Health Education England

The Medical Physics Workforce in the Midlands: Current and Future Challenges

A Report produced for Health Education England and NHS England/NHS Improvement
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Contents

Authorship
This report was produced by Dr. Leigh Griffin, an ex- NHS Chief Executive commissioned by HEE to undertake a series of workforce reviews to inform the current and future workforce demands of staff groups who offer support to the provision of diagnostic services. It could not have been produced, however, without the guidance and support of many medical physicists across the Midlands.

Foreword

1. Medical Physics is the application of physics to healthcare – using physics for patient imaging, measurement and treatment. The term Medical Physics is used in this report to encompass the work undertaken by Clinical Scientists and Clinical Practitioners working in Physical Science services. Healthcare Science staff in this area develop methods of measuring what is happening in the body, devise new ways of diagnosing and treating disease and ensure that equipment is functioning safely and effectively.

2. Staff working in Medical Physics support, develop and apply physical techniques such as ultrasound, the management of radioactivity, radiation, magnetic resonance, electromagnetism and optical imaging to explore or record the working of the body for diagnosis, monitoring and treatment. Throughout, the safety of patients, staff and members of the public is ensured.

3. Healthcare Scientists working in Medical Physics work closely with colleagues in biomedical engineering in supporting and developing new approaches to diagnosis and treatment and ensuring the effectiveness, efficiency and safety of equipment. They also play pivotal roles in commissioning and maintaining highly specialised and expensive machinery, critical to the delivery of services.

4. Despite the above, the role of Healthcare Scientists in general, and those working in Medical Physics in particular, is little understood and typically undervalued in the NHS. As the NHS addresses the impact of the Covid pandemic and seeks new models of delivery and service transformation, a greater appreciation of the role and potential of Scientists would prove highly fruitful. This report seeks to review workforce challenges in Medical Physics, to raise the profile and understanding of Medical Physics and support the immense recovery agenda facing the NHS. A separately focussed report for Biomedical Engineering would need to be commissioned to properly understand the engineering workforce.

5. This report has been commissioned by Health Education England (Midlands) and has been developed with the active support of colleagues at NHSE/I in the Midlands. In particular, the guidance and support provided by the Regional Lead Scientists, Claire Greaves and Peter Bill has been particularly appreciated. Thanks, are also extended to HEE's analysts, who provided access to Trust-submitted Electronic Staffing Record (ESR) data. Finally, I must acknowledge the value of Keith Langmack's report on the Physics Workforce in Radiotherapy, produced for HEE in March 2021. Many of my recommendations, and specifically those relating to radiotherapy physics, amplify the recommendations in that excellent report. Any errors in this report are, however, solely the failure of the author.

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Summary Of Recommendations

This report recommends that:

A) Management

- Trust HR departments liaise with service leads to review and ensure the validity of ESR returns (Para 22) – **Action:** Trust HR and service leads

B) Training and Development

- Greater consideration is given to more generic training programmes for Healthcare Sciences and diagnostic staff per se (Para 11) – **Action:** HEE
- Placement of practitioners onto the Academy for Healthcare Sciences (AHCS) accredited voluntary register is recommended with immediate effect (Para 35). Where this is difficult, equivalence routes should be actively encouraged and pursued - **Action:** All Trust Lead Scientists
- Opportunities for Advanced Special Expertise are extended, enabling the development of more specialists (Para 35) – **Action:** HEE
- A training levy is established to cover the costs of the (often-intensive) in-house supervision of trainee practitioners and scientists (Para 42) – **Action:** HEE
- Discussions are progressed between Health Education England (HEE) and providers to explore the scope for increasing HEE's support to practitioner training with a view to increasing the number of trainees and the support to such, including the establishment of regional practice educator roles to drive the recommended changes in training (Para 42) – **Action:** HEE
- A cohort of trainee practitioners is fully funded by NHSE/I and/or HEE to ensure an adequate future pipeline of practitioners (Para 42) – **Action:** HEE/NHSE/I
- Opportunities are actively explored to increase the number of practitioners apprenticeships for medical physics (and clinical engineering) and access to such (Para 42) – **Action:** HEE/Trust HR leads
- Urgent consideration is given nationally to the formal registration of clinical practitioners as a means of enabling their continuing development and deployment, including scope for their application of advanced practice (Para 42) – **Action:** AHCS
- Accredited centres for STP training align with non-accredited centres to create additional training capacity (Para 42) – **Action:** Accredited STP placement providers and Practice Educators

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- Subject to there being additional and sufficient training capacity, additional places are funded by HEE to support the demand for and enable access to STP training, supporting the pipeline of future scientists (Para 42) – **Action:** HEE

- The potential for advanced practice is actively explored by Medical Physicians, supported by the Regional Lead Scientists, the emergent regional network of Healthcare Scientists and through the identification and sharing of best practice through communities of interest (Para 66) – **Action:** Regional Lead Scientists to promote the creation of a regional Medical Physics network

- Support and encouragement is given to promote the attraction of RPA, RWA and MPE roles within Trusts (Para 67) – **Action:** Trust Lead Scientists

C) Recruitment and Retention

- Best practice in supporting staff well-being, staff retention and recruitment drives, including overseas recruitment post-Brexit, should be identified and shared collaboratively across providers, systems and emergent networks (Para 72). This may well warrant dedicated project work to provide guidance for Healthcare Scientists – **Action:** Regional Lead
- Scientists to consider the value of dedicated project work

D) Leadership

- It is recommended that the role of Lead Scientist should be formally recognised by Trusts, and ideally remunerated, at a level of two sessions a week (more for the largest providers) (Para 78) – **Action:** Trusts CEOs

