

The Royal College of Radiologists
RCR-Cyclotron Trust Visiting Fellowships 2022/23 (Clinical Oncology)

POST-VISIT REPORT

1. Name of Visiting Fellow	Dr David Noble	
2. Name of joint Visiting Fellow (if applicable)	Prof. Bill Nailon	
3. Institution(s) of Visiting Fellow(s)	Edinburgh Cancer Centre – NHS Lothian University of Edinburgh	
4. Name of Host(s)	Professor Jürgen Debus	
5. Institution(s) of host(s)	Heidelberg Ion Therapy Centre (HIT), Heidelberg University Hospital	
6. Expenses claimed	£1215.80	
7. Visit Dates (ACTUAL)	a. Start Date 04/12/2023	b. End Date 08/12/2023
8. 2nd visit dates (if applicable)	N/A	N/A
9. Aims of the visit		
<p>The 3 key objectives of the visit were laid out in our original application for the fellowship, and are listed below:</p> <ol style="list-style-type: none"> 1. We will aim to develop a much better understanding of the engineering and infrastructure challenges of heavy particle therapy, the physical layout of the department, and the architectural challenges associated with developing the centre. 2. To learn more about the radiobiology of heavy ion therapy, and relate this both to our knowledge of biology of different tumour types, and the current evidence-base. 3. To increase our knowledge about specific clinical aspects of using ion therapy for sino-nasal and skull base cancer. As part of this, we hope to develop our knowledge of radiation therapy for these difficult and complex diseases that will be directly relevant for X-Ray based radiotherapy in my own practice. 		

10. Activities undertaken

Activities undertaken summarised below:

- We attended clinical handover and radiotherapy plan review meeting at 8am each morning. This meeting is for the whole radiation oncology unit – not just HIT.
- Over the week we were able to coordinate several in-person meetings with key members of staff, including Professor Jürgen Debus – department lead, Dr Simon Höne – particle therapy specialist, Dr Semi Harrabi – particle therapy specialist and lead clinician for paediatric tumours. Dr Katarina Seidensaal - particle therapy specialist and lead clinician for sarcoma radiotherapy, Dr Angela Paul - lead clinician for Cyber-Knife unit, Dr Thomas Held - lead clinician for head & neck cancer. Dr Malte Ellerbrock – HIT medical physicist and deputy department head, Cornelius Bauer – HIT medical physicist.
- On Monday 4/12/23, the facility had a scheduled non-clinical service day, and we were fortunate to have a tour of the department, and specifically within the HIT unit. The HIT unit has a synchrotron, 3 clinical beam lines and a research beam line. 2 of the clinical beam lines are fixed, and one is delivered via gantry – one of only 2 such units globally. We were able to see a fixed beam line treatment room, and control room, the gantry treatment room, and the gantry itself – a truly unique experience.
- Professor Nailon and I attended for and observed run up of beam line 1 at 6.30 one morning, which helped to understand the checks necessary to ensure daily beam line quality and safety pre-treatment.
- We spent a significant amount of less structured time in the particle therapy planning room, where clinicians, dosimetrists and physicists all work together. In these sessions we observed and discussed several cases including contouring, planning and plan review. Over the week, we were able to follow one case - a sino-nasal adenoid cystic carcinoma - 'end-to-end' from contouring to plan sign off.
- Although we spent the significant majority of our time on the HIT unit, we used the opportunity to see as much as we could at the unit, and spent a morning observing treatment and delivery on their Viewray MR-Linac, and a 2-hour session on their cyber-knife unit.

11. Benefits of the visit (short term)

In an attempt to provide a succinct overall representation of the wide range of benefits we enjoyed with our visit, I have summarised them by theme. Based on the distinction within this report form, I have chosen some themes as being predominantly short-term benefit – based predominantly as specific knowledge gained at the time - and others as being longer term, with a greater focus on more general transferable knowledge and experience. In reality, there is significant overlap for all themes.

