SECURING A CANCER WORKFORCE FOR THE BEST OUTCOMES

THE FUTURE DEMAND FOR CANCER WORKFORCE IN ENGLAND – NOVEMBER 2018

CANCER RESEARCH UK

EXECUTIVE SUMMARY

A NATIONAL AMBITION TO IMPROVE EARLY DIAGNOSIS

Despite some progress in recent years, cancer survival in England continues to lag behind comparable countries in Europe and the rest of the world[i]. In large part this is because we do not diagnose enough cancers at an early stage, where treatment is likely to be more successful. In 2016, only 54% of cancers with a known stage were diagnosed at stage 1 or 2[ii].

Cancer services in England are also subject to significant regional variation, with cancer survival being far better in some parts of the country than others[iii]. And analysis by Cancer Research UK (CRUK) estimates that we need at least to double the rate of progress in some cancer sites to match the best cancer survival of comparable countries in 10 years.

That's why the Prime Minister's announcement in October 2018 was so significant. An ambition to diagnose 75% of cancers at stage 1 or 2 by 2028 marks a commitment to a step change in early diagnosis, and offers a real opportunity to transform cancer services and close the survival gap.

The Prime Minister highlighted several initiatives to support the early diagnosis of cancer, including the lowering of the bowel screening age to 50. This and other commitments are welcome, but they are only part of what is needed to reduce the burden of late stage disease.

To be able to diagnose more cancers at an earlier stage, many more patients will need to be tested for suspected cancer. This will require a significant growth in numbers in the staff groups who deliver these diagnostic tests.

At the same time, early diagnosis is only effective in helping more people survive cancer if there is equitable access to the best possible treatments – and the workforce required to deliver these treatments will change as more people are diagnosed at an early stage. And as treatments become more specialised, there will be a need for more staff to perform them.

The Prime Minister's announcement last month was very significant. But it was also significant for what it lacked – a commitment to grow the workforce to support the new ambition for earlier diagnosis and improve outcomes.

And while the £20.5bn funding increase the Government has pledged to NHS England by 2023/24 to support the delivery of the long-term plan is welcome, this does not include funding for training and educating the staff of tomorrow or developing a long-term strategy for the future of the workforce. We urgently need to see a long-term strategy, and associated investment, for the cancer workforce. Some of the additional investment in NHS England should be deployed to optimise the existing workforce and ensure that the cancer workforce is being prioritised at a regional level. However, beyond this it is vital that Health Education England receives additional funding to ensure that the right numbers of medical staff can be trained for the future.

A DEMAND-LED APPROACH IS NEEDED

By 2027, around 389,000 people in England are expected to be diagnosed with cancer every year. By 2035, this will rise to nearly 438,000 people - an increase of more than 130,000 on 2015 levels[iv].

Keeping up with this significant growing demand will rely – as always – on the dedicated array of staff involved in cancer diagnosis and treatment.

That is without considering the transformation that will be needed to achieve the new ambition to achieve greater early diagnosis of cancer and close the survival gap.

Workforce planning needs to be long-term, and needs to take account of predicted patient need – but this has been consistently lacking from NHS planning for several years, meaning we currently have significant gaps in the cancer workforce.

We have not yet seen a long-term strategy for growing the cancer workforce, despite the urgent need to ensure that we have enough staff to meet the needs of many more cancer patients in the future, and despite it being a recommendation of the 2015 Cancer Strategy for England[v].

In the absence of this strategy, through this report we have tried to demonstrate an approach to workforce planning that accounts for future need for care based on incidence projections – and considers how the transformation we need to close the survival gap might affect workforce needs.

The numbers in this report are estimates – they have been calculated with varying levels of clinical input and have varying degrees of confidence. We want to work with NHS England and Health Education England to refine this approach and ensure that we have a long-term workforce plan which plans for the right numbers of staff to meet future need.

STAFF NUMBERS MAY NEED TO DOUBLE TO MEET DEMAND

Our headline finding is that staff numbers may need to double across key workforce groups by 2027 just to meet the needs of the growing number of patients[1].Given the scale of this estimated increase, it is vital that NHS England and Health Education England conduct their own detailed modelling exercises to better understand what increases we need over the course of the new long-term plan, and that this is tested with the wider cancer community.

For example, our estimates suggest that by 2027 the number of radiologists may need to grow by 70%; the number of gastroenterologists by 45%; the number of therapeutic radiographers by 80%; and the number of oncologists may have to triple.

We have been unable to estimate the scale of increase needed for diagnostic radiographers, histopathologists or GPs, but these staff groups will clearly be crucial to the early diagnosis of

[1] This estimate is based only on the way care is currently provided, rather than taking into account potential changes in the NHS. These changes are explored in more detail below.

cancer in the future and it is therefore likely that they will also have to grow significantly in numbers to meet demand.

CHANGES IN THE NHS WILL NEED EVEN MORE STAFF

These estimates are only an attempt to quantify by how much staff numbers might have to grow just to meet the demand from an increased number of patients in 2027 – without accounting for any of the changes that are likely to take place in the NHS over that time.

We know that there are several changes that are likely to occur in the NHS over the next ten years – and many of these will have implications for the numbers of staff we need.

For example, the potential impact of AI has been discussed extensively, and HEE's Topol Review is currently considering the potential impact of AI on the workforce requirements of the NHS[vi].

And new initiatives to help us reach the Prime Minister's ambition for early diagnosis, such as lowering the bowel screening age, will likely have an impact on the staff we need in the future.

This report considers several of these key changes that CRUK feels are likely to impact on the way that cancer is diagnosed and treated, and explores how they could also impact on future workforce needs – in addition to the estimates above. These are not a definitive statement on how these changes will affect workforce needs, but demonstrate how many potential changes are in train and how significant their potential impact could be. HEE and NHS England should do further research to explore the impact of these changes, working with the cancer community to develop consensus.