- It is recommended that each Integrated Care System has access to a nominated (and appropriately funded) Lead Scientist, and uses this access to inform service planning (Para 79) – **Action:** ICS leads

- It is recommended that Trusts review how best to secure healthcare scientific advice in their internal decision-making processes, and that lead scientists have access to identified lead Medical Physicists (Para 80) – **Action:** Trust CEOs

- It is recommended that Lead Scientists should establish and maintain contact with all service leads across Physiological, Life and Physical Sciences (Para 81) – **Action:** Trust Lead Scientists

- It is recommended that Lead Scientists actively engage regionally and sub-regionally with their peers and support the scope for effective networking (Para 82) – **Action:** Trust Lead Scientists

- It is recommended that Lead Scientists forge effective working relationships with their HR leads to establish and maintain an understanding of the science workforce and to progress local workforce planning (Para 83) – **Action:** Trust Lead Scientists

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E) Growing the workforce

All of the above actions will help to strengthen the voice, impact and potential of Medical Physics, and enable growth of the workforce. In addition to filling existing vacancies, calculated at 9-10% of the overall workforce, or c70 WTE staff, increasing service demand (including opportunities for substitution), changing service models and the development of advanced practice all point to a need for a further 5-10% growth in the workforce by 2025/26. In summary, it is recommended that there is a need for a net growth of c100-120 WTE staff in Medical Physics over the next 4 years – to 2026/27. Whilst this is significant and will cost in the order of £6-8M over four years (some of which could be in existing budget establishments), it still falls short of the Institute of Physics and Engineering in Medicine (IPEM) recommendations. It is suggested that the increase comprises c60additional technologists and c50 additional scientists (Para 89).

Medical Physics

6. Medical Physics is part of the Healthcare Sciences, a profession that includes over 40 areas of science that support diagnosis and treatment. The work of Healthcare Scientists underpins over 80% of all NHS diagnoses.

7. Within healthcare sciences individual areas are grouped under life sciences, physical sciences and engineering, physiological sciences and bioinformatics. The component parts of physical sciences and engineering – described by the National School of Healthcare Science as the development and application of methods to see what is happening in the body and the development and applications of new methods to treat disease, are:

   - Radiotherapy Physics
   - Radiation Physics and Radiation Safety Physics
   - Non-Ionising radiation physics (MRI and Ultrasound)
   - Nuclear Medicine
   - Clinical Engineering
   - Clinical Measurement
   - Clinical or Medical Technology in Medical Physics
   - Clinical Pharmaceutical Science
   - Ionising Imaging
   - Medical Risk Management and Governance
   - Clinical Photography
   - Decontamination and sterile services
   - Renal Technology
   - Radiotherapy Physics
   - Reconstructive Science
   - Rehabilitation Engineering

8. Some of the above are clearly the preserve of engineers, and this report focuses specifically on the availability and role of medical physicists.

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9. The term Medical Physics appears to be recognised and is still used by the majority of providers and will be used throughout this report as an umbrella term to encompass the work of Clinical Scientists and Clinical Technologists and Assistants in the application of physics to healthcare.

10. Whilst this report focuses solely on the work of Clinical Scientists and Technologists, and does not encompass clinical engineering, the complementary importance of engineers in support of the delivery of safe, effective care must be recognised and emphasised. To add complexity, a few clinical scientists actually work within the clinical engineering workforce. Other reports speak of significant demographic pressures on the engineering workforce (with large numbers aged 55 or over), and the paucity of training and development opportunities for engineers. As will be separately highlighted, there is real value in pursuing more generic training opportunities for different groups of scientific staff (and across staff groups per se) to provide a broader training base and career flexibility. It is recommended that greater consideration is given to more generic training programmes across healthcare sciences and diagnostics per se.

11. Whilst differing management structures, the use of terminology and the different portfolios individual scientists and technologists can blur clear distinctions, the work of medical physicists typically falls into one of the following areas:

- Radiotherapy Physics
- Radiation Physics and Radiation Safety Physics
- Non-ionising radiation physics (MRI and Ultrasound)
- Nuclear Medicine physics

12. In addition, a handful of clinical scientists work in clinical engineering, whilst inputs can also be provided to Urodynamics and Audiology services.

13. In some trusts radiation safety physics is operationally divided across and embedded in the ionising radiation modalities, although the national training schemes is reverting to a model where ionising radiation safety is combined with.

14. Radiology Physics in terms of training. In several trusts the work of Clinical Pharmaceutical Scientists is included within nuclear medicine and thereby the medical physics functions.

15. Whilst radiotherapy physics is directly provided by all large acute trusts, other services are typically provided on a hub and spoke basis by the larger trusts. Workforce constraints may serve to perpetuate and further this model, although the planned development of Community Diagnostic Centres hubs and steady progression of user-led technologies point to the value of local responsiveness to needs.

16. The current focus on improving access to diagnostic services is promoting a better understanding of the many inputs that enable effective and efficient diagnostics, including the crucial contribution of clinical scientists and practitioners. This is welcomed, and it is

important that healthcare sciences use this opportunity wisely. Consideration must also be given, however, to the non-diagnostic aspects of medical physics and clinical engineering if there is to be a necessary and balanced strengthening of overall provision.

17. This report focuses on the current workforce, workforce challenges and projected needs across the 4 categories outlined in Para 12 above.

ESR Data

18. Whilst the starting point for this study was to access data submitted by trusts to the ESR database, there is widespread suspicion as to the accuracy of this data and the codes used. However, subsequent discussion with lead physicians at several trusts indicated that, in the main, ESR data does give a reasonable indication of the size and composition of the overall workforce. What is does not give, however, is detail on staffing numbers at the more disaggregated level outlined in Para 12.

