

Clinical academia for the future: research leaders and innovators

Report of a workshop on 3 April 2019

The Academy of Medical Sciences

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Opinions expressed in this report do not necessarily represent the views of all participants at the event, the Academy of Medical Sciences or its Fellows.

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Executive summary

The UK's outstanding research in world-class universities, vibrant pharmaceutical and medical technology industry, and significant capabilities in clinical and translational medicine in the NHS, underpin its world-leading position in health and biomedical research. However, financial and workload pressures are impinging on the ability of the clinical workforce to engage in the research agenda. Furthermore, the proportion of clinical academics, who play a vital role in driving important research, is in decline.

Clinical academics are university employees operating at the interface between academia and the NHS, with dedicated time in their NHS job plans for research. They differ from 'academic clinicians', who are research-active NHS employees whose primary commitment is to deliver clinical services for their employing NHS organisation.

To inform its wider project on 'Enhancing the NHS-academia interface', the Academy of Medical Sciences hosted a workshop on 'Clinical academic research careers, leaders and innovators for the future' on 3 April 2019. The workshop, chaired by Professor Paul Stewart FMedSci, the Academy's Vice President (Clinical), convened experts from across academia, industry, the NHS and public health to discuss the current and future requirements for clinical academic careers.

The one-day workshop explored clinical academic careers in the context of public and population health, discovery medicine, disruptive technologies, and innovation in the NHS. Key themes arising from discussions included the need:

- To upskill the workforce to tackle increasingly diverse and complex health challenges. Participants suggested that a small number of mandatory additional modules should be offered from a menu of strategic soft and hard skills – from research design and bioengineering through to team science and leadership – to enhance the workforce's capabilities. Training could be delivered in a range of formats, including additional degrees or continuing personal development.
- To raise awareness of research careers across healthcare professions, with appropriate signposting to these opportunities throughout training. At the undergraduate level, greater exposure of students to research is needed to increase their research skills. At the postgraduate level, enhanced funding mechanisms are needed to support research projects and to ensure a sustainable pipeline of clinical academics equipped with the necessary skills to undertake academic careers. This will also require a commitment from universities to invest in clinical academics. Schemes to increase research capacity in general practice and non-medical healthcare careers are urgently required. Clinical academic leaders with cross-sectoral and interdisciplinary expertise in technology-driven research are also needed to maximise the benefits of research for patient and population health.
- For greater permeability across sectors and disciplines to provide clinical academics with the skills required to undertake evermore complex research. Cross-sectoral secondments were thought to be particularly valuable, to enable individuals to explore different environments and develop additional skillsets.
- For flexibility within training pathways to enable individuals to be explorative within their career and develop additional skills. Providing protected time to undertake research and appropriate support – in terms of funding, mentoring and underlying infrastructure – will be essential to sustain clinical academic careers.
- For a new cadre of healthcare professionals with skills in innovation to be trained to build an NHS environment that is receptive to research and the adoption of innovation. Innovations also need to better consider and address unmet clinical need, as identified by patients and healthcare professionals.

Introduction

The UK has a world-leading position in health and biomedical research, driven by a combination of outstanding research in world-class universities, a vibrant pharmaceutical and medical technology industry, and significant capabilities in clinical and translational medicine in the NHS. Operating at the interface between academia and the NHS, clinical academics – individuals with joint university-NHS appointments who both lead research teams and deliver clinical excellence – play a leading role in driving this important research.

This subset of the clinical workforce has been pivotal in providing innovations and advances that have revolutionised patient care, and in driving innovation to meet the demands of the current and future NHS. They differ from ‘academic clinicians’, who are research-active NHS employees whose primary commitment is to deliver clinical services for their employing NHS organisation. At present, financial and workload pressures are impinging on the ability of the clinical workforce to engage in the research agenda, and the proportion of clinical academics is in decline. This has important ramifications for both the health and wealth of the UK.

On 3 April 2019, the Academy of Medical Sciences hosted a workshop on ‘Clinical academic research careers, leaders and innovators for the future’, chaired by Professor Paul Stewart FMedSci, the Academy’s Vice President (Clinical). The workshop convened experts from across academia, industry, the NHS and public health to discuss the current and future requirements for clinical academic careers. Discussions spanned public and population health, discovery medicine, harnessing the potential of medical and digital technologies, and the adoption of innovation in the healthcare system. The workshop explored existing and future challenges within clinical academic careers to seek potential solutions to retain the UK’s excellence in health and biomedical research.

The workshop was held as part of a broader Academy project exploring how the interface between the NHS and academia can be enhanced, to ensure the UK sustains its competitive position in biomedical research and continues to contribute to important advances in patient care.¹

This report presents a summary of the speakers’ presentations and the discussions that took place at the meeting. It does not necessarily represent the views of all participants at the event, the Academy of Medical Sciences or its Fellows.

