Estimating the cost of growing the NHS cancer workforce in England by 2029

Supplementary information pack

October 2020

Together we will beat cancer
Reference

This report should be referred to as follows:


Authors

Cancer Research UK commissioned RAND Europe and the University of Cambridge, partners in the Cambridge Centre for Health Services Research, to carry out the research underpinning this report.

The report authors are:

Jenny George (1), Evangelos Gkousis (1), Alexandra Feast (3), Professor Steve Morris (2), Jack Pollard (1) and Jyotsna Vohra (3)

1 RAND Europe
2 University of Cambridge
3 Cancer Policy Research Centre, Cancer Research UK

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Cancer Research UK

Cancer Research UK is the world’s largest independent cancer charity dedicated to saving lives through research. We support research into all aspects of cancer through the work of over 4,000 scientists, doctors and nurses. In 2018/2019, we committed £546 million to cancer research. We receive no funding from Government for our research.

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This research was carried out through a collaboration between researchers at the University of Cambridge and at RAND Europe, The Cambridge Centre for Health Services Research (CCHSR). Co-led by Steve Morris, RAND Professor of Health Services Research at University of Cambridge, and Jon Sussex, Chief Economist at RAND Europe, CCHSR’s aim is to inform policy through evidence-based research on health services.

http://www.randeurope.org
# List of Acronyms

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<th>Definition</th>
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<tr>
<td>AfC</td>
<td>Agenda for Change: (NHS pay scales)</td>
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<tr>
<td>ALB</td>
<td>Arm’s Length Body</td>
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<tr>
<td>CPD</td>
<td>Continuing Professional Development</td>
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<td>DHSC</td>
<td>Department of Health and Social Care</td>
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<td>ESR</td>
<td>Electronic Staff Record</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>FTE</td>
<td>Full Time Equivalent</td>
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<tr>
<td>HCHS</td>
<td>Hospital and Community Health Services</td>
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<td>Health Education England</td>
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<td>LTP</td>
<td>(NHS) Long Term Plan</td>
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Section 1: Detailed methods

The following section provides a detailed description of the methods applied during the study, which took place between October 2019 and March 2020.

Data collection

It is important for health workforce projection models to be driven by the latest available, robust and reliable data to create an accurate representation of the current situation as the baseline from which to project the future accurately.\(^1\) Our data collection for this research was in two parts: 1) workforce data, including the number of staff and those entering or leaving the profession, and 2) financial data on the cost to Health Education England (HEE) of increasing the number of staff.

Workforce data

We identified the latest data for each of the seven key professions included in HEE’s 2017 Cancer Workforce Plan: medical and clinical oncologists (combined), diagnostic radiographers, therapeutic radiographers, gastroenterologists, clinical radiologists, specialist cancer nurses and histopathologists.\(^2\) We collected data to form a baseline for our demographic stock-flow economic model. Figure 1 provides a simplified visual concept of this model. The stock of the seven key professionals in the cancer workforce increases through inflows from specialist training, re-joiners and international recruitment, while it is depreciated via outflow through retirement and early leavers.

*Figure 1: Inflow and outflow of key cancer professionals*

Source: RAND Europe
We identified data on the following for each profession disaggregated, as far as the data permit, by age and gender:

- **Stock of professionals:**
  - **Stock:** The latest head count and full-time equivalent (FTE) number, as of 31st March of the relevant year.

- **Inflow of professionals:**
  - **Training:** The annual FTE of new specialist medical students and/or the number of newly licensed cancer professionals.
  - **Re-joiners:** The annual FTE of cancer professionals returning to practice who had previously exited the profession.
  - **International recruitment:** The annual FTE of cancer professionals joining the workforce having immigrated from abroad.

- **Outflow of professionals:**
  - **Early leavers:** The annual FTE of cancer professionals leaving the workforce at an earlier point in their working life than retirement.
  - **Retirement:** The annual FTE of cancer professionals leaving the workforce to retire.

We captured data over at least the last five years, where such data were available, to understand the trends in the workforce inflows and outflows. This allowed us to project these trends forward to estimate workforce growth up until 2029, without any change by HEE in the results of their current workforce activity. We also identified data on historic changes in average FTE per person in the head count. This is important as across some parts of the NHS the FTE per person has dropped because more staff than previously are working part time.

In order to obtain the above data, we took two approaches:

- **Firstly,** we approached HEE through the steering group to request unpublished data that is relevant to the modelling.
- **Secondly,** we undertook extensive desk research to identify the latest publicly available data relevant for the economic model. To do this we first looked at the websites of the relevant health sector bodies, particularly NHS Digital which is responsible for publishing NHS-related statistics on workforce, Department of Health and Social Care (DHSC), NHS England and NHS Improvement, and HEE. We then looked at websites of other organisations that we considered would have an interest in the NHS cancer workforce. These included charities such as Cancer Research UK and MacMillan Cancer Support, think tanks and other health sector commentators such as The King’s Fund, Nuffield Trust and The Health Foundation, and representatives of those professions that we were modelling such as the Royal College of Physicians. The organisations whose websites we looked at were:
  - Association of Cancer Physicians
  - British Society of Gastroenterology
  - Cancer Research UK
Once we had checked websites and other publicly available information from targeted sources, we used targeted searches on google to identify any further available information. To do so we tried different search combinations based on terms including cancer and workforce and the different cancer professions within the scope of this report. We found many additional sources in this way such as news articles or journal articles, which often gave us specific additional information.

Once we had completed our desk research, based on the unpublished NHS Electronic Staff Record (ESR) data received from HEE, and the publicly available data identified in our extensive desk research, we established the stock of key professionals on a given day in each year, as well as inflows and outflows, for the baseline year – i.e. the current situation, or the ‘starting point’ for the model.

HEE’s unpublished ESR data provided the FTE stock for six of the seven priority professions identified in its 2017 workforce plan, but not specialist cancer nurses. In addition, some of the seven cancer workforce professions are included in NHS Digital’s workforce statistics so are relatively straightforward to track.

However, specialist cancer nurses are not recorded as a specific staff line in the ESR data, which made it more difficult to estimate the number of nurses supporting cancer services. In discussion with stakeholders we used a proxy approach to model just the specialist cancer nurses. Firstly, we built on Macmillan’s 2017 census of cancer, palliative and chemotherapy specialist nurses and support workers in England. Then for our inflow and outflow data we used the inflow and outflow rates of the three nursing Agenda for Change bands (Band 6, Band 7 and Band 8a). These bands comprise 99% of specialist cancer nurse specialists, as outlined in the Macmillan census but cover all conditions and types of nurse.

**Budgeting and spending data**

We sought to obtain the most recent data on HEE’s budgeting and spending on each of the
cancer-related professions included in this study. We focussed on estimating costs for increasing the inflows to each profession as costs associated with reducing the outflows would not be within HEE’s remit. We wanted to understand how much it costs to obtain one additional professional for each of our seven professions as this would allow us to estimate the cost of increasing the cancer workforce by the magnitude required. In order to obtain budgeting and spending data, we took two approaches:

- Firstly, we approached HEE through the steering group to request unpublished data relevant to costing the cancer workforce.
- Secondly, we searched publicly available data through desk review from a range of sources:
  - We reviewed information published by HEE about its budgets and its spending. We reviewed HEE’s annual report, financial data, business plans and board minutes. However, HEE does not collect or present its costs in a way that allows it to easily separate costs for different professions.
  - We also looked at other key sources such as the DHSC’s annual tariffs for education and training places. The tariff for education and training places is paid by HEE so is a key source of financial information.
  - We searched for data from a range of wider stakeholders (described above for workforce numbers) and in the financial accounts of some training institutions.
  - Finally we conducted targeted searches on google to look for, for example, research literature which describes NHS costs.

However, overall, the available data did not provide a comprehensive and granular picture of all HEE’s spending on the cancer workforce as HEE does not present its costs in this way.