19. ESR coding used to identify numbers of clinical scientists and clinical practitioners working in medical physics are:

Qualified Healthcare Science Staff

- UA – Consultant Healthcare Scientist (Scientist)
- U0 – Manager
- U1 – Specialist Healthcare Scientist (Scientist)
- U2 – Healthcare Scientist (Scientist)
- U3 – Specialist Healthcare Science Practitioner (Technologist)
- U4 - Healthcare Science Practitioner (Technologist)

Support to Qualified Healthcare Science Staff

- U5 - Healthcare Science Associate (Technologist)
- U6 – Trainee Healthcare Scientist (Trainee)
- U7 – Trainee Healthcare Science Practitioner (Trainee)
- U8 – Trainee Healthcare Science Associate (Trainee)
- U9 – Healthcare Science Assistant

Areas of work supported by the above are listed in ESR as:

- Angiography, Breast Screening, Clinical Pharmaceutical Science, Clinical Radiology, CT, Dental and Maxillofacial, Diagnostic and Interventional Radiology, Imaging, Mammography, Medical Education, MRI, Non-ionising Radiation, Nuclear Medicine, Radiation Safety, Radiotherapy Physics, Radio-pharmacy, Ultrasound and Medical Physics.

This indicates the potential breadth of work supported by clinical scientists and practitioners. Purely administrative support staff should therefore be excluded from the data.

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What ESR data returns as of 31 May 2021 show is:

- There were 711 WTE medical physics staff (scientists, practitioners and
- trainees) employed by NHS Trusts as of 31 May 2021. The actual head count was 790

- Of these, 595 WTEs were categorised as qualified staff, and 116 as support staff (trainees and assistants)

- This breaks down as follows (data for 31 March 2021): -
    - Consultant Healthcare Scientists – 46 WTE
    - Managers – 23 (these are likely to be healthcare scientists with leadership roles)
    - Specialist Healthcare Scientists – 31
    - Healthcare Scientists - 133
    - Specialist Healthcare Science Practitioners - 70
    - Healthcare Science Practitioners - 294
    - Healthcare Science Associate - 24
    - Trainee Healthcare Scientists - 33
    - Trainee Healthcare Science Practitioners - 14
    - Trainee Healthcare Science Associates - 3
    - Healthcare Science Assistants - 42

- Assuming that those categorised as managers are qualified scientists, there were therefore:
    - 233 qualified scientists
    - 364 qualified practitioners
    - 116 other staff, 50 of which were categorised as trainees

- The major employers are:
    - University Hospitals Birmingham NHS Foundation Trust – 142 WTE
    - Nottingham University Hospitals NHS Trust – 83
    - University Hospitals Coventry and Warwickshire NHS Trust – 77
    - University Hospitals of Leicester NHS Trust – 62
    - The Royal Wolverhampton NHS Trust – 54
    - University Hospitals of North Midlands NHS Trust – 51

- 27 WTEs were employed at A&C Bands 8d or 9, 147 at Bands 8a-8c, 186 at Band 7, 203 at Band 6 and 145 below Band 6

- 17.4% of staff who gave information on their ethnic origin were BAME. This percentage is higher for support staff (25.0%) than for qualified staff (15.6%)

- Turnover over the last year averaged at 8.1%. Three providers (Shrewsbury and Telford, Leicester, and Lincolnshire) reported turnover at over 11%

- Sickness levels averaged at 3.1% over the past year, below Trust averages.

Discussion with Trusts:

20. Following initial analysis of ESR data Trusts were approached to seek conversations and written views to validate the ESR findings and to ascertain provider views of current workforce challenges. Responses were received, and detailed discussions held with 9 trust leads, including leads from each of the largest 6 employers of medical physics staff.

21. Whilst there was some unease as to the accuracy of ESR data, more detailed analyses of current staffing structures indicated that the data returns were reasonably fit for purpose. It is recommended, however, that all Trust HR departments liaise with their Medical Physics leads to review and ensure the validity of ESR returns, given that these returns are likely to be critical for future workforce planning and any development of benchmarking.

22. It must be noted, however, that ESR data does not include any information on vacancies. Discussions with individual trusts indicate that there is typically a vacancy rate of 10-12% across both clinical scientists and clinical practitioners. This is higher for Clinical Practitioners, where it often exceeds 15%, than Clinical Scientists where it is close to 10%, and exceeds national averages of 8-9% as reported by the Institute of Physics and Engineering in Medicine (IPEM). Across the region, this vacancy factor equates to c80-90 WTE. Where vacancies (particularly practitioner posts) are used to fund and train apprentices (see below), it is unlikely that they continue to be declared as vacancies, whilst adding to the time commitment of supervision for qualified staff.

23. Specifically with regard to those trusts which are members of EMRAD, the East Midlands Imaging Network, the number of established posts at Band 7 or above is 48% of the guidelines issued by the European Federation of Organisations for Medical Physics (EFOMP) – nationally, levels are 54% of those recommended by EFOMP guidelines. Whilst there may be concerns that EFOMP guidelines may be somewhat inflated, a review undertaken by EMRAD indicates that, on average, trusts believe that they should be staffed at 84% of EFOMP guidelines to meet current demands. The difference between 48% and 84% in the East Midlands is 35 clinical scientists. This ‘gap’ relates to trusts which cover a population of 3.8M. Scaling it up across the whole of the Midlands region would equate to a shortfall of c95 clinical scientists. Such a scale of increase in clinical scientists is considerably greater than the more cautious, albeit significant increase proposed in this report.

24. Trusts manage their medical physics workforce in widely different ways, and have differing approaches to leadership, meaning that the medical physics ‘voice’ and involvement in service planning varies considerably. Recommendations regarding professional leadership and influence are made later in this report.

