The Academy of Medical Sciences

FORUM

Horizon scanning: looking ahead to 2025

March 2014

Report of the FORUM Annual Lecture 2014

The Academy of Medical Sciences

The Academy of Medical Sciences is the independent body in the UK representing the diversity of medical science. Our mission is to promote medical science and its translation into benefits for society. The Academy's elected Fellows are the United Kingdom's leading medical scientists from hospitals, academia, industry and the public service. We work with them to promote excellence, influence policy to improve health and wealth, nurture the next generation of medical researchers, link academia, industry and the NHS, seize international opportunities and encourage dialogue about the medical sciences.

All web references were accessed in June 2014.

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Overview

The Academy of Medical Sciences hosted its 12th FORUM Annual Lecture on 27 March 2014 at the Royal Academy of Engineering. The lecture was delivered by a panel of speakers drawn from academia, industry, the NHS and the regulatory sector, namely:

- **Sir Gordon Duff FRSE FMedSci**, Chairman, Medicines and Healthcare Products Regulatory Agency (MHRA);
- **Professor Sir Malcolm Grant CBE**, Chair, NHS England;
- **Professor Dame Nancy Rothwell FRS FMedSci**, President and Vice-Chancellor, University of Manchester; and
- **Professor Patrick Vallance FMedSci**, President, Pharmaceuticals R&D, GSK.

The speakers were invited in turn to present their views on the challenges and opportunities facing biomedical research looking ahead to 2025. The presentations were followed by a lively Q&A discussion session that generated a vibrant debate on topics including: changes in the healthcare landscape and enhanced collaboration between sectors, new modes of developing drugs and devices, flexibility of the regulatory framework, opportunities offered by the use of data, the importance of addressing health behaviours, and the centrality of patients and the public.

This report is divided into two sections: the first summarises each of the panel members' talks whilst the second encapsulates the stimulating discussion session that followed.

Film footage of this event is also available to view on the Academy's website: http://www.acmedsci.ac.uk/FORUM

Session I – Panel presentations

1.1 An academic perspective: Professor Dame Nancy Rothwell FRS FMedSci

Professor Dame Nancy Rothwell anticipated that the way education is delivered will have changed by 2025. Even today, the future role of practicals in school education is being debated. She called for stronger maths and analytical skills in all Science, Technology, Engineering and Mathematics (STEM) disciplines. This will be particularly important as scientific research is becoming increasingly multi-disciplinary in nature as the complexity of studies increases. She anecdotally reported that "industry has problems, and universities have departments" to highlight that research groups need to operate outside their 'silos'. The researchers of tomorrow will need to jump across disciplinary boundaries and work in teams, including with the social sciences. Professor Rothwell argued that distance learning will become more mainstream, anticipating that up to 50% of students will be based outside the UK. Boundaries, both geographical and disciplinary, will become blurred and the UK should benefit from inward migration.

Professor Rothwell also emphasised the importance of team science: every individual's contribution should be valued, not just the first and last authors on a publication.[1] An optimal balance between collaboration and competition should also be struck. Current funding models drive competition and it will be important to consider how metrics and incentives can be changed to address this. Collaborations will be increasingly international, and funders should consider how they too can collaborate to drive research. Clusters will remain at the heart of good working environments; the UK is ideally placed since it is in itself a cluster of talent.

The innovation model has improved, though more can be done to drive this agenda. Universities are working much better with industry and with the healthcare sector, but this tends to be unidirectional. Tripartite collaborations should be encouraged. The open data agenda is also gaining momentum, although it will be important to balance the intellectual property rights of researchers and the resources they are expected to invest in a project. Dissemination, communication and engagement with the public has never been more important and Professor Rothwell suggested that the public are likely to play a role in the decisions of certain projects in the future.

In that regard, Professor Rothwell stressed that by 2025 scientists and clinicians should be expected to communicate outside of their professional groups. This will be important to encourage public support for science investment and to rebuild the trust in scientists that has suffered of late.

