The Academy of Medical Sciences

Response to Consultation on the Industrial Strategy Green Paper

April 2017

1. ***Does this document identity the right areas of focus: extending our strengths; closing the gaps; and making the UK one of the most competitive places to start or grow a business?***

The Academy of Medical Sciences welcomes the opportunity to respond to the Government's consultation on the Industrial Strategy. The Academy has also contributed to the development of the Life Sciences strategy through direct engagement with the Office for Life Sciences.[1]

This Green Paper places science, research and innovation at its heart and the Academy welcomes this commitment from Government. Our response highlights the importance of supporting collaboration at the interface between academia, industry and the NHS (**question 7**). This will require models for partnership working and investment in the skills pipeline to ensure that academia and industry can access the skilled workforce that they require. Entrepreneurial and "team science" skills, including leadership, communications and project management skills, will be essential and must be valued across all career stages (**question 8**).

The Academy endorses the Industrial Strategy's ambition to drive growth and support excellence in science and innovation where it exists around the country. Our response highlights the role of life sciences clusters in helping to achieve this. We call for continued support for the regional strengths that exist in clusters. However, this support must also facilitate collaborative working across regions and between clusters, establishing a UK-wide offering for potential collaborators and investors (**question 9 and 36**). A local or regional approach to the Industrial Strategy should not drive competition between clusters.

Supporting the commercialisation of ideas and growth of innovative businesses across the country will require nationwide access to long-term capital. This landscape has improved to some extent in recent years, but the new Industrial Strategy provides a key opportunity to learn from, and better leverage, existing and new funding streams both from the UK and abroad.

One of our main concerns is that the Industrial Strategy does not sufficiently address the role of the NHS in driving the UK life sciences sector and access to research and innovation. Enabling the NHS to become an engine for innovation will depend on further embedding a culture of research within the NHS and establishing a pathway for the uptake of, and access to, innovation. This will encourage an environment in the NHS which supports research and innovation, and allows its pull-through into healthcare. We provide more details on this point under **question 24**.

<u>Investing in science, research and innovation</u>

[1] Academy of Medical Sciences (2017). Life Sciences industrial strategy dinner, https://acmedsci.ac.uk/life-sciences-industrial-strategy-dinner

5. *What should be the priority areas for science, research and innovation investment?*

The Academy of Medical Sciences welcomes the Government's £4.7 billion investment in science, research and innovation by the end of this Parliament. This represented the largest increase in government investment in research in several decades. Nevertheless, even with this increase in funding, the UK spends below the OECD average for public investment in research, which stands at 0.66% GDP.[2] **The Academy of Medical Sciences, together with the other national Academies, calls for the UK to set a target of 3% of GDP for combined public and private R&D spending in order to remain internationally competitive**.[3]

Investment in science, research and innovation must be provided across the whole research ecosystem. The new funding announced as part of this Industrial Strategy must be **appropriately balanced to support research and ideas at all stages of development from fundamental discovery research to applied research**.

Complex societal challenges, such as an ageing population with multiple morbidities cannot be addressed by a single discipline (see **question 13**). **Investment in science and research must be flexible enough to facilitate interdisciplinary approaches**.[4] The creation of UK Research and Innovation which brings together the research councils must be able to deliver on this requirement.

Finally the Industrial Strategy must acknowledge the role of public funding in leveraging additional spending on research and innovation in the UK. For example, in 2015 medical research charities invested over £1.4 billion into research, much of which was in UK universities.[5] Government funding in the form of the Charity Research Support Element issued by HEFCE contributes to the indirect costs of this research.[6] **The Industrial Strategy must recognise the vital importance of charitable investment in research in UK universities and ensure that the Charity Research Support Element continues to be financed appropriately**.

6. *Which challenge areas should the Industrial Strategy Challenge Fund (ISCF) focus on to drive maximum economic impact?*

This Green Paper proposes that the Industrial Strategy Challenge Fund (ISCF) should draw on the experience of the US Department of Defense's pre-eminent challenge-led funding agency, DARPA. DARPA is a well-established funding model in the US but at present no similar examples exist in the UK. DARPA's success in part depends on the level of autonomy it is afforded. Moreover the scale and risk appetite of DARPA allows for and anticipates failure. **The design of the ISCF must ensure that innovative projects with significant risk are funded and that the fund offers something different from existing sources**.