Training and Development

25. There are marked differences between training routes for practitioners and scientists, albeit that both are widely held to be insufficient and warranting change.

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a) Practitioners

26. Practitioners, also commonly termed technologists, are degree-qualified, whether prior to appointment or through apprenticeship training to Level 6. Extensive work-based experience is also required to secure registration. Once qualified, they are eligible for the Register of Clinical Technologists, an accredited voluntary register, and take on clinical roles. Some departments formally require their practitioners to register; some do not.

27. The use of apprenticeships to train Clinical Practitioners is limited by the fact that no funding is provided for the salary component of any apprenticeship, whilst, as has been already noted, there is a loss of clinical availability due to the need for formal education time. This means that Trusts have to use vacancies in their establishments to develop apprenticeships, with the added requirement to provide mentorship and on the job training from qualified staff, for which no training levy is available. In effect, the development of new roles is dependent on vacancies and the goodwill of experienced staff, frustrating the rate at which new apprentices can be trained. In addition, certain trusts only pay apprentices at minimum wage, whilst others pay them typically at AfC Band 5.

28. These challenges are further exacerbated by a dearth of externally funded routes for training and no direct entry degree courses. For trainees with a relevant degree at a good level the IPEM (Institute of Physics and Engineering in Medicine) equivalence training route can be used, whereby work-based evidence of competence and an examination enables qualification as a practitioner. The alternative to this has been a degree apprenticeship, although there is extremely limited access to such: the course at Cumbria has closed due to lack of numbers, whilst courses at UWE are under similar challenge. The only other course is at Swansea which, as a Welsh university, cannot currently access NHS apprenticeship levies.

29. The National School for Healthcare Science offers a Practitioner Training Programme (PTP), although this can only currently be accessed via the apprenticeship route given the lack of access to external degree courses.

30. It is worth exploring whether HEE (Midlands) and major providers could engage with HEIs to identify a critical mass for a degree-based apprenticeship programme primarily serving the Midlands, recognising the need for a steady stream of clinical practitioners in support of the delivery and development of medical physics expertise. This is likely to equate to an intake of at least 10-12 apprentices per annum, whilst extension of this initiative to engineering practitioners would create an even more viable critical mass for training. Further extension across Healthcare Science practitioners may be possible and enable the development of generic modules suitable for all groups of trainees, prior to more specialised training. Initiation of such a programme in pilot status (akin to the introduction of the L2/L4 cardiorespiratory apprenticeship pilot programme in the North East is worthy of early consideration.

31. If providers would be concerned at the potential reduction of in-house service support from trainees because of a greater use of degree-based courses, an alternative

approach may be to create a training levy to cover some of the costs of in-house training. This could also be enabled by a future Clinical Placement Expansion Programme (CPEP).

32. Creation of a regionally funded cohort of 10-12 trainees per annum, with full costs for training (and potentially a period following training) would be a solution to meet all needs and concerns, additionally enabling newly qualified practitioners to be deployed to areas of greatest needs, whilst enhancing their experience). This would be the 'gold standard' approach to ensuring a future supply of qualified clinical practitioners.

33. A number of service leads (particularly in nuclear medicine) highlighted the increasing appointment of qualified radiographers to practitioner roles, in part a reflection of difficulties in recruiting practitioners from other sources. Discussions with West Midlands providers indicate that 30-40% of practitioner roles are now filled by former radiographers. Whilst this may be an appropriate and acceptable means of easing practitioner shortfalls, it simply has the effect of undermining efforts to ease problems of radiographer supply.

34. Another oft-cited concern with regard to clinical practitioners is the lack of continuing development opportunities, which would enable technologists to take on advanced practice roles (e.g., target/OAR delineation). This is restricted in part by their lack of registration with the Health Care Professions Council (HCPC), in part by the perception that practitioners require further academic training and scientist status to do advanced roles. This glass ceiling to their continuing development and realization of their potential must be addressed, in part through formal registration. Pending such, placement on the AHCS accredited voluntary register is **recommended** to practitioners with immediate effect. It is also **recommended** that opportunities for Advanced Specialist Expertise opportunities are extended, enabling the development of more specialists.

b) Scientists

35. Clinical Scientists are registered with the HCPC, for which a minimum of a masters level qualification or equivalence/route 2 training is required. Many regard the latter as the most feasible means of generating more Scientists, subject to the availability of funding. The traditional route, the HEE funded Scientists Training Programme (STP), which combines HEI study with in-house training, attracts a high calibre of trainees, although the nature of the national recruitment process is such that trainees are often placed in centres rather than choose such, and often move once trained.

36. The equivalence route is a means by which the National School of Healthcare Science can assess experience and skills of staff in post to award 'equivalence' to masters level training, whilst Route 2 is a programme provided by the Association of Clinical Scientists which predates the STP and is the IPEM's version of equivalence training. In addition, consideration is being given to the STP scheme being accessible for apprenticeships.

37. The STP remains the majority route for the training of clinical scientists, accounting for the qualification of 45-50 Clinical Scientists each year nationally (IPEM), using designated training centres (trusts) (NB – in Pathology networks they are exploring how

accredited centres can support non-accredited centres to open up additional options for training places, whilst also easing demands on capacity in accredited centres). It is an HEE fully funded course, with salary reimbursement at AfC Band 6, albeit without any training levy for providers. The somewhat selective nature of STP access and placement of a limited number of trainees may also serve to frustrate a local desire to promote greater equality and diversity, enabling people from disadvantaged backgrounds to access specialist training. Work is being undertaken nationally to improve equality, diversity and equity of access to all National School programmes.