A LONG-TERM PLAN FOR THE WORKFORCE

A key element of the new long-term plan for the NHS must be a long-term workforce strategy to ensure that we have the staff we need to diagnose and treat cancer in the future. Without the right staff in place, we will not be able to achieve the ambition of diagnosing 75% of cancers at stage 1 or 2 by 2028.

As part of developing a long-term plan for the workforce, NHS England and Health Education England must consider the future demand created by a growing and ageing population. This report has attempted to demonstrate what the potential impact of increased demand could be on workforce numbers in key staff groups for the diagnosis and treatment of cancer. **NHS England and HEE should consider the findings of this report and incorporate them into their own models of future workforce needs.**

NHS England and HEE should also consider the impact of changes to technology and service delivery. Some of this work is already taking place, but there are potentially significant workforce implications for many likely changes to NHS cancer services which must be considered as part of a long-term workforce strategy.

This strategy will be ineffective unless it is matched by investment to ensure that the pipeline

of staff will deliver the right numbers in the future and that any actions to increase supply in the shorter term are fully funded. **The Government must ensure that funding is available to HEE for the purposes of developing and implementing a long-term strategy for the workforce.**

NHS England must ensure that part of its existing settlement is used to support optimising the existing workforce and to ensure that regional NHS organisations prioritise the cancer workforce.

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BACKGROUND

Following the Government's commitment of an additional £20.5bn for the NHS by 2023/24, NHS England is currently developing a long-term plan for the NHS. We welcome the priority that has already been attached to cancer as part of the development of this plan, and welcome the Prime Minister's recently announced ambition to increase the early stage diagnosis of cancer.

Following a recommendation in the 2015 Cancer Strategy[vii], HEE has been developing a long-term plan for the cancer workforce. A phase one plan, with actions to 2021, was published in December 2017[viii]. The phase two plan is unpublished, but it is our understanding that the new long-term plan for the NHS incorporates the work that HEE has already done to develop a long-term workforce strategy for cancer. This is vital.

To successfully anticipate workforce needs in cancer, it is essential to consider both how many patients are expected to be diagnosed and treated in the future, and the likely areas in which cancer services will change. This should inform the scale of growth to achieve future scenarios: and specifically, could suggest how many and what kind of staff will be needed in future. We have not yet seen a publication that sets out how this approach is being taken by the NHS in relation to cancer.

Therefore Cancer Research UK wanted to explore the future demand for staff in more depth, to demonstrate how this approach could be taken in a long-term plan for the workforce. We wanted this to highlight the scale of increase required to meet the future needs of cancer patients, as well as consider what impact potential changes in services could have on staffing requirements in the NHS. We commissioned 2020 Delivery to develop the model that we used to generate these estimates.

APPROACH

We first interviewed clinicians to determine, across several common cancer sites, what interventions were needed to diagnose and treat cancer, and how much time members of staff spend delivering those interventions. Using this data we were able to develop a 'best practice model' for diagnosing and treating these cancers, which also accounted for the fact that significantly more patients will be referred for diagnostic tests than will eventually be diagnosed with cancer.

This model was then applied, along with the projected number of cancer cases in 2027, to existing staff numbers drawn from NHS workforce data. This yielded a baseline estimate of how many additional members of staff might be needed to deliver the care that increased

numbers of patients will need in 2027. This estimate is not a categorical statement of what numbers are required in the workforce by 2027. Instead, it is an estimation of the scale of how much the workforce will need to increase by 2027 – we urge NHS England and HEE to replicate this kind of modelling to ensure the NHS has the right numbers in place in the future.

We then attempted to explore how predicted changes in services would impact on the need for staff in the future. Using HEE's 'five drivers of change,'[2] we have chosen several changes which we believe are the most likely shifts with substantial impact in the next few years. They largely reflect technology and innovation, with some service model changes also considered. They do not reflect *all* the potential changes in the health service, but capture those which we feel will have the most significant impact on cancer services.

While we have been unable to generate specific figures for how these changes will affect the staff numbers we need, we have used the latest evidence available to explore what the extent of the impact of these changes may be and what staff groups might be affected.

It should be noted that there are some elements that need to be built into the activity demands for the workforce which are not 'changes' but activity to address current gaps. One of these is more time for research. Without allowing for more time spent on research, we will not be able to achieve the ambitions of the Life Sciences Industrial Strategy[ix], or achieve research breakthroughs for the future.

As well as this, there are other gaps that need to be addressed which we have not considered as part of this paper, but should be considered in a future workforce plan, for instance:

- There is unwarranted geographical variation in cancer services, so ensuring that all patients across the country are receiving the best possible care may need further staff. For example, there is some evidence to suggest that bowel scope may not be offered to all eligible patients[x]
- Changes to services may require staff to be trained in new skills or to be aware of new treatments. For example, our survey of GPs found that nearly half were unaware of the potential benefits of tamoxifen to prevent breast cancer[xi]
- Existing shortages must be accounted for if current staffing levels are unable to meet demand e.g. around one in ten clinical radiology posts are currently unfilled[xii]
- Does the existing workforce have enough time to do a wide range of activities, including spending enough time with patients and providing high-quality care? E.g. our survey of the oncology workforce found that 73% of respondents identified staff shortages as a barrier to providing efficient cancer treatments and excellent patient experience[xiii].

[2] The five key drivers of change were set out in HEE's consultation on its draft workforce strategy to 2027 and comprise: demographic changes; technology and innovation; social, political and environmental changes; current and future service models; and patient/staff expectations.

KEY FINDINGS

HOW MANY STAFF MIGHT BE NEEDED IN 2027?

The first part of our work was to attempt to model how many more staff might be needed to diagnose and treat cancer in 2027, based only on projected cancer incidence until 2027. This estimate did not take into account the fact that there are shortages in the existing workforce, or account for any anticipated changes in the way that cancer services are delivered.