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2 OECD, Main Science and Technology indicators http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB

3 UK National Academies, (2016) Open for business https://acmedsci.ac.uk/file-download/41610-582d965e166ae.pdf

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

5 http://www.amrc.org.uk/our-members/sector-data

6 http://www.hefce.ac.uk/rsrch/funding/charity/

We welcome the inclusion of 'Leading Edge Healthcare and Medicine' and 'Bioscience and biotechnology' as potential challenges for ISCF and that for 2017/18, funding will be provided for accelerating access to innovative new drugs and treatments.[7] Questions remain over how the challenges for ISCF will be identified in the future. **We call for active dialogue with the science and research sector to establish the most effective mechanism for identifying the challenges and delivering the fund**. Finally, the ISCF must be responsive to innovative proposals which cut across the boundaries of the challenges identified in this Green Paper.

7. What else can the UK do to create an environment that supports the commercialisation of ideas?

Academia-Industry Interface

The modern innovation pathway is far more complex than the traditional linear view of translation where research findings are passed from academia to industry for commercialisation. Stakeholders are more diverse and increasingly innovation relies on collaborative work taking place at the academia-industry interface. This model of open innovation takes place across organisational borders and requires the ability of those organisations, institutions and people to work closely with one another.

The Industrial Strategy must seek to **improve linkages between academia and industry through supportive schemes and removal of barriers, in order to smooth the translation of basic research into products that can be commercialised**.

In the UK, barriers to collaboration include poor understanding of the cultural differences between academia and industry, inflexible reward systems in academia and in some cases mutual distrust between sectors.[8] Collaborative working could be supported through schemes to promote mobility of researchers, investment in shared facilities and co-localisation of academia and industry to bring organisations together and thereby lower the 'activation energy' for joint working.[9]

For example, the Immunology Catalyst at GSK promotes mobility by enabling academic immunologists to work at GSK alongside industry scientists. These researchers gain access to GSK's platforms whilst retaining ownership of IP. This model enables the scientists to return to their academic institutions after a few years.[10]

The Stevenage Bioscience Catalyst represents another successful example of promoting sector permeability and partnership. This open innovation campus is jointly supported by the Department for Business, Energy and Industrial Strategy, GSK, Wellcome Trust and Innovate UK.[11] The campus has been designed to facilitate co-operation and dialogue between scientists across sectors and to allow shared access to platforms and expertise

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[7] HM Treasury (2017). Spring budget 2017 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/597467/spring_budget_2017_web.pdf

[8] FORUM (2017). The UK Drug Discovery Landscape https://acmedsci.ac.uk/file-download/71272985

[9] FORUM (2017). The UK Drug Discovery Landscape https://acmedsci.ac.uk/file-download/71272985

[10] www.gsk.com/en-gb/careers/areas-of-opportunity/research-and-development/immunology-catalyst/

[11] www.stevenagecatalyst.com/

to support scientific discovery. Campus tenants retain full independence and ownership of IP generated.[12]

At the Francis Crick Institute, laboratories are arranged to facilitate interaction of scientists, including between academic and industry groups. This interaction is designed to promote cultural understanding and shared working environment between researchers.

Co-localisation is currently disincentivised by the loss of zero-VAT rating if a publically or charitably funded institution exceeds a threshold of 5% commercial occupancy.[13] The Industrial Strategy must remove such disincentives in the tax system. In addition, the Industrial Strategy must consider appropriate means of supporting the overhead costs of industry-funded research which takes place in universities. The business-research support element of QR funding goes some way to doing this, however, negotiations regarding payment of research overheads can still inhibit businesses wishing to invest in research taking place in universities.