38. The other routes are not supernumerary, requiring salary payment and education costs as well as the associated demands on training and supervision. They are well used however, with – as with practitioner training - staff vacancies being used to cover salary costs and can be more popular insofar as trainee scientists learn intensively 'on the job', supporting service delivery. Internally funded scientist trainees appear to be more likely to stay with the provider once qualified, and Route 2 is particularly popular with smaller providers for this reason.

39. A major concern amongst service leaders is the demand placed on qualified staff from supervision responsibilities. Many have expressed their concern that this takes senior staff away from clinical duties, whilst also limiting the number of scientist and practitioner trainees that can be managed at any one time. Managers have highlighted the real value that could be obtained if several people could be trained simultaneously through some means. This could be

40. enabled, for example, through greater networking and coordination between trusts, the commissioning of courses for cohorts of trainees from a HEI and, potentially, the support of a regional training academy (although the latter may be more attractive to and appropriate for practitioners).

41. There is also considerable concern that the responsibility for theoretical training has shifted in recent years from universities to hospitals with the change from university-based MScs to distributed learning. The delivery of theoretical training at hospital level is a particular burden on qualified staff.

42. Equivalence and Route 2 options are used because of the limiting capacity of STP placements, access to which and placement with providers are managed nationally. There is a strong sense that STP trainee scientists often move on from their training placement to larger centres, or those closer to their homes, and that training centres themselves have added attraction to non-training sites, as well as a widespread view that the number of STP places each year is insufficient to meet current and projected service needs. This is a function both of training capacity and funding, and steps to increase both in an aligned way are required.

43. There are therefore clear frustrations with regard to the training of both Practitioners and Scientists. It is recommended that:

- A training levy is established to support the costs of the (often intensive) in-house supervision of trainee practitioners and scientists. Pending such, where organisations establish training places, these should be established at 1.2 WTE in recognition of the

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formal education element. 2022/23 Spending Review recommendations included proposals for the funding of Practice Educators in Trust Imaging Departments and CDCs. This is supported.

- Discussions are progressed between HEE and providers to explore the scope for influencing HEE's support to practitioner training as a means of increasing the number of trainees and the support to such. This should include the establishment of region-wide or sub-regional Practice Educator roles to drive the recommended changes in training.

- A cohort of trainee practitioners is fully funded by NHSE/I and/or HEE to ensure an adequate future pipeline of practitioners. Again, 2022/23 Spending Review proposals included the creation of training grants for
- Medical Physics Technologists.

- Opportunities are actively explored to increase the number of practitioner apprenticeships for medical physics (and clinical engineering).

- Urgent consideration is given nationally to the formal registration of clinical practitioners by the AHCS, as a means of enabling their continuing development and deployment, including the scope for their application of
- advanced practice.

- Accredited centres for STP training align with non-accredited centres to open up additional options and capacity for training placements. There is scope for collaborative provider bids to secure STP places, whilst, in addition, the National School offers support for non-accredited courses to become accredited.

- Subject to the creation of additional training capacity, places are funded by HEE to support the demand for and enable access to STP training, supporting the pipeline of future scientists. Again, additional places for the STP and HSST in Medical Physics were included in recommendations submitted to the 2022/23 Spending Review.

44. Higher training is available for qualified scientists via the Higher Specialist Scientist Training Programme (HSST), a five-year doctoral training programme part-funded by HEE, or via an equivalence route with AHCS, which requires experience and a portfolio to gain access to the Higher Specialist Scientist Register (HSSR). Either route enables registration to practice as a consultant clinical scientist, roles which are particular characterised by advanced practice, and which could be used more efficiently and consistently across providers to ease service pressures.

c) Associates

45. The apprenticeship model has also developed successfully at more junior support levels, enabling Trusts to develop staff to Level 2 and Level 4 apprenticeship levels. This is enabled through access to trust apprenticeship levels, and services to develop typically younger people/school leavers in the basics of health care support. Again, training of

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these staff may well benefit from a more collaborative and collective approach across sub-regions, as well as by an appreciation of the greater scope and use of virtual learning.

d) General

46. Through promoting the recruitment and training of staff, it is vital that providers enable all staff to 'work to their licence' and continually develop their knowledge and skills. There is too much anecdotal evidence of scientists, trained to masters-level, being scribes or chaperones for Clinical Oncologists and of Practitioners being 'hand-maidens' for scientists. Each skill base should do what only they can do.

47. It is increasingly evident when reviewing various workforce reviews that there are common skill requirements which may lend themselves to more generic courses for the development of practitioners in particular. The structuring of a common course for Physical Sciences and Engineering which encompasses elements such as governance, safety, quality assurance and best practice may enable more collaborative, at-scale training. This may be further enabled by the significant recent shift to virtual/on-line training, with specialism inputs from guest lecturers, and may generate appetite amongst potential HEI providers. This appears to reflect the original spirit of Modernising Scientific Careers and would be a useful means of countering the unforeseen consequences of fragmentation in training and practice. This can be further discussed with the National School.

Individual Specialisms within Medical Physics

Radiotherapy Physics

This section owes much to Dr. Keith Langmack's recent review of the Physics workforce in Radiotherapy across the Midlands, encompassing both the medical physics and engineering workforce. Keith, Head of Radiotherapy Physics at Nottingham University Hospitals NHS Trust conducted this review for HEE (Midlands). The author of this current report did not wish to duplicate discussions recently held with Radiotherapy leads and has conducted this review with explicit reference to the previous review. Recommendations made herein largely serve to amplify Keith's recommendations regarding the clinical scientist and practitioner workforce.

