Industrial Strategy Green Paper
Response from The Institute of Cancer Research, London

March 2017

The Institute of Cancer Research (ICR) is one of the world's most influential cancer research organisations with an outstanding record of achievement dating back more than 100 years. We ranked first in the *Times Higher Education* league table of university research quality and impact compiled from the Research Excellence Framework (REF 2014). Together with our hospital partner, The Royal Marsden NHS Foundation Trust, we are rated in the top four centres for cancer research and treatment worldwide.

The ICR is committed to carrying out excellent research and exploiting it to its maximum potential for the public benefit. We carry out research collaboration and knowledge exchange activities with companies – working largely with the pharmaceutical, biotechnology and medical equipment industries. We see partnering with industry as an essential part of our mission since in many cases it is the only way to take our discoveries to patients.

Our area of expertise is in the life sciences so our response is focused on this area - we are not covering the range of areas which are included within the Industrial Strategy. We welcome the opportunity to comment on this Green Paper.

The challenge

1. Does this document identify 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?

We welcome and support the main aim of the strategy to grow the economy through investing in science, and recognising the commercial potential of research. However, we feel that the twin aims of extending our excellence in research, whilst distributing investment and promoting growth across the whole of the UK, can be at odds.

We strongly support the intention to build on our strengths by investing in key areas of research excellence as a means of making the UK globally competitive. However, we consider the strategy's emphasis on the need to spread investment and growth across the nation risks spreading resources too thinly, and fails to reward excellence. A one-size-fits-all approach across the whole of the UK won't work. Investment needs to be focused on national areas of expertise and excellence, wherever they are located, if we are to remain globally competitive.

Blue skies research

It is important that basic, or 'blue skies' research, also continues to be funded adequately. The Industrial Strategy is inevitably focused on commercially-relevant research, but it is important to

recognise that true innovation is often underpinned by advances in basic sciences. Retaining a strong base in blue skies research will be critical in order to maintain the UK's long-term competitiveness.

Many important technologies, such as smartphones and low-cost genome sequencing, were developed as a result of basic research where the future application was not identified when it was carried out. We need to ensure there remains the capacity and incentive to make the serendipitous discoveries that can have huge impact as well as those where the impact is planned.

Translational research must not be supported at the expense of blue skies research, from which paradigm shifts and whole new areas of economic activity may arise. Both are essential.

Investing in science, research and innovation

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

We welcome the recognition that we need to invest in innovative research and do more to commercialise our world-leading science base to drive growth across the UK.

The UK has many institutions of international standing and is world-leading in many research fields, and life science is a particular success story.

Technology-intensive businesses want to work with the best academic minds in their field, and areas such as the UK's leading basic science base, and in particular, its world-class drug discovery, are key factors in this success.

Government spending on science has declined in real terms since 2010 and risks slowing scientific progress, and damaging the UK's ambition to be internationally competitive in scientific and technological innovation. We welcome the focus of the strategy to combat this.

An interconnected funding ecosytem

The UK draws strength from its mixed funding ecosystem for biomedical research, with support from Government, charities and industry. However, these funding streams are interconnected, with funding from some areas leveraging additional funding from others, and reductions in one cannot simply be compensated for by the others.

Government money is vital for encouraging investment from the charity and private sectors through funding streams such as HEFCE's Charity Research Support Fund and the Higher Education Innovation Fund. A long term funding strategy for science is essential, particularly when the gap is widening between UK investment in R&D and that of our competitor countries. The UK spends approximately £134 per person on science in general, as opposed to £198 for Germany and £270 for the US[1]. We welcome the commitment in the strategy to substantially increase investment in R+D, although we have concerns that this still may not be able to plug the funding gap in the life

[1] https://scienceogram.org/in-depth/international-comparisons/

sciences, given the sector's increasing role in generating wealth for the nation, but more importantly, delivering innovative treatments to patients.

R+D tax environment review

We welcome the review of the R+D tax environment and believe this may help address financial barriers that prevent engagement between universities and business. For example, VAT is currently charged on new buildings in which academia and industry will work together but not on buildings solely for academic use, which may disincentivise colocation arrangements. **A tax arrangement that allows business to work with universities without causing additional tax challenges would help support commercialisation of research.**

7. What else can the UK do to create an environment that supports the commercialisation of ideas?
A lack of stability in schemes to support commercialization of research can be a barrier for both businesses and universities in forming long-term partnerships. In order to fully support the commercialisation of research the sector needs long-term stable plans, and novel models of risk sharing involving partnerships between businesses, universities, Government and charities.