Funding

In high-risk fields with lengthy timelines, such as drug discovery, there is a need for long-term (patient) funding. In the US, Venture Capital (VC) funding is an important source of financing for biotech companies. Conversely, in the UK this source of funding is less well developed. In recent years interest from VC has increased. For example, the Dementia Discovery Fund, managed by life sciences venture capital firm SV Life Sciences (SVLS), brings together a range of public, charitable and industry funders. The fund seeks to identify and invest in innovative new drug development projects for dementia.[14] **The Industrial Strategy and Patient Capital Review must identify opportunities to build on recent progress in venture capital funding in the UK**.[15,16]

Patient capital and funding for scale-up activities is particularly important for small and medium-sized enterprises (SMEs). For example, SMEs engaged in drug discovery are increasingly required to provide growing quantities of drug/target data in order for large pharmaceutical companies to take research forward and this can only be achieved with long-term investment. Furthermore, without flexible, long-term funding SMEs are less able to cope with the inevitable early failures associated with the high-risk nature of drug development. We therefore welcome the Patient Capital Review's focus on the ability of SMEs to obtain the long-term funding required for scale up. This must consider support for SMEs making the transition from private funding to Initial Public Offerings, as well as funding from larger evergreen investor funds or from debt capital.

In the UK, private financing and VC availability remains concentrated in the South East of England. It is therefore important to incentivise the spread of, and access to, additional funding including support from Government (as highlighted in the Green Paper), VC and other investment streams across all UK regions (see **question 9**).

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12 FORUM (2017). The UK Drug Discovery Landscape https://acmedsci.ac.uk/file-download/71272985

13 The Dowling Review of Business-University Research Collaborations (2015) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440927/bis_15_352_The_dowling_review_of_business-university_rearch_collaborations_2.pdf

14 http://www.alzheimersresearchuk.org/100m-dementia-discovery-fund-launches-to-support-pioneering-research/

15 FORUM (2017). The UK Drug Discovery Landscape https://acmedsci.ac.uk/file-download/71272985

16 https://www.gov.uk/government/publications/patient-capital-review

Given that it is common for SMEs to obtain VC funding from outside the UK, it is crucial to maintain and build international relationships to provide UK companies with continued access to investment from outside the UK. Supporting connectivity between clusters and providing a single "front door" for international investment will help to facilitate this (see **question 9**). It is important to note that the European Investment Bank supports significant VC funding across member states and that this investment in the UK may be negatively impacted by the UK's departure from the EU. There may be an opportunity for this investment to be better supported through the British Business Bank.

Finally it must be recognised that public funding for drug discovery will continue to play a vital role in early stage development.[17] This funding comes in a range of forms including the Biomedical Catalyst alongside investment from the MRC and others. [18,19] The Academy welcomes the recent announcement to extend funding for the Biomedical Catalyst to 2020-21.[20]

Intellectual property

The Academy agrees that the Industrial Strategy must create the conditions for university spin-outs and biotechnology companies to have the best chance to grow and survive. Therefore, we welcome the review of intellectual property and technology transfer announced in this Green Paper. The findings of this review must be used to embed best practice in universities' technology transfer offices and introduce a pragmatic approach to IP, which encourages collaboration between academia and industry.

Legislation

The Industrial Strategy must ensure that regulation and governance is proportionate and facilitates research rather than impeding it.[21] Regulation and governance structures must provide appropriate safeguards, but should not create an unnecessary legislative burden. It is important to consider this even in the light of legislation which does not primarily focus on research but where there may be unintended impact. For example, the Psychoactive Substances Act 2016 includes an exemption for legitimate medical research which is essential to ensuring that there is no legislative barrier or additional regulatory burden to using such compounds for research.[22] Where research and researchers may be adversely affected, Government must be ready to work with the research community to mitigate the potential for negative impacts.

