DOI: 10.1308/rcsbull.2020.121

# A surgeon among engineers

## A bridge from technology funding to healthcare solutions.

**D Rew** Consultant General Surgeon
University Hospital Southampton NHS Foundation Trust

The role of the UK Engineering and Physical Sciences Research Council (EPSRC) in health technology funding is not well-known. Most surgeons will associate national research funding in health with the Medical Research Council, the Wellcome Trust, Cancer Research UK and other major charities, along with specialist project funding from organisations such as the Royal College of Surgeons. In fact, EPSRC is funded by the government to the tune of approximately £800 million per annum. As of April 2019, £297 million of the funding has been used for grants to support the healthcare technologies theme. Other core themes include future manufacturing, energy, the digital economy, quantum technologies and major national research infrastructure assets (national capability).

Money from these budgets is primarily allocated to support grant and doctoral programmes among consortia of UK universities, with primary representation (self-evidently) from the high performing engineering faculties. The core mission of EPSRC is to stimulate and to fund fundamental and applied research at the earliest stages in the development of a new technology. Infrastructure investment that EPSRC has supported in recent years includes the Alan Turing Institute, the Henry Royce Institute, the Physical Sciences Institute, the Cavendish Laboratory and the National Quantum Technologies Programme.

Specifically in respect of the health technologies theme, EPSRC recognises four 'grand challenges'. These challenges are perceived to reside in:

1. developing future therapies – with technologies to enhance efficacy, minimise costs and reduce risk to patients
2. frontiers of physical intervention – by restoring function, by optimising surgery and through other physical interventions to achieve high precision with minimal invasiveness
3. optimising treatment – through effective diagnosis, patient specific prediction and evidence-based intervention
4. transforming community health and care – using real-time information to support self-management of health and wellbeing, and to facilitate timely interventions

These are in turn matched to the general objective of increasing UK national prosperity through the development of a productive, connected, resilient and healthy nation (Figure 1), and EPSRC corporate objectives of balancing capability, accelerating impact and building leadership.

Around 60% of EPSRC funding is allocated in response to researcher and community driven projects. Meanwhile, 40% is reserved for projects that are driven by national strategic priorities and specific objectives, such as the Global Challenges Research Fund. Another key purpose of the funding is to generate and maintain a stream of doctoral students and high performing postdoctoral career engineers with the broad skills to lead academic groups or successful teams in industry and other non-academic fields.

In order to inform the strategic direction and to improve the responsiveness and 'national situational awareness' of EPSRC and its constituent funding themes, EPSRC runs a strategic advisory team (SAT) for each of the themes. SAT members are recruited primarily from the UK university

engineering sector. However, SATs are increasingly enriched by members from industry: the charity sector, defence technology, the health sector and other research councils, including the Medical Research Council and Innovate UK.

Each SAT comprises 15–20 members who serve for 3 years on a *pro bono* and rotating basis, with a third of the membership moving on each year. One-day meetings are held three to four times per annum around the UK, along with annual group meetings of members of the SATs of other themes, to further increase strategic debate and cross-pollination of ideas. Members are also invited to act on peer review panels for EPSRC grant applications.

For the past decade, I have developed and led a digital transformation programme at University Hospital Southampton NHS Foundation Trust. This has brought me into contact with many interesting and diverse members of the digital engineering community. In May 2016, we brought members of this group together for a novel joint surgical–EPSRC symposium at the Association of Surgeons of Great Britain and Ireland national conference in Belfast.

In consequence, I was invited to apply and to join the SAT for health technologies, with effect from January 2017. At the time, the principal focus of the theme had been in imaging technologies, perhaps with a 'radiology-centric' emphasis. Membership of this team imposed on me a steep learning curve among a professional community of very experienced, able and talented individuals who were drawn primarily from the major university engineering faculties.

