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Chari, A

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Delivering Large-Scale Neurosurgical Studies in the UK: The Impact of Trainees

Aswin Chari^{1,2}, Rory J. Piper^{1,2}, Ellie Edlmann^{3,4}, Julie Woodfield^{5,6}, Paul M. Brennan^{5,6}, Carole Turner^{7,8}, Michael D. Jenkinson^{9,10}, Peter J. Hutchinson^{7,8,11}, Angelos G. Kolias^{7,8,11}, the British Neurosurgical Trainee Research Collaborative

The UK neurosurgical community has a track record of delivering high-quality, practice-changing clinical research studies, facilitated by a robust clinical research infrastructure and close collaborations between neurosurgical centers. More recently, these large-scale studies have been conceived, developed, and delivered by neurosurgical trainees, working under the umbrella of the British Neurosurgical Trainee Research Collaborative (BNTRC).

In this paper, we outline the current landscape of large-scale neurosurgical studies in the UK, focusing on the role of trainees in facilitating this research. Importantly, we focus on our experience of trainee-led studies, including the development of the network, current challenges, and future directions. We believe that a similar model can be applied in different settings and countries, which will drive up the quality of neurosurgical research, ultimately benefiting future neurosurgical patients.

has been facilitated by close collaborations across neurosurgical units, both locally and internationally, and between clinicians, and clinical academics at all levels of seniority. Important UK-led and collaborative randomized controlled trials (RCTs) include the British Aneurysm Nimodipine Trial (1989),¹ the International Subarachnoid Aneurysm Trial (2002),² the STICH trials (2005 and 2013),^{3,4} and, more recently, the RESCUEicp Trial (2016),⁵ BASICS Study (2019),⁶ Dex-CSDH Trial (2020),⁷ and the NERVES Trial (2021).⁸ Large-scale prospective observational studies have tackled chronic subdural hematoma and external ventricular drain infection rates.^{9,10}

In this paper, we will outline the current state of large-scale collaborative research in the UK, focusing on challenges and solutions to consistently delivering high-quality multicenter studies. In particular, we focus on the role of neurosurgical trainees, foundation doctors, and medical students in bringing these studies to fruition.

THE UK NEUROSURGICAL RESEARCH ECOSYSTEM

The majority of health care in the UK is delivered within the National Health Service (NHS). Many neurosurgical studies have been funded by the UK's largest funder for health and social care research, the National Institute for Health Research (NIHR). Founded in 2006, the NIHR works in close partnership with the NHS and funds studies that, specifically, will impact the care and outcomes of patients within the NHS. This does not limit the

INTRODUCTION

The United Kingdom (UK) neurosurgical community has a long-standing track record of delivering high quality, practice-changing clinical research studies. This success

Key words

- Clinical trials
- Evidence-based medicine
- Randomized controlled trial
- Trainee research collaborative

Abbreviations and Acronyms

BNTRC: British Neurosurgical Trainee Research Collaborative

CSDH: Chronic subdural hematoma

EV: External ventricular drain

NHS: National Health Service

NIHR: National Institute for Health Research

RCT: Randomized controlled trial

SBNS: Society of British Neurological Surgeons

SSL: Surgical Specialty Lead

UK: United Kingdom

College London, London; ³Department of Neurosurgery, South West Neurosurgical Centre, University Hospitals Plymouth NHS Trust, Plymouth; ⁴Faculty of Health, Peninsula Medical School, University of Plymouth; ⁵Department of Neurosurgery, NHS Lothian, Edinburgh; ⁶Centre for Clinical Brain Sciences, University of Edinburgh; ⁷Division of Neurosurgery, Department of Clinical Neurosciences, University of Cambridge, Cambridge; ⁸Department of Neurosurgery, Addenbrooke's Hospital, Cambridge; ⁹Institute of Systems, Molecular and Integrative Biology, University of Liverpool, Liverpool; ¹⁰Department of Neurosurgery, The Walton Centre NHS Foundation Trust, Liverpool; and ¹¹National Institute for Health Research Global Health Research Group on Neurotrauma, University of Cambridge, Cambridge, United Kingdom

To whom correspondence should be addressed: Angelos G. Kolias, Ph.D.
[E-mail: angeloskolias@gmail.com]

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From the ¹Department of Neurosurgery, Great Ormond Street Hospital, London; ²Developmental Neuroscience, Great Ormond Street Institute of Child Health, University

studies to being conducted in the UK and the success of many of the trials listed above is attributable to strong international collaboration and recruitment.