With input from clinicians we developed a model of how much time key staff might spend on the diagnosis and treatment of cancer – accounting for the fact that diagnostic staff will deliver care for patients with suspected cancer who do not go on to receive a cancer diagnosis, and the fact that only a proportion of a clinician's time will be spent on providing direct patient care to people with cancer. Using this model we estimated how much the current workforce would need to grow to keep pace with the projected growth in the number of cancers diagnosed, which is set to rise to around 389,000 by 2027.

We considered several key staff groups as part of this report, with seven being identified as key groups for the diagnosis and treatment of cancer: radiologists; gastroenterologists; therapeutic radiographers; clinical and medical oncologists; diagnostic radiographers; histopathologists; and GPs.

Based on this modelling, we estimate that for key staff groups where we have been able to make estimates, numbers will need to grow by the following amounts just to keep pace with the projected increase in demand:

Staff type	Consultant (where applicable) full time equivalent (FTE) in 2016[xiv]	Estimated numbers required in 2027 based on incidence projections only
Radiologists	2805	4764
Gastroenterologists	1065	1554
Therapeutic radiographers	2632	4763
Oncologists (clinical and medical)	1044	3002

Fig 1. Estimated required staff numbers in 2027 across key staff groups

These estimates mean increases ranging from between 45% to nearly 300% depending on the

staff group – and on average they suggest that we would need staff numbers to double across these workforce groups just to meet demand in 2027. The figures are not an exact calculation of the numbers we will need in the future, but as estimates they demonstrate the potential scale of the workforce increases we need – and the urgency of developing a long-term strategy for the cancer workforce.

While we didn't have enough clinical data to generate estimates for diagnostic radiographers, histopathologists and GPs, these are key staff groups in the diagnosis of cancer, so it is essential that we see growth in these areas if we are to achieve the ambition of 75% of cancers diagnosed at stage 1 or 2.

FUTURE CHANGES AND THEIR POTENTIAL IMPACT

The figures above are only an estimate of the workforce numbers required to meet the needs of future numbers of patients. They do not account for any of the changes we have identified as having a potentially significant impact on the way cancer services are delivered, and therefore the workforce required to deliver them.

The table below expresses in summary the key changes CRUK anticipates having the most potentially significant impact on the way cancer prevention, diagnosis and treatment is delivered in the future. Based on the available evidence about these changes, we consider the workforce groups that are likely to be affected, and the scale of the potential impact of these changes.

When developing a long-term plan for the cancer workforce, NHS England and HEE should consider these potential changes and model for their impact, testing these models with the wider cancer community. As NHS England and any other relevant organisations start to implement these changes, they should also consider the workforce implications of the changes.

Part of the cancer pathway	**Potential change**	**Workforce groups or activity affected (direct and 'spillover')**	**Estimated potential workforce impact[3]**
Prevention	Testing for inherited risks (genetic testing)	• Genetic counsellors • GPs • Molecular pathology (scientists, technicians and pathologists i.e. laboratory services) • Oncology • Radiology • Radiography • Endoscopy • Surgery	**Moderate** – more testing will lead to increased demand on pathology, and could see growth in preventative options (prophylactic surgery) as well as surveillance

[3] Based on our analysis of the latest available evidence, clinical input, and Cancer Research UK's own assessment of impact.

Screening	Lung health checks for high risk individuals	• Radiology • Radiography • Pathology • Surgery • Oncology • Chest physicians • GPs • Nurses or support staff • Smoking cessation staff	**Major** – if widespread could mean uplift in imaging and subsequent nodule management. NHS England should consider the workforce implications of any potential roll-out of this approach
	Faecal Immunochemical Testing (FIT) in bowel screening Age extension in bowel screening	• Endoscopy • Pathology • Surgery	**Major** – could lead to a significant increase in colonoscopy and pathology. Finding early stage cancers might also require more surgery
	Bowel scope	• Endoscopy • Pathology • Surgery	**Moderate** – if available nationwide, it would increase activity for colonoscopists and pathology, and finding early stages cancers might require more surgery
Primary care for initial diagnosis	Widespread use of NG12 guidelines	• GPs • Endoscopy • Pathology • Radiology and radiography • Surgery	**Major** – the effective use of NG12 guidelines would lead to many more patients being referred for diagnostic tests, which would require more diagnostic staff to deliver in a timely manner. If these tests were successful in identifying greater numbers of early stage cancer then this would impact on the required treatments workforce, e.g. more surgeries might be needed
	Rapid Diagnostic and Assessment Centres, Multi-disciplinary Diagnostic Centres, or other similar approaches to initial investigation	• GPs • Endoscopy • Pathology • Imaging	**Moderate** – RDACs were a key element of the announcement on early diagnosis, but it is unclear how these will be rolled out and to what extent. The centres are currently used to manage investigations for patients with serious but non-specific symptoms but could be more radical in substituting for

			GP activity. Alternatively, moving more diagnostic activity to primary care could mean fewer people are referred to specialists but at higher risk
Diagnostics	FIT for symptomatic patients	• Endoscopy • Pathology • GPs	**Moderate** – would lead to increased activity for pathology and GPs, could reduce use of colonoscopy. May shift demand to CT colonography, depending on the pathway.
	Multi-parametric MRI (mpMRI) for prostate cancer	• Radiology • Urology • Pathology	**Moderate** – would lead to increased activity for radiology and urology, could reduce level of biopsy
	Artificial intelligence in the diagnostic pathway	• Radiology • Pathology • Clinical oncology, clinical scientists and technicians • Bioinformaticians • Digital technologists	**Moderate** – could augment histopathology, radiology interpretation. Also likely to be used in radiotherapy planning.
	Biomarkers	• Pathology • Radiology • Endoscopy • Oncology • GPs, depending on point of access	**Moderate** – could reduce some surveillance imaging/scoping, would increase demand for pathology
	Molecular diagnostics and genomic analysis	• Molecular pathology (scientists, technicians and pathologists) • Oncology • Nurses • Biomedical scientists • Genetic counsellors	**Moderate** – will increase demand on molecular pathology and guide treatment options rather than grow activity
Treatment	Interventional endoscopy/radiology	• Endoscopy • Radiology • Surgery	**Minor** – may replace some surgical procedures
	Immunotherapy	• Oncology • Nursing • Pharmacy • Gastroenterology • Clinical immunologists	**Moderate** – immunotherapy could lead to an increase in activity and complexity, and immunotherapy is likely to be available for more patients. A successful shift to early stage diagnoses may affect demand.