However, as with all such boards, diversity of background and experience produces vigorous debate and fascinating perspectives. The key to making a productive contribution is wide background reading and knowledge, and the courtesy and confidence to offer constructive insights and personal professional perspectives on any general subject under discussion. In challenging established assumptions and practices, it is often possible to achieve common ground among specialists with diverse starting points through 'ideas ping-pong' around a boardroom table. This exchange produces more effective outcomes than were initially apparent to anyone.

**Figure 1** The overarching strategy of the UK's EPSRC to contribute to national prosperity (based on image supplied by EPSRC)

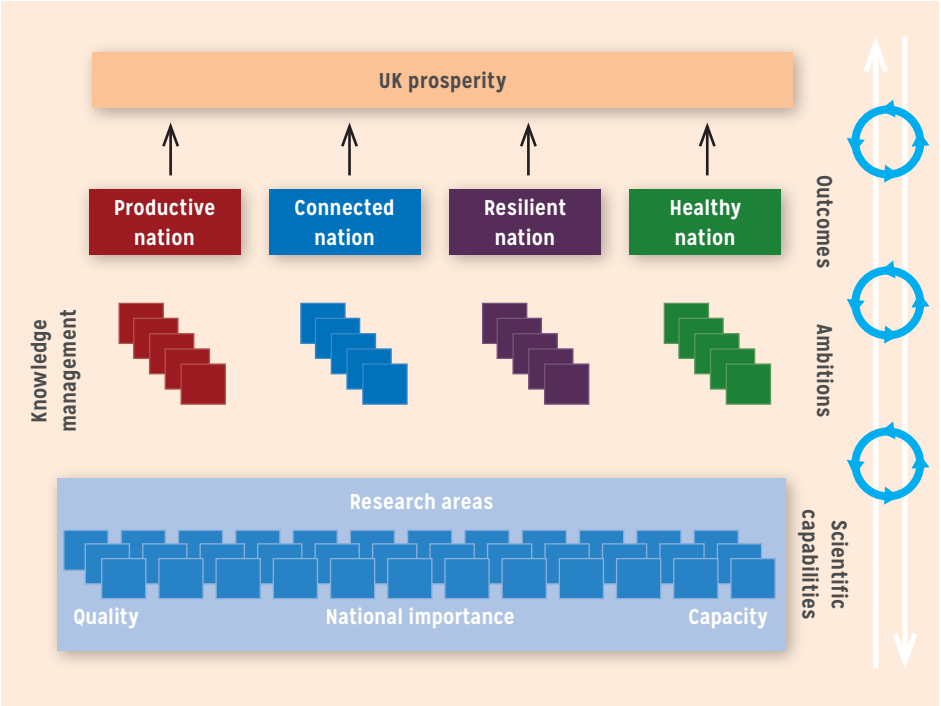
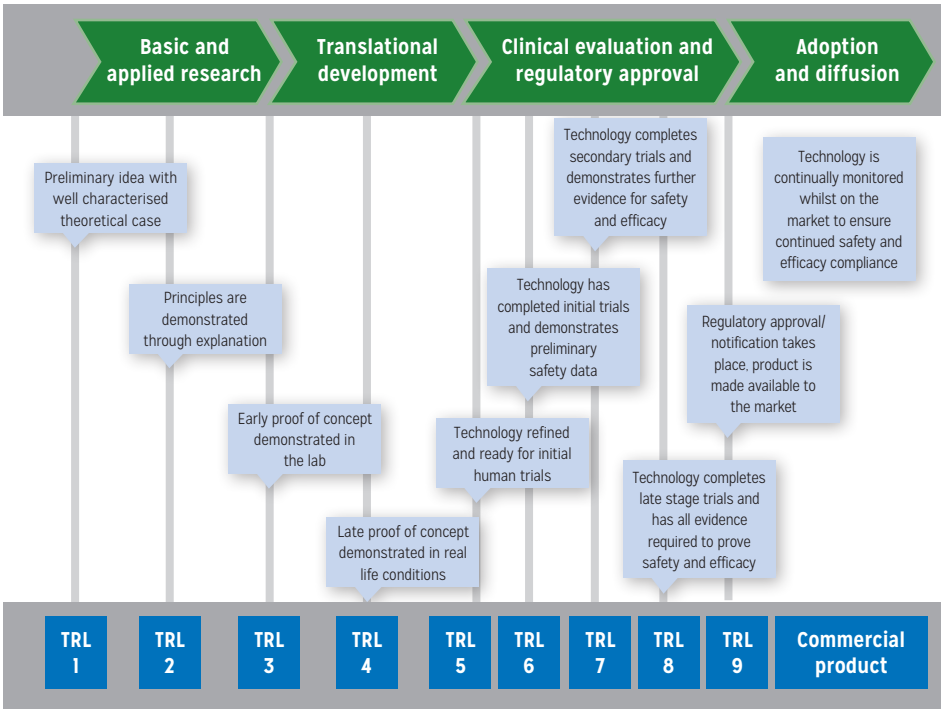