The funding of neurosurgical trials is also aided by the Royal College of Surgeons' Surgical Trials Initiative, which links Surgical Specialty Leads (SSLs) with a number of specialist surgical trials centers around the country, providing a robust infrastructure for trial planning and delivery.¹¹ Since 2017, this has been supplemented by an Associate SSL scheme for trainees, encouraging early involvement in the logistics of trial delivery.

The Academic Committee of the Society of British Neurological Surgeons (SBNS) is composed of experienced research surgeons across all subspecialties, as well as trainee members. The committee works closely with British Neurosurgical Trainee Research Collaborative (BNTRC) and supports the development of new RCTs and fosters collaborative research between UK neurosurgical units. Neurosurgery has benefited from NIHR funding for trials in traumatic brain injury, hydrocephalus, neuro-oncology, spine, and vascular. Many of these trials have completed and led to change in clinical practice, and trials in progress are expected to have a similar impact on patient care. The committee also facilitates the coordination of multicenter research activities in the UK, helps to identify, prioritize and submit research questions for consideration of NIHR-commissioned calls, as well as advocating for increased funding for neurosurgical research (current trial landscape shown in [Figure 1](#)).

TRAINEE-LED COLLABORATIVE RESEARCH STUDIES

Involvement of neurosurgical trainees has benefited the design, setup, and delivery of many of these successful trials. The BNTRC was founded in 2012 under the auspices of the SBNS and the British Neurosurgical Trainees Association.¹²⁻¹⁴ It was inspired by the successes of the West Midlands Research Collaborative, a general surgical trainee-led collaborative research group that designed, acquired funding for, and delivered a RCT ahead of schedule.¹⁵ The BNTRC has delivered large prospective observational studies and RCTs.

The BNTRC model requires 2-3 trainee leads for each study. For prospective observational studies, these leads coordinate a study management committee, which typically includes consultants (attendings) in addition to trainees. Each neurosurgical unit has local trainee and consultant leads, as well as local collaborators who are responsible for local center setup, recruitment, and/or data collection.^{12,14,16} A more complete description of the model is given in our previous publication and is outlined in [Figure 2](#).¹⁴ Trainee leads of each project form a central BNTRC committee with a chair being chosen from within this committee to lead the organization overall for a 1-year term. This turnover ensures constant turnover of new ideas for the organization.

The BNTRC initially focused on prospective observational cohort studies using routinely clinically collected data only. These studies examined conditions or procedures that are predominantly managed by trainees, namely, chronic subdural hematoma (CSDH) and external ventricular drains (EVDs).^{9,10} The multicenter studies recruited large cohorts, with 1205 patients in

the CSDH study and 452 patients in the EVD study. Conducted under the umbrella of clinical audit and service evaluation, approval was gained at each participating hospital. They have served a number of important roles. First, they provided proof of principle that a national network could be established, and it was feasible to conduct multicenter trainee-led studies within the UK neurosurgical framework. Second, they established practice variations and factors associated with key outcome measures, which, for both cohorts, provided useful information for subsequent randomized clinical trial proposals and funding applications.

More complex study designs have since been adopted in the form of prospective observational studies using patient-reported outcomes. These studies, encompassing cauda equina syndrome and Chiari 1 malformations, have established the ability of the organization and study teams to negotiate national ethical review processes and set up the infrastructure to collect patient-reported outcomes reliably.^{17,18} The cauda equina syndrome study is also an example of cross-specialty collaboration as cauda equina syndrome is managed by both neurosurgical and orthopedic surgeons in the UK, and both specialties and specialty organizations were involved in the design, data collection, and analysis. The BNTRC have also collaborated with the UK Breast Cancer Trainees Research Collaborative Group, with support from the British Oncology Network for Undergraduate Societies, to set up and run the PRIMROSE study (ISRCTN18204314), a prospective registry of all patients treated in the UK for breast cancer brain metastases.¹⁹

The BNTRC has also played a central role in the establishment and delivery of 2 large RCTs: the Dex-CSDH and Rescue-ASDH studies.⁷ Several members of the BNTRC were part of the team of co-applicants and played a central role in writing up the protocols, securing funding, recruiting patients, and writing up the main reports (publication of Rescue-ASDH is pending). The Dex-CSDH study, in particular, has been hailed as an important step in the "movement" of the trainee collaboratives in the UK, as it is the first RCT of a trainee collaborative to be published in the *New England Journal of Medicine*.