We found sufficient information to estimate the cost of training places. For some other inflow routes such as intra-NHS moves, HEE does not bear any costs as continuing professional development is mainly provided by Trusts or other employers. When looking at costs for international recruitment and rejoiners, HEE has specific schemes for nurses, although significant cost also falls to other parts of the NHS. For the other six professions within our study, HEE does not generally incur any costs associated with these inflows.

There are two important caveats in the data collected for this research. Firstly, we only sought to establish the cost to HEE of increasing the seven cancer professions by 45%, although in practice other health sector bodies such as NHS Trusts bear significant costs associated with workforce growth. Our approach fits with the research objective of estimating the additional funding required by HEE but does mean that cost comparisons between different ways of increasing staff numbers have important limitations as they do not include all costs to the health sector. Secondly, we only collected information on the cost of specialist training rather than foundation training. This was because for some cancer specialisms, new graduates who started training today may well not complete their training in time to become consultants in the time period modelled in this research.
Expert consultation

The objective of the expert consultation was to validate the data gathered through the desk research and from HEE and to seek data to fill gaps in what had been identified. Between October 2019 and March 2020, we conducted semi-structured interviews with representatives of the following seven organisations relevant to the seven key professionals in the cancer workforce:

- Association of Cancer Physicians
- British Society of Gastroenterology
- HEE
- Macmillan Cancer Support
- Royal College of Nursing
- Royal College of Radiologists
- Society of Radiographers.

We selected these organisations to ensure that we had at least two experts who had views on the workforce of each of the seven cancer professions within the scope of our report. We used our conversations to explore aspects of the economic modelling in more depth. More specifically we sought to:

- Discuss the accuracy, robustness and reliability of the data we identified from public sources and from HEE;
- Identify any further sources of data that would help to inform our economic modelling; and
- Validate our proposed assumptions, such as retirement age, for the economic model, and discuss adjustments where necessary.

We developed a tailored interview protocol, thereby ensuring we asked a similar set of questions of all stakeholders, while allowing us to ask questions on the different data sources already identified and ensuring emergent issues could be explored as the interviews progressed. We conducted each interview by telephone for 45 minutes to an hour.

We used the findings of the expert interviews to inform both our data collection and the design of the demographic stock-flow economic model as described below.

Economic modelling

In order to estimate how much additional investment HEE requires to achieve the desired growth in the cancer workforce in each profession we developed a tailored demographic stock-flow economic model, building on the stock-flow approach taken by the vast majority of health workforce planning models to estimate the supply side of the labour force.\textsuperscript{19} Rather than assuming that the number of FTE staff would remain constant from the baseline year to 2029 without additional investment, we have assumed that the ‘status quo’ scenario is a continuation each year of the average annual inflows and outflows observed over the most
recent three years in each profession. We believe this to be a more realistic estimation as, all other things being equal, it is likely given the long training periods required, that the recent trend will continue. We modelled this status quo increase using absolute numbers for inflows and outflows rather than percentage increases, as this approach is more cautious for such predictions.

Within a stock-flow economic model, as demonstrated in Figure 2, within the model each cohort of professionals (defined by age – in the example in Figure 2, cohort ‘X’ is people whose 21st birthday falls in 2019, 22nd birthday in 2020 and so on) is followed from the baseline year (the year with the latest available data) until 2029. A proportion of the cohort exits the workforce at an earlier point in their working life than retirement or due to retirement (outflows), while a proportion of the workforce joins the cohort through training, international recruitment and returning to practice (inflows). For the purposes of this modelling we have not included the foundation / core training element of a consultant’s training, as the time lag may mean that an individual starting today may not be a consultant by 2029. The modelling also accounts for changes over time in the average number of FTE worked per individual (changes in FTE). Additionally, each cohort exits the model at the assumed latest age of retirement for each key cancer profession, which is 69 years.

The stock of each specific age (e.g. 25-year olds) is modelled forward each year by aging the stock by one year (e.g. 25-year olds in 2019 become 26-year olds in 2020) and adding the annual net flow of the new age group (e.g. the net flow of 26-year olds). The projected stock of a given age in time $t$ is given by:

$$X_t = X_{t-1} + Net\ Flow$$

where $Net\ Flow_t = Inflow_t + Outflow_t + Change\ in\ FTE_t$
Building on these principles we developed a separate stock-flow economic model for each of the seven key professions in the cancer workforce with the baseline (i.e. ‘status quo’) stock of each profession in 2029 ($X_{29}$ in Figure 2) compared to three different scenarios, each resulting in a net increase of 45% in each profession by 2029. This enabled us to model how many key cancer professionals will need to join the workforce through training, international recruitment, returning to the practice and intra-NHS flows between professions to meet each scenario. In consultation with others, the modelling we carried out focussed on increasing inflows through training and other routes, rather than reducing outflows, as HEE has more influence over, and cost associated with, increasing inflows. The other way to increase staff number is to reduce the number of leavers, but the NHS programme to improve retention has been led by NHS Improvement and Trusts, not HEE.

The three scenarios modelled are as follows:

1) All the necessary additional workforce growth (to achieve 45% growth by 2029) is achieved through newly qualified staff (i.e. specialist training).

2) The necessary additional workforce growth is achieved through increasing training and international recruitment only (as this is where HEE have most scope), in the same proportions that were observed over the past three years.
   - For example, if 75% of the training and international recruitment inflow over the

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**Figure 2: Demographic stock-flow economic model**

<table>
<thead>
<tr>
<th>AGE</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>...</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
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<tr>
<td>21</td>
<td></td>
<td></td>
<td>$X_{2019}$</td>
<td></td>
<td>$X_{2020}$</td>
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<td>$X_{2021}$</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td>$X_{2020}$</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$X_{2021}$</td>
<td></td>
<td></td>
</tr>
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<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$X_{2027}$</td>
<td></td>
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<tr>
<td>29</td>
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<td></td>
<td></td>
<td></td>
<td>$X_{2028}$</td>
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<td></td>
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<tr>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$X_{2029}$</td>
</tr>
</tbody>
</table>

**Source:** RAND Europe
past three years came from training, then 75% of the necessary additional workforce growth would come through training and the other 25% through international recruitment.

3) The necessary additional workforce growth is achieved through the same proportion of inflows that were observed over the past three years.
   - For example, if 75% of inflows over the past three years came through training, then 75% of the necessary additional workforce growth would come through training.

After modelling how many FTE of each key cancer profession a net increase of 45% by 2029 would represent, and the means through which they inflow into the workforce, we combined this information with the available data on the cost to HEE of recruiting each of the seven cancer professionals.

**Assumptions and proxies**

This section sets out in detail the assumptions and proxies applied to the ESR data in carrying out economic modelling to project the estimated number of FTE NHS staff working in each of the seven cancer professions in 2029, as well as the scenarios to achieve 45% growth. In this section we cover:

- The assumptions made about each profession’s status quo growth
- The assumptions and proxies used for the inflows and outflows of NHS staff for each of the seven priority professions (covering medically qualified and non-medically qualified workforces separately);
- The overarching assumptions in modelling the growth of the workforces to 2029;
- Assumptions specific to particular workforces; and
- The assumptions applied in the scenario development.

**Status quo rates of increase**

Our modelling looks at how HEE can increase the number of staff in seven cancer-related professions by 45% by 2029. However, our modelling does not assume that the number of FTE staff would remain constant from the baseline year to 2029 without additional investment, as we know that the number of staff has been steadily rising in recent years. Instead, we have assumed that the ‘status quo’ is a continuation each year of the average annual inflows and outflows (expressed as numbers, not percentages) observed over the most recent three years in each profession i.e. extrapolating the previous trends of growth. We accept that this makes assumptions about the nature and stability of inflow and outflow trends but believe this to be a more realistic estimation as, for example, some trainees will be already part way through their training. We modelled this status quo growth using extrapolation of the growth as a number, rather than percentage, in line with a more prudent approach. To estimate this status quo growth, we assumed a continuation of the average inflow and outflow trends of the past three years as our ‘flow’ and then applied those to the known ‘stock’ of the profession,
including age, so that we could model cohorts retiring etc

**Medically qualified workforces**

HEE provided us with ESR data from 2012 to 2018 on medically qualified workforces, which include clinical and medical oncology (combined), gastroenterology, histopathology and clinical radiology. Data on inflows into the medical workforce and early leaver outflows from the workforce are not disaggregated by age band, so we have applied assumptions about the age distribution of each inflow category and early leaver outflows to enable more realistic economic modelling. We discussed these assumptions with others at our validation meeting, and increased our maximum age for a newly qualified specialist to 45 years based on the views expressed at the validation workshop. These assumed boundaries are shown in the ‘Age distribution assumption’ column of

Table 1. For example, all future inflows from newly qualified specialist training are distributed across individuals up to and including 44 years old in the economic modelling.

