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Editorial

The Challenge Facing Academic Radiotherapy Physics in the UK

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Medical physics has been central to the scientific and technical development of radiotherapy since its inception as a treatment modality for cancer patients. As well as delivering a safe and effective cancer treatment, radiotherapy centres are routinely implementing innovations into the clinic [1] and physicists are central to innovation generation and innovation adoption. Bortfeld and Jeraj [2] highlighted the historic achievements of physics research in radiation therapy (radiotherapy) and argued for the continuing role and the need to develop academic medical physics and radiotherapy physics research. Following up on this, Bortfeld *et al.* [3] identified the potential risk of the radiotherapy physics profession having only a clinical physicist role and argued strongly for the need for academic positions. This was supported more recently by Klein *et al.* [4], who highlighted the need for physicists who can adapt to changes caused by the rapid evolution and expansion of radiotherapy technology and imaging options within the clinic. The recent review of global radiation therapy research by Aggarwal *et al.* [5] highlighted physics research as an important metric and area of research within radiation therapy.

A mission of the National Cancer Research Institute Clinical and Translational Radiotherapy Research Working Group (CTRad) is to increase radiotherapy research within the UK. Key areas identified by CTRad include the development of radiotherapy clinical trials within the UK and building of the radiotherapy physics research workforce. A recent review of practice changing clinical trials, while

highlighting successes, identified challenges associated with radiotherapy clinical trials, including the limited pool of academic physicists [6]. In 2011 and 2014, CTRad ran workshops and surveys looking at academic radiotherapy physics. MacKay *et al.* [7] reported on the results of the first of these and proposed recommendations for developing radiotherapy physics research, including increased collaboration with higher education institutes (HEIs) and the need to examine the career path for academic radiotherapy physics researchers.

The historical importance and future requirements for sustainable academic radiotherapy physics activities are recognised nationally and internationally. As part of the ongoing commitment to advocating for, and developing, academic radiotherapy physics, CTRad Workstream 4 identified the need to assess the current status of hospital- and HEI-based radiotherapy physics research in the UK. To this end, a subgroup of CTRad Workstream 4 developed a survey, which was circulated to the UK Heads of Radiotherapy Physics on 16 April 2018 (open until 11 May 2018) with a data collection date of 31 March 2018. The survey looked at HEI–hospital linkages, research staffing, research training, publication output and research funding. There was a good response (about 50%) from a range of department sizes and geographical locations. Overall, most responses were fully or partially evaluable and it can be concluded that the data are representative of the current situation in the UK. The results of the survey showed that there are good hospital linkages with HEIs (65% of hospitals reported HEI links), although there were only substantive, i.e. permanent academic staff in the joint HEI–National Health Service departments. Fifty per cent of hospital

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radiotherapy physics departments had honorary academic appointments, but only 70% of these appointees were involved in research and development roles, with a significant proportion of these appointments probably linked to clinical training involvement (which includes undertaking an MSc degree) in either a supervisory or teaching role. Even though 65% of the hospital departments indicated that they had HEI links, only 38% reported having published in the previous 3 years and only 18% reported that there were grants associated with their department. Although there was a reasonable number of publications reported (54 per year in total from 13 responding centres), the output was heavily dominated by a small number of very active departments, with just four centres being responsible for 72% of the output. The publications were just under half physics led (first/last author), indicating that physics had a fairly equal role in leading and supporting projects. The publications were in a range of appropriate journals for the field. However, these were not generally journals with the highest impact factors, but were in the top quartile for their field.

A significant number of the areas of research and development being undertaken related to service implementation and optimisation. Fewer areas related to basic science and technology innovation. From the responses provided, most of the research reported is probably very clinically focused and is often the type that is difficult to obtain external funding to support. The type of research being undertaken and the low level of grant income are probably related. Considering the low level of grant income and the small number of existing permanent academic positions, most of the physics output is probably not due to external funding and is being supported by, and carried out by, clinically funded staff. The disappointingly small number of radiotherapy physics-related grants is probably reflective of the small number of established permanent academic positions. Although the existence of very few research council grants is not unexpected, the lack of National Institute for Health Research (NIHR) grants reported is disappointing. To address this shortfall there will probably need to be a significant increase in the number of radiotherapy physics staff with joint or full-time HEI appointments and a corresponding career structure that allows the development of a track record by being part of successful grant applications, as previously proposed by MacKay *et al.* [7]. Only 41% of the responding centres indicated that they were involved in research training (PhD, MSc, MSci). Of the 64 research training projects identified, less than a third were radiotherapy physics PhD students (full- or part-time), whereas more than half were masters level (MSc or MSci). This low level of research training is again probably reflective of the small number of academic positions held by radiotherapy physics staff. The survey illustrated that research positions, permanent and fixed-term, substantive or honorary, have a variety of ways of being funded and highlighted the complex and challenging nature of the physics funding

environment and the lack of clear funding mechanisms that are open to clinically based physics groups. The funding mechanisms used are unlikely to be robust or sustainable in the longer term, putting in doubt the continuation of even the current low levels of research staff in place.

The responses show that there is an interest in providing research and development activities and that some centres are achieving substantial outputs in terms of publications, even if research income is very low. However, it should be recognised that half of the UK centres did not respond to the survey and this is a limitation of the findings reported here. The survey did, however, clearly illustrate that there is very little core infrastructure funding for academic physics in the National Health Service and it seems that the ability to attract programmatic or project funding may be hampered by the lack of established academic positions. There are very low numbers of research leadership positions funded, and a low number of research staff available to support these leadership positions. Very few centres have the critical mass of research staff in place to drive forward radiotherapy physics led and supported research programmes. To address this, substantial dedicated core funding is required, together with HEI support in the form of permanent or joint positions to create the environment for future research leaders. Such core funding is essential if a critical mass of research staff is to be built and if a robust and resilient research workforce is to be achieved. The method for disseminating research experience and skills to radiotherapy centres throughout the UK will be primarily determined by the funding bodies and their preferred methods for achieving this. This could be via the development of networks of research groups where resource and experience are shared, it could be by providing open calls to individual centres or by a combination of the two.

The data from the survey provides evidence of the urgent current need for core funding, if this important field is to have its full impact on the future development of radiotherapy research. If such funding were made available, with support from both the hospital and HEI leadership, then this would potentially be transformative to the academic radiotherapy physics workforce and career structure. The recent Cancer Research UK strategic review [8] and the potential for a network of Cancer Research UK-funded radiation research units/centres together with funding opportunities from other bodies will hopefully go some way to providing funding of a transformative nature. A measure of such transformation should be that within the next 5 years the number of academic positions can be doubled, that this would lead to substantially more departments publishing at least at the level of the four most active responders in this survey and that both the number and the value of grant income doubles. The development of such a critical mass of academic positions would ensure that academic radiotherapy physics is a viable career pathway and that these key participants in radiotherapy research and development are available to help drive forward radiotherapy in the future.

Conflicts of Interest

The authors declare no conflicts of interest.

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