Professor Rothwell concluded her talk by outlining significant areas of scientific research, including human development, ageing, diseases caused by multiple complex genetic, lifestyle and environmental factors, and mental health. The discrepancy in funding for

[1] The Academy of Medical Sciences is preparing to launch a policy project on team science that will explore the challenges and key barriers in supporting and encouraging researchers' participation in collaborative research projects.

behavioural research, which currently attracts only 1% of funding despite 50% of disease being driven by behaviour in the West, was also highlighted as was the need for a revision of certain economic models for antimicrobials to address the increasing concern of antimicrobial resistance (please refer to the discussion in Session II). She emphasised that overall, the UK is in a strong position, with world-class facilities, funding and the NHS to support research towards 2025 and beyond.

1.2 An industry perspective: Professor Patrick Vallance FMedSci

Professor Patrick Vallance opened his talk by emphasising that the projects currently in the laboratory represent the medicines of 2025. One of the major challenges that has been facing the pharmaceutical industry is the falling number of approved drugs per unit of investment – the so-called Eroom's law.[2] Although this has been a worrying trend, things appear to be changing across industry, particularly in light of the potential of stratified medicines, which should allow industry to target the right patient population, with the right drug, at the right dose, at the right time.

Future challenges to the search for new medicines must consider: the target, underpinned by basic life science research; which modality (which type of molecule or intervention) would be most useful; how to demonstrate an effect in humans (experimental medicine); and the ways of exemplifying the effects of these novel treatments in the real world of healthcare.

There has been as shift in the types of medicines entering the phase III pipeline: roughly 40% are now vaccines or biologics, due in part to the greater protection against genericisation afforded by these approaches; 25% are cancer drugs, a disease group where more targets have been identified and clinical readouts are somewhat easier; and more than 10% are immuno-inflammatory drugs.

Healthcare changes that are likely to occur by 2025 will concern:

- **Diagnosis**: individual diseases will be better understood at a molecular level, which will allow industry to create greater segmentation within medicines and the patient populations they target. The sector is already moving away from 'all-or-nothing' blockbuster drugs to a model that supports the generation of targeted medicines.
- **Medicines**: the pharmaceutical industry is moving away from a focus on small molecules towards biologics, antisense molecules, gene and cell therapies (including *ex-vivo* gene manipulation), and bio-electronic interventions.[3,4]
- **Monitoring**: multi-modality sensors will have a dramatic impact on the type of information that can be collected for clinical trials and, as such 'invisible' wearable

[2] Scannell JW (2012). *Diagnosing the decline in pharmaceutical R&D efficiency*. Nature Reviews Drug Discovery **11**, 191-200.
[3] Biologics are medicinal products manufactured in or extracted from a biological source. They are often large, complex molecules, or mixtures of molecules, and are distinct from drugs that are synthesised chemically. Vaccines are an example of biologic.
[4] Antisense molecules are strands of nucleic acids that bind to specific messenger molecules, called messenger RNA (mRNA), which are degraded as a result of this binding. mRNA is a key intermediate that allows DNA to be translated into proteins. Antisense molecules could be used to prevent the production of a particular protein that is known to cause a particular disease state.

technology becomes part of everyday life, holds real promise to collect real time data for research. There is much excitement surrounding these technologies and it will be important to ascertain whether they meet current expectations of quality.

- **Access to medicines**: the ways in which medicines are adopted by healthcare systems will continue to evolve. It is currently impossible to predict whether there will be a shift to more rigorous regulatory assessment with later access to medicines or earlier access with ongoing data collection. This trend will dictate the future innovation model. Companies must also embrace the fact that medicines will not be limited by national boundaries. Global access and pricing may have implications for low and middle income countries and for the location of manufacturing that can now be undertaken in low-cost environments, particularly with the developments in mobile production capacity.
- **Patients**: remote and direct feedback will allow patients to play a much larger role in their own healthcare. This will fundamentally change patient relationships with their General Practitioner (GP).