Supporting a vibrant eco-system

The UK life sciences sector is heterogeneous. The sector includes small biotech and SMEs, large pharmaceutical companies, specialist and non-specialist Contract Research Organisations (CROs), research institutes and universities. In recent years, large

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17 FORUM (2017). The UK Drug Discovery Landscape https://acmedsci.ac.uk/file-download/71272985

18 https://www.mrc.ac.uk/funding/science-areas/translation/biomedical-catalyst/

19 http://science.mrctechnology.org/drugdiscovery/

20 HM Treasury (2016). Autumn Statement 2016 https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016

21 Academy of Medical Sciences (2011) A new pathway for the regulation and governance of health research https://acmedsci.ac.uk/file-download/35208-newpathw.pdf

22 Psychoactive Substances Act 2016 c. 2, http://www.legislation.gov.uk/ukpga/2016/2/contents/enacted

pharmaceutical companies have reduced their in-house research capacity. This has underlined the importance of a collaborative environment, where each sector is able to contribute to the wider life-sciences landscape. For example, CROs are a valuable resource for delivering comprehensive drug discovery capabilities, and facilitating access to expertise and relatively small start-up costs for new companies and small businesses by relieving the need to recruit in-house. The Industrial Strategy must recognise the role of all aspects of the ecosystem and acknowledge the importance of continuing support for these different components. This includes support for the vital role the NHS plays in this ecosystem, which is discussed further in **question 24**.

8. How can we best support the next generation of research leaders and entrepreneurs?

Global talent

Science is global. The continued access to a global pool of talent is essential for UK science, research and innovation to continue to flourish. As the UK prepares to leave the EU, this Industrial Strategy must encourage the world's brightest and best entrepreneurs and researchers from at home and abroad to choose the UK as a destination to undertake training and long-term residence.[23]

This will depend on an immigration system which is fair, transparent and efficient. It must recognise the strategic importance of senior research leaders and entrepreneurs as well as early-stage researchers, technologists and technicians with specialist expertise[24]. The system must have flexibility with respect to visas and levels of training or income; for example, it is currently challenging to recruit talented, non-EU technicians, who do not possess training to a PhD-level and whose proposed income falls below that required to meet the visa criteria.

Recruiting and retaining research leaders

This Green Paper identifies the impact of research "stars" in seeding and anchoring excellence within Academic departments. An example of a successful international model to attract such "stars" is the Government of Canada's Research Chairs funding, which invests approximately Can$260 million a year to recruit and retain exceptional talent to Canada.[25] A similar model in the UK could be developed to ensure that the UK remains one of the most attractive places for the best researchers from around the globe.

The most recent review of the Government of Canada's Research Chairs funding recognised the value of the scheme and its ongoing effectiveness, however it noted the importance of ensuring that the awards are sufficiently financially competitive to support both salaries and research interests.[26] Furthermore the study recommended additional efforts, including targets, for the recruitment of international Chairs. Any UK-based scheme must learn from these and other similar schemes to ensure optimal design.

As outlined above, the success of any scheme designed to attract and retain exceptional talent will rely upon an appropriate immigration system.

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[23] UK National Academies, (2016) Open for business https://acmedsci.ac.uk/file-download/41610-582d965e166ae.pdf

[24] UK National Academies, (2016) Open for business https://acmedsci.ac.uk/file-download/41610-582d965e166ae.pdf

[25] http://www.chairs-chaires.gc.ca/home-accueil-eng.aspx

[26] Goss Gilroy Inc,, (2016) Evaluation of the Canada Research Chairs Program Final Report, June 2016

Investment in skills

The skilled workforce underpins the science, research and innovation sector. We welcome the provision of £90 million for an additional 1,000 PhD places in areas aligned with the Industrial Strategy. We also welcome the announcement in the Spring Budget for an additional £160 million to "support new fellowships for early and mid-career researchers in areas aligned to the Industrial Strategy". **These investments must form part of a wider strategy to invest in the whole career pathways, be it in academia or in industry rather than a one off injection of funding**.

The Spring budget announced that 40% of these additional studentships will be delivered through business and academia partnerships[27]. These must draw on the successes and experience from existing schemes such as CASE studentships.[28] Provision of entrepreneurial and business skills training should also be considered as part of this package. This is discussed further below. The additional PhD studentships must also be coupled with appropriate support for the associated consumables costs

Entrepreneurship

Consultation with our Fellows has revealed that the academic sector would benefit from additional skills in business and entrepreneurialism. The Academy welcomes the review into entrepreneurship by Professor Tim Dafforn, Chief Entrepreneurial Adviser at the Department for Business, Energy and Industrial Strategy. This review must consider the provision of entrepreneurial skills training at all career stages, as well as the incentives for academic staff to engage with this training. It must also consider how to develop skills in management and gaining experience in guiding and growing businesses.