1. Specific Learnings in relation to particle, and specifically heavy ion therapy.

Over the course of the week, and not least because we were able to see the gantry, we were able to learn a lot more about both the physics and radiobiology of particle therapy. HIT provides Proton and Carbon Ion therapy as standard and are working towards making Helium therapy part of their standard treatment armamentarium. We learned about the engineering challenges of focusing and shaping the beam, as well as consideration for shielding and overall unit design. We discussed the different properties of proton and carbon beams – specifically that carbon beams have narrower penumbra and sharper Bragg peaks, but do have a small exit dose beyond this due to secondary particles. We learned about the importance of radiobiology in particle therapy planning. In contrast to PBT – in which an RBE of 1.1 is assumed all the way along the proton path length, there are 2 accepted radiobiological models (LEM1 and LEM3) that account for the fact that RBE may be as much as 3-5 times higher at Bragg beam than it is at beam entry for Carbon particles. These models are incorporated within the treatment planning system (RayStation), and planners at HIT have direct control over parameters within the models at planning, meaning high levels of understanding and expertise are crucial. It was interesting and instructive to gain a deeper and broader understanding of the key differences between PBT and particle therapy, and to see how the HIT team choose which treatment modality for which indication.

On the clinical side we were able to learn about which tumour sites particle therapy is mainly used for (adenoid cystic carcinoma, sarcoma and skull base tumours make up the majority of their case load), and to start to understand their evidence base a little more. It was interesting to see how important early phase trials are in both the culture and structure of their day to day practice a significant proportion of the patients we saw treated were enrolled in phase 2 trials.

2. Opportunities to see and observe other cutting-edge radiotherapy technologies.

Although we spent the significant majority of our time in the HIT unit as outlined above, we took the opportunity to see and observe other cutting-edge radiotherapy technologies – specifically their ViewRay MRI-Linac and Cyber-Knife units. In relation to the MRI-Linac, it was fascinating to see the workflow in practice. The team in the room for these treatments comprised 2 RTT's, a physician, and a medical physicist. It was very instructive to see the teamwork necessary to make this workflow effective, and understand the role of each team member in delivering this. It was interesting to see practical and technical aspects of treatment, such as the image quality, the importance of image registration, and the limitations of IMRT delivery in the context of MRI-Linac as well as practical difficulties such as plan evaluation decision making as to which plan to use. In relation to the Cyberknife unit, it was interesting to see the unit in action and understand the crucial importance of daily setup, and how Cyberknife planning works.

12a. Envisaged benefits of the visit longer term (your own practice)

As indicated above, I have chosen some benefit themes as being predominantly longer term, and these are discussed here.

1. General broadening of experience – widen my radiation oncology education.

It was truly fascinating to observe and discuss a very different system for delivering radiation oncology services close up. Although there are many similarities with radiotherapy delivery in the UK, there are also significant differences, not least in the training and skillsets of radiation oncologists who train and work in Germany. For example, it was fascinating to see that many of the 'senior' and 'lead' clinicians we were working with were very young – early to mid-30's – and yet were clearly highly experienced experts in their fields. This may be partly because radiation oncology training in Germany begins immediately after graduating from medical school, with no general medical training preceding specialty training. We saw that radiation oncology trainees in Heidelberg spend a year working with a radiologist to formally report all radiotherapy planning CT's done in the department. This is, in part, to satisfy a stipulation in German law, but seems to provide trainees with excellent radiological anatomy and image interpretation skills, and means that trainees are also comfortable planning radiotherapy across all anatomical sites. Although radiation oncology trainees rotate through teams within the department as in the UK, the teams are divided by treatment unit (e.g. HIT, Cyberknife, TomoTherapy, Elekta Linacs) as well as by tumour site. This seems to give trainees a detailed and broad experience in radiation oncology, and is at least in part possible due to the greater separation of radiotherapy and SACT services in Germany.

It was fascinating to see how the workload in the department was allocated based on resources available, in terms of hardware (radiotherapy platforms) and skillsets available. For example, Heidelberg receives a lot of paediatric referrals, and the vast majority of these patients are treated at HIT, but careful thought is also given to the caseload division between the other assets within the unit, such as the MRI-Linac, CyberKnife and Tomotherapy machines. In this way, the unit seems to really maximise their available resources, in terms of both radiotherapy hardware but also staff knowledge and skillsets.