Research and development (R&D) models will also change as we move towards 2025 and will focus on:

- **Open innovation**: while it is important for organisations to protect their inventions, open innovation has the potential to provide a knowledge base for the entire sector and drive innovation. Current exemplars include the GSK, EMBL-European Bioinformatics Institute and Wellcome Trust Sanger Institute collaboration for target identification.[5] Clinical trial data is increasingly available to researchers under appropriate models of access and global health priorities, including malaria and tuberculosis, will greatly benefit from increased access to pre-competitive data.[6,7] If such models of open innovation are successful in generating novel treatments, their use may become more widespread.
- **Global participation**: there will be a shift from the current US/EU domination of pharmaceutical research to developing domestic industries, such as those found in China.
- **Major hubs**: hubs of excellence will nevertheless continue to exist and prosper. They will be driven by an ecosystem of collaborative clusters of universities, smaller biotechnology enterprises and pharmaceutical companies.
- **Real-time iteration**: developments in monitoring technologies will greatly inform the course of drug development. Post-launch surveillance and the increased use of real world data, will inform the development of novel treatments and has the potential to enable earlier patient access to medicines.
- **Less uncertainty**: there will be a need to move to a business model that has a higher degree of certainty and lower risk. This will be achieved by greater insights in biology and more sophisticated patient segmentation so that medicines for targeted populations can be delivered, rather than following the 'one-size-fits-all' blockbuster model which has a very high cost when it fails. This change in predictability is a must if the margins decrease with increased pressure on healthcare budgets.

[5] http://www.targetvalidation.org/
[6] https://clinicalstudydatarequest.com/
[7] http://www.gsk.com/research/sharing-our-research/open-innovation.html?tab=tabopen-lab-tres-cantos

The pharmaceutical industry model will evolve to 2025 by establishing flexible partnerships and acquisitions, bridging the gap between sectors, encouraging open innovation, and sharing risk.

1.3 An NHS perspective: Professor Sir Malcolm Grant CBE

NHS England, as an independent body, has a mandate to improve health outcomes rather than processes, and gives a unique capacity to think to the future of healthcare in England that transcends political timelines.

Disseminating change in the NHS is an enormous task considering the range and complexity of activities it undertakes. For example, the NHS carries out:

- 1 million patient consultations per day in England, including 21.7 million visits to accidents and emergency (A&E) each year
- 19 million A&E ambulance calls per year
- 458 million community pharmacy interactions per year

The workforce includes 1.3 million NHS employees in England, 1.5 million community services employees and 5 million community carers. It is estimated that for every hour of contact with the NHS, 5,000 hours of self care are administered. The NHS must focus on the recipient and recognise that its most important asset is the patient's time.

Since its inception in 1948, the NHS has enjoyed a 4% increase in expenditure in real terms year on year. However, these finances have been frozen since 2011. At the same time, demand has continued to rise, with new problems presented by an ageing population and co-morbidities. Consequently, years of healthy living have not expanded at the same rate as life expectancy.

By 2020, the funding gap is expected to rise to £30 billion, of which only 30-40% can be addressed through improved procurement, pay and efficiency savings. Questions remain as to whether the NHS in its current format is still fit-for-purpose, even if the funding gap could be addressed.

The NHS is an ecosystem split between commissioners and providers. The newly established 211 Clinical Commissioning Groups (CCGs) have been allocated £65 billion to spend on healthcare and represent populations ranging from 60,000-900,000 patients. This new format could be transformative, allowing GPs and clinicians to influence commissioning decisions in response to their patients' needs.

Replicating innovation across the organisation, with 250 Trusts and primary care delivered by 20,000 GPs across 8,000 practices, cannot be achieved by a top-down approach. A holistic vision in the best interest of patients needs to be created and delivered by a dynamic system that embraces innovation.

This can be achieved at the patient-level by:

- **Keeping the patient at the heart of the NHS**: advances in medical technology will help patients monitor their health and prevent illness. The relationship between patients and professionals will change. Already young people are interacting with the healthcare system in a much more casual way – many are not registered with a GP but rely on last-line services such as A&E. There is also a trend to shift long-term conditions out of the hospital and into the home setting.
- **Transforming general practice**: primary care must embrace scale with shared responsibilities and the ability to attract clinicians out of the hospital wards and into the community. Single-handed practices are unlikely to be able to cope.
- **Integrating care**: integration of care is essential. It is often the handover of care between providers that is the most flawed aspect of healthcare, especially when coupled with poor record keeping. It has been a decade-long aim for the NHS, but provision of integrated care is uneven across the UK. 2015 will see the NHS invest £2 billion in joint funding with local government to advance social care.