Crossing the valley of death

Drug discovery is a complex ecosystem, involving pharmaceutical companies, smaller biotechnology firms, academic institutions such as the ICR, as well as charity funders, private investors and the public sector.

There is a major funding gap that prevents medical research discoveries from being optimally translated into new products – the so-called 'valley of death'. Academic organisations such as the ICR can help bridge this gap, by shouldering much of the risk in early-stage drug discovery and sharing risk with industry through collaborative drug discovery and development projects. **But Government support is also required and there is a real need for effective risk-sharing initiatives which are likely to involve partnerships between businesses, universities, Government and charities.** The ICR is of the opinion the Industrial Strategy should be more explicit in this.

We need to incentivise companies to work in partnership with universities and charities on innovative projects, sharing risks and costs. That could be done through tax incentives for companies that work in partnership with universities or charities to share risk, or extensions to the periods of market exclusivity granted as part of the approval of a new therapeutic intervention.

Schemes to support commercialisation

Building links with industry is about strengthening relationships, and funding to support this activity needs to be guaranteed for several years to allow relationships to be developed and retained.

We consider HEFCE's Higher Education Innovation Fund essential in supporting business-university collaboration, and organisations such as the ICR have used it successfully to interact with industry and take our scientific discoveries to patients sooner. We welcome the commitment in the strategy to expand HEIF. **This funding needs to be guaranteed for a number of years so that cohorts of highly skilled professionals can be developed and retained.**

In other areas of innovation funding, there can be a lack of clarity and continuity in the schemes to support business-university collaboration in the UK. With high turnover and multiple schemes in the current system, there is currently a lack of stability and it is difficult for both higher education institutions (HEIs) and industry to gain and keep knowledge of how all of these funding schemes work.

There is a need to review and evaluate existing schemes and simplify the landscape before setting up new ones. A lack of stability can be a barrier for both businesses and universities in forming long-term partnerships.

We recommend current support is evaluated and simplified, and that future strategies to support business-university collaboration need to be long term and consistent.

New funding models to support innovation

We propose a fund that invests in innovative drug discovery and development studies in an academic environment. It would take the new technologies to clinical proof of concept and then partner them with pharma on the condition that drugs and other healthcare advances are then made available on the NHS at an affordable (and much lower than current) price.

Pharmaceutical companies would benefit by getting a supply of late-stage drugs that have been de-risked by academia. The NHS gets affordable innovative drugs, and patients are able to access drugs for unmet needs. This would make the UK the place to do innovative drug discovery and development.

As a model to sencourage private investment in research, in cases where private investment funding for drug development exists, the Government could provide matched funding, or flexible loans.

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

Movement of people between the academic and commercial sectors plays an important part in successful joint working. Several of our team leaders have spent significant time in the pharmaceutical and biotechnology industry. This promotes cultural understanding across the different sectors which helps generate trust in collaborations. **We believe it is important that the Government helps facilitate the movement of staff between universities and industry.**

It's also important that companies can find mentors, advisors and Non-Executive Directors who are truly innovators in the field, not just middle management.

The ICR is strongly committed to promoting equality in every aspect of our work. We are working hard to create a working environment that is supportive of all our talented researchers and a fully inclusive environment for staff and students. Public funding streams need to be family friendly and allow for parental leave cover or suspension of funding.

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?

We work in an international marketplace and difficulty in gaining visas for people with specialist skills could limit our ability to recruit the best international researchers in the future.

Big data

Big Data is an emerging field, with a limited number of people with the necessary skills and experience, making it hard to recruit staff. The ICR and other medical research organisations have highlighted skills shortages in bioinformatics in the past in a joint response to the Migration Advisory Committee[2], which as a result recommended that the job titles 'informatician' and 'bioinformatician' be included on the Government-approved Shortage Occupation List. We welcomed the addition of these titles to the list.

However, we also need to future-proof our workforce. Bioinformatics training in the past has tended to focus on the analysis of next-generation sequencing data but technologies quickly change and training can rapidly become outdated. **We need to ensure that we train people with skills which will allow them to adapt to changing technologies.** The next generation of data scientists need to be trained in a combination of mathematics, statistics and computing, allowing them to apply their skills to data mining and artificial intelligence. **We recommend the establishment of training and internship programmes to build the skills base in Big Data. We also believe there needs to be an increased emphasis on science, technology, engineering and maths (STEM) in school and universities to ensure we have the people to exploit the new functionalities enabled by the UK's investment in digital infrastructure.**

Drug discovery and development skills

Over the last decade, industry bodies have expressed significant concerns that the UK is not training the right combination of graduates. In the 2015 report *Bridging the skills gap in the biopharmaceutical industry*[3] the ABPI identified and addressed skills shortages in the biomedical sector, highlighting major skills gaps in mathematical and computational areas, translational medicine/clinical pharmacology, and also in communication and team working skills.