**Figure 2** The overarching strategy of the UK's EPSRC to contribute to national prosperity (based on image supplied by EPSRC)



EPSRC SAT roles are both advisory and stimulatory of new perspectives, and discussions and recommendations are inevitably rinsed through the higher corporate structures and policy making boards. Despite this, over the course of three years, our board discussed a grand diversity of subject areas in which engineering in all its forms may impact on individual and community health, from microsensors to smart cities and environmental monitoring.

Our horizon scanning and search for the next big thing in technology was balanced by the recognition that we are often blindsided by advances from unforeseen places and directions. As part of the recent Transformative Healthcare Technologies for 2050 call, EPSRC is looking to support excellent research with impact. The projects of the researchers should look to the future and beyond current requirements. Indeed, I have expressed the view that the search for future directions should be as much focused on the extraordinarily creative minds among the world's science fiction writers, film and electronic games producers as on literature search strategies and grand scientific committee meetings. As a child of the 1960s, I believe that the original 26 episodes of *Thunderbirds* and the first series of *Star Trek* were probably the best predictors of the extraordinary digital and mobile technology boom of the later 20th century.

Did I make a difference to the discussions and the work of EPSRC health technologies SAT? I would like to think so. At the outset of my tenure, it was very clear that major EPSRC grants were being submitted and awarded for health technology research without adequate, rigorous or in-depth research of the practical needs of the true clinical end users. Such clinical input and representation as was appended to grant applications sometimes seemed to have little more than token value. In consequence, technologically clever solutions were not coming up against real world practicalities until much time and effort had been expended.

*I would also like to think that the insertion of a practising NHS surgeon into the health technologies SAT has helped broaden the practical 'health technology consumer' focus of EPSRC debate*

EPSRC recognises a process from the original idea to societal adoption and public impact as passing through nine technology readiness levels (TRLs). In a progressing project, each level takes approximately a year to transition (Figure 2).

Unfortunately, inadequate end user research at TRL 1 leads to project failure, frustration and disappointment at the TRL 3–4 interface. I have therefore pressed the case for a much tougher policy towards insistence on evidence of really robust and in-depth clinical user research and user case development within the original application. In military parlance, time spent on reconnaissance is seldom wasted.

This, in turn, leads to the question of where engineering researchers can go to test out early hypotheses and meet with appropriate and sympathetic groups of healthcare professionals within that particular technical field, whether it be for a new mobility aid, a microorganism detector or a ventilation assist device in intensive care. There is a strong case to be made for the creation and integration of 'meet, greet and test' centres of excellence on a regional basis, akin to clinical trials incubators such as are run by the Wellcome Trust. I would also like to think that the insertion of a practising NHS surgeon into the health technologies SAT has helped broaden the practical 'health technology consumer' focus of EPSRC debate.