At the hospital level, this can be achieved by:

- **Transforming A&E**: in many cases, A&E has become a substitute for primary care and this model is not sustainable. A properly integrated service, as discussed above, would not need to fall back on this provision. The ideal would be for 40-70 NHS Trusts with full clinical backup to provide this service, with local staging posts.
- **Providing elective care**: valuable lessons may be learnt on efficiency from abroad in raising productivity. It could be enhanced by separating planned admissions for elective care from unplanned admissions through A&E.
- **Specialised commissioning**: there are clear examples of the benefit of focussing specialised care into fewer larger centres. One such example is stroke care in London, which was focussed down from around 30 centres to eight centres providing experienced care around the clock and resulting in significantly improved care. Nationally this process might result in a significant reduction in the number of centres providing tertiary services.

CCGs have already been tackling many of these challenges, which should be done under the banner of better care, not austerity. Increased access to information, monitoring and diagnostics will help care be driven by patients.

Access to patient data will be key in driving change in the NHS. Recent concerns over care.data are understandable. However, it will be important to address these for the full potential of the scheme to be realised. Care.data will be vital in: providing better services – the NHS is currently operating without any formal feedback, realising the huge potential of linking '-omics' data (for example genomics, proteomics, metabolomics) with clinical data, and improving health by analysing big data to better our understanding of how the body works and responds to treatments.

It is an exciting but perilous time for the NHS, which will only survive as free at the point of access by combining the unique assets of England in having a comprehensive healthcare system, outstanding universities and a strong life sciences research sector.

1.4 A regulatory perspective: Sir Gordon Duff FRSE FMedSci

Sir Gordon Duff expressed his desire for the MHRA not to be viewed as an "iron-fist of regulation"; rather the MHRA should be perceived as a facilitator for those wishing to innovate, with a primary agency mission of protecting the public health and a co-agenda to support wealth creation.

The current challenge for the regulatory sector is the unprecedented rate at which science is developing, with rapid progress seen in big data collection and analysis, whole genome sequencing, stem cell therapies, novel devices and matrices, genetic therapies, diagnostics, among others. The rise of '-omics', wearable devices, and combinations of devices and drug products also mean that many new opportunities and challenges are in the pipeline, coupled with an increasingly globalised marketplace that will warrant widespread international scrutiny.

At the same time, stakeholder expectations are also changing: patients want faster development of better, cheaper, safer medicines. It is imperative for the regulators to strike an appropriate balance for patient safety. Patients must be informed on the risk:benefit ratios and their voice should be louder when it comes to patient-reported end points in the design and evaluation of clinical trials, and in the reporting of suspected adverse effects of medicines and medical devices.

The MHRA is taking a risk-based approach in its fields of responsibility to avoid over-regulation. It is also determined to support a firm science base to provide underpinning knowledge. Its merger with the National Institute for Biological Standards and Control (NIBSC) brought world-class expertise in standardisation and control of biological medicines, and now has a new Advanced Therapeutics Division.[8] Similarly, the Clinical Practice Research Datalink (CPRD) is now also part of MHRA and provides one of world's largest databases of longitudinal health records for research purposes. The MHRA is also using it to support post-marketing vigilance and to ascertain safety and efficacy in real life circumstances.

Recently, the MHRA has changed its internal system to get best scientific and clinical advice for devices by setting up internal group links with the Royal Colleges, specialised societies and other sources of expertise. It has also established an 'Innovation Centre' for pre-filing advice, including the possibility to set up joint meetings with the National Institute for Health and Care Excellence (NICE). Advice should be pro-active, targeting quality, safety and efficacy.