Embedding entrepreneurship in university undergraduate courses will be important, equipping STEM students with an understanding of these skills at an early stage. However this must be coupled with targeted training at later stages. Early career researchers considering non-academic careers should have easy access to opportunities to develop entrepreneurial skills. Senior academics should also be able to develop these skill sets, from in-house training opportunities to support for MBAs. Mobility between sectors, as discussed above, will also provide some of the core soft skills required for entrepreneurship.

Encouraging universities and academia to recognise and value entrepreneurial activities has in part been achieved through the inclusion of "impact" in the REF.[29] Building on this success, universities must be incentivised to reward a more diverse range of activities from those traditionally associated with academia. In part this will be facilitated by investment in technology transfer services within HEIs, ensuring the provision of expertise in intellectual property as well as policies which facilitate interactions with industry and rapid commercialisation of IP (see **question 6**). The announcement of commissioned research into different institutions' principles and practices on commercialisation of intellectual property will help to spread best practice within universities' technology transfer offices.

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28 https://www.mrc.ac.uk/skills-careers/studentships/how-we-fund-studentships/industrial-case-studentships/

29 Academy of Medical Sciences response to HEFCE consultation on the second Research Excellence Framework https://acmedsci.ac.uk/file-download/85486062

Mobility between sectors

Increasing partnership working and mobility between sectors will support training of a cadre of researcher leaders with experience and understanding of the culture and demands of both academia and industry. A strategic approach to this is made more prescient by the downsizing of large pharmaceutical companies' research facilities in the UK over recent years. A recent report on "Bridging the skills gap in the biopharmaceutical industry", produced by ABPI, identified potential impacts of this trend on recruitment for UK SMEs[30]. SMEs in the UK have benefitted from the ability to recruit senior staff with diverse experience from large pharmaceutical companies to fill their leadership positions. Obtaining the diversity of experience required to lead successful SMEs will therefore be more challenging as a result of the downsizing of large pharmaceutical companies' research facilities in the UK.[31]

9. ***How can we best support research and innovation strengths in local areas?***

A successful Industrial Strategy should be flexible enough to deliver a national vision while recognising that the UK is not uniform[32]. The Strategy must find a careful balance between providing necessary support for local economies; exploiting and building upon local strengths in universities, businesses, NHS Trusts and the wider life sciences ecosystem; and yet avoid focusing too much on a regional agenda. A regional focus must not promote competitiveness between regions as this would further fragment the landscape. Instead it must support local strengths and allow these diversities in capabilities to flourish, encouraging regions to work together and contribute to a national strategy.

Supporting clusters to create a national offering

Clusters, whether led by business, institutions or others, play an important role in growing innovation at both a local and national level. The UK life sciences clusters will form an integral part of delivering the Life Sciences Industrial Strategy and the wider Industrial Strategy, which should aim to **continue fostering and nurturing existing clusters and partnerships, and support the growth of new clusters where appropriate**.

Sufficient connectivity at a national level must complement the differentiation and bottom-up assembly of clusters around their individual strengths. Striking this balance is essential to ensuring this rich UK-wide offering.[33] Support for connectivity between clusters must be considered in the context of mayoral devolution deals and an increasing focus on local economies. Care must be taken to avoid collaboration between clusters from being prevented by regionally restricted, devolved funding.

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30 http://www.abpi.org.uk/our-work/library/industry/documents/skills_gap_industry.pdf

31 FORUM (2017). The UK Drug Discovery Landscape https://acmedsci.ac.uk/file-download/71272985

32 UK National Academies, (2016) Open for business https://acmedsci.ac.uk/file-download/41610-582d965e166ae.pdf

33 FORUM (2017). Geographical Clusters: a vision for the future https://acmedsci.ac.uk/file-download/31821958

The Industrial Strategy should **consider support for a 'supercluster' through cross-regional strategies**.[34] UK-wide connectivity would allow clusters to compete more effectively at an international level by presenting a combined UK offering built on their individual strengths. A long-term strategy for investment in large scale infrastructure will be important to support this connectivity. Strengthening road and rail links through large-scale projects such as HS2 and rail links between Oxford and Cambridge will help to boost link clusters and increase mobility of talent.[35]