Reflections on the current and future requirements for clinical academic careers

Clinical academics provide an important link between academia and the healthcare system, combining research and teaching roles in academia with clinical healthcare duties. Yet, clinical academic numbers are limited and in decline, putting the future of UK medical research at risk. In 2017, clinical academics represented 4.2% of NHS medical consultants (down from 7.5% in 2004), but this varies considerably across disciplines and only 0.5% general practitioners (GPs) are clinical academics.

Clinical PhD programmes can have an important role in increasing capacity for research at the interface between academia and the NHS. For example, a study investigating the outcome of MD-PhD clinical research training fellows showed that within 10 years of completing their fellowship, over 90% of respondents were based within a university or teaching hospital, with one quarter (24%) holding Professorships and a third (27%) employed NHS consultants, two-fifths (41%) of whom self-identified as research active.²

To future proof the clinical academic workforce, it is necessary to acknowledge the shifting research and healthcare landscapes, as well as the evolving nature of clinical academic careers. The workshop opened with four scene-setting presentations to explore the current and future requirements for clinical academic careers:

- In public and population health prevention.
- In discovery medicine.
- To harness the potential of new medical and digital technologies.
- To deliver cutting edge treatments across the NHS.

Clinical academic careers in public and population health

Professor Dame Anne Johnson FMedSci, Professor of Infectious Disease Epidemiology at the Institute for Global Health, University College London, discussed the role and impact of clinical academic leadership in public and population health.

Research undertaken by population health clinical academics in the UK plays a central role in improving global wellbeing. However, the numbers of these clinical academics has remained static over the last decade, and there are concerns that in future the discipline could suffer huge losses if recruitment rates do not replenish the losses from the currently ageing workforce. Large numbers of lecturers are progressing along the training pathway, but careers are stalling at the senior lecturer level, where appropriate funding and positions are needed.

Dame Anne spoke of a broad subset of researchers and clinicians who self-define as public health researchers even though they do not possess a formal public health accreditation. This group represents potential untapped capacity and mechanisms to engage this community should be explored. Dame Anne was supportive of the Royal College of Physicians' 'Research for all' agenda,³ and expressed a need for upskilling the healthcare workforce in areas such as clinical trials and data science. One skill set that would be particularly valuable to public health would be the ability to better understand the relationship

between multiple risk exposure and outcomes, how to deliver personalised prevention, and when and how to intervene for individuals and populations.

The 2012 Health and Social Care Act moved Public Health Services and Prevention into Local Authorities in England. Public Health England (PHE) was created as an executive agency of the Department of Health (now the Department of Health and Social care) in 2013. This change resulted in the movement of public health contracts into Local Authorities, while public health clinical academics remained associated with universities, holding honorary contracts variously with PHE, the NHS and some Local Authorities. This overall shift in public health to reside outside the NHS has had benefits but also posed challenges to public health delivery, and to the link between research and practice. Significant recent budget cuts were a further major challenge.

Dame Anne welcomed the inclusion of public health priorities in the NHS Long Term Plan, including:⁴

- The development of Sustainability and Transformation Partnerships (STPs) into Integrated Care Systems (ICSs) for closer partnership working with communities in population health planning.
- An emphasis on preventing and tackling health inequalities, which will require cross-organisational working with Local Authorities and PHE that holds the budget for operational delivery.
- Better using data and digital technology in the interest of patients, populations and service delivery. Mechanisms to develop and extend public health skills to optimise benefits from data and digital health revolution will need to be developed. The recommendations for developing the workforce in the recent Topol Review for delivering a digital future in clinical settings are also highly relevant to public health practice.⁵

Dame Anne highlighted the increasing importance of multidisciplinary teams in tackling public health challenges, engaging with a range of other disciplines, including, for example, environmental scientists, architects, lawyers, economists and behavioural scientists, to address the upstream drivers of health. The establishment of the UK Strategic Co-ordinating Body for Health of the Public Research (SCHOPR) and UK Prevention Research Partnership (PRP) represent important initiatives to coordinate and incentivise this type of working (Box 1).^{6,7}

Box 1: Public health initiatives

UK Strategic Co-ordinating Body for Health of the Public Research (SCHOPR)

Established in 2018, SCHOPR convenes a broad range of research funders and stakeholders beyond the traditional biomedical sphere, with a focus on transdisciplinary working to coordinate research to improve the health of the public.

UK Prevention Research Partnership (PRP)

UK PRP is a multi-funder partnership of research councils, health departments and charities, which have committed £40 million in investment to date. The partnership aims to bring together a range of disciplines and stakeholders to build multidisciplinary teams to undertake public health research.

