

Boosting translational research in the U.K.

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Over the past 10 years, the U.K.'s National Institute for Health Research (NIHR) has invested in several leading translational research facilities that are individually and collectively delivering substantial impact for patients as well as new opportunities for commercial partnerships and growth. Here, we reflect on the capacity, capability, and year-on-year increase in translational research in the U.K. after a decade of investments (1). We analyze key data demonstrating accelerating performance in several collaborative funding streams and highlight issues to be addressed to ensure sustainable growth in the medium to long term.

STATUS UPDATE

Early-phase translational research and experimental medicine have been areas of growth and development since the publication of the U.K. Department of Health document, *Best Research for Best Health*, in 2006, which set clear goals for translational research (2). This publication was closely followed by the Cooksey report on health research funding, which led to the establishment of the Office for Strategic Coordination of Health Research (3), an organization designed to oversee the budgetary and research strategies of the Medical Research Council (MRC) and the NIHR. The NIHR is embedded in the U.K.'s National Health Service (NHS) and directly funds translational research through eleven Biomedical Research Centres (BRCs) within leading NHS hospitals and university centers (1). BRCs, along with Biomedical Research Units (BRUs), are linked through several national collaborative programs, including translational research partnerships, the NIHR BioResource, and NIHR Health Informatics Collaborative (4). Substantial progress has been made since the inception of BRCs and BRUs in 2007. From 2014 to 2015, more than 5400 research projects were supported, 5585 peer-reviewed articles were published, and £844 million in external funding was obtained (Fig. 1). Over the last 5 years, the total industry annual

income generated from intellectual property has quadrupled from £33 million to £120 million (Fig. 1), with almost 100 patent applications granted, 107 licensing deals reached, and more than 40 spin-off companies established. In addition, research charities, such as the Wellcome Trust, have contributed more than £1.5 billion in financial support to various BRCs and BRUs in the U.K. (5).

At a time of austerity in public spending and political uncertainty after the European Union (EU) referendum, the recent comprehensive spending review by the U.K. government, which allocates budgets for the next 5 years, highlighted the vital role of science and translational research to the U.K. economy and protected its funding in real terms (6). The U.K. government pledged to protect funding for the sciences for the financial year April 2015 to April 2016 and announced investment in science infrastructure at a rate of £1.1 billion per year, protected in real terms until 2021 (7). This means an overall increased allocation by the U.K. government, with investment in science and research reaching £5.8 billion for the financial year 2015 to 2016 (7). The U.K. government has acknowledged that research excellence is a critical asset for the country and plays a key role in economic growth. Almost one-third of MRC-funded research groups have established collaborations with the private sector, creating new businesses, improving the performance of existing businesses, and attracting at least £700 million in direct financial commitments from more than 500 companies worldwide to the U.K. science base since 2006 (7).

HEALTH CARE INFRASTRUCTURE

Health care in the U.K. is primarily delivered by a single provider, the NHS. Translational research infrastructure in the U.K. has focused on developing a coherent national research strategy and creating research networks. The bulk of experimental medicine and early-phase translational research in the U.K. is carried out in the BRCs. The BRCs were created with specific practical aims to facilitate translational research. They are physical centers uniting clinical research facilities with clinical and scientific activities. Each BRC is lo-

cated within an NHS hospital, which allows access to patient populations and provides researchers with a streamlined transition from research laboratory to the clinic, catalyzing patient-focused research on a local and national scale (8).

The NIHR Health Informatics Collaborative is an example of the cohesive nature of the BRCs. This program was set up to bring together expertise from five of the country's leading NIHR BRCs, along with their associated NHS trusts and academic partners, to make NHS clinical data more readily available to researchers, clinicians, and industry. The NIHR Health Informatics Collaborative focuses on five scientific themes: viral hepatology, acute coronary syndromes, ovarian cancer, renal transplantation, and critical care. Access to a population of more than 20 million people across the five centers provides an extensive resource for high-quality clinical data, electronic patient records for front-line delivery and continuity of care across different NHS trusts, and the ability to assemble large patient cohorts for cross-site translational clinical studies with academic and industry partners (www.nihr.ac.uk/about/hic.htm). The next phase of this program is likely to involve a rollout across the wider BRC and BRU network.