In a bid to nurture international collaborations, the BNTRC has recently embarked upon an international retrospective study to validate a prognostic tool for incidental meningioma, the IMPACT study.²⁰ There are currently 72 collaborating units from 23 countries. This established model enables the efficiency in the setup of such studies, exemplified by the rapid response of the BNTRC to the COVID-19 pandemic and to deliver key data on the pandemic to the UK Neurosurgical Oncology service.²¹

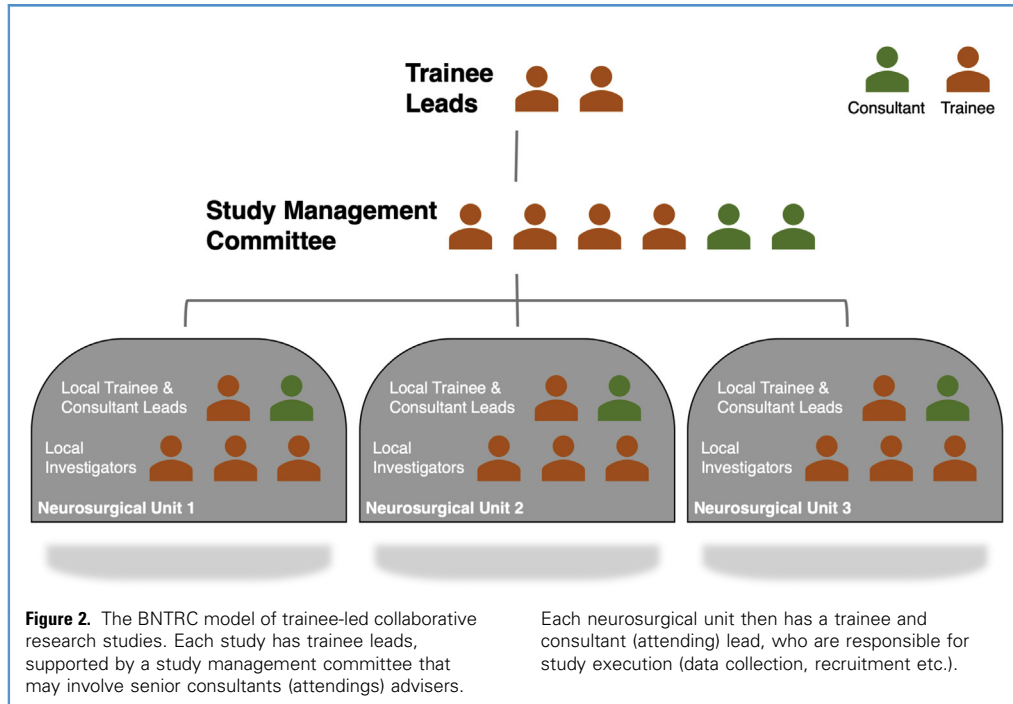
The BNTRC model of trainee-led, collaborative research that has delivered important research projects in the UK over almost a decade ([Figure 2](#)) has now been replicated in other countries, such as with the Canadian Neurosurgery Research Collaborative.²² Encouragingly, we also note that the Congress of Neurological Surgeons is supporting a resident research forum that will aim to translate the trainee collaborative model in the United States.²³ Importantly, it has also engrained the collaborative ethos in the next generation of neurosurgeons in the UK. With the support of the BNTRC and the SBNS, the Neurology and Neurosurgery Interest Group (a national medical school student and junior doctor organization) have set up and delivered a



number of important studies investigating glioblastoma, cauda equina, and cerebrospinal fluid rhinorrhoea.^{24,25} Early exposure and guidance from senior clinical academics should prime early-career clinical academics, from medical students to neurosurgical trainees, to develop the mindset, skills, and experience to continue to deliver high-quality large-scale neurosurgical studies throughout their careers.

SUSTAINING THE MOMENTUM

Sustaining interest and momentum requires incentivization of continued participation. The BNTRC has sought to empower trainees by hosting open calls for new projects each year and choosing 1 or more of these through open, transparent competition. Trainee leads for new studies are provided with mentorship from more experienced trainees and academic neurosurgeons with



extensive experience in running multicenter studies and trials. Trainees at all levels of participation (trainee leads, management committee members, local leads, and local collaborators) have the ability to develop research skills through participation and also have access, subject to approval by the study management committee, to the data collected from the studies for secondary analyses. The BNTRC has organized research methodology workshops including an RCT workshop in 2020, a few weeks prior to a call for new RCT ideas with the specific aim of equipping trainees with the skills to develop their RCT ideas into robust proposals.