	Innovative radiotherapy	• Clinical oncology • Therapeutic radiographers • Clinical scientists (medical physicists) • Clinical technologists • Nursing	**Major** - Significantly more time could be required for planning and activity if techniques are used more frequently
Research	New approaches to clinical trials	• Research nurses • Oncologists • Clinical scientists	**Minor** – not likely to increase or decrease activity but would be more complex to organise

Fig 2. Summary of future changes and their potential impact

The detail and evidence which informs our assessments of the potential impact of these changes is available in the appendix to this paper. From the table above, it is clear that there are several changes which we anticipate would or will have a major impact on workforce requirements, including:

- The potential expansion of targeted lung health checks
- The introduction of FIT in bowel screening, and expanding the age range to 50
- The widespread uptake of NG12 guidelines
- The increased use of innovative forms of radiotherapy

For example, depending on how lung health checks are expanded, this change is likely to have a significant impact on demand for staff. It could significantly increase demand for nurses (for the initial triage) and imaging staff (radiographers and radiologists) for the low-dose CT scan. The intervention could shift workload onto thoracic surgeons and clinical oncologists – if more patients were diagnosed at an earlier stage, there would likely be more operable early lung cancers, or those which can be treated curatively with targeted radiotherapy. Estimates from a Canadian study estimated that the rate of operable early lung cancer per thoracic surgeon increased by at least 16%.[xv]

Similarly, the introduction of FIT in bowel screening could significantly increase demands for colonoscopy – without accounting for future increases in the sensitivity of the test or the proposed expansion of the age range for bowel screening.

It is particularly important that NHS England considers the workforce implications of these potential or planned changes, ensuring that the right workforce is in place to deliver these potential changes so that the full potential of reducing late stage cancer can be realised.

RECOMMENDATIONS

The estimates above are an attempt to account for how both increasing incidence of cancer and planned and potential future changes to cancer services will affect the need for staff in the future. They demonstrate the potential scale of future increase that is needed, suggesting that we may need to double the workforce to 2027 – even before accounting for the changes that need to be made to improve outcomes.

We urge NHS England and Health Education England to consider this approach as they develop a long-term plan for the NHS – and a strategy for its workforce. Based on these findings we make the following recommendations to the Government, NHS England and HEE:

1. **NHS England and Health Education England must work together to deliver a long-term workforce strategy, including HEE's existing work on the long-term cancer workforce**
2. **NHS England and HEE should consider the findings of this report and incorporate them into their own models of future workforce needs**
3. **The Government must ensure that funding is available to HEE for the purposes of developing and implementing a long-term strategy for the workforce.**
4. **NHS England must ensure that part of its existing settlement is used to support optimising the existing workforce and to ensure that regional NHS organisations prioritise the cancer workforce.**

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APPENDIX

FUTURE WORKFORCE NEEDED TO MEET DEMAND – METHODOLOGY

Workforce planning has previously been determined by affordability rather than forecasting activity. We have taken an approach which could be analogous to 'zero-based budgeting'[4]. The methodology was developed with 2020 Delivery, who we commissioned to work with us on this project.

The steps in our approach are:

- Create a baseline of current activity, using best practice estimates of the time taken to deliver some tasks. We have sought opinion from health professionals (from diagnostics, oncology, surgery) to do this.
- Multiply this by the projected number of cancer cases for 2027, ensuring that this reflects that more people will receive diagnostic tests than actually go on to be diagnosed with cancer
    - This results in a 'do nothing' scenario where the only thing that has changed in future is demographics and epidemiology (i.e. larger population, older population, certain trends in cancer incidence)

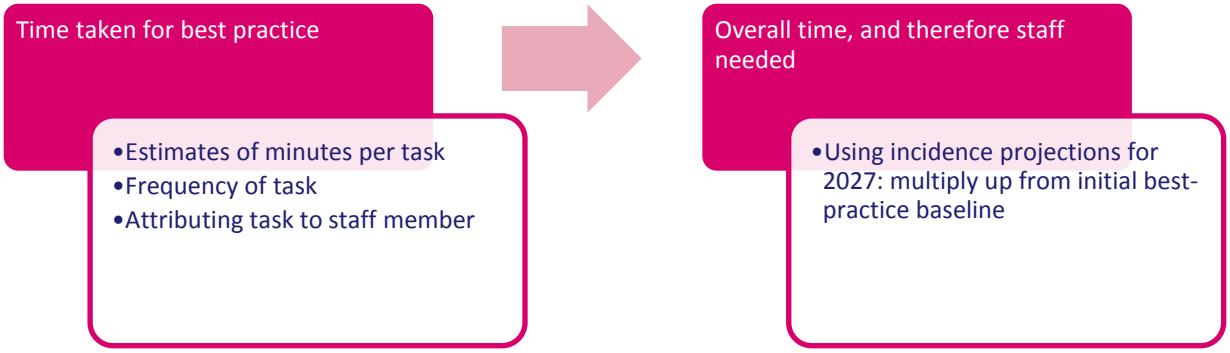

Fig 3: methodology for calculating the baseline

ESTIMATED IMPACT OF CHANGES IN THE NHS

Below, we set out in more detail our assessment of the potential impact of anticipated changes to the way cancer services are delivered in the NHS. These are not estimates of the

[4] Zero-based budgeting starts from a "zero base" or blank slate and every function within an organisation is analysed for its needs and costs. This is in contrast to incremental budgeting which uses the existing budget as a starting point with small increases or decreases for the current period. Workforce planning has often taken an incremental approach, based on the existing staff in post and also the number of staff that an employer can afford to pay.

impact of these changes in terms of numbers, but demonstrate the need for HEE and NHS England to do further modelling on the impact of these changes so that they might be better understood.