ACADEMIC AND INDUSTRY COLLABORATIONS

A key strategic aim of early-phase translational research and experimental medicine in the U.K. has been to form strong collaborations among academia, clinical medicine, and industry (both pharmaceutical and nonpharmaceutical). Here, we outline some exemplars of national programs with distinguished global industry partners.

The 100,000 Genomes Project and genomic medicine centers

Genomics England was formed by the U.K. Department of Health to create a new genomic medicine service for the NHS (www.genomicsengland.co.uk/the-100000-genomes-project/). By sequencing 100,000 genomes of patients with cancer and rare diseases, this project offers not only the possibility of a diagnosis but also the development of new, effective therapies. Genomics England provides a resource for studying the best use of genomics clinically and has been awarded an additional £250 million to introduce whole-genome sequencing technology to the NHS. In 2014, the Wellcome Trust announced a £27 million investment in a genome sequencing hub, allowing Genomics England to become a part of

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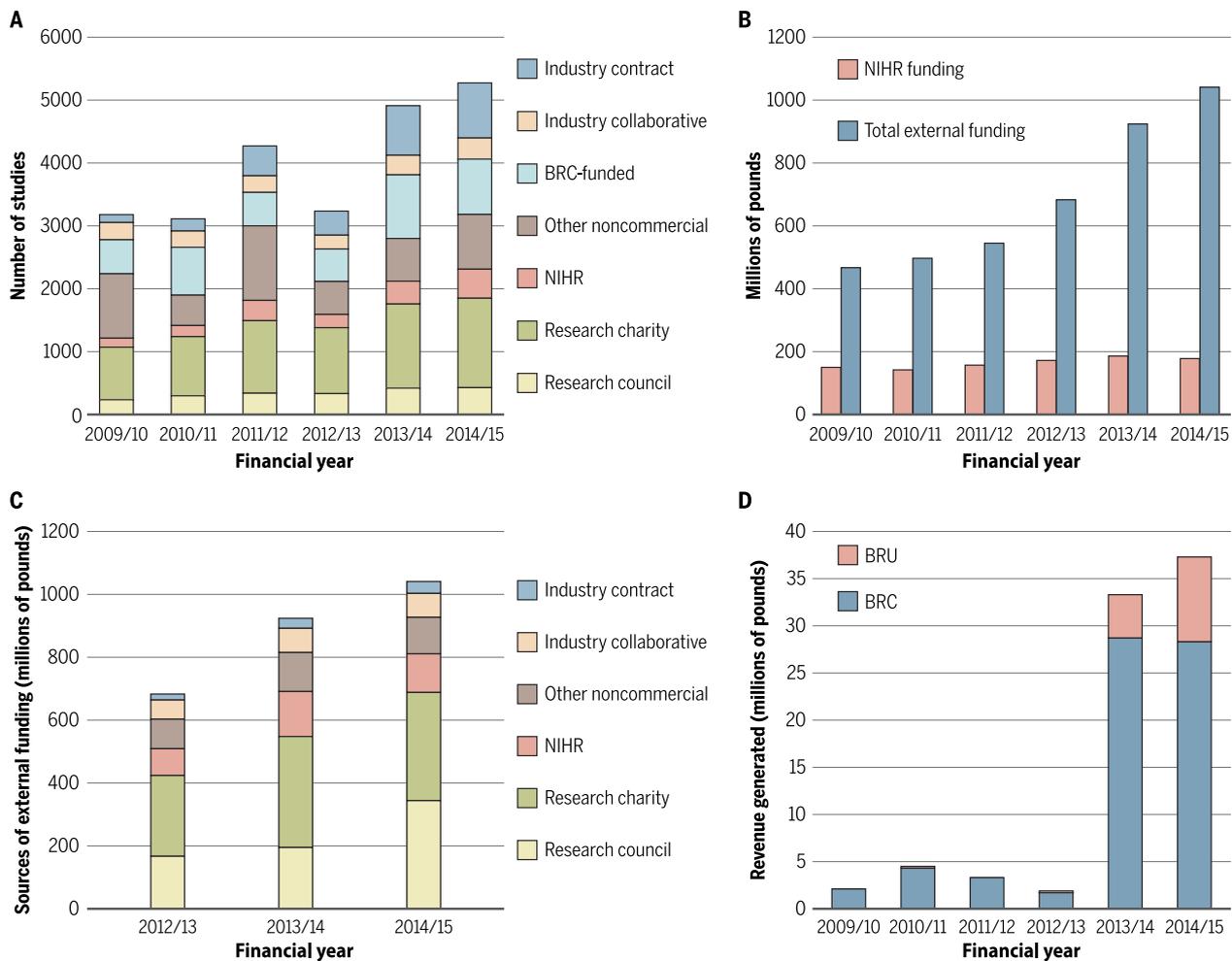