The MHRA has played a role in influencing the EU Clinical Trials regulation to ensure clinical trials can operate within a workable framework. It is also launching the Early Access to Medicines Scheme, a two-phase scheme aimed at providing "patients with life threatening or seriously debilitating conditions access to medicines that do not yet have a marketing authorisation when there is a clear unmet medical need".[9] The European

[8] http://www.nibsc.org/

[9] http://www.mhra.gov.uk/Howweregulate/Innovation/EarlyaccesstomedicinesschemeEAMS/index.htm

Medicines Agency (EMA) is launching an adaptive licensing pilot scheme, which should complement the MHRA's initiative and provide increased treatment options for patients.[10]

The MHRA must meet these new challenges while supporting innovation and safeguarding public health.

10 http://www.ema.europa.eu/ema/index.jsp?curl=pages/news_and_events/news/2014/03/news_detail_002046.jsp&mid=WC0b01ac058004d5c1

Session II – Discussion

Following the speakers' presentations, the floor was opened to the audience for a Q&A discussion session, chaired by Professor Sir John Tooke, PMedSci. Wide-ranging themes were debated including: quality of education, healthcare delivery and products; enhanced collaboration between sectors; issues surrounding clinical trials and the antimicrobial drug development model; the importance of addressing health behaviours; access to patient data; and new technologies and treatment strategies.

Quality

Quality, be it of education, healthcare delivery or products, was highlighted as a priority for all the sectors represented by the panel.

It was noted that despite the changes to the system introduced in 2012 that resulted in increased tuition fees, Higher Education income has actually dropped. The new system has shifted the burden of payment onto the individual but in real terms universities are still facing budgetary constraints. The challenge will be for the higher education sector to provide high quality education within these tighter budgets.

In terms of medicinal products it is paramount to tackle counterfeit medicines, which are a threat to public health, through greater co-operation between industry and regulators. Technologies are now available to trace the origins of products, which will help in this regard.

Quality of healthcare delivery and clinical outcomes will remain central to the NHS looking ahead to 2025, and is at the heart of NHS England's work.

Enhanced collaboration between sectors

It was felt that true partnerships between the three sectors (academia, industry and the NHS) need to be developed (a focus of the Academy of Medical Sciences' FORUM activity), with a shared understanding of the problem, aligned goals and a more collaborative approach.[11] Current barriers will need to be removed and greater movement of talent between the sectors encouraged. Boundaries between the sectors should become more porous, with people prepared to take the chance of a transition. It was thought that a breakdown of barriers between primary and secondary care was also needed.

The current temptation is to allocate responsibility for discovery to universities and industry, and delivery to the NHS. However, it is no longer enough for innovation to go in a linear way from "benchside-to-bedside"; rather it needs to go in a cycle from "bedside-to-bedside", where the NHS is actively involved in shaping the discoveries their patients need. Academic Health Science Networks (AHSNs) could play a vital role in the adoption and diffusion of innovation, and in the dissemination of good practice within the NHS. It

[11] http://www.acmedsci.ac.uk/FORUM

was felt that there is still a big variation in the focus and opportunities these networks provide across regions and that sharing working practices between AHSNs would be essential.

Collaborations will also extend beyond the current 'traditional' types and involve collaborations with physical sciences, engineering, and non-healthcare sectors. It was predicted that, although already in existence, these types of collaborations are likely to increase in numbers. Companies such as Samsung and Google that are not traditionally regarded as healthcare companies already have big healthcare divisions and collaborations with such organisations could have a clear benefit for society.

Clinical trials

Although the landscape for clinical trials has improved in the UK, it was felt that at present, the structure and culture of the NHS continues to hinder the UK's potential for being the country of choice for carrying out such studies. The Health Research Authority (HRA) will have an important role to play in streamlining the governance of clinical trials, as will the AHSNs in better organising this type of research.[12] Another challenge lies with performing clinical trials involving primary care as GPs generally do not see it as their role to participate in such studies. It will be important to encourage GPs to step away from conservative, defensive practices, and to recognise practitioners' efforts to do so.

In that regard, it will be essential for GPs to understand and respond to research, which should feature in undergraduate medical training and even extend to post-16 year old education in schools. It was felt that stronger academic-primary care partnerships, modelled on good academic-hospital partnerships, would be helpful although the time pressures facing GPs and their practices must be recognised.