An important incentive is recognizing participation in publications and other research output. The BNTRC has followed the ethos of collaborative authorship by ensuring that all collaborators are PubMed-citable, yet allowing each study some flexibility in designing its own authorship criteria at the time of protocol development.¹⁴

The national academic requirements for completion of neurosurgical training have also been adapted to ensure that participation and recruiting to large-scale studies is given its due credit. Academic trainees have also been incentivized by the establishment of central infrastructure to recognize trainee involvement in clinical trials. In 2020, the NIHR established the Associate PI scheme that allowed trainees to take on local leadership roles in national multicenter studies—responsibilities that were traditionally limited to established senior academics.

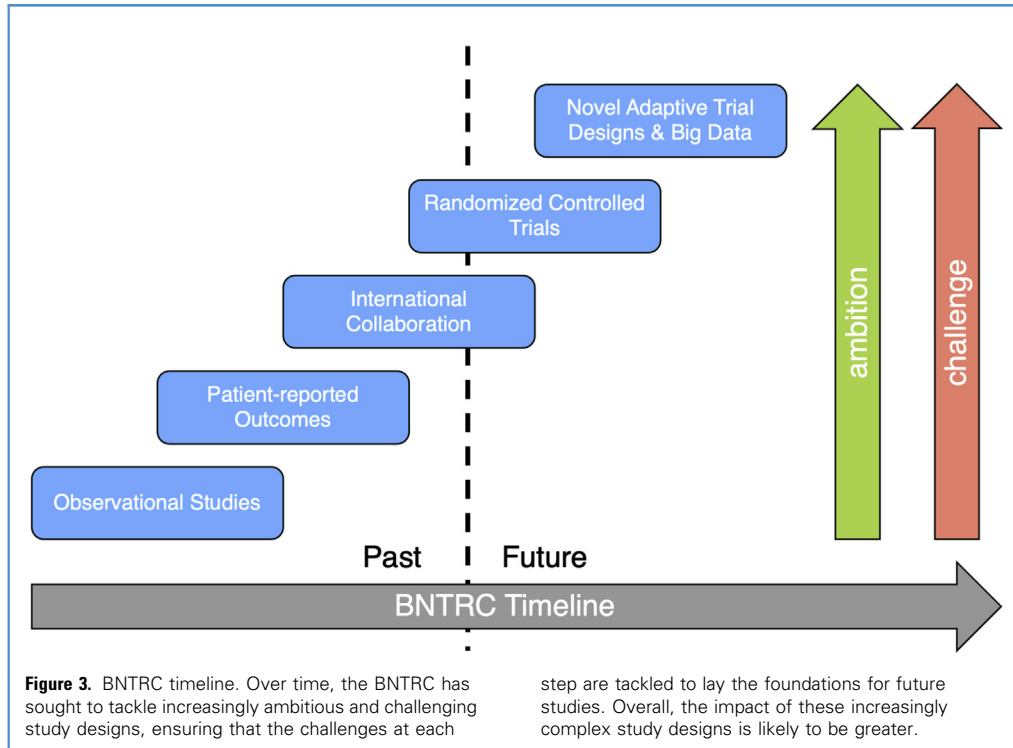
Following the successful mentoring scheme for junior researchers run by the Academy of Medical Sciences, the SBNS have set up a similar program for academic trainees. Each academic trainee is offered a senior neurosurgical mentor to support their academic career. The mentor and mentee are matched so as not to

be based in the same unit, with the aim of providing independent advice. This scheme has received good feedback and is an additional method of sustaining momentum for both trainees and studies.

CHALLENGES

Authorship is an inevitable challenge, especially with authorship on peer-reviewed publications being part of the evaluation criteria at every level from entry into neurosurgical training and beyond. Several research groups have moved entirely to a “group authorship” model. Although truly collaborative, it likely does not specifically recognize the work of those who primarily design, lead, and write up these large-scale research studies. This can breed disenchantment, threatening the viability of subsequent studies. Conversely, the inclusion of certain members on the author byline can lead to situations where individuals only want to lead studies, diminishing the collaborative ethos. Whatever the authorship model, specifying criteria for authorship and collaborator status in the study protocol allows participants to decide whether or not to be involved at the outset. For many BNTRC studies, we have invited the trainee leads of the top 5 recruiting centers to join the writing group. This policy increases the involvement and participation of local investigators who play a vital role in multicenter studies and potentially acts as an incentive that can drive up recruitment, while at the same time allowing us to ensure that the International Committee of Medical Journal Editors authorship criteria are met. However, this is not a perfect solution—as, for example, smaller sites may be disadvantaged.