Fig. 1. Plotting growth in translational research. Funding for NIHR BRCs and BRUs from 2009 to 2015. (A) The number of active research studies in NIHR BRCs by funding category. (B) External funding (millions of pounds) for NIHR BRCs and BRUs. (C) Sources of external funding (millions of pounds) for NIHR BRCs and BRUs. (D) Revenue generated (millions of pounds) by NIHR BRCs and BRUs from intellectual property.

the Wellcome Trust Genome Campus at the Sanger Institute in Cambridge. Partnering with the U.S. company Illumina, whose services were secured in a £78 million agreement, Genomics England has ensured sufficient sequencing capacity to deliver on its objectives. This partnership was recently expanded to include bioinformatics services to develop a set of informatics tools, which will support the delivery of genomic clinical and research services at a population scale to the 13 nationwide NHS genomic medicine centers and the Genomics England Clinical Interpretation Partnership (GeCIP). GeCIP is a U.K.-based consortium of academic researchers, clinicians, and trainees, who work in collaboration to improve the clinical application and data interpretation of the 100,000 Genomes Project, with the aim of developing genomic services for routine use at NHS point of care.

Catapult

The Catapult was established in April 2015 (<https://pm.catapult.org.uk/>) and is funded by Innovate U.K., the U.K. government’s innovation agency, which has committed an initial investment of £50 million in the first 5 years. Catapult has created a network of centers to develop products and services that will push the U.K. forward in the area of precision medicine. With strong growth in the global market for precision medicine therapies and diagnostics, this is an area that provides an opportunity for national economic growth.

NIHR Clinical Research Network

The NIHR Clinical Research Network (CRN) is funded by the U.K. Department of Health and supports late-phase industry studies and patient recruitment (www.crn.nihr.ac.uk/). It has 15 local CRNs within NHS hospitals with a single CRN coordinating center. Over the

past 5 years, 98% of NHS hospitals have actively engaged in the CRN, and more than 3 million people have had the opportunity to participate in CRN studies. Recruitment of the first patient to a worldwide study (“first global” patient) is a key performance indicator of clinical research delivery. The CRN recruited 25 first global patients in commercial studies in the financial year 2013 to 2014, demonstrating that the U.K. has the research infrastructure in place to support rapid setup of clinical studies.