Antimicrobial drug model

Concerns were raised about the economic model for the development of antimicrobial drugs. It was recognised by all the sectors represented at the meeting that antimicrobial resistance is an issue and one that very few companies are currently working on. Novel antimicrobial treatments are difficult to develop and at the same time they cannot be prescribed freely as they need to be kept as last line defences. Therefore the current economic model is not fit-for-purpose. Four key steps for progression were proposed:

1. Identifying good targets, driven by partnerships between academia and industry;
2. Supporting and maintaining clinical trial expertise, despite the low product throughput in the pipeline;
3. Ensuring greater harmonisation between regulators on the global stage; and

[12] The Academy of Medical Sciences played a seminal role in the establishment of the HRA, which was a major recommendation of its 2011 report, '*A new pathway for the regulation and governance of health research*'. http://www.acmedsci.ac.uk/policy/policy-projects/a-new-pathway-for-the-regulation-and-governance-of-health-research/

4. Reconfiguring the market to make such drugs commercially viable (for example pre-purchase).

One of the major issues is the expectation that antimicrobial drugs should be inexpensive. This dramatically impacts the business model and will need to be reviewed to incentivise industry research in this area. Regulators will also need to be open to innovative approaches to incentivise research into antimicrobials.

Health behaviours

It was felt that addressing harmful health behaviours, such as alcohol and substance abuse, will require collaboration between experts in health and social sciences research, industry, marketing sector, local governments, Public Health England and NHS England. The landscape of incentives, price and health advertising should be examined. There is a need for a deeper understanding of communications, and an effort to tailor messages to audiences such as young people who may not respond in traditional ways.

Two specific issues were discussed:

1. **Obesity**: Britain is currently the most overweight nation in Europe, which puts a significant strain on the NHS. To tackle obesity, it is important to recognise that self-regulation only goes so far. There needs to be a concerted effort involving different parties to: review the design of our cities and houses to increase exercise levels; examine food content, portion size and advertising; and better understand the science and psychology of obesity.
2. **e-cigarettes**: the MHRA lobbied for e-cigarettes to be licensed as medicines to ensure the quality, consistency of dose and dose delivery, and the need for appropriate post-marketing surveillance. As it stands, the long- term effects and risk of nicotine addiction are unknown and, without the regulatory framework overseeing their use, these effects will be harder to ascertain.

Future advances in preventative public health should lower the burden of chronic disease, whilst further investment in exploiting behavioural sciences could help improve health. This should go some way in balancing increasing healthcare demands with available resources. It will also be important to avoid becoming too defensive in treatment strategies and risk over-diagnosis and overtreatment. There needs to be more transparent decision-making about intervention based on quality of life.

As mentioned by the speakers, it was felt that more needs to be invested in behavioural research. Data are already available on public behaviour through retailer loyalty schemes for example. Universities, industry and NHS England should look to utilise this wealth of information to guide research. However, it will be important to balance privacy issues with research priorities. Some also thought that healthcare should be moved into the community rather than keeping it fixed to institutes, which often fail to best serve modern requirements.

In terms of healthcare decisions, the issue of the public understanding of biology was raised. The panel felt that individuals need to understand symptoms and their implications rather than the fundamental underlying biology of disease states. The key transition is the switch from self-treatment to reliance on the NHS, and educating people on when to make this switch is important. Information must be simple and relevant, too much detail may be counter-productive. It was felt that the main problem in the current landscape was the proliferation of readily-available information, the accuracy of much of it being hard to verify.

Access to patient data

It was highlighted that recent privacy concerns, sparked by events in the global landscape including the activities of Edward Snowden who disclosed classified documents linking the US National Security Agency (NSA) with global surveillance programmes, have raised public concerns about access to private data. Analysis of patient data will be critical to the NHS to improve overall service delivery and healthcare. As such, public anxiety over the long-term collection and analysis of health data needs to be addressed. This could be achieved through clear delineation of access rights, and plainly detailing what data will be accessed by whom and for what purpose. There should also be open dialogues with the public. There was a comment that access to healthcare brings both rights and responsibilities: sharing data to help others should be a cornerstone of this. It was also noted that many patients, when asked, are surprised that researchers do not already have access to their data.