Looking ahead, Dame Anne highlighted the need to transform mechanisms of engaging with patients and the public. This may include favouring and evaluating new uses of social media over hard-copy leaflets to communicate health messages, or using remote sensors as preventive, diagnostic, clinical or environmental monitoring tools. Citizen scientists will have an important role to play in this space. In addition, the innovative use of big data could be transformative in the public health space, including infectious disease and other health surveillance, through linking administrative, environmental and health data sets. The newly established Health Data Research UK (HDRUK) will play a key role in the coordination of activities, which would be complemented by a new career pathway in leadership in clinical and population health informatics.⁸ Dame Anne indicated that public health training more broadly will need to refocus not only on the upstream environmental and socio-economic drivers of health but also on bringing public health approaches and preventive principles into clinical practice.

Clinical academic careers in discovery medicine

Professor Duncan Richards, Climax Professor of Clinical Therapeutics at the University of Oxford, discussed the challenges and opportunities surrounding clinical academics in discovery medicine.

Professor Richards opened by stating that discovery medicine is a core element of the Life Sciences Industrial Strategy.⁹ Clinical translation is a fundamental step in the development of a medicine and is the opportunity to establish whether it has the potential to be a useful medicine for patients. The majority of this work is conducted by industry physicians. It can be greatly enhanced by collaboration with academia, but industry still remains less visible to those in traditional academic environments and opportunities for productive collaboration are lost.

The development of a new medicine typically has four fundamental stages: target selection, selection of the modality for intervention, clinical biological experimentation, and demonstration of clinical effect and value. Clinical translational physicians have a critical role to play in the clinical stages of development, but also have an important role to play in the drug discovery process to support target selection and validation.

Given that a number of successful treatments have now been developed to treat the most common diseases, there is a need for greater engagement with clinicians to benchmark and understand how a medicine fits within the existing armamentarium and the value it would add. Late stage drug development is particularly expensive, therefore treatments that are most likely to make a clinical difference, and therefore most likely to be reimbursed, need to be prioritised.

To be effective in discovery medicine, clinicians need to develop a broad understanding of the drug development process. This is especially important as many new treatments have multiple potential applications, and selection of which to study (first) is a key decision. Clinical pharmacology skills are also important. Lack of or insufficient efficacy remains a major cause of late stage failure and, to address this, there is a need to improve measurements of the downstream pharmacological effects of new drugs in early studies to build confidence this will translate into real clinical benefit.

A more secure early clinical dataset will, in turn, support robust investment in clinical efficacy studies that clearly delineate the place of a new medicine in the treatment pathway. Development of human challenge models and experimental medicine techniques are an important area for focus, as these are more translationally relevant than many pre-clinical disease models. Modelling and simulation which draws on mathematical, biological and biophysical skills is a vital component of early clinical development. Academic methodological exploration and development of these skills has an important contribution to make to more efficient and effective clinical translation for the future.

Professor Richards emphasised the importance of collaborative training opportunities across academia, industry and the NHS. Successful collaborative efforts, often in the form of clinical PhDs and secondments, are underpinned by genuine collaboration, to include co-ownership of projects for the mutual benefit of both parties, greater permeability at a bidirectional level, and shared knowledge of the culture and language of each working environment. Increased signposting of such opportunities is needed to increase their visibility to the academic community.

Clinical academic careers to harness the potential of new medical and digital technologies

Professor David Hawkes FEng FMedSci, Professor of Computational Imaging Science at University College London, explored how new medical and digital technologies could best be co-developed between the healthcare and technical communities. He also considered how emerging technologies could be harnessed for the greatest patient and population benefit, whilst maintaining public trust.

Professor Hawkes highlighted the lack of uptake of many engineering solutions that could impact on healthcare in the UK, with a translation rate of just 14% within clinical practice. To illustrate the potential held within disruptive technologies, Professor Hawkes shared a number of cutting edge therapeutic imaging techniques, including:

- The use of artificial intelligence (AI) in Alzheimer's disease to track disease progression, where Magnetic Resonance Imaging (MRI)-acquired images of the brain have been used to determine complex patterns of disease progression to stratify patients for better disease management.¹⁰

- Superimposed Computed Tomography (CT) imaging, used to help guide surgeons when performing liver laparoscopy, ultimately increasing the accuracy of surgical removal of the liver and improving patient outcomes.¹¹
- Colonoscopy supported by AI to identify polyps that may be undetectable to the human eye, improving the efficiency of diagnosis and subsequent patient outcomes.¹²

Professor Hawkes stressed that – despite fears that the introduction of new technologies, such as AI and robotics, may encroach on, and in some instances replace, traditional roles within the NHS – if integrated effectively, there is potential for these technologies to enhance the operational and delivery capacity of healthcare professionals. This could include: negating the need for repetitive tasks, such as those often found in screening; enhancing the accuracy of visual-based screening techniques; and supporting healthcare specialists, where skills are in short supply. In craft-specialities, such as surgery, technology and robotics can support the accuracy and efficiency of operations, and virtual stimulation could assist the training of surgeons. The rapid rise of data and computational therapeutics has generated a complex skills gap within the NHS, which must be addressed in order to realise the potential of new digital technologies on patient care and outcomes.