FUTURE CHALLENGES

The interim report of the U.K. government’s Accelerated Access Review of Innovative Medicine and Medical Technologies has outlined key propositions for future development (9). First and foremost, it promotes the concept of patient-led outcome measures, greater patient involvement at every stage of innovation, and a

greater emphasis on the “patient voice.” It goes on to highlight the need to accelerate patient access to new therapeutics and models of care in a sustainable and affordable manner. The U.K. has the distinction of having a single national healthcare provider, allowing a coherent national strategy and access to an entire country’s population of patients. This crucial asset must be preserved, and the research-to-clinic connection must be further strengthened. The research infrastructure already implemented is not only achieving these objectives but also serving to nurture future leaders in translational research and experimental medicine. At a time of financial austerity and political uncertainty, protected funding for science is an acknowledgement of the importance of the scientific sector to the U.K. economy. However, it is imperative that there continues to be a sustainable economic environment for translational research in the U.K.. The ramifications of the result of the recent EU referendum are difficult to quantify because the terms of the U.K.’s exit from the EU have not yet been determined. However, the NIHR is based primarily in England, and its early-phase translational research is underpinned by global collaborations, allowing sufficient flexibility to manage research programs and ensure delivery of key outcomes, independent of the U.K.’s exit from the EU. Nationally, collaborative networks have successfully leveraged external funding and generated leading health care advances, such as the NIHR health protection research units, which provided a rapid response to the Ebola outbreak and supported vaccine trials that have been cited in the World Health Organization’s guidance documents. Commercial partnerships with

efficient, rapid setup of clinical trials and integrated access to innovation are essential to compete on the world stage and to encourage further external investment in the U.K.’s research base.

To maximize impact, patient and public engagement must be promoted. The BRCs have already raised the profile of translational research within NHS hospitals. They provide an excellent environment to encourage patients to speak up, to advocate for patient-centric outcomes, and to disseminate national and global biomedical innovations locally. Numerous initiatives have already been established to promote patient and public engagement, such as research road shows, which go out into the local community to tell people about current research, and the “demonstrating science” program aimed at school-aged children, which showcases the interaction between science and medicine (www.guysandstthomasbrc.nihr.ac.uk/patients-public/community-engagement/).

The BRC model has facilitated the creation of an ecosystem for translational research and experimental medicine at a local level, while maintaining close interactions with national and global academic and commercial partners to achieve patient-centered research and improved patient outcomes. This translational research infrastructure has established leading experimental medicine capability, making investment in U.K. research an attractive prospect for commercial partners. The challenge now and moving forward is not only to maintain relevance in an ever-changing competitive market but also to improve efficiency to minimize the lag time from research laboratory to the clinic, while upholding the

highest standards in patient safety and delivering improved clinical outcomes in a sustainable manner.

REFERENCES

1. K. Soderquest, G. M. Lord, Strategies for translational research in the United Kingdom. *Sci. Transl. Med.* **2**, 53cm28 (2010).
2. T. W. Evans, Best research for best health: A new national health research strategy. *Clin. Med.* **6**, 435–437 (2006).
3. D. Cooksey, *A Review of U.K. Health Research Funding* (The Stationary Office, 2006); https://gov.uk/government/uploads/system/uploads/attachment_data/file/228984/0118404881.pdf.
4. The U.K.’s National Institute of Health Research (NIHR); www.nihr.ac.uk/about/structure.htm.
5. National Institute for Health Research (NIHR), “Analysis of NIHR Biomedical Research Centres Annual Report 2014/15” (2015); www.nihr.ac.uk/documents/about-NIHR/NIHR-Publications/NIHR-Annual-Reports/NIHR%20Annual%20Report%202014-2015.pdf.
6. “The Spending Review and Autumn Statement” (2015); www.gov.uk/government/publications/spending-review-and-autumn-statement-2015-documents.
7. “The Allocation of Science and Research Funding 2015/16: Investing in World-class Science and Research” (2015); www.gov.uk/government/uploads/system/uploads/attachment_data/file/33276_7/bis-14-750-science-research-funding-allocations-2015-2016-corrected.pdf.
8. G. M. Lord, R. C. Trembath, A strategy for translation. *Lancet* **369**, 1771–1773 (2007).
9. Accelerated Access Review: Interim Report, “Review of innovative medicines and medical technologies, supported by the Wellcome Trust” (2015); www.gov.uk/government/uploads/system/uploads/attachment_data/file/47156_2/AAR_Interim_Report_acc.pdf.

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