48. Radiotherapy Physics provides a variety of specialist services to Radiotherapy to ensure its accuracy and quality, enabling the legal, safe and effective delivery of radiotherapy (high energy radiation) to patients. Accountability is typically to both the ahead of Medical Physics and the clinical head of radiotherapy. In essence, staff working in this field are responsible for the precision and accuracy of treatments by using computer calculations to develop individual patient treatment plans (National School of Healthcare Science). It is therefore treatment-focused, reflecting the fact that patients undergo radiotherapy typically over several weeks. It is crucial that staff maintain awareness of steady advances in radiotherapy and advanced computer systems.

49. The specialist services provided by radiotherapy physics is shaped by the range of services provided by the radiotherapy services. Most trusts provide a radiotherapy physics service, whose functions can typically include:

- Quality assurance of treatment machine dosimetry (dose calibration) in accordance with IR(ME)R regulations, including the commissioning of new treatment machines
- Mould room work
- Patient immobilisation and shielding, including the design and manufacture of bespoke devices when necessary
- Use of complex computer systems to carry out radiotherapy treatment planning in an individual patient basis, commissioning new software, planning treatments and checking treatment plans
- Use of sealed radioactive sources for the treatment of cancers – brachytherapy – ensuring compliance with regulations
- Imaging of patients in support of radiotherapy
- Design and management of software to capture and store technical information on treatment
- Consultation on any proposed changes to radiotherapy practice and
- incident reporting
- Teaching, training, and supervision
- Support to clinical trials

50. A significant number of clinical scientists and practitioners working within the domain of medical physics work in radiotherapy physics. Whilst ESR data does not provide detail of exact numbers, Keith Langmack's report indicates that in early 2021 the region-wide establishment of clinical scientists was 125.31 WTE, of whom 114.46 WTE were in post. For clinical practitioners the establishment was 93.25 WTE, of whom 83.85 WTE were in post (the establishment for Engineering practitioners was 47.7 WTE, of whom 42.2 WTE were in post). The overall vacancy factor was therefore c10%.

51. The notion of establishing radiotherapy networks with a centralized employment model was floated several years back. Whilst this model has been generally dismissed, the value of networks has been developed nationally most notably in the East Midlands, attracting significant national attention.

Radiation Physics and Radiation Safety

52. Radiation Physics, sometimes termed Diagnostic Radiation, and Radiation Safety is concerned with the safety, for both patients and staff, of the equipment used in treating patients X-Rays, radioactive materials, lasers and ultraviolet radiation. Ionising radiation has potential to alter DNA and living tissue, and careful monitoring of equipment performance, ensuring its compatibility with stringent regulations, is critical. This involves the measurement and calculation of doses of radiation.

53. At a senior level Radiation Protection Advisors (RPAs) or Radioactive Waste Advisors (RWAs) ensure that regulatory requirements are met and implement and monitor quality standards for the use of radiation and radioactive materials. Medical Physics Experts

(MPEs) also ensure image quality, patient safety and optimisation. RPAs, RWAs and MPEs are all roles which are formally required under the regulations relating to ionising radiation.

54. Radiation safety services are typically provided on a hub and spoke basis by a limited number of trusts. Work involves dosage audits, incident analysis, input to the design and commissioning of facilities, risk assessments, advice (e.g., on screening) and environmental dosimetry (shielding requirements). Occasionally, as is the case with University Hospitals Birmingham, which historically provided a regional Radiation Physics and Protection service, these can be provided at some distance from the host site. Services may also be provided to support local dentists and vets, generating additional income for the host trust. These services are also provided in some cases by private providers.

55. The development of new service models (e.g., Community Diagnostic Centres) and advances in imaging signal the likely need for further growth in and strengthening of radiation protection services. With limited staffing, this may drive greater collaboration and integration of services.

56. Many colleagues have commented that many trainees (scientists in particular), limited though actual numbers may be, are attracted to work in radiotherapy physics and nuclear medicine due to their patient-facing nature, to the detriment of other functions. Whilst this perspective has not been analysed, there is no doubt that radiation physics, and radiation safety/protection in particular, struggle to secure adequate numbers of qualified staff.

Non-Ionising Radiation (Imaging)

57. Non-ionising radiation is extremely low frequency radiation, using optical radiation or electromagnetic fields. In medicine, it typically involves the use of Ultrasound, Magnetic Resonance Imaging (MRI) and optical imaging, and can extend to support to ultra-violet treatments for skin conditions and to laser surgery.

58. These treatments need to be delivered safely, and staff need to continually quality assure their application and keep opportunities for improvement continually under review. This is particularly the case with the use of MRI, which is a specific area of steady growth in imaging the central nervous system, characterising normal and abnormal tissue and producing contrasts to review blood flow, cellular density and tissue stiffness arising from blood oxygenation.

59. Staffing shortfalls in non-ionising radiation tend to particularly reflect traditional shortfalls in non-obstetric ultrasound staffing and the growing demand for experience and skills in MRI (MRI activity is increasing at 5.6% per annum). Multi-modality imaging is also increasingly common.

Nuclear Medicine

60. Nuclear Medicine uses radioactive materials to generate images of the body's inner functioning to diagnose and treat disease. Staff working in this area prepare and inject the short-lived radioactive tracer material, ensuring minimal exposure and designed to target the organ under investigation. It is undertaken in a highly regulated environment, with input from designated Radiation Protection and Radioactive Waste Advisors (RPA and RWA) as well as a designated Medical Physics Expert (MPE) and a requirement to comply with strict transport and pharmacy regulations.

61. Nuclear Medicine scans show how the body and its component parts are functioning, rather than simply showing its structure. Techniques include the increasing use of gamma cameras, which are also used for Single Proton Emission Computed Technology (SPECT) and Positron Emission Topography (PET). Nuclear Medicine services often perform therapeutic procedures using radionuclides, and manufacture radio pharmaceuticals. Bone densitometry services sometimes sit within Nuclear Medicine services.