A group of learned societies formed a joint Drug Discovery Pathway Group, tasked with addressing capacity in training the next generation of drug discovery scientists. They recommended a model of working in academic therapeutic centres of excellence, integrating the work of chemists, biologists, biomedical researchers and clinicians, and bringing together staff and skills from industry, academia and hospitals. They highlighted the ICR's Cancer Research UK Cancer Therapeutics Unit as a

[2] http://www.mrc.ac.uk/documents/pdf/mac-consultation-on-the-review-of-the-shortage-occupation-lists-for-the-uk-and-scotland-and-creative-occupations-submission-from-researchers/
[3] *Bridging the skills gap in the biopharmaceutical industry* - http://www.abpi.org.uk/our-work/library/industry/Documents/Skills_Gap_Industry.pdf

world-class example of a drug discovery centre here in the UK. The group attributed this success to the integration of the academic unit with clinicians at The Royal Marsden NHS Foundation Trust, sustained funding, supportive collaborations and strong leadership.

Training

There is a significant role for both academic institutions and industry in training the next generation of researchers. Industry could provide more placements and work experience opportunities for HE students as well as sabbaticals for staff to gain skills and experience. Companies could also offer mentors and career coaching to academics and get involved in outreach with local schools. A new funding scheme could support industrial placements and sabbaticals for staff to move between organisations.

Higher education institutions could talk to businesses about their curriculums, provide courses that incorporate work experience, placements and exchange programmes, and provide more opportunities for hybrid courses teaching scientific and business skills. Entrepreneurship training could also be embedded in undergraduate programmes (and even at secondary schools) so that all graduates have the skills to transfer between academia, industry and start-up.

Skills to work at the interface

Scientists now increasingly appreciate that the most challenging research problems are only going to be solved using a 'team science' approach – with multidisciplinary teams drawing on diverse skill sets, expertise and ways of working. This may require incentives to encourage world-class researchers based in the UK to collaborate to ensure integrated propositions are available to potential global collaborators. It will also ensure groups within the UK do not individually take sub-optimal solutions to partners, diluting the UK's proposition, which should be based on excellence rather than opportunity.

We welcome schemes set up to promote a team science approach such as the Cancer Research UK Grand Challenge funding which specifically brings together multidisciplinary teams, and the National Council of University and Business's Konfer database which supports finding researchers in the disciplines you are interested in.

We believe training is required in the specific skills to support team science including managing people in teams, complex trans-disciplinary technical management skills, communication, milestone setting, problem solving, decision making, cross-disciplinary research data integrity audit, and conflict resolution.

Future skills shortage

For the UK to remain competitive, we need to be an attractive place to work and study for the best scientists throughout the world. Researcher mobility also allows UK researchers to spend time working in other countries and picking up new skills that they can later bring back to the UK.

Uncertainties around funding, researcher movement and the ability to participate in collaborations following the vote to leave the EU may combine to create a perception that the UK is not a welcoming destination for research.

Once the UK has left the EU, European researchers may feel it is too difficult to move to the UK to work, and this could reduce our ability to attract talent. EU staff also make up a significant

proportion of the NHS workforce and play a key role in clinical research conducted at universities. Any loss of EU staff from the NHS workforce would have an impact on our ability to carry out and lead research through multi-centre clinical trials.

The UK Government needs to secure a deal with the EU which does not damage our ability to recruit leading researchers from across the world or make the UK a less attractive location.

Upgrading infrastructure

17. What further actions can we take to improve the performance of infrastructure towards international benchmarks? How can government work with industry to ensure we have the skills and supply chain needed to deliver strategic infrastructure in the UK?

Driving growth through data infrastructure

The ICR supports the planned investment in economic infrastructure in the strategy. We need increased digital infrastructure to collate and share complex data, allowing us to maximise the potential of our research and ensure our discoveries have the greatest patient benefit. This integrates elements of the Eight Great Technologies.