Finally, HEE also provided us with ESR data on the ‘FTE change’ of each medical workforce, which captures all inflows and outflows not included in the proxies outlined in

**Table 1.** Specifically, this means that outflows that are not captured as early leaver and retirement, and inflows that are not captured as newly qualified training (NQT), intra-NHS, re-joiner and international recruitment, are captured in the ESR data as ‘Change in FTE’. Therefore, ‘Change in FTE’ captures changes in individuals contracted number of FTEs, as well as any other flows that are not explicitly captured in the outflows outlined in

**Table 1.**

**Table 1: ESR inflows and outflows for the medically qualified workforce**

<table>
<thead>
<tr>
<th>Data description in ESR</th>
<th>Category of staff</th>
<th>Age distribution assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outflows</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left specially to NHS</td>
<td>EARLY LEAVER</td>
<td>&lt;55 years</td>
</tr>
<tr>
<td>Left to training or to take NHS role that is neither consultant nor training¹</td>
<td>EARLY LEAVER</td>
<td>&lt;55 years</td>
</tr>
<tr>
<td>Left ESR &lt;55 years</td>
<td>EARLY LEAVER</td>
<td>&lt;55 years</td>
</tr>
<tr>
<td>Left ESR 55+ years</td>
<td>RETIREMENT</td>
<td>55+ years</td>
</tr>
<tr>
<td><strong>Inflows</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joined from training</td>
<td>NEWLY QUALIFIED (NQT)</td>
<td>&lt;45 years</td>
</tr>
<tr>
<td>Joined speciality from NHS</td>
<td>INTRA-NHS</td>
<td>21+ years</td>
</tr>
<tr>
<td>Joined ESR from outside NHS</td>
<td>RE-JOINER</td>
<td>INTERNATIONAL RECRUITMENT</td>
</tr>
</tbody>
</table>
Note 1: There are NHS roles where an individual that is neither a consultant nor in training. A trained individual may, for example, choose to take a non-consultant role if there are no vacancies for a consultant in the area to which they would like to move.

Non-medical workforce

HEE provided us with non-medical workforce ESR data from 2012 to 2019 on non-medically qualified workforces, which includes diagnostic radiographers, therapeutic radiographers and adult nurses. It is not possible to know why an individual entering or leaving the workforce has done so using the non-medical ESR workforce data provided to us. However, we used individual level characteristics as proxies for the different types of inflows and outflows to the workforce.

Figure 3 demonstrates the proxies we have applied for those leaving the workforce:

- Early leavers: those under 55 years leaving the workforce or leaving the workforce to another NHS position.
- Retirement: those 55 years and over leaving the workforce and the NHS.

Figure 4 demonstrates the proxies we have applied for inflows to the workforce:

- Newly qualified training: those under 30 years entering the workforce from outside the NHS.
- Intra-NHS: those entering the workforce from within the NHS regardless of age, capturing individuals entering the workforce through continued professional development routes.
- International recruitment: non-UK nationals over 30 years entering the workforce from outside the NHS (although a reasonable proxy, some non-UK nationals may have lived in the UK for many years before joining and so are not recruited internationally).
- Re-joiners: UK nationals over 30 years entering the workforce from outside the NHS.

Figure 3: ESR data proxies for outflows from the non-medical workforce

Source: HEE & RAND Europe analysis.
HEE also provided us with ESR data on the ‘FTE change’ of each non-medical workforce, which captures all inflows and outflows not included in the proxies outlined in Figure 3 and Figure 4. Specifically, this means that outflows that are not captured as early leaver and retirement, and inflows that are not captured as NQT, intra-NHS, re-joiner and international recruitment, are captured in the ESR data as ‘Change in FTE’. Therefore, ‘Change in FTE’ captures changes in individuals contracted number of FTEs, as well as all other flows that are not explicitly captured in the outflows outlined in Figure 3 or the inflows outlined in Figure 4.

Overarching modelling assumptions

- In the model the age of each workforce is restricted to be from 21 to 69 years of age. This implies that all individuals aged 70 years and over are assumed automatically to retire from the workforce.

- The stock of each workforce is projected forward to 2029 using the latest available three-year arithmetic mean FTE inflows and outflows for each workforce. We used three years rather than five years as it corresponds more closely to the Cancer Workforce Plan20 (although we checked there were no very significant differences between the two trends).

- The inflows and outflows of each workforce are disaggregated by specific age (e.g. 55-year olds) using the age distribution across the relevant age band (e.g. 55-69 years for retirement) from the latest available stock data (e.g. 2019 for diagnostic radiographers).
  - For example, the total FTE of outflows due to retirement are provided for the whole 55-69 year age band. The retirement FTE outflow by specific age (e.g. 55-year olds) was estimated using the age distribution across the 55-69 year age
band. If, for example, 55-year olds accounted for 10% of the individuals in the 55-69 year age band, 10% of the total FTE outflows due to retirement were assigned specifically to 55-year olds.

- The costing only presents costs of specialist training, not core and foundation training.

**Workforce-specific modelling assumptions**

**Clinical radiology**

- ‘FTE change’ was used from the clinical radiology 2018 UK workforce census rather than the ESR data. This was deemed by the validation workshop participants to provide more realistic projections.

**Specialist cancer nurses**

- The Macmillan 2017 Cancer Workforce in England census is used as an estimate for the stock of the specialist cancer nurse (adult) workforce, as ESR data are not available for specialist cancer nurses specifically. This provided information on the Agenda for Change (AfC) band of specialist cancer nurses.
- The stock of specialist cancer nurses is disaggregated from age bands provided in the Macmillan 2017 Cancer Workforce in England census into specific ages (e.g. 25-year olds) using the age distribution across the relevant age band (e.g. 30-39 years) in the ESR data for all adult nurses, broken down by AfC band.
  - For example, 27% of specialist cancer nurses are AfC band 6, therefore the age distribution across the AfC band 6 adult nurses in the ESR data is used to estimate the stock of specific ages (e.g. 25-year olds) for 27% of the specialist cancer nurse workforce.
- The inflows and outflow rates of all adult nurses in the ESR data, broken down by AfC band, were used as a proxy to estimate the inflows of specialist cancer nurses.
  - For example, 61% of specialist cancer nurses are AfC band 7, therefore the three-year geometric mean of the rate of FTE inflows and outflows of all adult nurses at AfC band 7 were used to model forward 61% of the specialist cancer nurse workforce stock.

**Scenario development assumptions**

- Additional individuals entering the workforce to achieve the growth target of 45% are assumed not to leave the workforce before 2029.
- Additional inflows entering the workforce to achieve the growth target of 45% are disaggregated by specific age (e.g. 25-year olds) using the age distribution across the relevant age band (e.g. 21-44 years for newly qualified medical staff) from the latest available stock data (e.g. 2018 for medical workforces).
**Costing estimations**

As outlined in the results section of the main report, we were only able to identify sufficient HEE budgeting and spending data to cost the additional training inflows, using information on training tariffs published by the DHSC each year for specialist training. Tariff payments are paid by HEE to providers, as reimbursement for the training placements that they deliver. The payments are expected to cover all direct costs incurred by providers as a result of delivering education and training.

Tariffs have a fixed component, but they vary depending on the duration of the training and the salaries paid to medical postgraduate trainees. The research team identified the standard number of years required to specialise in each profession using the NHS’s Health Careers resources. For non-medical professions, the data indicate that it takes three to four years to specialise, although it is possible to complete the training in two. Specialising in a medical profession requires at least five years of training, often more. The cost scenarios in our analysis therefore assume a duration of three and five years for non-medical and medical professions respectively.