Most importantly, I would hope that my time-limited contribution to this process will raise awareness of the work of EPSRC in the healthcare space. I also hope that it will provide a conduit for laterally thinking colleagues into a parallel universe of resources and engineering talent to help shape the world of work of the 21st-century surgeon.

**POSTSCRIPT**

At the time of proofing this article in the first week of April 2020, events related to COVID-19 have highlighted the importance of a wide range of engineering skills and an advanced national manufacturing base to healthcare delivery.

These contributions have been manifold. They have included the rapid construction by civil engineers of emergency field hospitals across the UK, the development and resourcing of large numbers of continuous positive airway pressure (CPAP) devices by a combined team from University College London and the Mercedes Benz Formula 1 team,[1] and the creation of high fidelity analytical instruments for COVID-19 RNA sequencing and for antibody testing.

As new threats to human health are met and overcome, these remarkable programmes presage a new era of awareness and cooperation between clinical and engineering teams.

**Reference**

1. F1 team helps build new UK breathing aid for Covid-19 patients. www.theguardian.com/world/2020/mar/30/f1-team-helps-build-new-uk-breathing-aid-for-covid-19-patients (cited April 2020).

# Council noted with regret the deaths of the following fellows and members of the RCS

AL-BAHRANI, Zuhair Raouf of YARM. FRCS 1963
BAKER, Geoffrey Cecil Winchester of CHESTERFIELD. FRCS 1960
BALL, Pamela Margaret of BEWDLEY. FRCS 1954
CHALSTREY, John of LONDON. FRCS 1962
CLOTHIER, John Campbell of WEST BROMWICH. FRCS 1976
CURRY, Rodney Campbell of LISBURN. FRCS 1961
ESAU, Timothy of WOTTON-UNDER-EDGE.
ESPINER, Henry John of BRISTOL. FRCS 1959
HALL, Anthony John of HOOK. FRCS 1968
HARRISON, John Meredith of NSW, Australia. FRCS 1974
HUDSON, Christopher Neville of EPPING. FRCS 1960
IRVING, Irene Marion of LIVERPOOL. FRCS 1957
JONES, Philip of SALTASH. FRCS 1978
LANCASTER, John Michael of BRADFORD-ON-AVON. FRCS 1956
LEWIS, James Laurence of DANA POINT, United States of America. FRCS 1976
LO, Wan Shun of WILLOWDALE, Canada. FRCS 1963
MATTHEWS, David Owen of LIMASSOL, Cyprus. FDS 1971
MISTRY, Firoz Dara of SOUTH WINDSOR, United States of America. FRCS 1971
MOFFAT, David Andrew of CAMBRIDGE. FRCS 1976
NEWBEGIN, Christopher John Richard of YORK. FRCS 1982
OWEN, Owen Elias of BANGOR. FRCS 1953
PIGOTT, Ronald Wellesley of GUNNISLAKE. FRCS 1962
RENDALL, Max of LONDON. FRCS 1964
SELLERS, Jeffrey Irvin of YORK. FRCS 1964
STOCK, Douglas Graham of GRAVESEND. FRCS 1967
SYKES, David of ISLE OF MAN. FRCS 1961
SYMON, Lindsay of MARLBOROUGH. FRCS 1959
WEAVER, Hugh Lloyd of VIC, Australia. FRCS 1976
WILLIAMS, Grant Burkhill of BEDFORD. FRCS 1961
WILLIAMS, John Pritchard of HASLEMERE. FRCS 1956
ZACHARIAH, Philip of HANOVER, Canada. FRCS 1964

## *Plarr's Lives of the Fellows*

A biographical register of the fellows of The Royal College of Surgeons of England.
It can be accessed online at: livesonline.rcseng.ac.uk.
If you are interested in writing a fellow's obituary, please email: lives@rcseng.ac.uk.
To report a death, please email: membership@rcseng.ac.uk.