The UK has a long tradition of innovation including in areas such as computer science and artificial intelligence. Big Data analytics is a rapidly evolving field, and if our strength in innovation is combined with investment from Government and industry, the UK could lead globally in Big Data, opening up significant economic opportunities.

Research institutes need to transfer data between, or within, organisations on an incredibly large scale and we do not currently have the hardware or software capable of achieving this. **There needs to be a greater coordinated effort including Government, industry and academia to design and implement the next generation of data-transfer infrastructure and technologies in order to create Big Data transfer highways.**

Technological developments in research and healthcare now mean vast quantities of genomic, imaging and clinical data, among other forms, are being generated at an unprecedented scale. Data collection is getting cheaper and faster, but this has not been matched with systems for analysing different types of data together or maximising their value for patient benefit.

The ICR welcomes the investment of £400m in a new Digital Investment Fund. However, we consider that capital investment, in the absence of longer-term funding does not provide a sustainable model, and will not realise the opportunity afforded by our world-class life science research, and excellence in healthcare delivery.

We also need investment in research that can deliver these capabilities in the long term - such as how to mine data - as well as funding training to the people to support Big Data initiatives.

Data security standards

We welcome the particular emphasis on investment in digital infrastructure that is robust, resilient and secure. In the life sciences, the ability to communicate effectively and safely between research institutes, hospitals and companies is extremely important and the ambition to make the UK the safest place to do business online is very welcome. Access to patient data is vital for the medical research conducted at the ICR, and we regard it as essential that the public can trust and have confidence in the processes in place for securing and controlling access to data.

We welcomed the focus on data security in the National Data Guardian review of Data Security, Consent and Opt-outs in 2016, but caution that some of the proposed security standards are particularly NHS-centric, with a risk of being too specific to apply to the full range of organisations that handle patient data. **We must make sure that the standards are applicable to multiple types of organisations.**

It is critical that any solutions for storing data are compatible with the NHS – which may need Government support in setting up systems for data collection and storage. The Government could pick a few centres (academic and NHS) and fund a pilot project to evaluate what is currently possible and what technological, legal and ethical issues still need to be addressed. **We recommend funding from Government is provided to support the infrastructure required for storage systems for NHS organisations.**

Further work is needed to produce an implementation plan for Dame Fiona's recommendations in the review, with information on timescales and the resources available to introduce the standards across the sector.

Transport infrastructure

For the UK to get the best out of investing in world-leading research, we need to ensure it is supported by high-quality transport infrastructure.

As an example, the ICR and The London Borough of Sutton are developing a truly world-leading life-science campus specialising in cancer research, treatment, education and enterprise. The London Cancer Hub will deliver an exceptional environment for cancer research that enhances the discovery of new treatments and their development for patients.

This will require public transport links to the site to be significantly upgraded. We need to ensure that the site can cope with increasing traffic from staff and visitors, and that people can efficiently access it through comfortable, reliable, low-emission transport routes. It is hoped that The London Cancer Hub will bring further public transport investment into Sutton through the creation of an integrated transport system that extends the Tramlink from Wimbledon to Sutton Station via Morden and onwards to the site of The London Cancer Hub. **We need targeted investment in transport infrastructure in order to deliver projects such as this.**

Improving procurement

23. Are there further steps that the government can take to support innovation through public procurement?

It's essential that we find ways of making sure that patients can benefit from the latest, highly innovative treatments, and the Government has a role to play in ensuring innovation is taken up throughout the NHS.

Siloed budgeting

We need funding models which do not discourage hospitals from providing innovative new treatments.

The fragmented arrangements for commissioning, and the NHS's schemes for reimbursing hospitals for the procedures they have conducted, can act as financial barriers to adoption, even where treatments should save the NHS money. We have two examples.

- The START radiotherapy trials carried out at the ICR found that comparable levels of cancer control were achieved when radiotherapy for breast cancer was given in a lower overall dose in fewer, larger fractions, requiring fewer hospital appointments. Implementing the results of this research across the NHS could save it £50 million per year in treatment costs. However, as hospitals are paid on the number of hospital visits, adopters of the new regimen receive less money, and aren't able to benefit themselves from the wider savings to the NHS.
- A genetic test costing just a few hundred pounds can be used to determine which patients are suitable for targeted treatments – in some cases saving tens of thousands of pounds in treatment costs. However, genetic testing is not usually paid for out of the oncology budget, so it can be difficult for hospitals to find the money to conduct them.