The tariff guidance document indicates that salary contributions from HEE to providers for postgraduate medical placements vary with training grade and location. For example, a trainee in London would receive a higher salary than someone outside of London. Since the study concerns England as a whole, national average values were used. The Health Careers resource indicates that the entry requirement for histopathology and clinical radiology is specialty training level ST1, while gastroenterology and clinical and medical oncology require ST3. These data allow the calculation of the total salary contribution for an individual, from the beginning to the end of their training. On average, the salary contribution is £108,265 for someone completing ST1 to ST5 levels, and £120,631 for someone completing ST3 to ST7. Non-medical trainees are not eligible for salary contributions.

The Market Forces Factor (MFF) is an estimate of unavoidable cost differences between health care providers, based on their geographical location. For modelling the cost of training, the MFF should remain constant. The lowest cost part of the country has its MFF set at 1. The average scaled MFF across the country as a whole is 1.078240, based on Annex A of the 2019/20 National Tariff Payment System. This average scaled MFF was applied to the tariff payment for placement activity costs. The tariff guidance states that salary contributions are not multiplied by the MFF. Additionally, there is an annual study leave budget of £734 per student.

Estimating the number of new FTE trainees requires us to make adjustments for two other factors. Because some individuals work part-time, the average FTE worked per person in the seven cancer professions is less than one FTE. For example, one gastroenterologist works on average 0.95 FTE. In order to estimate how many additional trainees would be required, in terms of headcount, the number of required additional FTE is divided by the average FTE of one individual. In addition, as with any profession, there is a drop-out rate of people who start (or even complete) their training but then do not go on to take up that post. In our model, we...
estimate a 10% drop out rate during training, which means that for every 10 people who start training there will only be nine new staff by the end of the training.

The data above is used to calculate the total cost of training a certain number of people using the following formula:

\[ N \times Y \times ((T \times MFF) + SL) = £X \]

Where \( N \) is the number of required new trainees, \( Y \) is the number of years it takes to complete the training, \( T \) is the annual tariff, \( MFF \) is the average national MFF, \( SL \) is the annual study leave budget per trainee and \( £X \) is the total cost of the additional trainees.

This calculation allows us to estimate how much HEE would have to spend on specialist training places to increase the stock of each cancer workforce in the three different scenarios by 45% by 2029. The main model cost outputs are expressed in 2019/20 prices.

With any projection exercise it is important to test the effect of the inevitable uncertainty surrounding the inputs to the model. We therefore used deterministic sensitivity analysis, where the value of a single (univariate) parameter or multiple (multivariate) parameters is varied simultaneously to determine how such changes impact the predicted supply of each key cancer profession. We have presented this analysis in Section 4: Sensitivity analysis.

Our model for workforce growth was developed in Microsoft Excel, allowing for a high degree of transparency as all formulae are clearly displayed in any given output cell. The use of Excel ensures that the analysis is comparatively easy for others to understand, is replicable and amenable to regular updating.

**Validation workshop**

Once we had prepared draft economic models for the seven professions, we convened a half-day workshop facilitated by the RAND Europe and University of Cambridge team, which was held in RAND Europe’s Cambridge office. The purpose of the workshop was to validate the preliminary outputs from the stock-flow economic model and finalise it with Cancer Research UK, HEE and other key stakeholders. Thirteen participants (nine excluding the RAND Europe and University of Cambridge research team) from the following organisations attended:

- Department of Health and Social Care
- NHS England and NHS Improvement
- Cancer Research UK
- Macmillan Cancer Support
- Society of Clinical Radiographers
- Royal College of Radiologists
- RAND Europe
- University of Cambridge.

Some invited stakeholders, including from HEE and the British Society of Gastroenterology, could not take part due to work pressures. However, individuals from both of those
organisations engaged with the pre-read information and the notes from the workshop discussion and fed back their thoughts and comments in writing following the workshop.

A week in advance of the meeting we sent out a detailed pre-read document setting out the methods undertaken, data sources used and preliminary results, setting some questions for participants to discuss during the workshop.

The workshop covered the following:

- The research team gave an overview of the project and outlined the methodological approach taken;
- Discussion of the data we had identified and input into the economic model, including comparisons between data sources where they were available;
- Testing the assumptions made in projecting the workforce stock of each key cancer profession, and adjusting the assumptions where appropriate as a result of the discussions; and
- Exploring the preliminary outputs of each of the seven stock-flow economic models and discussing the most appropriate growth scenarios to model.

The validation workshop enabled very productive challenge and discussion between participants in a way that moved the discussion forward, building cohesion and agreement on the final stock-flow economic model to be used in the analysis.

**Project oversight**

In addition to the work already described, we created a small stakeholder group comprising Cancer Research UK, Macmillan Cancer Support, HEE, the Department of Health and Social Care and NHS England and NHS Improvement. This group provided oversight of the project, as well as a readily accessible point of contact for the research team to discuss queries as they arose to reach appropriate solutions. We consulted this group at an inception meeting, at the validation workshop and to provide comments on the factual accuracy of an early draft of this report.
Section 2: Workforce data collection and validation

Workforce data

Data collection resulted in the identification of numerous workforce data sources, with data identified for each of the seven professions. Firstly, HEE provided aggregated data from the NHS Electronic Staff Record (ESR). Secondly, through desk research and expert consultation, we identified further workforce data. To promote consistency across the economic modelling of the seven professions we have used ESR data where possible, which we have validated as much as possible using the additionally identified data. Both types of data are discussed in more detail below.

Using Electronic Staff Record data

ESR data capture individual level information on NHS staff working in all organisations that directly employ NHS staff in the Hospital and Community Health Services (HCHS) sector in England, except for two trusts which account for approximately 1% of directly employed HCHS staff. The ESR contains information on profession, organisation, contracted FTEs and some demographic information, such as age, gender and nationality.

It is important to note that the ESR is used as a payroll tool for NHS staff and therefore individuals employed in the private health care sector are out of scope. ESR also excludes agency staff as, although they provide services in the NHS, they are employed by private organisations. Staff who solely work ‘bank’ shifts are employed by the NHS but they are assigned an FTE value of zero in the ESR, meaning that in practical terms they are also excluded from the ESR data provided to us by HEE.

We investigated whether the approach of using the ESR and therefore omitting private sector and agency staff would materially misrepresent the seven workforces that we modelled. Overall, the consolidated provider accounts for 2018-19 indicate that non-permanent staff costs comprise 8.7% of staff costs in total. Agency costs were 4.4% of overall employee costs, although the use of bank staff increased. Some of these bank shifts are already captured through the ESR data. NHS Digital does not collect data on permanently employed staff working additional shifts as bank staff, unless they are paid separately for doing so. Several participants at the validation workshop confirmed that their data indicated that the use of bank and agency staff was sufficiently low that excluding these data would be unlikely to affect the accuracy of the economic modelling significantly.

As private sector providers will be commissioned to carry out some of the NHS workload for cancer patients, and their staff are often trained in the NHS, we also investigated whether we might include data available on the number of staff working in the private sector. However, we
found that there were insufficient data available. Experimental data collated by NHS Digital showed that as at September 2018 there were about 42,000 FTE staff employed by independent healthcare providers in England. However, these data do not include every independent health provider, nor are they broken down by specialism in a way that would allow us to use the data for our seven priority cancer professions. We therefore excluded the private sector workforce from the modelling.

Despite the ESR’s limitations, there is no other single data source that provides as much coverage of the NHS workforce. As the ESR is fundamentally a payroll tool, designed to ensure that NHS staff are paid appropriately for their work, there is a high level of data completeness and therefore confidence in its workforce stock, inflow and outflow data.

ESR data are analysed by HEE to estimate the FTE stock of a profession at the end of a financial year (i.e. on 31 March), as well as the FTE inflows and outflows from one year to the next. HEE takes cuts from the end of each financial year dating back to 2012, extracting the data at least three months after the end of the financial year to allow the data to ‘settle’, thereby ensuring that all joiners and leavers are accounted for as accurately as possible.