Interactions between healthcare professions, Medtech industries and academics could be improved to increase the rate of translation of new technologies in the NHS. Clinical academics have much to offer in the space, and should seek to engage with other disciplines and sectors to expand their research capabilities. In addition, clinicians and NHS staff more broadly will require strategic skills to support the formation of collaborations. Good platforms to develop these skillsets include National Institute for Health Research (NIHR)-funded research, engagement with spin-out companies and bi-directional secondments. Professor Hawkes also stressed the importance of placing patients at the centre of research when seeking clinical translation of technologies.

The difficulties in ensuring adoption of new technologies by the NHS remains a key barrier, particularly under current financial and resource pressures. It was also suggested that the NHS needs to be more accepting of risk: risk where the technology requires further development to meet the clinical need as expected, and economic risk in instances where a technology is not yet commercially viable. Furthermore, it was suggested that the absence of early commissioning in the NHS has resulted in UK-developed technologies being evaluated abroad. There was a plea for a flexible form of commissioning independent of the NHS to support emerging technologies and ensure the translation of resultant benefits to the NHS.

Clinical academic careers to deliver cutting edge treatments across the NHS

Dr Bruno Holthof, Chief Executive Officer of Oxford University Hospitals, spoke on the future of clinical research with a focus on the adoption of innovation in the NHS.

Dr Holthof outlined the financial pressures currently facing the NHS, exacerbated by an increased demand from an ageing population, as well as the workforce pressures resulting from ongoing staff shortages. Staffing shortages are being met with overseas recruitment in the short-term and increased training to grow the domestic workforce for the longer term; however, these are both lengthy processes and it will take time for the benefits to be fully translated into practice. He highlighted how many of the challenges facing the NHS are consistent with those faced by many other countries due to budget constraints. One such example is the health disparities resulting from socioeconomic status, with great fluctuations in health status observed over very small geographic areas, even within towns, in the UK.

Dr Holthof noted that a lack of funds is the main barrier to adopting innovation in the NHS. To address such shortages, Oxford University Trust has explored alternative sources of funding for research and care, including collaborations with private healthcare providers to capture the value created by public research. One such example is the creation of Sensyne Health.¹³ Sensyne Health uses anonymised patient data to answer clinically-relevant questions and generate new discovery hypotheses. It is through the commercialisation of this research that the Trust was able to meet its financial target last year.

Adoption of innovation and financial prosperity requires collaboration between academia, the NHS and industry. Box 2 describes transformative innovations developed at Oxford University Hospitals, which are also exemplars of patient-driven innovation. To maximise their impact, Dr Holthof highlighted the need to commercialise these innovations such that financial gains also benefit the NHS. This process from innovation and commercialisation in the NHS harnesses the power of all three sectors to create health and wealth for the UK.

Box 2: Innovations developed at Oxford University Hospitals

Early screening to reduce treatment costs and increase chances of survival

Patients that presented generic symptoms, such as unexplained fatigue and weight loss, received a low-dose abdominal CT scan as part of a trial that enabled the diagnosis of cancers in 10% of patients that were referred. Treating early stage cancers is cheaper than treating more advanced, stages and also improves the survival rate for the patients.

Electronic vital signs to support patient prioritisation

Paper-based systems for capturing vital signs in the hospital were replaced with a new system developed by a collaboration between intensive care clinical academics, engineers and human factor specialists. The new system takes less time to record the vital signs, and subjects this information to machine learning to prioritise clinical time to those most in need. In addition to time savings, this innovation has reduced rates of mortality. This technology also enabled the development of a longitudinal dataset for further research.

Next steps for clinical academia

Informed by the speakers' presentations, participants were asked to further explore the challenges and opportunities for the clinical academic workforce in the context of public and population health, discovery medicine, disruptive technologies and adoption of innovation in the NHS. This chapter provides a summary of the wide-ranging discussions at the meeting.

Upskilling the clinical workforce

The skills needed for a career in healthcare are changing. Activities to upskill the clinical workforce are therefore necessary to better meet the needs of the population, and to retain the UK's world leading position in medicine and medical research.¹⁴ Some participants expressed concerns that existing undergraduate curricula conformed to guidelines set out by the General Medical Council without seeking mechanisms to encourage individuals to think creatively, understand discoveries and consider how to apply them in clinical practice. Launched in 2018, the Scottish Graduate Entry Medicine programme (ScotGEM) was praised for its health improvement focus and mandatory training in data science – a clear example of considering skills to support future career needs.¹⁵

Participants suggested wider initiatives to upskill the workforce at all career stages, while noting the challenges in influencing the training system to promote academic growth in a workforce where the vast majority (approximately 95%) have non-academic careers. Participants suggested streamlining the curriculum and offering a small number of mandatory additional modules from a menu of strategic skills. These could include soft and hard skills, such as research design, health economics, public health, bioengineering, genomics, data science, computation, through to team science, entrepreneurship, leadership, and public and patient involvement (PPI). Participants suggested that these 'bolt-on' training components could be delivered through a range of formats, including intercalated undergraduate degrees, master's degrees or less intensive introductory courses and continuing personal development (see Box 3).