62. As is noted below, Nuclear Medicine has been heavily dependent on overseas recruitment in the past. The reduced scope for this, aligned to difficulties faced by smaller departments in meeting regulatory requirements, and the steady growth in the use and number of gamma cameras and PET scanning all present significant difficulties regarding staffing, with a particular need for qualified practitioners. In some places this is being addressed by the deployment of trained radiographers, exacerbating skill shortages in radiography.

Advanced and Expert Practice

63. There is real value in for their developing leadership and senior-level advice within Medical Physics, strengthening the influence, impact and voice of Medical Physics leads. This investment in leadership could be achieved through the development of Scientists with at least 2 years' experience and accreditation to function as an RPA, RWA or MPE. It is critical if the current spread of medical physics provision is to be sustained.

64. The value of advanced practice from clinical scientists and clinical practitioners is twofold: - firstly, it enables the continuing development of practice from well-qualified, educated and experienced staff. Secondly, it can ease workload demands on other professions at greater value and at a time when there are many professions facing workforce shortages. It pays to invest in healthcare sciences.

65. Examples of where there is demonstrable scope for role extension include Radiotherapy, where practitioners can produce and scientists can approve treatment plans – increasingly using bespoke software applications - in accordance with IR(ME)R regulations, freeing up Clinical Oncologist time. In Nuclear Medicine, there are examples (e.g., at Derby) of medical physics leads taking lead responsibility for reporting, mitigating the impact of Radiologist and Oncologist shortages. Elsewhere, some departments have developed consultant dosimetrist roles where practitioners can outline target volumes

and identify means for the management of organs at risk, advising MDT meetings. Formal trading routes and recognition for such practices could help to ease the burden on hard-pressed other specialties.

66. Another example of advanced practice potentiality is the building of experience amongst scientists to guide the development of AI based applications safely and effectively. More generally, the work of medical physics staffing in ensuring the safety, effectiveness and efficiency of newly commissioned planning and treatment modalities is critical.

67. The presence of advanced practice may often reflect the local trust culture of collaborative working between different professions. It is recommended that the potential for advanced practice is actively explored by Medical Physics leads, supported by the Regional Lead Scientists and the emergent regional network of Healthcare Scientists and through the identification and sharing of best practice.

68. One area in which advanced practice and qualifications are critical is in the designation and deployment of RPA, RWAs and MPEs (see Para 58). These are critical roles which many trusts have increasingly struggled to fill, leading to service closures. Typically, Scientists with at least 2 years' experience and accreditation via RPA2000, these roles are required to support and guide Nuclear Medicine, Radiotherapy Physics and Radiation Physics. Placement on the statutory MPE register introduced by IR(ME)R17 qualification is available for those at or below Consultant Scientist level. It is recommended that support and encouragement to undertake such roles is actively encouraged by Trusts, (although this does not imply that MPE status automatically leads to consultant status).

Recruitment and Retention

69. Difficulties in recruiting practitioners and scientists in large part reflect the shortcomings in training capacity highlighted above. There is also the tendency of newly qualified staff, and of practitioners in particular to gravitate towards the larger urban teaching centres and departments, presenting challenges to smaller units, many of whom are increasingly dependent on hub and spoke arrangements managed by the larger centres.

70. Traditionally this has driven a high dependence on overseas recruitment. Managers cited the significant number of nuclear medicine scientists and technologists appointed from Portugal in particular, but also from Australia, the Philippines, India, Pakistan and the Middle East. With the strengthening of the pound and the impact of Brexit, including increased regulatory requirements, this flow appears to have run dry and in-service training is increasingly critical.

71. Supply challenges were identified for radiation safety scientists, with many departments reporting that they are short-staffed. This will be reflected in the overall vacancy levels for clinical scientists and practitioners of c10-12%. Several referred to the pull of radiotherapy physics amongst trainees, and resultant shortages elsewhere, often leading to grade creep (although one department reported that it was 25% below its establishment in radiotherapy physics).

72. 15.5% - almost 1 in 6 - of medical physics staff are aged 55 or over. Whilst traditional assumptions regarding age of retirement may no longer hold, there is still a real risk of loss of staff through retirement, and there are anecdotal suggestions that this has been exacerbated by the pressures of the pandemic. This can be countered in part through provision of support to staff well-being, whilst NHSE/I support on measures to enable retention is available from Michelle Lee, Senior Strategic HR Workforce lead and her colleagues (michelle.lee22@nhs.net) and the Model Health System (www.model.nhs.uk) has its own retention section. In addition, the Nottinghamshire system has developed late career guidance for AHPs and Nursing, many aspects of which will be equally relevant to the healthcare sciences ('The Late Career Hub – Care4Notts' – on the Care4Notts website).

73. It is **recommended** that best practice in supporting staff well-being, staff retention and recruitment drives, including overseas recruitment post-Brexit, should be identified and shared collaboratively across providers, systems and emergent networks, facilitated by the Regional Lead Scientists.

The Importance of Leadership

74. There is considerable variation in the nature, status and impact of the role of Lead Scientist within trusts. If Healthcare Scientists wish to enhance their profile, voice and influence, leadership within organisations and systems is
75. critical.

76. Lead Scientists should provide professional leadership and voice to those working in physiological, life and physical sciences, providing a source of advice for service reviews and planning. They should also act as lead links for system-wide, regional and national engagement, support networks and academy development and promote research and audit.