Increased genetic testing for inherited risk

Description of change: Some people have an increased risk of particular types of cancer because they have an inherited gene fault. Genetics specialists estimate that only about 2 or 3 in every 100 cancers diagnosed are linked to an inherited gene fault.[xvi]

NHS England has estimated that of 11,589 eligible people, around 7,000 would make an informed choice to take part in BRCA genetic testing. NICE estimated in 2012 that 3,930 individuals were accessing BRCA1 and BRCA2 testing: suggesting a gap in provision for over 3000 patients, who should be offered the test every year.[xvii]

There is likely to be an increase in testing and interpreting the risk associated with inherited gene faults, due to increased public awareness and likely changes to clinical guidelines. The cancer strategy suggested that more bowel, ovarian and breast cancer patients should be offered genetic testing[xviii].

In future, these tests could also be used in a targeted testing programme[xix] – where they are offered to all individuals who fit specific criteria. Where inherited faults are found, individuals can be invited to take additional diagnostic tests to monitor the development of cancers. Some individuals may also be prescribed and take chemopreventative drugs such as tamoxifen or aspirin. Others may decide to have prophylactic surgery.

For example, clinical guidance states that all bowel cancer patients should be tested for Lynch syndrome at the time of diagnosis.[xx] Provision of this test is variable and below the level it should be – Bowel Cancer UK have found that only 17% of hospitals in the UK are testing all bowel cancer patients at diagnosis[xxi]. Providing the right level of genetic testing would increase demand for genomic medicine laboratories, genetic counsellors, and endoscopy services. They should also receive chemopreventative drugs (aspirin)[xxii] which should be prescribed by their GP.

Likelihood of this change[5]: Medium

Timeline: Could be immediate, dependent on clinical guidelines

Any cancer types highlighted: Breast, bowel, ovarian, prostate, kidney, melanoma, pancreatic, retinoblastoma, thyroid and womb cancer

Impact on workforce demand: An increase in volume of patients eligible for genetic testing woud lead to an increase in workload for genetic counsellors and relevant staff within molecular pathology. It may also increase demand for GP and other specialist time as they need to be able to provide relevant referrals to genetics services and intepret the results of

[5] Based on Cancer Research UK's understanding of likely changes and clinical consultation.

the genetic tests. If an inherited risk factor is found, it may lead to increased demand on diagnostic services who would provide surveillance tests (e.g. mammograms, colonoscopies) to see if a cancer has developed. It may also increase demand for prophylactic surgical procedures.

Targeted health checks for individuals at high risk of lung cancer

Description of change: Several local projects in England and international trials have been exploring ways to diagnose lung cancer in individuals who are at high risk of the disease because of their smoking history. For example, a model of the intervention involves identification of increased risk individuals using the GP record, followed by further refinement of risk via a questionnaire about the individual's smoking history and consultation with a health professional. Eligible patients would then be invited for a low-dose CT scan.

Further work is needed to understand what the potential impact of a roll-out or scaling up of these approaches would be on the number of lung cancers diagnosed, but it is likely that there would be an increase.

It could also increase the level of treatment activity for radiotherapy and surgery – across Accelerate, Coordinate and Evaluate (ACE) lung health check projects in Manchester, Liverpool and Nottingham, 80% of lung cancers detected were diagnosed at stage 1 or 2[xxiii]. At these early stages, curative treatment (e.g. surgery or radiotherapy) is more likely.

53% of stage 1 lung cancer patients have surgery, whereas this drops to 2% for stage 4[xxiv]. If the expanded schemes were successful in diagnosing cancers at an earlier stage, this could have a workforce implication as there could be an increase in the number of surgical procedures and a decrease in the number of people receiving chemotherapy.

Likelihood of this change: High

Timeline: Some of these projects are already in operation and it is likely to become more widespread in some form.

Any cancer types highlighted: Lung

Impact on workforce demand: Depending on the protocol used and whether this is comprehensively available, this intervention is likely to have a significant impact on demand for staff. It would significantly increase demand for nurses (for the initial triage) and imaging staff (radiographers and radiologists) for the low-dose CT scan. There could also be an impact on GP workloads depending on how the programme is developed, for example if there is a new referral pathway for GPs. The health check also offers an opportunity to deliver smoking cessation advice, which requires sufficient staff trained in giving this advice. There is also likely to be an impact on the pathology workforce. This intervention could shift workload onto thoracic surgeons and clinical oncologists, as well as radiotherapy physicists and therapeutic radiographers – with more patients diagnosed at an earlier stage, there are likely to be more

operable early lung cancers, or those which can be treated with radiotherapy. Estimates from a Canadian study estimated that the rate of operable early lung cancer per thoracic surgeon increased by at least 16%.[xxv] With more patients diagnosed early, it may reduce some demand for medical oncologists, although they may be involved in the adjuvant treatments and monitoring disease progression. Physicians would need to be involved with managing nodules identified by CT scans that need monitoring rather than active treatment.

FIT and age range of bowel screening

Description of change: FIT has been recommended by the UK National Screening Committee to replace the guaiac faecal occult blood test in the national bowel screening programme and is set to be rolled out in England in late 2018/early 2019. It is a more sensitive test, and in pilots has been associated with greater uptake[xxvi].

There is ongoing work to determine the most optimal configuration of the bowel screening programme. But it is likely that to achieve optimal bowel cancer prevention and early diagnosis, FIT thresholds will need to be more sensitive. The Prime Minister has also recently announced a reduction in the lower age limit for bowel cancer screening. The introduction of FIT into bowel screening will lead to a significant increase in colonoscopy and pathology activity.