New technologies and treatment strategies

Advances in technologies, such as wearable devices discussed in the presentation session, promise to improve healthcare. The “Proteus” pill, which communicates with Bluetooth-enabled devices, was highlighted as a potential solution to the issue of patient adherence to medicines.[13] It was noted, however, that whilst such devices may be helpful for patients with conditions such as dementia there may be a negative societal impact and privacy issues in incorporating them into every pill that is manufactured. It was also recognised that although forgetting to take medicines does occur, a proportion of non-compliance is done entirely consciously and that this technology is unlikely to tackle the underlying causes of non-adherence. Cost will also remain an important issue in any decisions about the use of these technologies.

Genetic tests, including panel tests and whole genome sequencing, are also becoming increasingly available. For their application, there will need to be strong evidence to link the test to a clinical diagnosis and/or treatment. If the diagnostics sector can provide appropriate evidence, there may be a real market for them in healthcare decisions in the future. However, it was felt that at present, many such tests remain too inaccurate for clinical impact and it remains to be seen how they will compare with larger scale diagnostic laboratories in guiding healthcare treatments in the future.

[13] http://www.proteus.com/technology/digital-health-feedback-system/

The potential of targeting epigenetic reprogramming to limit the risk of long term disease was also raised. There is some evidence to suggest that exposure to drugs or nutraceuticals at certain periods in development may help prevent or delay the risk of developing certain diseases.[14] While drug development programmes are currently underway to explore the potential of epigenetic influence in the treatment of disease, particularly in cancer, research is currently at far too early a stage to explore the effects of preventative reprogramming for long term health from birth, and the likelihood of being able to undertake trials in this area is very low. If such a novel treatment strategy is efficacious and safe, standard regulatory processes would apply to facilitate its application in public healthcare.

Summary

Biomedical research and healthcare delivery is undergoing a period of transformation. The manner in which health education is provided, research is conducted, products are regulated, and patients influence their healthcare decisions, will evolve to adapt to the changing requirements of society. This is likely to translate into increasingly personalised medicines and a transformation of the interactions between patients and their healthcare professionals. It will also require increased investment in behavioural research to better understand the drivers behind many of the chronic diseases in developed countries. Above all, this FORUM Lecture has reasserted the centrality of the patients and citizens to decision-making in healthcare.

Future successes in healthcare will be dependent on combining the strengths from academia, industry and the NHS, with support from the regulatory authorities. The UK is in a strong position, with world-class facilities and teaching, excellent funding streams, a valuable pharmaceutical sector, and the NHS, to lead research and its translation towards 2025 and beyond.

[14] Nutraceutical is a portmanteau word merging ‘nutrition’ and ‘pharmaceutical’ used to define a food or food product that may provide health benefits.

Appendix I Programme

27 March 2014

The Royal Academy of Engineering

14:00 – 14:30	**Registration and refreshments**
14:30 – 14:35	**Welcome and introduction** *Professor Sir John Tooke PMedSci*, President, Academy of Medical Sciences
14:35 – 14:50	**Academia** *Professor Dame Nancy Rothwell FRS FMedSci*, President and Vice-Chancellor, University of Manchester
14:50 – 15:05	**Industry** *Professor Patrick Vallance FMedSci*, President, Pharmaceuticals R&D, GlaxoSmithKline
15:05 – 15:20	**NHS** *Professor Sir Malcolm Grant CBE*, Chair, NHS England
15:20 – 15:35	**Regulatory** *Sir Gordon Duff FRSE FMedSci*, Chairman, Medicines and Healthcare Products Regulatory Agency
15:35 – 16:35	**Panel Discussion Session with Q&A** *Chaired by Professor Sir John Tooke PMedSci*, President, Academy of Medical Sciences *Panel members:* • **Academia:** *Professor Dame Nancy Rothwell FRS FMedSci* • **Industry:** *Professor Patrick Vallance FMedSci* • **NHS:** *Professor Sir Malcolm Grant CBE* • **Regulatory:** *Sir Gordon Duff FRSE FMedSci*
16:35 – 16:40	**Closing comments from the President** *Professor Sir John Tooke PMedSci*, President, Academy of Medical Sciences
16:40 – 17:00	**Refreshments**
17:00	**Close**