The benefits of working collaboratively within and between clusters can be seen in many examples, including; the Northern Health Science Alliance's (NHSA) role in coordinating multi-centre trials of an antimicrobial resistance diagnostic across different universities and NHS Trusts and the SETsquared partnership between the Universities of Bath, Bristol, Exeter, Southampton and Surrey, a university business incubator which supports over 250 companies and has raised over £1 billion worth of investment since 2003.[36'37'38]

Currently, funding for cluster organisations is available in two or three year cycles. More long-term (patient) investment is needed in order for clusters to be able to fully integrate within their regions and provide sustainable support for the growth of small businesses.[39] As noted in **question 7** there is a need for a greater diversity of funding for businesses across different regions.

Academia

Excellence exists in universities across the UK as demonstrated by the REF.[40] Universities outside of the Golden Triangle are finding success by focusing on particular areas of strength rather than trying to excel at everything. Regional excellence in academia can attract strong SME presence. In the US, institutions with world-leading expertise in particular disease areas have attracted strong biotechnology presence around them. Institutions across the UK host world-leading research in specific disease areas, for example Newcastle University's National Innovation Centre for Ageing and the University of Edinburgh's Centre for Cardiovascular Research.[41'42] Therefore this Industrial Strategy must help to build on this expertise and provide incentives to promote investment from biotech firms around these academic centres of excellence across the UK.

Local infrastructure

Driving growth across the whole country and supporting research and innovation centres around the country must also consider the need for investment in satellite infrastructure, including local housing, schools, roads and transport. For example, the development of

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34 FORUM (2017). Geographical Clusters: a vision for the future https://acmedsci.ac.uk/file-download/31821958
35 FORUM (2017). Geographical Clusters: a vision for the future https://acmedsci.ac.uk/file-download/31821958

36 Northern Health Science Alliance (2017). *Portable technology to fight antimicrobial resistance brought into North Hospitals* www.thenhsa.co.uk/2017/01/portable-technology-fight-antimicrobial-resistance-brought-north-hospitals/
37 http://www.setsquared.co.uk/global-1-university-business-incubator
38 FORUM (2015). Geographical Clusters https://acmedsci.ac.uk/file-download/38074-561783d0f179b.pdf

39 FORUM (2017). Geographical clusters: A vision for the Future https://acmedsci.ac.uk/file-download/31821958

40 http://www.ref.ac.uk/pubs/201401/
41 http://www.ncl.ac.uk/nica/
42 http://www.cvs.ed.ac.uk/

the South Campus of the Alderley Park BioHub will include affordable on and off-site housing for eligible employees.[43] This is essential for attracting and retaining a diverse, skilled and flexible talent pool at all levels of seniority. This should be complemented with provision of training by local educational institutions to build the capacity and capability that meets specific regional needs.

Developing skills

13. What skills shortages do we have or expect to have, in particular sectors or local areas, and how can we link the skills needs of industry to skills provision by educational institutions in local areas?

Under **question 8**, we outlined measures needed to support future research leaders, highlighting the need for entrepreneurial skills in academia and the importance of skills to work at or across the academia-industry interface. Here we discuss additional skills requirements of the life sciences sector.

Team science

The Academy's report *Improving recognition of team science contributions in biomedical research careers* highlighted the need for team science skills.[44] Team science is output-focused research involving two or more research groups, often requiring interdisciplinarity and remote working. As researchers seek to address the complex and multidisciplinary challenges posed by global challenges and ageing populations, team science is becoming increasingly common. The Academy's report found that despite the growth in team science, researchers (at all levels) often lack the support and skills required to contribute effectively to this way of working. These include leadership skills, communication skills, networking, forming successful collaborations and project management. As part of its report, the Academy recommended that employers should develop and provide training in these skills for researchers at all career stages.[45]