Such activities would support the ambitions outlined in the NHS Long Term Plan, which calls for more generalists while also enabling trainees to shape their careers to align with their strengths and interests.¹⁶ Buy-in from the funding community would be necessary to deliver this complementary package of skills.

Routes to a clinical academic career

Participants agreed that, for the UK to retain its position as a leader in both healthcare and biomedical research, research should be signposted and accessible across all stages of medical training. Raising awareness of academic medicine and equipping individuals with the sorts of skills to support potential future careers in this area could start as early as in primary and secondary education. Such skills include entrepreneurship, team working, data analysis and computational modelling, which are increasingly important in medical careers. Participants also suggested that existing career guidance could better highlight the opportunities of combining careers in medicine and research.

Undergraduate training

At the undergraduate level, participants expressed concern that scientific questioning seemed to no longer be an integral component of medical training and suggested that opportunities to expose students to research, and increase their research skills, were needed. The Academy's INSPIRE programme was highlighted as an exemplar in engaging students in research and upskilling them with basic research skills.¹⁷

Box 3: Pharmaceutical medicine in the undergraduate medical curriculum

A partnership between the Association of the British Pharmaceutical Industry, Brighton and Sussex Medical School and the Faculty of Pharmaceutical Medicine has led to the development of an educational programme pilot aimed at providing medical undergraduates with an understanding of the process of drug discovery and development. In addition, the programme is geared towards equipping medical students with knowledge, skill and behaviour appropriate for drug safety reporting and an ethical interaction with the pharmaceutical industry. This programme utilises a spiral curriculum approach, where medical students receive education throughout their undergraduate years of study and are exposed to teaching and learning that might enhance their safe and effective use of medicines. Launched in 2019, the project is jointly developed by academic and industry colleagues and has been introduced to medical students in years one, three, four and five. Following a review of the pilot, there is potential to upscale and deliver the programme across medical schools nationally.

Intercalated degrees were highly valued by participants, with the majority of individuals who go on to pursue the Integrated Academic Training (IAT) pathway originating from these programmes. Participants suggested broadening the offering of intercalated degree subjects beyond the life sciences. This would have the added benefit of breaking down silos between disciplines and encouraging cross-disciplinary working. Novel medical programmes were welcomed, as highlighted in Box 4.¹⁸

Participants also noted the potential of individuals studying graduate entry medicine (GEM) in building the clinical academic workforce. The majority of GEM students possess a life sciences bachelor's degree, with many also having also higher degrees. Sourced from a range of backgrounds, it was suggested that this pool of individuals adds a diversity and richness of skills to the workforce, in addition to being equipped with the ability to engage with the research agenda. Training increased numbers of graduates would also help to increase the domestic supply of doctors.

Box 4: Medical education for physician innovators

The Carle Illinois College of Medicine is the world's first engineering-based medical school aiming to harness advancing technologies to train physician innovators to deliver better, more compassionate, and accessible care to patients. Delivered through a non-traditional curriculum and in an active learning environment, clinical experience, engineering and innovation are central to the course, which aims to empower students to think differently. Alongside the training, students are encouraged to develop solutions to healthcare challenges, one of which will be pursued as a translatable innovation.

Postgraduate training

There is a need to ensure a more balanced funding portfolio across clinical academic career stages. While increased funding provision in recent years at the PhD level was welcomed, this has not been matched at the post-doctoral level, limiting research opportunities. Participants expressed particular concerns about the lack of funding at the senior lectureship level. It

will be important for universities to invest in clinical academics to ensure a sustainable pipeline going forward.

Participants praised the IAT pathway in academic medicine, which has been strengthened by the alignment of multiple funders. Funding must be maintained to create a sustainable pipeline of clinical academics equipped with the necessary skills to undertake academic careers. Additionally, the launch of the Medical Research Council's Clinical Academic Research Partnership scheme was widely praised for its ability to increase opportunities for research in the NHS by offering research-trained consultants funding to re-engage with research.¹⁹

The absence of formal continuous training in non-medical healthcare careers was highlighted as a barrier for such professions to engage with research. The Health Education England/NIHR Integrated Clinical Academic Programme and devolved equivalents for non-medical healthcare professions were highlighted as opportunities to develop research activity within the NHS.^{20,21} But further schemes are needed to expand research capabilities into these professions.