Although the UK does not currently have a particle therapy programme, and to the best of my knowledge there are no immediate plans for this to change, I think it is extremely useful to have developed a much deeper understanding of this radiotherapy treatment. As indicated above, an important aspect of this is to compare and contrast to PBT (which of course the UK does have), and I believe that the visit has given me a much broader understanding of both treatment modalities that will be truly beneficial as I progress in my career.

2. Compare and contrast clinical protocols.

It was extremely instructive to compare and contrast overall management approaches for different tumour types, as well as more specific technical radiotherapy considerations such as dose/fractionation schedules, contouring protocols and OAR constraints. As a head and neck oncologist, it was particularly interesting to spend an afternoon with Heidelberg's lead head & neck clinician discussing a wide range of current 'hot topics'. This included the management of sino-nasal disease, and I also saw a number of these cases treated at HIT. It was extremely interesting to discuss planning approaches and OAR dose constraints, not least because of the possibility of a forthcoming UK trial of PBT in this space. In addition, I had ample opportunity to discuss the topic of re-irradiation, which was also a pre-visit learning objective, and is also very topical in UK radiation oncology currently. Re-irradiation is one of the specific indications for treatment with particles in HIT, but is not confined to that platform. I learned a lot from discussing this topic with different clinicians at the centre.

3. Collaboration

It was energising and inspiring to meet so many highly skilled, motivated and knowledgeable radiation oncologists, medical physicists, dosimetrists and radiographers from the host institution and to discuss such a wide range of topics from the physics, training and clinical consideration outlined above to mutual areas of interest in research that both Professor Nailon and I work in.

12b. Envisaged benefits to the wider group (dissemination to others in your centre/clinical oncology community/multiprofessional team)

Professor Nailon and I plan to present a summary of our experiences and learnings at a departmental meeting in the coming months. This will include all multi-disciplinary members to the department. In addition, we will offer to share our experiences at a Scottish level at national meetings, and to disseminate learnings via this forum. We would also be very happy to engage with any other concepts or activity that the College may have in this regard.

13. Please outline any problems you encountered before, during or after your visit

Aside from a few minor travel hiccups (see top tips below), we encountered very few problems with the visit. The only significant issue worthy of note was that our visit was delayed 6 months from the original planned date due to short notice staffing issues at our institution, which meant that visiting at the original planned dates would have compromised clinical safety. However, the host institution were extremely understanding and accommodating of this and it therefore had no negative consequences for the visit once we has rescheduled.

14. Any additional comments

None

15. Do you have any 'top tips' that you would like to share with prospective visiting fellows?

Heidelberg was relatively straightforward to get to and visit. The most practical airport for most UK travellers is likely to be Frankfurt. Getting from Frankfurt airport to Heidelberg is not entirely straightforward. There are regular trains, but many of these involve at least some travel on fast inter-city ICE trains, and the tickets available from machines at the airport are not valid on ICE trains, which reduced options. Pre-booking specific train tickets should avoid this problem. We ended up using a FlixBus, which got us there in the end, but the bus times and destinations bore no resemblance to the timetable, the drivers spoke minimal German and no English and we were unable to get a receipt. So with retrospect would recommend pre-booking a train from Frankfurt airport to Heidelberg. The town of Heidelberg itself is long and thin stretched out along the River Neckar. We stayed just over the river from the university hospital, meaning we could walk to and from the HIT centre, but the campus is huge, and walking across takes longer than you think, especially when finding your way at first. I would encourage future applicants to try and book accommodation close to the host site. It facilitates day to day flexibility with schedule (for example it made it easier to attend for beam-line 1 run up at 6.30am!) and the opportunity to meet and network with colleagues from the host institution after working hours. Being able to speak some German was helpful day to day, but in the hospital, most colleagues spoke flawless English. Both my colleague and I were very glad to have done some pre-reading, which made the first few days much more profitable in terms of what we were able to see, learn and understand. My final 'top tip' would be to take plenty of contemporaneous notes whilst visiting – they are interesting to refer back to, and consolidate learning and help with dissemination of that learning.

Signed: David Noble

Date: 10/01/2024

Report approved by:

Date