Specific disciplines

There are currently major shortages of data scientists and those with digital skills. These skills gaps are not restricted to the life sciences, however, the increasing volume of data generated by the changing nature of biological research means that the supply of high quality mathematical and computational skills has become critical to the life sciences R&D sector. An increasing number of reports suggest that there is a significant skills gap in this area.[46] For example, of those organisations recruiting big data staff, 57% have struggled to find suitable candidates. Furthermore demand for big data specialists in the UK is expected to increase by 160% between 2013 and 2020.[47] In summary, the global

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[43] http://cheshiresciencecorridorez.com/wp-content/uploads/2015/09/alderley_park_summary_FINAL.pdf

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

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

[46] 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

[47] 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

shortage of these skills is already impinging on our ability to conduct academic research on large and complex datasets and this problem is expected to worsen.

Drug discovery skills

Changes to the UK's drug discovery landscape have seen increasing outsourcing of drug discovery activities to biotech, CROs and academia. As highlighted in **question 8** these changes may impact on the opportunities for new drug discovery scientists to access training opportunities in large pharmaceutical industry companies.[48] In addition to these broad concerns a number of other specific skills areas have been identified as being in short supply, including: medicinal chemistry, the design and synthesis of drugs; and clinical pharmacology, which is crucial for translating basic research into medicines for patients. ABPI surveys on skills gaps in the biopharmaceutical sector in 2008 and 2015 identified clinical pharmacology as a top priority area, with both the quality and number of candidates being an issue.[49]

Improving procurement

24. What further steps can be taken to use public procurement to drive the industrial strategy in areas where government is the main client, such as healthcare and defence? Do we have the right institutions and policies in place in these sectors to exploit government's purchasing power to drive economic growth?

The NHS as a single healthcare system represents an opportunity that has not yet been properly exploited as a means for driving innovation. The world-class research and innovation conducted in the UK's science base and industry is not readily translated into the clinic in the NHS. At present too many barriers slow down the access and uptake of innovation in the NHS. These barriers exist both in the NHS and those structures which surround it. An NHS which is open to innovation must therefore be supported by structures which are equally receptive to innovative technologies.

The Industrial Strategy must fully capitalise on the potential of the NHS to drive innovation. This must be achieved through increasing the readiness of the NHS to adopt innovation early, facilitating access for patients. It must also include the embedding of research, innovation and partnership working with industry in the culture of the NHS, for both staff and patients. An NHS which is able to adopt these characteristics can not only act as an enabler of innovation but also as a catalyst for accelerating innovation.

The Industrial Strategy must ensure that effective innovation has an unimpeded pathway to market, as recognised by the Accelerated Access Review.[50] The NHS, as a single healthcare provider and key UK market needs to facilitate and drive uptake and adoption of innovation.[51] This is particularly relevant in light of the UK's impending departure from

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[48] 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

[49] 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

[50] Accelerated Access Review: Final Report, Review of innovative medicines and medical technologies (2016) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/565072/AAR_final.pdf

[51] FORUM (2017). The UK Drug Discovery Landscape https://acmedsci.ac.uk/file-download/71272985

the EU and the need to ensure that the UK remains an attractive place for all stages of drug development, including access to market.

Broadening the definition of value

In order to overcome the barriers to access and uptake, the NHS must develop a new approach to commissioning innovative therapies. A broader definition of "value" is required to reflect the true value of new technologies and interventions beyond direct health benefits such as avoiding disruption caused by switching between treatments and the ability of patients to work. New models for pricing and reimbursement should therefore be considered to reflect this value and offer a more pragmatic, affordable solution for the healthcare system by more closely aligning price with value and thereby driving uptake and adoption in the NHS.

In addition, the **NHS must be better able to recognise long-term value of emerging technologies and employ them accordingly**. A culture of short-term cost-saving measures in the NHS will inhibit the adoption of innovation which may indeed bring about long-term health benefits and efficiencies to the system.

Integrating research and development into the NHS

This Industrial Strategy must also seek to better integrate research and development into the NHS. For example, greater patient and clinician engagement, and improved use of health data and clinical infrastructure, can contribute to an NHS which is more open to research.

It is important to emphasise that this will require appropriate and proportionate regulation and governance of research within the NHS and surrounding bodies. These important safeguards must be in place to protect patient health, however they must also produce a conducive environment for research.