Participants noted the challenges to increasing research activity in underrepresented specialities as well as in general practice, where solutions to grow research capacity are urgently required. Participants suggested that the need to complete core competency training in general practice prior to commencing a PhD may exacerbate the problem, as securing preliminary research funding at this later stage is particularly difficult. An initiative praised in support of academic GPs was NIHR's In-Practice Fellowships, which fund master's-level training for GPs and dentists in clinical practice to equip them with the skills and experience necessary to prepare an application for a competitive, peer-reviewed doctoral level research training fellowship.²² Fellowships such as these were hoped to increase research capacity in the first instance, and then provide further role models to increase the visibility of research careers for the next generation. There was also appetite to create wider provision for protected time for research, which could help with recruitment and retention, as outlined in Box 5.^{23,24}

Box 5: NIHR Academic Clinical Fellowships (ACFs) in primary care

NIHR ACFs are specialty training posts that incorporate academic training. Medical and dental ACFs spend 75% of their time undertaking specialist clinical training and 25% of their time undertaking research training. ACF posts in primary care receive a consistently higher application ratio compared to standard GP posts (on average 6 applications per ACF post in contrast to 1.3 applications for traditional clinical posts), suggesting that the introduction of a research component may help to attract staff to understaffed specialities.

Clinical academia and public health

Since the transition of public health services to Local Authorities following the Health and Social Care Act 2012, public health no longer resides in the NHS. This poses an additional challenge for clinical academics working in the public health space as research activities also need to be aligned across local government. Greater alignment between health and social care with greater involvement of public health experts to promote healthy lives was encouraged. While the transition of funding was agreed to be a barrier, there are instances of success, with Wigan being highlighted as an exemplar from which the wider UK can learn (Box 6).²⁵

To enhance public health research, participants called for more widespread training in public health, which can assist disease prevention across all specialities. Training in digital skills will be necessary to harness the digital revolution for public health gains through health surveillance. Within public health research, it was felt that there were opportunities to better utilise the capacity of researchers and clinicians who self-define as public health researchers even though they do not possess a formal public health accreditation, many of whom work within the NHS.

Box 6: Integrated health and social care

Wigan is one of the 10 local authorities in the devolved Greater Manchester Health and Social Care Partnership, which has joint commissioning arrangements for health and social care. Building on this, it has chosen to align health and social care budgets with those of housing and leisure, creating a single public sector purse for the borough to maximise efficiency spending. With service delivery anchored around primary care services and schools, with alignment of mental health and children's services, a holistic and asset-based approach is being taken to support Wigan's residents and to ultimately tackle the wider determinants of health.

Permeability across sectors

Participants agreed that single discipline research endeavours are no longer fit for purpose when seeking solutions to evermore complex research questions, and that team science approaches spanning sectors and disciplines are increasingly required.^{26,27} As such, greater permeability across sectors and disciplines will be increasingly important to provide clinical academics with the skills required to undertake such research. The importance of a porous exchange between sectors was recognised across funders, industry and academia. Exemplars, such as the initiative described in Box 7,²⁸ are needed to inspire greater activity across the sector.

Cross-sector secondments to enable individuals to explore a different environment and develop an additional set of skills were thought to be particularly valuable. For secondments to be successful, it is important for both parties to benefit. For instance, clinicians undertaking a secondment in industry would provide invaluable clinical insight into the industry's discovery science, while acquiring important knowledge and experience of translational research and commercialisation to enhance their performance as a clinician and future interactions with industry.

Differences in language and culture were, however, highlighted as two of the main challenges to cross-sector working. Participants noted the value of mentoring individuals through organisational barriers and supported the development of a cross-sector mentoring programme.

Box 7: Oxford-Celgene Fellowship to enhance permeability

Aimed at stimulating scientific discoveries and supporting the transfer of skills and people between academia and industry, the Oxford-Celgene Fellowship is a co-developed 3-year fellowship between the global pharmaceutical company Celgene and the Oxford Medical Sciences Division. The award is made to principal investigators at the University of Oxford who are assigned a Celgene mentor, and an opportunity to undertake research in and visit Celgene's laboratories.

Flexibility

Participants agreed that flexibility, time and support to enable individuals to explore different disciplines, specialties and sectors were key enablers for a successful clinical academic career. Participants, therefore, identified a need for:

- Protected time to undertake research within an intensive clinical training pathway and an increasingly demanding clinical role.
- Support in the form of funding, individual coaching and mentorship, and underlying infrastructure. The timing at which this support is provided is crucial.
- Flexibility within training pathways to explore different specialties and research areas, and to ensure that individuals who take career breaks are not disadvantaged.

To enable greater flexibility in training pathways, a subset of participants proposed an elongated training pathway with opportunities to explore broader disciplines with more flexible training. This would be targeted at those willing to explore an academic route in greater detail than foundation rotations permit, or to sample multiple specialties.