NHS England has decided that FIT will be implemented in England initially at a threshold of 120 micrograms of Hb per gram of faeces (µg/g), with a reduction in threshold over time. If the threshold was lowered to the 80µg/g threshold used in Scotland, compared with 120µg/g, we estimate that around 1,100 more cancers could be detected through the bowel screening programme each year. Further to this, 6,700 more patients could be detected with 'advanced' adenomas (precancerous changes that are high risk for developing into cancer). However, the 80µg/g threshold would require nearly 23,000 extra colonoscopies per year to follow up an abnormal FIT screening result (this doesn't include the extra 'surveillance' colonoscopies that would also be required). A significant amount of extra pathology resource would also be required to test the pathology of samples from the colonoscopies. This has been estimated by assuming 4.5 million people will be invited to FIT bowel screening in 2018/2019, and extrapolating data from the England FIT pilot study provided on request by Stephen Halloran.

There would be larger gains in cancer and adenoma detection when the threshold is lowered further. For instance, compared with the threshold of 120µg/g, if it was lowered to 20µg/g in England, it's estimated that around 3,300 more cancers and 34,000 more advanced adenomas could potentially be detected through screening each year. But 157,000 extra follow-up colonoscopies would be required each year, which would be roughly 200 extra per screening centre per month on average (again, this doesn't include the impact on number of surveillance colonoscopies.)

The Prime Minister has recently announced that the age range for bowel screening will expand to 50 – 74 years. If uptake increases to over 75% this will also increase activity in colonoscopy. The impact on pathology would mean significantly more samples needing to be analysed. As part of plans to implement this change, NHS England and Public Health England must consider the workforce implications.

Likelihood of this change: Introducing FIT into the bowel screening programme is certain, and the Prime Minister has recently announced the expansion of the age range. Colonoscopy capacity is required to increase the sensitivity threshold.

Timeline: This is likely to occur in the short term – from 2019 onwards.

Any cancer types highlighted: Bowel cancer

Impact on workforce demand: Even at a sensitivity level of 120µg/g, the implementation of FIT will increase demand on endoscopy services – an increase in sensitivity and the extension of the age range will increase this demand further. Further work is being undertaken by the School of Health and Related Research in Sheffield to model the likely levels of activity (and related benefits to population health) which could be used to confirm the scale of these changes.

Bowel scope – full implementation or removal from programme

Description of change: Bowel scope is the use of flexible sigmoidoscopy – a type of endoscopy – as a screening test. The programme invites individuals aged 55 who have no symptoms to have the procedure. It was recommended as part of the screening programme in 2011, and began its introduction in 2013. Due to endoscopy constraints, it has not yet reached full coverage (i.e. invites are not yet being sent to all the eligible population). In clinical trials it was shown to reduce mortality through both diagnosing bowel cancers at an earlier stage and preventing cancers by allowing the removal of precancerous changes. Little data has been published but uptake of bowel scope should be improved.

Likelihood of this change: Although bowel scope is already in operation, it is unclear if will be fully rolled out as there is an ongoing review about retaining it as part of the bowel screening programme. There is discussion about how cost-effective it is compared to using endoscopy capacity alternatively for FIT at a wider age range and with more sensitive thresholds.

Timeline: Immediate

Any cancer types highlighted: Bowel

Impact on workforce demand: If removed, this would reduce some demand on endoscopy and pathology services. If fully implemented, this would increase demand. As it not clear how far it has reached, the impact of full roll out is hard to determine.

Widespread use of NG12 guidelines

Description of change: NICE published guidelines for recognition and referral of suspected cancers in 2015. These were designed to reduce the threshold of risk needed before an investigation to a positive predictive value of 3% or higher. We would expect that full implementation of NG12 would increase demand for timely investigations. Through further investigation, this may mean more cancers are diagnosed at an earlier stage and may have an impact on the use of different treatments, with a shift towards more curative treatments being given. We would expect to see greater use of surgery and curative radiotherapy in particular.

Likelihood of this change: High

Timeline: Ongoing, up to 3 years

Any cancer types highlighted: all

Impact on workforce demand: Thorough implementation of NG12 guidelines will increase testing – this will vary depending on the current levels of conversion and where more investigations are likely to be ordered. Evaluation of the current impact will help assess the future demand on services.

Rapid Diagnostic and Assessment Centres (RDACs), Multi-disciplinary Diagnostic Centres (MDCs) or other approaches to initial investigation and referral

Description of change: The Prime Minister has recently announced the roll-out of Rapid Diagnostic and Assessment Centres, which are similar to MDCs in offering a referral route for individuals who visit their GP with symptoms which are less specific to one particular type of cancer, such as unexplained weight loss. Each pilot is configured differently. Most currently still require an initial referral by a GP, and provide a range of tests (including imaging, endoscopy and pathology depending on what is appropriate).

Further innovation may include more investigations which are direct access or straight to test – essentially with a streamlined pathway following a GP referral, and potentially a triage step involving a nurse or other healthcare professional. Self-referral is a potential innovation – this is currently being explored by Bupa[xxvii], but if it became more common in the NHS it could reduce demand for a GP appointment. At the same time, research is also ongoing to explore ways of implementing new and improved diagnostic tests into GP surgeries[xxviii, xxix, xxx]. This could shift some testing responsibility onto GPs and increase the number and complexity of some of the interventions they are required to carry out.

Likelihood of this change: The roll-out of RDACs is certain, but the model used is yet to be decided.

Timeline: MDCs are already operating as pilots in 2018, with others beginning to adopt this

model. The Prime Minister has announced the roll-out of RDACs. Other diagnostic pathway innovations are also likely to occur in the very near future. Shifting diagnostic responsibility is also possible as there is existing research in this area.

Any cancer types highlighted: Colorectal, upper GI tract, lung, haematological, urological, gynaecological, sarcoma, head and neck, breast, brain and CNS and skin. (These have all been diagnostic in the initial wave of the MDC ACE pilots[xxxi]).