Appendix II Delegates

Dr Christiane Abouzeid Head of Regulatory Affairs	BioIndustry Association
Mr Matteo Aliberti Principal Consultant - Digital Strategy and Innovation	PA Consulting Group
Dr Caroline Aylott Head of Research Awards & Translation	Arthritis Research UK
Ms Catherine Ball Science Policy Officer	Biochemical Society
Dr Tom Barlow Scientist	Department of Health
Mr Richard Bellamy	
Ms Colby Benari Senior Programme Officer	Academy of Medical Sciences
Mr Ben Bleasdale Intern	Academy of Medical Sciences
Mr Guy Boersma Managing Director	Kent Surrey Sussex Academic Health Science Network
Ms Elizabeth Bohm Senior Policy Adviser	Royal Society
Dr Annette Bramley Lead, Healthcare Manager	Engineering and Physical Sciences Research Council
Sir Alasdair Breckenridge CBE FRSE FMedSci Chairman	Emerging Science and Bioethics Advisory Committee
Mr Daniel Bridge Policy Manager	Cancer Research UK
Dr Omer Casher Director	Imaqa
Dr Andrew Clempson Research Policy Manager	Association of Medical Research Charities
Professor Jonathan Cohen FMedSci Emeritus Professor of Infectious Diseases	Universities of Brighton and Sussex
Sir David Cooksey GBE FMedSci Chair	The Francis Crick Institute
Professor Cyrus Cooper FMedSci Professor of Rheumatology & Director	University of Southampton
Dr Claire Cope Policy Officer	Academy of Medical Sciences
Dr Nathan Cope Principal Consultant - Life Sciences and Healthcare Strategy	PA Consulting Group
Professor Janet Darbyshire CBE FMedSci Emeritus Professor of Epidemiology and Honorary Senior	University College London

Scientist at MRC Clinical Trials Unit	
Mr John de Pury Assistant Director of Policy	Universities UK
Dr Michael Devine Academic Clinical Lecturer	University College London
Ms Rebecca Devlin Intern	Academy of Medical Sciences
Ms Emma Du Four Senior Director Regulatory Policy	AbbVie
Dame Karen Dunnell Trustee	National Heart Forum
Mr Finlay Edridge Principal Consultant	PA Consulting Group
Dr Mark Edwards R&D Director	Ethical Medicines Industry Group
Dr Catherine Elliott Director, Clinical Research Interests	Medical Research Council
Dr Robin Fears Biosciences Programme Secretary	European Academies Science Advisory Council
Mr Felipe Fouto Programme Officer	Academy of Medical Sciences
Mr Leslie Galloway Chairman	Ethical Medicines Industry Group
Mr Nigel Gaymond Executive Chairman	Personalised Healthcare Alliance
Mr Rob Gear Futurist	PA Consulting Group
Dr John Gordon Commercial Director/Entrepreneur in Residence	Glasgow University
Mr James Gravesend	
Dr Jim Hagan Chief Executive Officer	Global Medical Excellence Cluster, King's College London
Dr Jeremy Haigh European Chief Operating Officer, Research & Development	Amgen
Dr Sobia Hamid	Invoke
Dr Mike Hardman VP IMI Collaborations	AstraZeneca
Professor Graham Hart FMedSci Dean, Faculty of Population Health Sciences	University College London
Dr Adam Heathfield Senior Director	Pfizer Ltd
Mr Nick Hillier Director of Communications	Academy of Medical Sciences

Sir Miles Irving FMedSci Emeritus Professor	
Professor Susan Iversen CBE FMedSci Emeritus Professor of Psychology	University of Oxford
Sir Roland Jackson Bt Executive Chair	Sciencewise
Dr David Jefferys Senior Vice President	Eisai Medical Research
Dr Edwin Jesudason Reader	University of Liverpool
Professor Derek Jewell FMedSci Professor Emeritus of Gastroenterology	University of Oxford
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