R&D". It is enabling research operations within the major pharmaceutical companies to use new and powerful skills and disciplines which will bring about new opportunities in many areas – in science, technology, medicine and the market place.

I am not saying that the skills and disciplines learned during the first and second generations are obsolete – on the contrary, they are as important today as they ever were and must be developed further.

Science – New Genetics

For example science within the pharmaceutical industry was driven initially by chemistry and more recently by biology and these disciplines will still be critical components of

drug discovery. This is an industry that grew up via the chemical industry of Germany, Switzerland and the north-east of the US.

To complement these older disciplines, third generation science is seeing a greater role played by genetics in the way drugs are discovered and developed and this is a subject I would like to spend some time on now.

Genetics is a crucial newcomer in drug discovery and provides an entirely new approach for studying the development of disease, an individual's susceptibility to it.

It helps us to discover the hows and the whys behind facts we already accept. For example, we all know that certain things such as heart disease or cancer can run in families. Genetics identifies factors that influence if, when and to what extent someone in a particular family will get a particular disease. In other words, it shows us exactly what is running in a family and how we can do something about it.

This achievement originates from the significant advances of the human genome project – the international collaboration devoted to completely sequencing the haystack of three billion base pairs of human DNA which make up the 80,000 or so genes. As a consequence of flexible and focused management strategies, this programme is ahead of schedule, with a current prediction that >90% of the genome will have been sequenced by 2001.

Let's look briefly at how this tremendous effort will bring about significant improvements in the provision and practice of healthcare:
First *addressing the common diseases*: with the exception of infectious diseases, the most intransigent health problems and those which are rising at a worryingly high rate – such as Alzheimer's, asthma and heart disease – have in the past been addressed by merely providing palliative relief. However, human genetics and genomic research will identify many genes associated with the common diseases, and this will ultimately enable us to understand the underlying mechanisms of disease.

This leads to the second of the five benefits – the *redefinition of disease* areas as we currently know them. So called 'single' diseases will be divided into clinical subgroups, each subgroup having a different, underlying mechanism. So instead of merely describing diseases according to the phenotype – that this on the basis of clinical symptoms, we will be able to redefine them according to genotype which describes the underlying mechanisms involved in the expression of the clinical picture.

The third benefit relates to the specific *targeting of treatment.* We now know that an individual's genetic profile determines whether or not a given patient is likely to respond favourably to a standard therapeutic dose. And furthermore, we also know that the incidence of drug-induced side effects also has a significant genetic component. Genetic tests will therefore enable individual patients to be targeted with specific treatment to maximize efficacy and minimise side effects. In other words we will be able to target drugs towards those people most likely to respond.

The fourth benefit is the *discovery of novel targets and effective treatment.* By identifying underlying disease mechanisms, genetics will enable us to focus on novel, well-defined targets, and ways to modify these targets so that we can develop effective treatments which have the potential to cure or at least significantly modify disease.

The fifth benefit is the potential genetics has *in providing effective preventative healthcare.* In future we will be able to assess and act upon the risk of individuals developing many diseases, since genetics will allow us to screen to susceptibility long before the symptoms of disease develop. This genetic information can then be combined with known conventional risk factors – such as inactivity, diet and smoking – to assess the risk of developing disease with much greater accuracy than has been possible up until now.

Let's have a look at how genetics is already having a demonstrable impact on the well-being of ordinary people. This requires an understanding of susceptibility genes. These genes contribute to the increased risk of a common disease where, more often than not, there is a high unmet need.

As I said earlier, in the past we have not been able to address common diseases since we did not understand the genetic component and hence underlying mechanism. Most genes identified to date are those for fairly rare diseases which arise from a fault in a single gene – for example cystic fibrosis or Huntington's Disease.

However, now one – and to date only one – susceptibility gene has been linked to a common disease that is widespread in the population.

That gene is apoE which has been linked to Alzheimer's disease.

Everybody in this room has two apoE genes: one from your father and one from your mother. It is likely that 2% of the population have the genotype aopE4/4, 20% of people are ¾ and 12% are 2/3. These two genes constitute your apoE genotype.

The mean age of onset of Alzheimer's disease as a function of apoE genotype, and is based on data that have been confirmed widely throughout the world. If you are a 4/4 your average age of onset is before the age of 70. If you are 2/3 your average age of onset is over the age of 90. So simply on the basis of your apoE genotype alone, there is more than a two decade difference in the onset of succumbing to Alzheimer's disease. If you are 3/4, the average age of onset is about 77, and if we all lived to 140 years of age we would all get Alzheimer's disease!