The UK has the great advantage of having a regulator of drugs and devices (the MHRA), which has a global reputation for its skills base and competencies. These strengths should be maintained so that it can continue to provide advice and guidance to UK manufacturers (especially SMEs) on the quality, safety and efficacy of new products as well as the studies needed to demonstrate these qualities.

Patient data

The NHS holds a unique and rich source of patient data, which represents a potentially huge asset to the UK medical research sector. Capitalising on this resource to drive medical research, derive patient benefit and attract inward investment must be a priority of the Government's Strategy. As recommended by the National Data Guardian's 'Review of Data Security, Consent and Opt-outs' the Government must establish a clear framework for the governance of sharing health data.[52] This must prioritise public support and confidence in data security and robustly communicate the value of sharing health data to facilitate research to benefit individual patients and the wider healthcare

[52] National Data Guardian for Health and Care (2016). Review of Data Security, Consent and Opt-Outs, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/535024/data-security-review.PDF

system. Moreover, it must also provide appropriate safeguards to allow reliable and secure data access and linkage whilst protecting individual privacy.

Open innovation in the NHS

The adoption of open innovation practices, which bring together industry, academia and the NHS, can deliver outputs to patients faster, better and cheaper than single sector working. This approach can also enable clinical problems which are not tractable by any one group to be tackled.[53] The Industrial Strategy must encourage this kind of working within the NHS to stimulate innovation.

Examples of successful open innovation in the NHS do exist and are characterised by trust and openness between partners; shared risk and reward; and the delivery of mutually beneficial outputs. As highlighted in **questions 7 and 8**, cultural differences between the researchers in these environments can inhibit effective collaboration.

Team science skills (**question 13**) and increased partnership working at the industry-academia interface are required to break down these barriers which may impede the benefits which can arise from open innovation.

Cultivating world-leading sectors

31. How can the Government and industry help sectors come together to identify the opportunities for a 'sector deal' to address – especially where industries are fragmented or not well defined?

A recent report published by PWC identified that UK Life Sciences contributed £30.4bn to the economy in 2015 and supports almost half a million UK jobs[54].The Academy has provided input to the development of this strategy through direct engagement with the Office for Life Sciences and Sir John Bell.[55]

Driving growth across the whole country

34. Do you agree the principles set out above are the right ones? If not what is missing?

This Green Paper describes the importance of supporting clusters to grow innovation at both a local and national level. As addressed in detail in **question 8** the Academy endorses this vision and highlights the role of the life sciences clusters in achieving growth across the whole country. However, we emphasise that clusters must be supported to become a national offering for the UK. The focus on regional growth and devolved funding must not drive clusters to compete against one another.

Creating the right institutions to bring together sectors and places

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[53] FORUM (2014). Open Innovation in the NHS https://acmedsci.ac.uk/file-download/35041-53eb4d80e4aed.pdf

[54] PWC (2017). | The economic contribution of the UK Life Sciences industry, http://www.abpi.org.uk/our-work/library/industry/Documents/The_economic_contribution_of_the_UK_Life_Sciences_industry.pdf

[55] Academy of Medical Sciences (2017). Life Sciences industrial strategy dinner, https://acmedsci.ac.uk/life-sciences-industrial-strategy-dinner

36. Recognising the need for local initiative and leadership, how should we best work with local areas to create and strengthen key local institutions?

As highlighted in **question 9 and 35**, the life sciences clusters play a key role in the driving an industrial strategy which works for the whole country. Provision of continued support for Local Enterprise Partnerships (LEPs) will help drive engagement between clusters and local government. The additional £1.8 billion of funding from the Local Growth Fund, some of which will go to LEPs, should help to drive this engagement.

The Governments' Green Paper highlights support for networks of universities to come together to improve commercialisation. Promoting innovation and commercialisation within these clusters could be encouraged through shared technology transfer platforms and the Government's commitment to place Intellectual Property Office representatives in key UK cities.

As highlighted throughout this response it is essential that support for clusters also promotes the interaction and connectivity between clusters to complement strengths, share best practice and provide a nation-wide offering from the UK.

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