

Introduction

1. The Academy of Medical Sciences is the independent body representing the diversity of medical science within the UK. Our elected Fellowship includes the UK's foremost experts drawn from a diverse range of research areas, from basic research through to clinical application and commercialisation.
2. The supply of high quality STEM skills is essential if the UK to maintain its place at the forefront of research and innovation. Our response provides an overview on three vulnerable areas for the biomedical sciences sector that the Committee might wish to consider:
 - Team science
 - Big data analysis
 - Drug discovery skills (clinical pharmacology and medicinal chemistry in particular)
3. Given the Academy's remit and current strategic priorities, we focus on postgraduate level training and beyond.

Team science skills

4. Team science, output-focused research involving two or more research groups, is becoming increasingly common and necessary as researchers seek to solve diverse and complex global challenges such as addressing the needs of an ageing population with multiple morbidities. It is critical for individual researchers at all career stages to demonstrate behaviours and skills that are crucial for undertaking successful team science.
5. The Academy's report *Improving recognition of team science contributions in biomedical research careers* found that despite the growth in team science, researchers (at all levels) often lack the skills required to contribute effectively to this way of working.¹ These include leadership skills, communication skills, networking, forming successful collaborations and project management.
6. Our engagement with researchers during our team science project highlighted that different institutions offer varying degrees of exposure to specific training opportunities in team skills. The report recommends that academic employers should develop training in team skills for researchers at all career stages. It highlights examples of training opportunities, for example, at the Sanger Institute which offers a range of courses relevant to team science including networking, people management and conflict resolution. Other examples include Vitae's Preparing for Leadership programme and the Research Team Leadership programme offered by the Leadership Foundation for Higher Education.

¹ Academy of Medical Sciences (2015). *Improving recognition of team science contributions in biomedical research careers*. <https://www.acmedsci.ac.uk/viewFile/56defebabba91.pdf>

Big data skills

7. The big data revolution and the changing nature of biological research mean that the supply of high quality mathematical and computational skills has become critical to maintain a thriving R&D sector. Activities such as the 100K genome project generate enormous datasets and require informatics skills to analyse the data. Informatics skills are applicable to many areas of both the biosciences and the medical sciences. An increasing number of reports suggest that there is a significant skills gap in this area.² Of those organisations recruiting big data staff, 57% have struggled to find people with the requisite skills and experience, and demand for big data specialists in the UK is expected to increase by 160% between 2013 and 2020.³ This shortage is therefore limiting our ability to conduct academic research on large and complex datasets.
8. A 2015 survey by the Biotechnology and Biological Sciences Research Council (BBSRC) and Medical Research Council (MRC), in collaboration with the Society of Biology, highlighted the need for improved mathematics, statistics and computational skills as there is difficulty recruiting skilled researchers at postgraduate and postdoctoral levels.⁴ Data analytics, especially bioinformatics, appears to be particularly vulnerable. The results of the survey helped inform the development of the funders' studentship and training portfolios (detailed in Box 1).
9. The Academy's *Health of the Public 2040* report highlights the need to incorporate training in quantitative skills at an early stage for current and future researchers, and health and social care practitioners.⁵ Many university departments now provide data science and health informatics courses. Funders are also providing programs, including cross-disciplinary Centres for Doctoral Training, to recruit and train more researchers in these fields (Box 1). Investment in postdoctoral funding is also required, so that the research sector retains highly trained staff after they complete their PhDs.
10. Our *Health of the Public 2040* report also recommends that higher education institutions and key research funders (such as Research Councils and the Wellcome Trust) further enhance training pathways in informatics for health that are open to a wide range of disciplines if the UK is to take full advantage of the opportunities presented by the big data revolution. The aim should be to help build a critical mass of expertise to process and analyse the full range of available data now and in the future.⁶ This will require both capacity building within the existing biomedical workforce and a new approach to the education of future generations.
11. Finally, delegates at the Academy's meeting on 'real world evidence'⁷ suggested potential steps to building capacity and capability in data skills including:

² ABPI (2015). *Bridging the skills gap in the biopharmaceutical industry: Maintaining the UK's leading position in life sciences*. http://www.abpi.org.uk/our-work/library/industry/Documents/Skills_Gap_Industry.pdf

³ The Tech partnership (2014). *Big Data Analytics: Assessment of Demand for Labour and Skills 2013–2020* https://www.thetechpartnership.com/globalassets/pdfs/research-2014/bigdata_report_nov14.pdf

⁴ BBSRC and MRC (2015) *Review of Vulnerable Skills and Capabilities*. <https://www.mrc.ac.uk/documents/pdf/review-of-vulnerable-skills-and-capabilities/>

⁵ Academy of Medical Sciences (2016). *Improving the health of the public by 2040*. <https://www.acmedsci.ac.uk/viewFile/5807581429f81.pdf>

⁶ *Ibid*

⁷ *Ibid*

- Engagement with other industries such as IT and finance to draw expertise from those with experience of working with real world data.
- Educational programmes, potentially sponsored by industry, to build the skills base.
- Kitemarking of particular training and educational programmes.