HEE provided us with two sets of data: one covering clinical radiologists, gastroenterologists, histopathologists and clinical and medical oncologists, i.e. the medical professions; and another covering diagnostic radiographers, therapeutic radiographers and adult nurses, i.e. the non-medical professions. Data on the non-medical professions was extracted from the HEE ESR Flow Tool (HEFT) model. For the medical professions, HEE provided us with data from the HEE Employment, Registration and Medical Education Supply tool (HERMES) that covered the years 2012 to 2018. In this tool, data on inflows into the different workforces from the ESR are supplemented with two additional sources of information, which helps in identifying the inflows of newly qualified individuals:

- General Medical Council (GMC) annual National Trainee Survey census; and
- Registration data from the GMC List of Registered Medical Practitioners.

It is important to note that ESR data are not available for specialist cancer nurses specifically because this profession is not coded separately on the database. Instead, HEE provided us with data on adult (i.e. non-paediatric) nurses in Agenda for Change Band 6, Band 7 and Band 8a, from which inflow and outflow rates were used as a proxy for inflows and outflows to and from specialist cancer nurses. (This is discussed in more detail in the Key Assumptions section). Because ESR data are not available for specialist cancer nurses, the Macmillan 2017 Cancer Workforce in England census was used as an estimate for the stock of the workforce.

**Additional limitations in the medically qualified workforce data**

It is important to note that the medical workforce ESR data used in the economic modelling only considers consultants and does not include Specialty and Associate Specialist (SAS) or Specialist Trainee (ST) staff, largely because it is not possible to isolate non-consultant grades using ESR data alone. SAS staff comprise a small part of the medical workforce; an average of
5% across the five professions included in NHS Digital’s workforce data, so their omission will not greatly alter the results of our modelling.[38]

ST staff, sometimes called specialist registrars, comprise on average 30% of the medical workforce, so are more significant in number than SAS staff. However, the ST grades require supervision from a senior doctor and are not therefore able to contribute to managing workload independently to the same extent as a consultant.[39] We heard from the validation workshop participants that the extent of independent working in such roles is likely to vary significantly from one profession to the next. For example, in one profession a ST may require considerable oversight from a consultant whereas in another the oversight may be less.[40]

Overall, therefore we have considered consultants only as this approach allows for a consistent comparison across professions, although of course ST grades of doctor do also make contributions to managing the workload of cancer cases.

There are also issues with unseen contribution in the medical workforce ESR data. The measure of workforce supply in the ESR is FTE, with one FTE being the equivalent of ten Programmed Activities (PAs). In practice some consultants work more than ten PAs per week. However, PAs are not consistently recorded across the ESR, meaning that PAs worked beyond the standard ten are not captured in the data. If the number of additional PAs worked above ten remains constant over time this becomes less of an issue, as the relative scale of the workforce remains the same. However, if the number of additional PAs worked above ten changes over time, then projected future supply may under- or over-estimate true supply. The ongoing pension dispute in the NHS suggests consultants are reducing the number of additional PAs they are working.[41]

Again, despite the ESR’s limitations, there is no other data source that provides as much coverage of the medically qualified NHS workforce.

**Validation of Electronic Staff Record data**

As outlined above, additional workforce data were identified through desk research and expert consultation. The following section compares ESR data with any directly comparable additionally identified workforce data, going through each workforce in turn, in order to validate the ESR data by comparison with other, external sources.

This validation exercise has been undertaken using the most recent directly comparable external data available for the same time period. If external data were only available for the UK, and England level data could not be estimated from it, then it was not included in the validation exercise as the geographical focus of this study is England. In some instances, comparable external data are several years old, but still provide insights into the similarities and differences between ESR and other workforce data figures.

Overall, we found that the validation for each profession (details below) supported the data we have used in our modelling which gives a high degree of confidence in the data used for the modelling. The data from different sources do not match completely, but explanations for minor differences between the sources are:
• The ESR data only includes staff employed and paid through the NHS, whereas other workforce censuses may include all qualified staff;
• The ESR data do not include two NHS Trusts, which comprise 1% of the NHS workforce;
• In the stock comparisons, we compared data for the same time period. The ESR and NHS Digital workforce statistics are snapshots of the data as at 31 March of the year given, but data from censuses may have been collected at a different time of the year. For example, the Royal College of Radiology census is carried out in September;
• There may be differences between stock figures due to how individuals are coded between specialisms and how locums and agency staff are accounted for; and
• There may also be differences in the data on inflows and outflows; for example, some staff retire but then come back as agency staff. This scenario may be shown differently on ESR for payroll information than on a workforce census.

Clinical and medical oncology
We discussed at the validation meeting that there are some coding difficulties between clinical and medical oncologists, which is why it does not make sense to disaggregate the two professions for the purposes of this study. We compared the data obtained from the ESR to the two other available sources of information: workforce statistics published by NHS Digital and to the census information collected by the Royal College of Physicians and of Radiologists (Figure 5). We found only a 2% maximum difference between these three data sources, which gives us a high degree of assurance that the data used to inform the model are reasonable. We did not have comparative data on the inflows and outflows to the workforce.

*Figure 5: Clinical and medical oncology workforce stock validation*
Source: ESR data; NHS Digital NHS Workforce Statistics 2018; Royal College of Radiologists (RCR) 2018 workforce census & Royal College of Physicians (RCP) 2018-19 consultant census.
**Gastroenterology**

We compared the data on gastroenterology obtained from the ESR for 2018 to two other available sources of information: workforce statistics published by NHS Digital and to the census information collected by the Royal College of Physicians (Figure 6). We found a maximum 6% difference between the three data sources, which gives us a reasonable degree of assurance that the data used to inform the model are reasonable. We did not have comparative data on the inflows and outflows to the workforce.

*Figure 6: Gastroenterology workforce stock validation*

Source: ESR data; NHS Digital NHS Workforce Statistics 2018; Royal College of Physicians 2018-19 consultant census.
Histopathology

We compared the data obtained from the ESR to the workforce statistics published by NHS Digital for the same year (Figure 7). We found a 4% difference between the two data sources, which gives us a good degree of assurance that the data used to build the model are reasonable. We did not have comparative data on the inflows and outflows to the workforce.

Figure 7: Histopathology workforce stock validation

Sources: ESR data; NHS Digital NHS Workforce Statistics 2018.
Clinical radiology

We compared the data obtained for clinical radiology from the ESR for 2018 to two other available sources of information: NHS workforce statistics published by NHS Digital and to the census information collected by the Royal College of Radiologists (Figure 8). We found a maximum 2% difference between the three data sources, which gives us a high degree of assurance that the stock data used to inform the model are reasonable. In addition, our expert interviews explained that locums may not be included within ESR data but they are included within the Royal College of Radiologists workforce census.

Figure 8: Clinical radiology workforce stock validation

We also compared available data on the inflows and outflows to the workforce between the ESR and 2018 census data from the Royal College of Radiologists and found some variation between the two sources (Figure 9). For inflows and outflows we would expect to see more variation between the ESR and other data sources than for stock. This is because ESR does not record reasons for entry or exit to the profession, so as stated above we have made some assumptions based on demographic characteristics (such as age) about the different inflow and outflow streams. For example, our assumption is that a person joining clinical radiology in the...
ESR who is under the age of 30 is a newly qualified trainee, whereas in reality, in addition, some may be over the age of 30 when they first qualify. However, we used the ESR data even with the assumptions as comparative data on inflows and outflows was not available for most other professions.

Taken overall, the differences in inflow and in outflow are not as concerning as the individual bars may seem to imply. Taken together, the two inflow streams in ESR compared with the two inflow streams in the census by the Royal College of Radiologists are less than one percent different in total. There appears to be slightly more difference in the outflow numbers; possible reasons for this may include the self-reported nature of retirement in the census or the exact timing of the data collections.

*Figure 9: Clinical radiology workforce flow validation*

Source: ESR data; Royal College of Radiologists 2018 workforce census & additional data provided by the Royal College of Radiologists.