This information has meant that an accurate diagnosis in the early stage of Alzheimer's has risen from 60-70% to 97-98%. Once we know who is likely to suffer from the disease and once we understand the basis of this picture and can change this line, we may be able to design drugs that will slightly alter people's metabolism so that they get

Alzheimer's at 110 instead of 70 years old – in that way we have not only a treatment, but also a prevention for Alzheimer's disease.

I have mentioned the use of genetic testing to diagnose disease on several occasions, so I will touch upon one of the dramatic developments which could revolutionise the speed and precision of genetic screening.

I am referring to genetic microchips that are being developed by a number of commercial organizations, including Affymetrix of Santa Clara, California – a Glaxo Wellcome affiliated company.

These so-called genechips, have the capacity to completely display the sequence of a single gene so that all variations within a particular gene can be detected. And importantly, this technology has the potential for widespread use, since it can perform vast and sophisticated analysis quickly and relatively cheaply.

The dramatic impact that such technology could have on the way medicine is practiced was summed up in an article in Time magazine, in the USA, at the end of last year. The opening paragraph of this article reads as follows:

"As he chats with the young mother, the doctor flicks a cotton wool swab into the mouth of her infant son, collecting a small sample of mucus from inside his cheek. In the back room of his office, he inserts the sample into a machine, which extracts DNA from the mucus cells and compares it with the genetic material on a dime-size chip. Minutes later, a computer printer begins to spit out a list of the infant's genes. Fortunately, all but a few of the genes are labelled "normal". It is those few that the doctor discusses as he explains the results to the mother. "your son's genetic inheritance is generally good", he says, "but he is somewhat predisposed to skin lesions. So starting right away, he should be protected against excessive exposure to the sun". And, the doctor warns, "he may well be susceptible to cardiovascular disease later in life. To lessen his risk, after about age two he should begin a lifelong low-fat, high-fibre diet".

Fact or Fiction?

Before we get carried away we must recognize that these same scientific and medical advances are not only giving us hope for a healthier future, they are also raising a host of ethical, legal and social questions.

First, there is the issue of diagnosis being easier than cure. There is considerable debate as to whether genetic testing, before disease symptoms are apparent, should be restricted to those diseases for which effective therapy exists.

For example, positive tests for Huntington's disease can have a devastating effect on not only the individual tested, but also on family and friends. And even a negative test can create problems, by removing a spectre on which a whole life may have been organized.

Another controversial issue is that our ability to perform and commercialise genetic-based tests is already overtaking our ability to understand the biological relevance of the results.

This is aptly summed up by this caption:

"It's like this, Mrs Cameron. The results are negative, but that doesn't mean positive, exactly. Nor is it negative, we wouldn't want a double negative there, would we…."

The potential for genetic information to be misused is another major cause of concern.

Reports already exist of people who after testing positive for disease genes, experience problems in obtaining life insurance coverage. Of course insurance companies have always to some extent been able to identify some people at risk by merely requesting information about the health and cause of death of parents and siblings. However access to genetic test results will make this much easier and systematic.

Concerns are also rife in certain sections of society surrounding other sensitive areas – such as eugenics and human cloning – the potential for genetics to tamper with nature.

However, it can be argued that in the case of mutational genetics, tampering with nature to the extent of choosing normal offspring has already occurred and in doing so, has diminished pain and suffering for many families. Before the gene for Duchenne disease – a form of muscular dystrophy – was discovered, male children of most women who had the disease were all aborted. Today, we can test which unborn child has the genetic susceptibility, thereby allowing many boys who would otherwise have been aborted to live.

But what can be done to prevent unnecessary anguish and controversy which, at worst, could ultimately delay or even prevent further progress in genetic research and translated improvements in medical practice? All of these complex issues initially require broad, informed and rational debate. Such debate is already happening in the form of various national commissions and bodies.

For example, it is refreshing to discover that the UK is to take a considered and informed route towards decisions on human cloning – through our Human Genetics Advisory Commission – a route which seems sensible and neatly cuts through knee-jerk reactions of blanket bans and ill-informed hysteria.

Medicine

Returning now to the third generation of pharmaceutical research and development and how this is changing the practice of medicine.

Medicine used to be an art form and then it became experience driven. The older doctors made all the decisions since they had the most experience and had seen a lot of patients.

There is a welcome move towards treatment decisions being made by the best informed, who understand the underlying science and the most recent clinical trials data. This is known as evidence-based medicine.

Technology

Moving to the third category.

Technology is the area that will drive the business. We have moved from manual and automated methods of research into the exciting area of computer-controlled robotics.

The advantage being that the robots can carry out all the mundane tasks scientists previously had to spend precious time doing themselves, leaving scientists free to do the thinking and be more creative.