Impact on workforce demand: These changes are likely to have a mixed overall impact on GP and diagnostic service time. As part of plans to roll out the RDACs model, NHS England should consider the workforce implications of their chosen approach.

Following current models, MDCs may reduce demand on GPs and diagnostic services, but possibly not significantly. Pathway navigators and clinical nurse specialists (CNS) have been identified as a key staffing requirement to enable the MDCs to function well.

Streamlined diagnostic pathways could result in reduced numbers of outpatient appointments. For example, the rapid colorectal diagnostic pathways involved a telephone triage step with a nurse, but during ACE pilots reduced the number of outpatient appointments by 59%[xxxii].

If self-referral is introduced this may reduce demand on primary care, but also may require additional staff to ensure appropriate use and equity of access. Shifting diagnostic tests into primary care may increase demand for GP time.

FIT for symptomatic patients

Description of change: There are two ways of using FIT for symptomatic people.

One is for patients who have a set of lower risk symptoms and characteristics which means it is not appropriate to refer them via an urgent cancer referral. This is currently recommended by NICE via their 'DG30' guidelines, and decides which patients should be considered for a colonoscopy, or suitable alternative, as a 'rule in' test. The impact on demand for colonoscopies is varied as it depends on previous local practice.

The second type of FIT for symptomatic patients is for patients whose symptoms are more concerning and would be given a colonoscopy via an urgent referral. FIT could be offered to 'rule out' the need for a colonoscopy which would previously have been offered. This is only experimental as the safety has not yet been established. There are several pilots trying approaches and these 'FIT pioneers' will be evaluated by NHS England in 2018/19 and 2019/20.

The final element which will also change demand for endoscopy capacity is through new surveillance guidelines, in development by the British Society of Gastroenterologists. This means people with polyps might not need as many follow up colonoscopies. This is expected in late 2018.

Likelihood of this change: High, especially for low-risk patients and in terms of changes to surveillance. The changes relating to high-risk patients will be dependent on findings from the ongoing research projects.

Timeline: 1 –3 years

Any cancer types highlighted: Bowel

Impact on workforce demand: This will have implications for endoscopy and pathology capacity: it may reduce demand for endoscopy, especially if surveillance guidelines and the use of FIT for high-risk symptomatic patients reduces the number of colonoscopies needed. This will also have an impact on GP workload, for example because safety netting will be vital for patients referred on this pathway.

Widespread use of MPMRI for prostate cancer

Description of change: Multi-parametric MRI is a type of MRI scan which can be more effective at identifying men with aggressive forms of the disease than the standard biopsy test. It would require more imaging capacity – both equipment and staff to deliver the additional MRI tests. It would decrease demand for urological pathology biopsies being taken, processed and interpreted.

Likelihood of this change: High

Timeline: From 2018 onwards, likely to be relatively rapid but the pace of widespread implementation will depend on workforce and kit constraints.

Any cancer types highlighted: Prostate

Impact on workforce demand: This will lead to a significant increase in radiology and urology expertise but a decrease in pathology related activity as fewer biopsies would be processed and interpreted.

Artificial intelligence in the diagnostic pathway

Description of change: Artificial intelligence (AI) can be defined as technologies with the ability to perform tasks that would otherwise require human intelligence, such as visual perception, speech recognition and language translation[xxxiii]. There are many ways in which AI can contribute to health: optimising processes or clinical decision making; in research; through patient-facing applications such as 'chatbots'; understanding population health; and in the example below which is within clinical pathways. At the moment, most activity ongoing that is relevant to cancer is within clinical pathways and, more specifically, diagnostics.[xxxiv]

There are currently products and services undergoing research evaluation which are aiming to use AI to augment radiology and pathology tasks. In imaging, this could include determining if a mammogram shows abnormal findings, or to identify and determine the likely prognosis from an information about a lung nodule. In pathology, this could be applied to help identify cells that have been highlighted by immunohistochemical stains.

For diagnostic uses, it is most likely that AI could be applied most quickly to tasks which have:

- A binary result (e.g. abnormal cell present or not) – this is likely to be used in screening scenarios where the tests are being used to determine presence of an indicator rather than a complex clinical diagnosis.
- Underlying input which is already digitised
- A vast quantity of high-quality clinical and/or outcome data, which can be used to 'teach' the AI software about the appropriate decision based on the digitised input it is reviewing.

Likelihood of this change: Moderate – although many products are in research and development, applications have yet to be seen in routine use. They are highly dependent on good quality 'curated' data

Timeline: At the earliest, some applications may be possible within 5 years, but for others 10 years is a more realistic timeline for widespread adoption.

Any cancer types highlighted: All, however breast screening applications are likely to be first

Impact on workforce demand: These tools are likely to augment the work of pathologists and radiologists, rather than replace them. It may speed up their work or free up time to be spent on other tasks, including 'time to care' (featured in the Topol Review interim report) and time to take part in education or research. More research is required to understand what the imapact of AI will be on the necessary future growth in radiologists and pathologists.

Biomarkers

Description of change: 'Biomarkers' can describe a range of things. They are changes in some aspect of the body that can be measured to understand if an individual has a predisposition for cancer, currently has cancer, how the cancer is developing, or whether a treatment is working. They can be based on taking a sample from tissue, urine, blood, stool, breath or even earwax; or taking an image. They may measure the presence of a substance like a specific protein, a fragment of DNA (e.g circulating tumour DNA) or RNA.

More research is focusing on what biomarkers might be clinically useful and it is therefore possible that some of them will reach routine practice, either as new screening programmes, initial diagnostic tests, monitoring disease progression or surveillance.

They could provide an initial 'triage' for all investigations – and therefore reduce demand on other procedures (and staff) which are used at the moment to assess disease progression or diagnose cancer.