77. To do the above effectively, it is recommended that the role of Lead Scientist should be recognised by trusts, and ideally remunerated, at a level of at least two sessions a week (more for the largest providers). It is also recommended that each Integrated Care System has access to a nominated Lead Scientist, and uses this access to inform service planning, including the development of Community Diagnostic Centres.

78. It is also **recommended** that trusts review how best to secure healthcare scientific advice in their decision-making processes. Most typically this should be secured at Divisional level, with Executive access to the designated Lead Scientist when necessary.

79. With specific regard to Medical Physics, the existence of Heads of Medical Physics in trusts appears to have steadily reduced over recent years. If the value of Medical Physics expertise is to be effectively captured and channeled into decision-making and investment processes, it is recommended that Trusts review the value of establishing formal leadership responsibilities within Medical Physics.

80. It is also **recommended** that Lead Scientists should establish and maintain contact with all service leads across Physiological, Life and Physical Sciences and Engineering. This is critical in maintaining oversight and an effective advisory and supporting role.

81. It is also **recommended** that Lead Scientists actively engage regionally and sub-regionally with their peers and actively explore and support the scope for effective networking.

82. Finally, it is **recommended** that Lead Scientists forge effective working relationships with their HR leads to establish and maintain an understanding of the science workforce and to progress local workforce planning.

83. The work sponsored by NHSE/I on the 'AHPs into Action' framework, and the recent publication by NHSE/I of 'Investing in Chief AHPs: insights from trust executives' (August 2021) provide useful insights as to how to strengthen the leadership voice of healthcare scientists.

Future Demands: New Service Models and New Technologies

84. The bulk of this report has focused on the current workforce challenges in Medical Physics and means for their mitigation. While existing vacancies exist and training and supervision needs persist it is hard to look forward with great confidence. However, the growing demand for diagnostics, the drive to increase the availability of imaging modalities, the growing demand for such, the immense ask of service recovery post-pandemic and the drive for new service models and technologies all highlight the need to increase the stock of clinical scientists and practitioners, supported by appropriate training, development and working environments in which they are fully valued.

85. Professor Sir Mike Richards' 2020 report 'Diagnostics: Recovery and Renewal' highlighted both the value of developing Community Diagnostic Hubs (now Centres) – now being driven hard across the country – and the need to significantly increase diagnostic capacity. The acceptance of the report's recommendations by NHSE/I included the need to improve the early diagnosis of cancer through a radical increase in scanning capacity, the separation of acute and elective diagnostics, wherever possible, and significant additional investment in radiologists and radiographers.

86. The report explicitly recommends that the number of 'medical physicists' is increased by 220 over the next five years (2021-2026). The Midlands comparative share of this would be 40, although it should be noted that there are c70 current vacancies across the Midlands. Given the proposed doubling of CT capacity by 2026, a massive increase in other scanning capacity, an increase of 2000 radiologists and 4000 radiographers, and the creation of Community Diagnostic Centres, the Richards projections appears somewhat conservative, and it is recommended that the Midlands seek to increase their medical physics workforce (technologists and scientists) by a net 100-120 WTE (incl. current vacancies) by 2025/26, equating to an increase of c15-20%. It may be noted that submissions to the 2022/23 Spending Review highlighted the need for increased STP and HSST places.

87. Dr. Keith Langmack's 2021 review of radiotherapy physics sets out the case for a 10-15% increase in clinical scientists and practitioners to support needs and developments in radiotherapy physics alone. This equates to 40 additional posts: an increase in the establishment by c20 WTE posts, in addition to 20 WTE to close current vacancy levels.

88. The development of CDCs will add to the demands for strengthening of other specialisms, with an assessed need for 50-80 additional WTE (c30 WTE in radiation physics, and c50 WTE in nuclear medicine). An even greater increase is required if IPEM staffing recommendations are to be met.

Additional Investment

89. There will be many compelling cases for additional investment in the NHS workforce over the next few months and years, and proponents will need to present value for money and a clear understanding of return on investment – particularly with reference on its contribution to service recovery and the demonstrable reduction in backlog numbers.

90. For medical physics, cases for additional investment need to demonstrate the above and the deliver ability of proposals: - hence the need to address the critical training pipelines. Potential sources of funding are those which are targeted to the recovery of service backlogs, and those which relate to cancer improvements.

Next Steps

91. As high priority next steps to support an increase in the number of WTE Medical Physics staff by 20% over the next 4 years, priorities for action are proposed as: -

Practitioners

- Immediate consideration is given by HEE to an increase in number of practitioner training places, supported by a training levy for providers
- HEE and NHSE/I to explore the concept of establishing annual cohorts of
- trainee practitioners, supported by the appointment of Practice Educators
- Greater use to be made by Trusts of apprenticeships for trainee practitioners

Scientists

- Accredited STP training centres to align with non-accredited centres to increase the capacity of and access to STP training, supported by the appointment of Practice Educators
- HEE to consider the potential for a training levy for all providers who
- supervise STP trainees

Advanced Practice

Authorship

This report was produced by Dr. Leigh Griffin, an ex- NHS Chief Executive commissioned by HEE to undertake a series of workforce reviews to inform the current and future workforce demands of staff groups who offer support to the provision of diagnostic services. It could not have been produced, however, without the guidance and support of many medical physicists across the Midlands.

- Opportunities for advanced practice to be promoted by the Regional Lead Scientists, informed by current exemplars of such

Leadership

- All Providers should formally designate and remunerate the role of Lead Scientist and, through such, designate a Medical Physics lead
- Lead Scientists should be proactive in strengthening networking across providers, including the creation of a regional Medical Physics network

Growth

- Systems should schedule additional investment in Medical Physics. Region-wide this should be in the order of a WTE increase of 15-20% by 2026/27.

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