Innovation

Barriers to adoption and innovation in the NHS were thought to result in the loss of innovations to overseas investment. Barriers were thought to include a lack of funds, low capacity in innovation skills, and a misalignment between health, social care and public health. A healthcare environment more receptive to research was hoped to result in greater patient outcomes, cost savings through the production of bespoke in-house innovations, and financial gains as a result of commercialisation.

To support increased innovation capacity, a new cadre of health care professionals with skills in innovation should be developed to recognise and pursue commercialisation opportunities (see Box 8).²⁹ Existing opportunities to pursue a career combining both innovation and medicine are limited, therefore concerted effort is needed to retain this subset of healthcare professionals in the NHS, and to better harness their skills for the benefit of the health service. There is also a need to better identify and pursue potential commercialisation opportunities within existing translatable research. The MRC Confidence in Concept scheme encourages research at the interface between academia and industry, as well as the exchange of people between these two sectors to take early discoveries to a point at which commercial exploitation is realistic.³⁰ The translation team at the Francis Crick Institute was also recognised as providing important expertise and oversight in innovation to assist researchers in identifying potential innovations.³¹

Box 8: Encouraging innovation and entrepreneurship in undergraduate medicine

Encouraged by the numbers of students establishing their own technology-based companies, the Medical School at the University of Leeds has introduced Medicine+ and the opportunity for students to graduate as Bachelor of Medicine and Bachelor of Surgery (MB ChB) with a Master of Science degree (MSc) in Enterprise. This aims to harness entrepreneurial skills, alongside clinical practice, to transform patient care and healthcare delivery for the future.

Participants also stressed the importance of reverse-translation to design innovations to address unmet clinical need, starting at the bedside with real patient experiences and working backwards to inform the research and development (R&D) process. Upskilling the workforce with entrepreneurship skills to identify R&D opportunities will be helpful in this regard.

Conclusion

The workshop aimed to highlight the opportunities and challenges facing clinical academic careers, to inform the Academy's wider project on enhancing the interface between academia and the NHS.³²

Participants called for training reforms to upskill both clinical academics and the broader workforce in contemporary skills. These include data analytics and innovation for the healthcare system to support and continue to benefit from technological advances. There was also a plea to equip the workforce with soft skills in areas such as team science and public and patient involvement to enhance current research practice. Better funding mechanisms are needed to support research projects and to ensure a sustainable pipeline of clinical academics across healthcare professions, including a commitment from universities to invest in clinical academics. There was a desire to facilitate and promote cross-disciplinary and cross-sectoral research to tackle evermore complex research questions, and accelerate the development and adoption of innovation.

Participants agreed that the community is facing a window of opportunity to effect change, but that strong leadership will be required across the life sciences sector to succeed in these ambitions. To impact patient and population health, the clinical academic leaders needed will require expertise in technology-driven research, and interdisciplinary and cross-sector working. These leaders will need to work across integrated health and social care structures to advance disease prevention and early detection, digital medicine, bioengineering, and drug discovery.

Annex 1: Agenda

Academy of Medical Sciences, 41 Portland Place, London W1B 1QH

Wednesday 3 April 2019, 09.30 - 16.00

09.30-10.00	Registration
10.00-10.10	Welcome and introduction Professor Paul Stewart FMedSci, Vice President (Clinical), Academy of Medical Sciences
Session 1: Reflections on the current and future requirements for clinical academic careers	
10.10-10.30	The future of clinical academia in public and population health prevention Professor Dame Anne Johnson FMedSci, Professor of Infectious Disease Epidemiology, University College London
10.30-10.50	Clinical academic careers in discovery medicine Professor Duncan Richards, Professor of Clinical Therapeutics, formerly Head of Clinical Pharmacology and Experimental Medicine, GlaxoSmithKline
10.50-11.10	Clinical academic careers to harness the potential of new medical and digital technologies Professor David Hawkes FEng FMedSci, Professor of Computational Imaging Science, University College London
11.10-11.30	Clinical academic careers to deliver cutting edge treatments across the NHS Dr Bruno Holthof, Chief Executive Officer, Oxford University Hospitals
11.30-12.00	Plenary discussion Professor Paul Stewart FMedSci, Vice President (Clinical), Academy of Medical Sciences
12.00-13.00	Lunch
Session 2: Next steps for clinical academia	
13.00-15.30	Breakout session <ul style="list-style-type: none"> • Public and population health prevention Chair: Professor Carol Brayne CBE FMedSci, Professor of Public Health Medicine, University of Cambridge • Disruptive technologies Chair: Dr Mobasher Butt, Chief Medical Officer, Babylon Health • Discovery medicine Chair: Dr Melanie Lee CBE FMedSci, Chief Executive Officer, LifeArc • Adoption of innovation in the NHS Chair: Malcolm Lowe Laurie CBE, Executive Director, Cambridge University Health Partners
15.30-16.00	Feedback, summary and close Professor Paul Stewart FMedSci, Vice President (Clinical), Academy of Medical Sciences