NQ training = Newly Qualified Training

Rejoin & Int Rec = Re-joiners and International Recruitment
Diagnostic radiography

We compared the data on diagnostic radiography obtained from the ESR for 2019 to the data published by NHS Digital in its NHS Workforce statistics for the same period (Figure 10). We found only a 2% difference between these two data sources, which gives us a high degree of assurance that the data used to inform the model are reasonable.

**Figure 10: Diagnostic radiography workforce stock validation**

We also compared available data on the outflows from the workforce via retirement between the ESR and 2018 census data from the Society and College of Radiographers (Figure 11). We found only a 1% difference between the two sources which gives a high degree of assurance that that our data used for the model are reasonable.

Figure 11: Diagnostic radiography workforce flow validation

Source: ESR data; Society and College of Radiographers (SCoR) 2018 census.

Therapeutic radiography

We compared the data on therapeutic radiography obtained from the ESR for 2015 to the data published by Cancer Research UK in its 2017 publication Full Team Ahead\textsuperscript{43} (Figure 12). We found a 3% difference between these two data sources, which gives us a high degree of assurance that the data used to inform the model are reasonable. Similarly, we also compared the data on therapeutic radiography obtained from the ESR for 2019 to the data published by NHS Digital in its NHS Workforce statistics for the same period and found a 3.5% difference between the two data sources. These sources give us a good level of assurance that the data used for our modelling is reasonable. We did not have recent comparative data on the inflows and outflows from the profession.
Figure 12: Therapeutic radiography workforce stock validation


Note: CRUK Full Team Ahead 2017 provides England stock in headcount; the FTE stock was calculated using the headcount to FTE ratio for UK stock, which were provided in the report.
Section 3: Study Strengths and Limitations

Strengths of the study

This study aimed to understand the increase in HEE’s future budget, beyond existing trends based on current levels of investment, required to recruit and train more staff to increase the NHS cancer workforce by 45 per cent by 2029 in England. Various research outputs have looked at different aspects of the estimated required growth in the cancer workforce but we have not seen other attempts to estimate the associated training cost to HEE of increases to those seven cancer professions which were identified in the 2017 Cancer Workforce Plan as being priorities for growth.

The economic modelling carried out in this research is built on the most complete set of NHS data: the Electronic Staff Record (ESR), which is used to pay its staff. It also builds forward from the historic growth trend of each workforce, rather than modelling scenario increases from a static baseline number. Although there are limitations in any analysis, this distinction is important in estimating the step change in funding required for training by HEE if the number of staff in each cancer professions is to increase by 45%.

We have taken a collaborative approach to conducting this research, including deciding on the assumptions used. We have sought a range of data sources and validated the data wherever possible to give us confidence that the data allow us to make a reasonable estimate, using both external discussion of data sources and consultation with expert stakeholders. The validation workshop exposed a great deal of agreement over the trends and findings in our analysis, with no fundamental points of difference raised. There was a good deal of consensus around the approximate numbers from other sources too, including from NHS Digital and from census information collected by bodies representing the different professions such as Macmillan Cancer Support, the Royal College of Radiologists and the Royal College of Physicians.

Limitations and caveats of the analysis

Despite its strengths, there are several limitations and caveats of the economic modelling contained in this study.

There are some caveats in the workforce data we used as the basis of our model:

With any economic modelling exercise, the validity of the results depends on the accuracy of the data and assumptions used to build the model. We have used ESR data that are largely complete and are comparable between professions, and we have sought to validate and check our key assumptions through consultation, comparison and sensitivity analysis. However, we
know that the data we have used to build our model are not perfect. Key caveats are:

- The ESR data do not include two NHS Trusts (out of a total of 223 Trusts).
- For some professions the coding of staff to that profession is not 100% accurate.
- The ESR does not include some agency and temporary staff employed to support activity in the key professions.
- ESR does not provide data on the number of specialist cancer nurses. We have used the information from the 2017 Macmillan census of specialist cancer nurses as our baseline, and then used inflow and outflow trends for all adult nurses at grades 6 to 8a as a proxy for specialist cancer nurses to build our model for this workforce.47
- As explained in our method and assumptions, we do not have full information about the source of inflows to or outflows from the ESR so we have made certain assumptions. For example, we have assumed in the model that all people over the age of 55 who leave ESR are retiring. This caveat particularly affects the inflow and outflow information but has less effect on the overall stock of the workforce.

The model assumes that previous rates of change in workforce would continue

We modelled the additional staff required over and above a status quo increase in staffing in line with recent rate, i.e. assuming that inflows and outflows from the workforce would continue the rate experienced in the last three years. We took this approach because it is a reasonable baseline assumption as many people will now started training contracts etc. However, it relies on the NHS to achieve the same level of results year on year from a similar level of investment in the workforce. We explored this in our validation meeting, in case there were any major one-off initiatives that may have dramatically skewed this projection, but none were flagged as possible to incorporate into the model. We also collected data going back five years, so that we could check whether the trend had changed significantly over the longer time period, although we used the three-year time period in the modelling as this timing was more consistent with the 2017 Cancer Workforce Plan. However, it is not necessarily the case that each profession could continue a constant rate of growth. There may be some easy initial wins, for example in international recruitment, but there is no guarantee that the same activity will result in the same outcomes in terms of inflows and outflow. There may also be wider costs associated with infrastructure and teaching staff, for example, once a certain threshold of training places is reached. The environment for re-joiners and international recruitment can also change with political and economic factors, such as the impact of COVID-19 and the UK’s exit from the European Union.
In modelling different cost scenarios for achieving the 45% growth ambition we do not consider the contribution or costs of other parts of the NHS

This analysis seeks to model the cost to HEE of increasing the workforce, but some significant costs of growing the workforce accrue to other parts of the NHS. For example, in training a radiologist, the cost of the specialty training is normally split between HEE and individual NHS Trusts. It is NHS Trusts who organise and fund international recruitment campaigns. Other factors such as delaying retirement or increasing retention may be important ways to increase the workforce, and NHS Improvement has led the recent initiative on improving retention. One of the biggest factors leading to improved retention is reserved time for Continuing Professional Development, for which the costs, including of time away from caring for patients, will fall to the NHS trust as the employer. In our three scenarios, the only element that relates to HEE’s budget is the cost of increasing the number of trainees; not increasing re-joiners or international recruitment which means that this report does not provide a full picture of the costs.

**The model does not include all professions who help people with cancer**

In line with the scope of this study, we have focussed our modelling on seven priority professions as identified by HEE in 2017. However, these professions do not map directly onto the NHS staff working most closely with cancer patients. A proportion of some of these professionals’ time (e.g. gastroenterologists) will be spent with patients with different diseases, not only cancer. Equally there are a significant number of other roles in the NHS who play a vital part in helping to diagnose, treat and support people with cancer. For example, haematology is not one of the listed seven professions. There are also a significant number of consultant healthcare scientists who work in histopathology services.

**The economic model does not consider changing roles of key cancer professions**

The research question was how many staff would be required, and at what cost, to meet an overall increase of 45% in each of seven key cancer professions. However, this project does not model changes in the shape of the workforce by 2029. Other research has indicated, for example, that there might be a need to increase numbers in some professions more than in others. For example, the 2018 Cancer Research UK report *Securing the Cancer Workforce for the Best Outcomes* estimated that it might require an 80% increase in therapeutic radiographers but that oncologists may need to triple in numbers. We do not factor these considerations into our modelling.