This very complex-looking machine is a combinatorial chemistry synthesiser which was built by our wholly-owned subsidiary Affymax at Palo Alto.

Combinatorial chemistry uses a mix of computer software, chemistry, molecular biology and ingenious automated technology to synthesise thousands of diverse molecules per week.

This machine, without doubt, is the most advanced combinatorial chemistry synthesiser in the world – with one person, with some technical back-up, and one computer-driven synthesiser, it can literally make millions of compounds a year.

The enormous number of compounds generated by combinatorial chemistry all have to be tested for basic biological activity, and this is achieved with robotic systems.

These robots have increased our screening capacity about 100-fold since 1995 and importantly, they can keep up with the rate at which we are preparing compounds.

At the moment Glaxo Wellcome can screen about half a million samples per week and that will go up to about a million per day next year with the next phase of technology that we are implementing.

The combined technology of combinatorial chemistry and high-throughput screening have significantly improved the chances of discovering potentially new medicines.

Market Place

And finally the market place. Ten years ago quality was the issue, in the past 5 years it was more about cost – squeezing prices and efficiency. Now markets are looking for value – quality at a fair price.

Sales and marketing was traditionally characterised by communication between the pharmaceutical company which had developed the medicine and the prescribing physician. This has been changing, with the focus that value is paramount.

First the customer base has been expanding to encompass many other target audiences, such as payors and even the patient.

In addition, the expansion of information has facilitated more objective decision-making. There is now the potential for a more rational and powerful approach to purchasing decisions and the use of medicines – linking interventions to outcomes via the growth of evidence-based medicine.

Medicines of Real Therapeutic Value

So how will the changing face of science, medicine, technology and the market place translate into therapeutic gain?

First of all, new types of medicines will emerge, characterised by an increase in biotechnology products. Novel vaccines are a particularly interesting area, not only because we are understanding more and more about the immune response, but also because they are a uniquely cost-efficient form of healthcare. And to facilitate the optimal delivery of medicines, diagnostics will gain wider use – to detect disease, to define the appropriate treatment and to monitor disease during treatment.

Not only do we have the potential to produce new types of medicines, but the potential also exists to increase the number of these innovative compounds which actually reach the patient.

And finally, the tremendous advances I outlined in genetics and genomic research will bring about a very different approach in the way we address disease and also has the potential to bring about more effective preventative healthcare.

All of these advances will contribute to the provision of medicines of real therapeutic value.

How do we define medicines of real therapeutic value?

Quite simply, they go further than just affecting the disease in some way – such as relieving symptoms which is the limit of many of today's treatments. These medicines have the potential to cure or significantly modify the common serious diseases, thus reducing the need for secondary care, and this of course will bring about significant cost savings. Medicines of real value also give patients increased quality of life and increased workplace productivity by reducing time off work.

We already have examples which demonstrate that investment in medicines delivers economic returns to society many times greater than the outlay.

First AIDS, where medicines have dramatically reduced the costs of treatment.

Combination therapy with Glaxo Wellcome's Retrovir and Epivir, plus a protease inhibitor can reduce the AIDS virus to undetectable levels in some patients, enabling many people to return to work, thus reducing the need for hospitalisation. Annual costs of combination therapy ranges from $10-16,000. In contrast, the cost of treating AIDS in a hospital in the US is estimated at $100,000 per year.

And secondly, Schizophrenia. Drug therapy is just a fraction of the institutional treatment costs.

Clozaril, developed by Novartis, has helped many patients to be treated outside of hospital in less costly settings. The annual cost of drug therapy in another US example was $4,500, compared with over $73,000 per year for treatment in a state mental institution.

So there is firm evidence that medicines represent the best value and the greatest efficiency there is in healthcare. We need more innovative medicines so that these kinds of cost-savings advantages can be realised in many other diseases.

There is no doubt that the pharmaceutical industry can deliver more, so long as an environment exists to ensure the optimal use and prescribing of innovative medicines. This in turn necessitates that some key issues are addressed. The primary ones being:

- financing mechanisms for healthcare
- and social attitude

Financing Mechanisms

First the dilemma of burgeoning healthcare demand and the tradition of public financing.

Public payors have to change the focus from healthcare or medicines as a % of GNP, towards the measurable benefits of different interventions. This is likely to lead to increased levels of expenditure on pharmaceuticals, based on the recognition that they are cost-effective approach to healthcare.

The public finance problem will need to be tackled by rethinking the balance between private and public financing. We need to examine why the state feels obliged to finance all health demands – from the essential to the elective. It does not do this for housing or food which are equally fundamental needs. For these commodities people have been given discretion to spend their money, with state support available for those who are economically disadvantaged. Why should healthcare be any different particularly since people want to see more money spent on health.