Embedding innovation

We would like to see a system for introducing new cancer treatments into the NHS that properly prioritises and incentivises the discovery and development of innovative new medicines.

The UK needs to encourage innovation in life science for the benefit of patients, whilst reducing the financial burden on the taxpayer. **As such, we recommend a review of the therapeutic development pathway, so that new innovations can be delivered to patients quickly, whilst minimising costs.** Streamlining the development process, in the era of personalised medicine and payment on outcomes, will enable partner companies to receive a fair return on their investment, while delivering treatments to patients faster and more cheaply, making the UK the leading innovator in the world for genuinely integrated translational research.

We welcomed the Accelerated Access Review and its aim to speed up access to truly innovative medicines on the NHS. We need the rapid implementation of the report's recommendations and, importantly, the provision of sufficient resources to make this happen.

In order to encourage innovation the concept needs to be embedded throughout the whole process of bringing a drug to market, including during the preclinical and clinical development stages, drug licencing and evaluation by NICE . We need to demonstrate to global partners that health systems will pay for the most innovative and effective cancer treatments to encourage them to work on these high-risk projects, and the UK is the best place in the world to do it. This will be particualy true after the UK leaves the EU.

We also need a shared recognition of highly innovative treatments and understanding of what an innovative treatment looks like. We believe drugs with a brand new mechanism of action

should be regarded as especially innovative. This sort of innovation in drug discovery is essential to make big step-change improvements in outcomes from cancer.

We should be moving our focus away from 'me too' drugs, similar to others on the market, and on to novel treatments and those for diseases where there is unmet need – including many types of cancers.

We also need financial incentives for research into riskier targets**.** This is particularly important in areas of unmet need like childhood cancers, where the small populations make it expensive and non-profitable to develop drugs. **Incentives such as extra protection of market exclusivity or R&D tax credits can help in encouraging companies to develop drugs in unprofitable areas.**

We also need to bring the cost of drug development itself down. Stratified medicine should enable smaller, more focused trials, potentially making drug development quicker and cheaper. We need to be looking at how altering trial design can bring costs down – by using biomarkers to stratify patients into the most appropriate trials, where they are likely to receive the most benefit, and also through better target validation.

Phase III trials make up the largest cost of developing a new drug, so as we see more approvals based on Phase II trials data, this will substantially reduce companies' initial costs, and if costs come down, any savings need to be passed on to the NHS.

New models to support innovation

New models of partnership are also worth exploring. Academic teams could partner with new forms of private company to fund clinical trials and marketing. These new companies could specialise in partnerships with the non-profit sector, and would agree to cap the price of new medicines. There is currently only limited capacity within academia for drug development – but **Government could support academic organisations to take drugs through to a later stage of development, where they are working on novel innovative drugs targets for areas of unmet need.** In turn, by creating drugs more cheaply in academia, this could provide competition for traditional pharmaceutical companies and help drive down prices.

Enhanced research within the NHS is needed to deliver innovation. Programme such as the AHSNs which allow the early adoption of new ideas and support roll out across the NHS are welcome.

Creating the right institutions to bring together sectors and places

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

We welcome the recognition that successful research clusters supporting innovation are key for driving growth, and that higher education institutions can have a big impact on local growth, as well as fostering business connections and helping ideas to spread.

Our ambition is to create a truly world-leading life-science district specialising in cancer research, treatment, education and enterprise in Sutton, South London. The project will not only be a major boost to London's life-science industry but also the wider economy, locally and nationally.

In order for research clusters such as this to be world leading in translational research, they need to have sufficient scale, a core focus, co-location of research alongside healthcare and to be world leading at both. **The Government need to be channelling investment into those projects which meet these criteria and supporting and investing in them.**

37. What are the most important institutions which we need to upgrade or support to back growth in particular areas?

If we are to deliver an ecosystem where research can deliver the greatest improvements for patients, we need to invest in the NHS.

The UK has all the components needed to lead the way in the integration of high-throughput genomics into routine healthcare, through programmes such as Genomics England, which could in turn drive an innovation boom. However, the NHS will require substantial investment in order to deliver this opportunity.

We strongly support the rebrand of the Health and Social Care Information Centre as NHS Digital to increase public awareness and to more clearly convey the role of the organisation. **It is also crucial that NHS Digital also gets substantial investment in quality systems and people in order to deliver improvements in data security and ensure public trust.**

Any degradation of NHS infrastructure would damage the possibility of rolling out genomics across the whole of the UK and we would lose the advantage we have over other countries through our centralised public health system.