It is vital to ensure that the BNTRC continues to grow, with junior members entering the committee and a wide and diverse



group of trainees contributing to ideas and project design. We have endeavored to provide platforms for trainees to contribute ideas and thoughts in a welcoming and fair environment, and have the opportunity to stay involved in a project as much or as little as they intend. This must be balanced with the inevitability that only a handful of trainees are likely to deliver the bulk of the work. Contribution to projects, especially in these leadership roles, has been aided by many trainees having dedicated academic time, either as part of their clinical training (Academic Clinical Fellowship or Academic Clinical Lectureship) or during completion of an out-of-program higher degree (M.D. or Ph.D.). However, these roles are by no means restricted to those with such posts.

Other than strong study leadership, the successful completion of any large collaborative project relies on the active participation of trainees from as many units as possible. As the number of studies increases, so too does the workload required to complete them. Therefore, it is imperative to not only maintain the levels of engagement achieved to date, but to try and increase it. By holding open, transparent calls for new projects that have subsequently been distributed across many units throughout the UK, we have hopefully fostered a collaborative spirit among all members of the BNTRC where it is recognized that active cooperation is key to the successful completion of all studies.

Enabling trainees to develop research ideas, drive them forward, and successfully complete large-scale studies often requires the support and mentorship of senior colleagues. Although the majority of studies have received such support from senior members of the SBNS and its Academic Committee, some studies have not

made it past the protocol phase due to lack of senior engagement. Although this may be viewed as “research waste”, the exposure to study design from such projects can still be useful research training.

FUTURE DEVELOPMENTS

Going forward, we believe that this model in the UK will continue to provide opportunities in research and research training to new generations of trainees, while aspiring to deliver increasingly complex trainee-conceptualized and trainee-led studies that require cross-specialty and international collaboration (Figure 3). Future avenues to further expand trainee-level collaborations might include: implementation science through quality improvement initiatives, by assessment of how RCT results can be best implemented in individual units; contribution to and analysis of global neurosurgical outcomes; leading international RCTs containing patient cohorts from both developing and developed countries, providing a real world assessment of efficacy; establishment of RCT-derived data repositories to allow for big data mining; and collaborative laboratory research, either in its own right or embedded within clinical studies. Collaborations with allied specialties, across the multidisciplinary team and internationally across borders are also desirable. As an example, the NIHR Global Health Research Group on Neurotrauma, a collaborative network aiming to improve neurotrauma outcomes in low- and middle-income countries, has recently completed a prospective, observational cohort study involving 1635 patients undergoing emergency neurosurgery after a head injury in 159

hospitals in 57 countries, leveraging the BNTRC collaborative model.²⁶ These ambitions will bring new challenges and requirements not yet encountered in existing studies.

Research training is another area of vital importance that has not yet received the same emphasis as studies. In addition to endorsing robust research methods, the BNTRC should help trainees develop skills in study design and data analysis to ensure greater access to research training. Skills are also needed in emerging areas such as novel trial designs (e.g., Bayesian and adaptive trial designs), qualitative research, and big data science so that they may be applied to future collaborative studies (Figure 3). The infrastructure within the NHS is ideally suited to collecting large amounts of data from national cohorts of neurosurgical patients, and the BNTRC must be poised to take advantage of this.

CONCLUSIONS

The UK has a strong track record of large-scale neurosurgical studies and, in the process, has nurtured a cohort of neurosurgeons with the skills, experience, and will to continue to deliver such practice-changing research for the benefit of our patients. We believe that a similar model can be applied in different settings and countries, which will drive up the quality of neurosurgical research, ultimately benefiting future neurosurgical patients.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

Aswin Chari: Conceptualization, Writing – original draft, Writing – review & editing. **Rory J. Piper:** Writing – original draft, Writing – review & editing. **Ellie Edlmann:** Writing – original draft, Writing – review & editing. **Julie Woodfield:** Writing – original draft, Writing – review & editing. **Paul M Brennan:** Writing – original draft, Writing – review & editing. **Carole Turner:** Writing – original draft, Writing – review & editing. **Michael D. Jenkinson:** Writing – original draft, Writing – review & editing. **Peter J. Hutchinson:** Writing – original draft, Writing – review & editing. **Angelos G. Kolias:** Conceptualization, Writing – original draft, Writing – review & editing, Supervision. **The British Neurosurgical Trainee Research Collaborative:** Writing – review & editing.

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British Neurosurgical Trainee Research Collaborative: Daniel M. Fountain, Ruichong Ma, Ian Coulter, Aminul Ahmed, Aimin A. B. Jamjoom, Fahid T. Rasul, Claudia Craven, Michael T. C. Poon, Josephine Jung, Jignesh Tailor,

Abdurrahman I. Islim, Mueez Waqar, Sara Venturini, Soham Bandyopadhyay, Robin Borchert, Conor S. Gillespie.

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