Box 1 Examples of capacity building for data science

The Farr Institute's Centre for Improvement in Population Health through E-records

works to build capacity and capability in health informatics research, by increasing the number of trained individuals in the research community (including the NHS and industry). To achieve this, a number of technical, practical and skills-based short courses at undergraduate level are currently being developed. Masters level modules are also being planned, and opportunities for PhD studies will be developed.⁸

The Alan Turing Institute is the UK's national institute for data science. Bringing together leaders in advanced mathematics and computing science, its aim includes conducting cutting-edge data science research, facilitating collaboration between researchers from industry and academia, and drawing in leaders from around the world to engage with the UK in data science and its applications.⁹

Engineering and Physical Sciences Research Council Centre for Doctoral Training (CDT) in Data Science, based at the University of Edinburgh, provides 50 PhDs over five intake years. It aims to train a new generation of data scientists with the technical skills and interdisciplinary awareness required to become R&D leaders in this emerging area.¹⁰ The Government is investing over £40 million in CDTs in different areas of data science.¹¹

Medical Research Council Skills Development Fellowships are early postdoctoral training fellowships that support capacity building in MRC priority areas. The scheme currently focuses on:

- Quantitative expertise: covering mathematics, statistics, computation and informatics applicable to any biomedical or health-related data sources, from molecular to population level.
- Expertise at the social science interface: with a focus on areas of health economics and/or mixed methods research.¹²

The Q-Step programme, funded by the Nuffield Foundation, ESRC and the Higher Education Funding Council for England, is designed to promote quantitative social science training in the UK. For example, the UCL Q-Step Centre offers training in quantitative methods on interdisciplinary undergraduate degree programmes including a BSc in Social Sciences with Quantitative Methods.¹³

Drug discovery skills

12. The UK's dynamic and changing drug discovery landscape raises challenges for its future, particularly around the development of the next generation of researchers. This topic arose

⁸ <http://www.farrinstitute.org/>

⁹ <https://turing.ac.uk/>

¹⁰ <http://datascience.inf.ed.ac.uk/>

¹¹ House of Commons Science & Technology Committee (2016). *The big data dilemma: Government response to the committee's fourth report of session 2015-2016*.

<http://www.publications.parliament.uk/pa/cm201516/cmselect/cmsctech/992/992.pdf>

¹² <http://www.mrc.ac.uk/skills-careers/fellowships/skills-development-fellowships/>

¹³ <https://www.ucl.ac.uk/q-step/study-with-us>

several times at a recent Drug Discovery workshop co-organised by the Academy of Medical Sciences and the Association of the British Pharmaceutical Industry (ABPI), based on the findings of an ABPI research report. The report highlighted that the drug discovery industry landscape has changed dramatically in the last decade with 60% of firms reporting an increase in the outsourcing of their drug discovery activities to biotech, contract research organisations (CROs) and academia. A quarter also report a decrease in in-house investment in drug discovery activities. Meanwhile, over one third of CROs have seen over 25% increase in their commissioned activities. However, these trends are a concern for the development of new drug discovery scientists as gaining experience in small firms is difficult due to limited exposure to different areas alongside decreased capacities of small firms to invest in training.¹⁴

13. A possible solution suggested at the meeting was the partnering of biotechs to create sustainable clusters with pools of scientists that move within the cluster to gain training as needed. Universities will also play a key role in high-quality scientific drug discovery training.

Medicinal chemistry

14. Medicinal chemistry, the design and synthesis of drugs, is critical to the development of novel clinical compounds and is an area that is at risk of skill shortage. In a recent ABPI survey, 17% of respondents highlighted medicinal chemistry as a "major concern" and 50% as an area of "concern".
15. Similar concerns were highlighted at the Academy's Drug Discovery meeting, with industry delegates noting the future pipeline of skills such as medicinal chemistry, as being a particular priority. These skills are currently found in academic drug discovery units, biotech and CROs. However much of this workforce was originally trained in the big pharma industry prior to its downsizing in the late 2000s. Future medicinal chemists will need to be developed *via* other routes. There are concerns about whether there is sufficient resource and stability within biotechs and small-medium sized enterprises (SMEs) to nurture and train such researchers.
16. The pharmaceutical industry is aware of the need to ensure sufficient training of medicinal chemists and as such have taken steps to encourage this. As an example, GSK have shared with us the initiatives they have put in place in an attempt to fill the gap in the provision of medicinal chemists at all levels of education. GSK have told us that they recognise that industry and academia have complementary skills that are relevant to the development of the medicinal chemistry workforce. As a result, they have:
 - Developed high quality training and development programmes in association with UK universities such as Bristol, Kent and Strathclyde;
 - Provide apprenticeships, currently with four apprentices in chemistry at GSK Stevenage.
 - Partnered with academia to provide industrial placements to undergraduates and graduate students;
 - Assigned GSK chemists to universities to facilitate specific activities which promote excellence in synthetic organic chemistry.