Annex 2: Participant list

Participants

Professor David Adams FMedSci, Pro-Vice Chancellor, Head of College of Medical and Dental Studies, University of Birmingham

Dr Caroline Aylott, Head of Research Awards & Translation, Versus Arthritis

Dr Helen Bodmer, Head of Health Systems Partnership, Medical Research Council

Professor Carol Brayne CBE FMedSci, Professor of Public Health Medicine, University of Cambridge

Dr Mobasher Butt, Chief Medical Officer, Babylon Health

Martyn Coomer, Director of Research, Royal College of Surgeons

Dr Lisa Cotterill, Director of the NIHR Academy, National Institute of Health Research

Professor Constantin Coussios, Director, Oxford Institute of Biomedical Engineering

Professor Yvonne Doyle, Regional Director for London, Public Health England

Professor Tim Eisen FMedSci, Vice President Oncology Early Clinical Projects, AstraZeneca

Professor Gary Ford CBE FMedSci, Chief Executive Officer, Oxford Academic Health Science Network

Professor Bernie Hannigan, Director of Research, Translation & Innovation, Public Health England

Professor David Hawkes FEng FMedSci, Director, Wellcome/EPSRC Centre for Intervention and Surgical Sciences, University College London

Richard Hebdon, Head of Health & Medicine, InnovateUK

Dr Bruno Holthof, Chief Executive Officer, Oxford University Hospitals

Professor Peter Hutchinson FMedSci, Professor of Neurosurgery, University of Cambridge

Professor David Jayne FMedSci, Clinical Director, NIHR Surgery MedTech and In-Vitro Diagnostic Co-operative

Professor Dame Anne Johnson DBE FMedSci, Professor of Infectious Disease Epidemiology and Chair of the Grand Challenge for Global Health, University College London

Professor David Jones OBE, Dean for the NIHR Academy, National Institute of Health Research

Professor Sir Peng Tee Khaw CBE FMedSci, Consultant Ophthalmic Surgeon, Moorfields Eye Hospital

Professor Ajit Lalvani FMedSci, Vice Chair, Research and Academic Medicine Committee, Royal College of Physicians

Dr Melanie Lee CBE FMedSci, Chief Executive Officer, LifeArc

Professor Graham Lord FMedSci, Vice President & Dean of the Faculty of Biology, Medicine and Health, University of Manchester

Malcolm Lowe-Lauri CBE, Executive Director, Cambridge University Health Partners

Professor Sheona MacLeod, Chair, Conference of Postgraduate Medical Deans

Dr Susan Mitchel, Policy Manager, Alzheimer's Research UK

Professor Paul Morgan, Director of the Systems Immunity Research Institute, Cardiff University

Professor Dion Morton, Director of Clinical Research, Royal College of Surgeons

Dr Karen Noble, Head of Research Careers, Cancer Research UK

Dr Rickie Patani, Group Leader, The Francis Crick Institute

Dr Katie Petty-Saphon, Chief Executive, Medical Schools Council

Professor John Pickard FMedSci, Honorary Clinical Director, NIHR Brain Injury MedTech and In-Vitro Diagnostic Co-operative

Dr Sheuli Porkess, Deputy Chief Scientific Officer, Association of the British Pharmaceutical Industry

Dr Vibhore Prasad, NIHR Clinical Lecturer in General Practice, King's College London

Professor Chris Pugh FMedSci, Professor of Renal Medicine, University of Oxford

Professor Duncan Richards, Professor of Clinical Therapeutics, University of Oxford

Professor Sir Nilesh Samani FMedSci, Medical Director, British Heart Foundation

Dr Alexandra Santos, Senior Clinical Lecturer & Honorary Consultant in Paediatric Allergy, King's College London

Professor Debbie Sharp CBE, Professor of Primary Care, University of Bristol

Dr Malcolm Skingle CBE, Director of Academic Liaison, GlaxoSmithKline

Professor Paul Stewart FMedSci (Chair), Vice President (Clinical), Academy of Medical Sciences & Executive Dean, Faculty of Medicine & Health, University of Leeds

Professor Helen Stokes-Lampard, Chair, Royal College of General Practitioners

Professor Sir John Tooke FMedSci, Executive Chairman, Academic Health Solutions; Chair, Collaboration for the Advancement of Sustainable Medical Innovation (CASMI)

Dr Estée Torok, Clinician Scientist Fellow, University of Cambridge

Dr William van't Hoff, Clinical Director for NHS Engagement, National Institute of Health Research

Dr Louise Wood, Director of Science, Research & Evidence, Department of Health and Social Care

Secretariat

Dr Suzanne Candy, Director of Biomedical Grants and Policy, Academy of Medical Sciences

Dr Claire Cope, Policy Manager, Academy of Medical Sciences

Dr Mehwaesh Islam, Policy Officer, Academy of Medical Sciences

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