**In this research we could not fully consider the feasibility of the modelled scenarios for increasing the workforces**

In this research we describe three potential ways in which the NHS could seek to grow its
workforce by increasing the staff inflows: increasing new trainees, recruiting staff from overseas or re-training existing staff. We modelled three different scenarios for how the growth might be achieved through different combinations of increasing those three inflows. However, in practice there may be limitations on the feasibility of those modelled increases. For example, there will be a limit to the number of additional training places that may be made available for a similar cost per person. Above a certain level, the training organisations may require more significant investment, for example, in infrastructure, or there may be other limiting factors such as the availability of required clinical training placements. If historically there has not always been sufficient demand to fill available training places, then it may not be realistic to predicate future workforce growth on increasing the number of trainees. There is also likely to be a limit to the number of suitable medical staff who can be recruited from other countries, particularly given the ethical considerations as set out by the World Health Organisation (WHO). For the purpose of this research we have estimated the cost to HEE of increasing the number of specialist doctors. However, we have only included the costs of the specialist training, which means that all modelled increases require a sufficiently large pool of doctors to complete their core training.
Section 4: Sensitivity analysis

Purpose and approach
It is important to test the possible effects of the inevitable uncertainty surrounding the inputs into the model. We therefore undertook deterministic sensitivity analysis, varying a single (univariate) parameter to explore how such changes impact the predicted supply of each key cancer profession.51

Specifically, we examined how sensitive the output of the 45% growth Scenario 1 is to changes in the inflows and outflows to each of the cancer professions, except for gastroenterologists where status quo growth is 48% from 2019 to 2029 meaning that growth scenarios were not undertaken for this workforce. In Scenario 1 the necessary additional workforce growth to achieve 45% growth, above and beyond status quo growth, is achieved entirely through newly qualified training (or continued professional development in the case of specialist cancer nurses).

The deterministic sensitivity analysis varies each of the inflows and outflows to the workforce in turn, firstly increasing the flow by 10% and then decreasing the flow by 10%, as is presented in the results section below. For example, in the ‘+10% early leavers’ sensitivity analysis case, the outflow of early leavers was increased by 10% while all other inflows and outflows remained constant. We chose 10% because these cost models already contain a large number of assumptions, so it is appropriate to use a relatively large margin for our sensitivity analysis. In this model, we sought to determine how many NQT FTEs we would need to train and therefore the cost to HEE to compensate for 10% changes in the other assumptions e.g. other inflows or outflows. We did not test the sensitivity of newly qualified training (NQT) as we used this to consider the impact of each sensitivity analysis case on the additional FTE, headcount and total cost of the NQT required if we were still to achieve 45% growth in Scenario 1.

As with the caveats elsewhere in this study, all costs in this section are expressed in 2019/20 prices and assume that the real cost of training per trainee does not change over time.
Results

Clinical and medical oncology

*Table 2: Clinical and medical oncology sensitivity analysis*

<table>
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<th>Sensitivity analysis case</th>
<th>2029</th>
<th>Newly Qualified Training</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>FTE</td>
<td>%</td>
</tr>
<tr>
<td>Estimated baseline at 2019</td>
<td>1185</td>
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<tr>
<td>Estimated FTE achieved through status quo increases to 2029</td>
<td>1662</td>
<td>40%</td>
</tr>
</tbody>
</table>

**Outflows**

| | | | | |
| +10% Early leaver | 1616 | 37% | 97 | 105 | £21,559,496 |
| -10% Early leaver | 1708 | 44% | 17 | 19 | £3,903,012 |
| +10% Retirement | 1645 | 39% | 71 | 77 | £15,797,906 |
| -10% Retirement | 1678 | 41% | 43 | 47 | £9,478,744 |

**Inflows**

| | | | | |
| +10% Intra-NHS | 1682 | 42% | 39 | 43 | £8,735,313 |
| -10% Intra-NHS | 1641 | 39% | 74 | 81 | £16,727,195 |
| +10% Re-joiner & Int. recruit. | 1701 | 43% | 23 | 25 | £5,204,016 |
| -10% Re-joiner & Int. recruit. | 1623 | 37% | 90 | 99 | £20,258,492 |

*Source: RAND Europe*

*Note (1) Int. recruit. = International recruitment*
(2) Sums may not add up precisely due to rounding

The Scenario 1 output for the clinical and medical oncology workforce appears to be considerably sensitive to changes in each of the inflows and outflows, as shown in Table 2. The smallest variation in the NQT outputs comes from changes in retirement outflows, whereas the greatest variation comes from changes in early leaver outflows.
Histopathology

Table 3: Histopathology sensitivity analysis

<table>
<thead>
<tr>
<th>Sensitivity analysis case</th>
<th>2029</th>
<th>Newly Qualified Training</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2029</td>
<td>FTE</td>
<td>%</td>
<td>Additional FTE</td>
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<td>Estimated baseline at 2019</td>
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<tr>
<td>Estimated FTE achieved through status quo increases to 2029</td>
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<td>-2%</td>
<td>580</td>
<td>616</td>
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<tr>
<td>Outflows</td>
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<tr>
<td>+10% Early leaver</td>
<td>1163</td>
<td>-5%</td>
<td>612</td>
<td>650</td>
</tr>
<tr>
<td>-10% Early leaver</td>
<td>1238</td>
<td>1%</td>
<td>547</td>
<td>581</td>
</tr>
<tr>
<td>+10% Retirement</td>
<td>1167</td>
<td>-5%</td>
<td>608</td>
<td>646</td>
</tr>
<tr>
<td>-10% Retirement</td>
<td>1234</td>
<td>0%</td>
<td>551</td>
<td>585</td>
</tr>
<tr>
<td>Inflows</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+10% Intra-NHS</td>
<td>1211</td>
<td>-1%</td>
<td>571</td>
<td>606</td>
</tr>
<tr>
<td>-10% Intra-NHS</td>
<td>1190</td>
<td>-3%</td>
<td>588</td>
<td>625</td>
</tr>
<tr>
<td>+10% Re-joiner &amp; Int. recruit.</td>
<td>1233</td>
<td>0%</td>
<td>551</td>
<td>585</td>
</tr>
<tr>
<td>-10% Re-joiner &amp; Int. recruit.</td>
<td>1168</td>
<td>-5%</td>
<td>608</td>
<td>646</td>
</tr>
</tbody>
</table>

Source: RAND Europe

Note: Int. recruit. = International recruitment

The Scenario 1 output for the histopathology workforce does not appear to be considerably sensitive to changes in any of the inflows and outflows, as shown in Table 3. The smallest variation in the NQT outputs comes from changes in intra-NHS inflows, whereas the greatest variation comes from changes in early leaver outflows.
Clinical radiology

Table 4: Clinical radiology sensitivity analysis

<table>
<thead>
<tr>
<th>Sensitivity analysis case</th>
<th>2029</th>
<th>Newly Qualified Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTE</td>
<td>%</td>
</tr>
<tr>
<td>Estimated baseline at 2019</td>
<td>3087</td>
<td></td>
</tr>
<tr>
<td>Estimated FTE achieved through status quo increases to 2029</td>
<td>4091</td>
<td>33%</td>
</tr>
</tbody>
</table>

**Outflows**

| +10% Early leaver                                            | 4029 | 31%| 439            | 476                 | £90,909,662          |
| -10% Early leaver                                            | 4154 | 34%| 330            | 359                 | £68,355,738          |
| +10% Retirement                                              | 4042 | 31%| 426            | 463                 | £88,307,286          |
| -10% Retirement                                              | 4140 | 34%| 342            | 372                 | £70,958,114          |

**Inflows**

| +10% Intra-NHS                                               | 4094 | 33%| 382            | 415                 | £79,285,717          |
| -10% Intra-NHS                                               | 4089 | 32%| 386            | 420                 | £80,153,175          |
| +10% Re-joiner & Int. recruit.                              | 4212 | 36%| 279            | 304                 | £57,946,235          |
| -10% Re-joiner & Int. recruit.                              | 3970 | 29%| 489            | 531                 | £101,319,165         |

Source: RAND Europe

Note: Int. recruit. = International recruitment

The Scenario 1 output for the clinical radiology workforce does appear to be considerably sensitive to changes in most of the inflows and outflows, except intra-NHS inflows, as shown in Table 4. The smallest variation in the NQT outputs comes from changes in intra-NHS inflows, whereas the greatest variation comes from changes in re-joiner and international recruitment inflows.
Diagnostic radiography