¹⁴ ABPI (2016). *The changing UK Drug Discovery Landscape*. <http://www.abpi.org.uk/our-work/library/industry/Pages/The-changing-UK-drug-discovery-landscape.aspx>

Participants on GSK's medicinal chemistry programme at the University of Nottingham have successfully secured medicinal chemistry roles at GSK and other pharma companies.

Clinical pharmacology

17. Clinical pharmacology, which is crucial for translating basic research into medicines for patients, has long experienced a skills shortage. The ABPI last reported the skills needs of the biopharmaceutical sector in 2015, following on from their 2008 report. Both the 2008 and 2015 reports highlighted clinical pharmacology as a top priority area, with both the quality and number of candidates being an issue.¹⁵
18. The findings of the ABPI skills survey are echoed by other reports from the British Pharmacological Society. In 2012, the number of Clinical Pharmacology and Therapeutics (CPT) consultants in the UK was only 77, significantly fewer than a workforce of 440 as recommended by the Royal College of Physicians, one in each large district general hospital and one per 180 medical students in training.^{16,17} A recent report commissioned by the British Pharmacological Society demonstrates that for every pound invested in clinical pharmacologists has the potential to reduce NHS costs by almost £6.¹⁸
19. Funders have launched training schemes to address this need including a substantial investment by the MRC in a clinical pharmacology and pathology fellowship programme, and programmes by the Wellcome Trust.¹⁹ However, as the ABPI report notes there is a need for continued attention and investment to maintain and build capacity in this area.²⁰
20. The skills gap in clinical pharmacology is covered in more detail in the response to this inquiry from the British Pharmacological Society.

This response was prepared by Dr Mehwaesh Islam (Policy Officer) and Zoë Stephenson (Policy Intern). For further information, please contact: Dr Mehwaesh Islam at mehwaesh.islam@acmedsci.ac.uk; +44(0)20 3141 3240.

Academy of Medical Sciences
41 Portland Place
London, W1B 1QH
+44(0)20 3141 3205
info@acmedsci.ac.uk
Registered Charity No. 1070618 Registered Company No. 35202

¹⁵ ABPI (2015.) *Bridging the skills gap in the biopharmaceutical industry: Maintaining the UK's leading position in life sciences*. http://www.abpi.org.uk/our-work/library/industry/Documents/Skills_Gap_Industry.pdf

¹⁶ British Pharmacological Society (2014). *A prescription for the NHS: Recognising the value of clinical pharmacology and therapeutics*. [https://www.bps.ac.uk/BPSMemberPortal/media/BPSWebsite/BPS A prescription for the NHS FINAL SP\(1\).pdf](https://www.bps.ac.uk/BPSMemberPortal/media/BPSWebsite/BPS_A_prescription_for_the_NHS_FINAL_SP(1).pdf)

¹⁷ British Pharmacological Society (2015). *Clinical Pharmacology: A dynamic medical speciality essential for UK Healthcare*. <https://www.bps.ac.uk/BPSMemberPortal/media/BPSWebsite/Clinical-Pharmacology-A-dynamic-medical-speciality-essential-for-UK-Healthcare.pdf>

¹⁸ PricewaterhouseCoopers, commissioned by the British Pharmacological Society (2016.) *Clinical pharmacology and therapeutics: the case for savings in the NHS*.

<https://www.bps.ac.uk/BPSMemberPortal/media/BPSWebsite/Assets/CPT-case-for-savings-in-the-NHS.pdf>

¹⁹ Wellcome's Translational Medicine and Therapeutics (TMAT) programme was a one-off £11 million initiative initiated in 2009 to promote clinical pharmacology and collaboration with industry.

²⁰ ABPI (2015). *Bridging the skills gap in the biopharmaceutical industry: maintaining the UK's leading position in life sciences*. http://www.abpi.org.uk/our-work/library/industry/Documents/Skills_Gap_Industry.pdf