A solution to this problem is to allow individuals the discretion to purchase additional amounts. This would encourage a complementary private sector in healthcare as has been achieved with other public services such as education and transport. In this way the extra private spending provides a way of improving levels of service without raising public expenditure which is inevitably constrained.

This does not imply that changes should be brought about overnight, but represents a long-term policy adjustment that governments need to address.

Social Attitude

The second issue we need to address if the industry is to deliver innovative medicines is social attitude.

There is no question that the pace of modern innovation can create anguish and controversy within society and this is to be expected when so many of the recent advances are still shrouded by the unknown. Human genetics is a good example. The response to the cloning of Dolly was not to celebrate an achievement of British science or to examine the opportunities it could open up for medical advance, but to fear the threat that we would soon be overrun by human clones.

To remove this fear, society must be adequately informed of both progress and hurdles. Despite the proliferation of medical and scientific news in the media, society still has a lot to learn, and the medical profession has a vital role to play in ensuring the information is disseminated in a useful and meaningful way. When innovation works and improves the quality of life, the public will accept it and will regard it not as a threat but instead, an opportunity. The fear and anguish is all part of the learning process.

Society must also be educated that good healthcare like everything has a price. There needs to be a channel of communication to the public by pharmaceutical companies, to convince people to focus on value rather than cost, to be concerned about healthcare and to try to get the best possible treatments. This is already happening in the US where companies are allowed to advertise their products direct to consumers – which serves to inform patients and allow them to be involved in their own personal healthcare. Why should European patients be denied the same level of information and involvement?

Contribution of Improved Health to Economic Growth in Developing Countries

Many of the issues I have addressed up to this point demonstrate the value that medicines can bring to developed countries. However, equally compelling evidence exists that improved health contributes to the economic growth of developing countries too. Here are some examples.

An obvious source of gain is *reduced production losses caused by worker illness.* Take leprosy as a classic example. This is a disease that effects people in the prime of life, seriously deforms 30% of those affected, and may shorten working life as well. A study

estimates that the prevention of deformity in all of India's 645,000 lepers would have added an estimated $130 million to the country's 1985 GNP, quite apart from the reduction in human suffering.

Improved health also *permits the use of natural resources that have been totally or nearly inaccessible because of disease*. This is being demonstrated by the Onchocerciasis (river blindness) Control Programme which was set up in 1974 to cover 11 Sahelian countries in West Africa. Apart from the enormous health benefits (more than 1.5 million people once seriously infected have completely recovered; estimated that it will have prevented at least 500,000 cases of blindness by the year 2000), it has freed up approximately 25 million hectares of previously blighted land for re-settlement and cultivation, thereby boosting agricultural production.

Improved health *increases the enrolment of children in school and makes them better able to learn*, and there is no question that schooling pays off in higher incomes. Studies in Ghana, Kenya, Pakistan and Tanzania indicate that workers who scored 10% above the sample mean on various tests have a wage advantage ranging from 13 to 22%, whilst in Nepal, farmers with better mathematical skills are more likely to adopt profitable new crops.

And finally *spending that reduces the incidence of disease can produce big savings in treatment costs*. As I mentioned previously, AIDS is a prime example. Calculations for India show that given prevailing transmission patterns, each currently HIV-positive person infects one previously uninfected person every 4 years. If the transmission rates could be slowed to one every 5 years, the corresponding reduction in medical costs, amounts to $750 by 2000 for each currently HIV-infected person, for a potential total of $750 million.

All of the examples I have quoted come from the World Bank's "1997 World Development Report" in which it states, and I quote:

"The detrimental effects of poor health on individuals and households and on the use of resources suggest that better health should lead to better economic performance at the national level".

So there is plenty of evidence to suggest that improved health means more rapid growth for the developing countries, and as such, should be explicitly recognised in formulating policies and reflected in the optimal use of the tools and mechanisms now available for combating and eliminating disease.

Conclusion

So to conclude, there is no doubt that health and wealth can be created from "molecules". Good health – as you all know from experience – is a crucial part of our well-being, but spending on health can also be justified on purely economic grounds.

The biopharmaceutical industry has generated considerable health and wealth to date. And importantly, the rapid and profound advances in technology and scientific knowledge are significantly increasing our ability to create even greater benefits in the future. The potential certainly exists, but we must not forget that a real social commitment to innovation is needed for this potential to come to fruition.

I am incredibly proud to be part of the UK pharmaceutical industry which must be regarded as one of Britain's true success stories. We have made a significant contribution to past success and we are now laying the foundations for continuing success in delivering medicines of sustainable value to patients around the world way into the next century.