Table 5: Diagnostic radiography sensitivity analysis

<table>
<thead>
<tr>
<th>Sensitivity analysis case</th>
<th>2029 FTE</th>
<th>%</th>
<th>Additional FTE</th>
<th>Additional headcount</th>
<th>Additional total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline at 2019</td>
<td>14997</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated FTE achieved through status quo increases to 2029</td>
<td>19155</td>
<td>28%</td>
<td>2591</td>
<td>2821</td>
<td>£32,822,089.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outflows</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>+10% Early leaver</td>
<td>18238</td>
<td>22%</td>
<td>3508</td>
<td>3819</td>
<td>£44,436,222.</td>
</tr>
<tr>
<td>-10% Early leaver</td>
<td>20072</td>
<td>34%</td>
<td>1674</td>
<td>1823</td>
<td>£21,207,956.</td>
</tr>
<tr>
<td>+10% Retirement</td>
<td>18965</td>
<td>26%</td>
<td>2781</td>
<td>3027</td>
<td>£35,223,190.</td>
</tr>
<tr>
<td>-10% Retirement</td>
<td>19345</td>
<td>29%</td>
<td>2401</td>
<td>2615</td>
<td>£30,420,989.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inflows</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>+10% Intra-NHS</td>
<td>19469</td>
<td>30%</td>
<td>2277</td>
<td>2479</td>
<td>£28,844,936.</td>
</tr>
<tr>
<td>-10% Intra-NHS</td>
<td>18841</td>
<td>26%</td>
<td>2905</td>
<td>3163</td>
<td>£36,799,242.</td>
</tr>
<tr>
<td>+10% Re-joiner</td>
<td>19524</td>
<td>30%</td>
<td>2222</td>
<td>2419</td>
<td>£28,146,819.</td>
</tr>
<tr>
<td>-10% Re-joiner</td>
<td>18786</td>
<td>25%</td>
<td>2960</td>
<td>3223</td>
<td>£37,497,359.</td>
</tr>
<tr>
<td>+10% Int. recruit.</td>
<td>19333</td>
<td>29%</td>
<td>2413</td>
<td>2627</td>
<td>£30,569,074.</td>
</tr>
<tr>
<td>-10% Int. recruit.</td>
<td>18977</td>
<td>27%</td>
<td>2769</td>
<td>3015</td>
<td>£35,075,104.</td>
</tr>
</tbody>
</table>

Source: RAND Europe

Note: Int. recruit. = International recruitment

The Scenario 1 output for the diagnostic radiography workforce does not appear to be considerably sensitive to changes in most of the inflows and outflows, except early leaver outflows, as shown in Table 5. The smallest variation in the NQT outputs comes from changes in international recruitment inflows, whereas the greatest variation comes from changes in early leaver outflows.
### Table 6: Therapeutic radiography sensitivity analysis

<table>
<thead>
<tr>
<th>Sensitivity analysis case</th>
<th>2029 FTE</th>
<th>%</th>
<th>Additional FTE</th>
<th>Additional headcount</th>
<th>Additional total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline at 2019</td>
<td>2844</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated FTE achieved through status quo increases to 2029</td>
<td>3516</td>
<td>24%</td>
<td>609</td>
<td>663</td>
<td>£7,711,023</td>
</tr>
<tr>
<td><strong>Outflows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+10% Early leaver</td>
<td>3256</td>
<td>14%</td>
<td>868</td>
<td>945</td>
<td>£10,990,058</td>
</tr>
<tr>
<td>-10% Early leaver</td>
<td>3775</td>
<td>33%</td>
<td>349</td>
<td>381</td>
<td>£4,431,987</td>
</tr>
<tr>
<td>+10% Retirement</td>
<td>3487</td>
<td>23%</td>
<td>637</td>
<td>694</td>
<td>£8,070,659</td>
</tr>
<tr>
<td>-10% Retirement</td>
<td>3544</td>
<td>25%</td>
<td>580</td>
<td>632</td>
<td>£7,351,386</td>
</tr>
<tr>
<td><strong>Inflows</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+10% Intra-NHS</td>
<td>3626</td>
<td>27%</td>
<td>498</td>
<td>543</td>
<td>£6,314,788</td>
</tr>
<tr>
<td>-10% Intra-NHS</td>
<td>3405</td>
<td>20%</td>
<td>719</td>
<td>783</td>
<td>£9,107,257</td>
</tr>
<tr>
<td>+10% Re-joiner</td>
<td>3565</td>
<td>25%</td>
<td>559</td>
<td>610</td>
<td>£7,086,948</td>
</tr>
<tr>
<td>-10% Re-joiner</td>
<td>3466</td>
<td>22%</td>
<td>658</td>
<td>716</td>
<td>£8,335,097</td>
</tr>
<tr>
<td>+10% Int. recruit.</td>
<td>3527</td>
<td>24%</td>
<td>597</td>
<td>651</td>
<td>£7,573,515</td>
</tr>
<tr>
<td>-10% Int. recruit.</td>
<td>3504</td>
<td>23%</td>
<td>620</td>
<td>675</td>
<td>£7,859,108.</td>
</tr>
</tbody>
</table>

*Source: RAND Europe*

*Note: Int. recruit. = International recruitment*

The Scenario 1 output for the therapeutic radiography workforce does not appear to be considerably sensitive to changes in most of the inflows and outflows, except early leaver outflows and intra-NHS inflows, as shown in Table 6. The smallest variation in the NQT outputs comes from changes in international recruitment inflows, whereas the greatest variation comes from changes in early leaver outflows.
## Specialist cancer nurses

### Table 7: Specialist cancer nurses sensitivity analysis

<table>
<thead>
<tr>
<th>Sensitivity analysis case</th>
<th>2029</th>
<th>Newly Qualified Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FTE</td>
<td>%</td>
</tr>
<tr>
<td>Estimated baseline at 2019</td>
<td>4135</td>
<td></td>
</tr>
<tr>
<td>Estimated FTE achieved through status quo increases to 2029</td>
<td>5284</td>
<td>28%</td>
</tr>
<tr>
<td><strong>Outflows</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+10% Early leaver</td>
<td>4635</td>
<td>15%</td>
</tr>
<tr>
<td>-10% Early leaver</td>
<td>5932</td>
<td>40%</td>
</tr>
<tr>
<td>+10% Retirement</td>
<td>5203</td>
<td>26%</td>
</tr>
<tr>
<td>-10% Retirement</td>
<td>5364</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Inflows</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>+10% Intra-NHS</td>
<td>6128</td>
<td>43%</td>
</tr>
<tr>
<td>-10% Intra-NHS</td>
<td>4439</td>
<td>11%</td>
</tr>
<tr>
<td>+10% Re-joiner</td>
<td>5353</td>
<td>29%</td>
</tr>
<tr>
<td>-10% Re-joiner</td>
<td>5214</td>
<td>26%</td>
</tr>
<tr>
<td>+10% Int. recruit.</td>
<td>5291</td>
<td>28%</td>
</tr>
<tr>
<td>-10% Int. recruit.</td>
<td>5276</td>
<td>28%</td>
</tr>
</tbody>
</table>

**Source:** RAND Europe

**Note:** Int. recruit. = International recruitment

The Scenario 1 output for the specialist cancer nurse workforce does not appear to be considerably sensitive to changes in most of the inflows and outflows, except early leaver outflows and intra-NHS inflows, as shown in Table 7. The smallest variation in the number of new specialist cancer nurses comes from changes in international recruitment inflows, whereas the greatest variation comes from changes in intra-NHS inflows.
References

3 See for example: https://www.cancerresearchuk.org/about-us/we-develop-policy/our-policy-on-cancer-services/workforce
4 See for example: https://www.hee.nhs.uk/our-work/cancer-workforce-plan
7 See for example: https://improvement.nhs.uk/improvement-hub/workforce/
12 See for example: https://www.kingsfund.org.uk/publications/closing-gap-health-care-workforce
24 After two years of medical foundation training trainees can choose to specialise in a given medical profession, which typically starts in the first year of specialist training (ST1) or in the third year of specialist training (ST3), after two years of core medical training.
The two trusts not included in the ESR are Moorfields Eye Hospital NHS Foundation Trust and Chesterfield Royal NHS Foundation Trust.


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