For example – Cytosponge is the subject of a randomised controlled trial in the UK. This captures cells from the oesophagus which can then be tested for the presence of a biomarker – trefoil factor 3 – which may indicate Barrett's oesophagus, a precursor to oesophageal cancer. It could be used in primary care and determine which patients do not need a gastroscopy for surveillance of their condition. Another example – CA19-9 – is a protein biomarker which is still undergoing research to see if it's suitable to detect recurrent disease.[xxxv]

Likelihood of this change: High

Timeline: May take longer than ten years to have widespread availability of blood based tests.

Any cancer types highlighted: Lung, GI cancers, breast, prostate, ovary

Impact on workforce demand: The use of more biomarkers will increase the demands on laboratory services, including pathology and clinical scientists. Provision within the NHS would need to be made to ensure sufficient capacity for taking the relevant samples (e.g. if it is a blood test this would need phlebotomists). It could reduce the need for some other diagnostic tests. Depending on how patients are referred for these tests, this may have an impact on GP workloads.

Molecular diagnostics and genomics

Description of change: Cancer patients can be given more precise diagnoses and guided treatments by analysing their tumour at a molecular level. The National Genomic Medicine Service has recently launched in England, with an intention to meet existing demand and potentially offer more testing as technology develops. Previous reports have shown that existing tests were not comprehensively available to patients, as we estimated in 2014 that around 24,000 patients in England missed out on tests that would have helped guide their treatment.[xxxvi]

In future, it is likely (and it is hoped) there will be more widespread usage (i.e. providing access to more eligible patients) as commissioning arrangements become more straight forward because of the introduction of the genetic testing directory.

Other relevant mutations and resulting treatments are likely to emerge with further research. While most molecular diagnostic activity is likely to use panels of tests that identify particular biomarkers, there is also likely to be more widespread use of whole genome sequencing. Whole genome sequencing, like other molecular testing, could indicate 'diagnostic subtypes,

predict tumour behaviour, prognosis and drug response, and enable monitoring for early recurrence of disease'[xxxvii]. This is likely to become more routine for some cancer types as the Genomic Medicine Service begins operation.

As well as supporting initial diagnoses, genomic analysis may also play more of a role in monitoring response to treatment and post-treatment surveillance – for instance, using circulating tumour DNA. This is currently an area of focus in medical research[xxxviii].

Likelihood of this change: High

Timeline: Some molecular diagnostics are already in use – six were commissioned by NHS England in 2016 and this number is likely to grow. Genome sequencing may take longer to become common practice but it's been suggested that more routine use of gene panel testing and whole genome sequencing will be offered for several cancer types in the very near future.

Any cancer types highlighted: Current molecular diagnostic tests with associated standard of care treatment are available for metastatic colorectal cancer (KRAS), breast cancer (oncotype DX), melanoma (BRAF), GI stromal tumours (KIT) and lung cancer (ALK 1 and 2).

Impact on workforce demand: Staff working in genomic and genetic services (e.g. pathologists and scientists, including bioinformaticians – where there is already a skills gap[xxxix]) will experience increased demand, both due to more requests for existing tests, and increased tests and sequencing as understanding of genetic changes improves. This could also increase the complexity of treatment decision-making for oncologists, who may have a greater range of genomic tests available and may need more time to dedicate to interpreting results. There is also likely to be a significant resource impact on staff analysing the results of tests, especially if whole genome sequencing becomes more prevalent. While greater use of stratified treatment may mean there could be a reduction in inappropriate treatments being given, patients will still need support from their clinical teams and other supportive care.

More interventional endoscopy and radiology

Description of change: Both endoscopy and radiology professionals can provide interventions which may reduce the need for more invasive surgery. In GI endoscopy, endoscopic mucosal resection could involve the removal of polyps (precancerous changes in the bowel), or by dealing with abnormal cells found in patients with Barrett's oesophagous. Interventional radiology is also used diagnostically – to help guide the taking of biopsies in breast, for example; or therapeutically using techniques like high intensity focused ultrasound.

Likelihood of this change: Moderate**:** dependent on research

Timeline: Some techniques are already in use but further developments will depend on both

training of gastroenterologists and/or radiologists, plus further research to establish effective interventions.

Any cancer types highlighted: Liver, lung, kidney, bone, breast, prostate, pancreatic, bladder and GI cancers.

Impact on workforce demand: This is unlikely to change the overall demand for staff time, but may shift activities from surgeons to endoscopists or radiologists as these interventions are often less invasive – so if demonstrably effective would likely become a preferred option for patients. This would therefore increase demand for endoscopy and radiology services.

Increased use of immunotherapy and other targeted treatments, including individual cell therapy

Description of change:

Immunotherapy uses our immune system to fight cancer. It works by helping the immune system recognise and attack cancer cells. There are several different types of immunotherapy, including:

- Monoclonal antibodies (including checkpoint inhibitors)
- Artificial cytokines
- Vaccines
- Cell therapy/adoptive cell transfer (including CAR T-cell therapy)

Some types are administered in a similar way to chemotherapy – typically intravenously or orally – and may be administered on a daily, weekly, or monthly basis. Others (e.g. CAR-T) are given as a 'one off' treatment.

Immunotherapies are currently most used in later stage disease. Therefore, more early stage diagnosis could have an impact and reduce demand for these types of treatment. However, this could change if future evidence suggests that there is also a benefit in earlier stage disease. There is a significant amount of research underway exploring whether immunotherapies could have benefit in more cancer types. However, any additional impact on outpatient oncology services may be partially mitigated by the fact that immunotherapy can be given in fewer doses than chemotherapy.

In some cancer types, immunotherapy has transformed outcomes for patients with advanced disease, with a durable, long-lasting response in some patients. Immunotherapy can also be given in fewer cycles than chemotherapy, which may have an impact on outpatient oncology services.

However, a significant proportion of patients receiving immunotherapy will experience severe side effects. These can require very different management to side effects from chemotherapy and may present immediately following treatment, or some time after. Research is underway to explore whether immunotherapy doses could be reduced, giving the same clinical benefit but fewer side effects.

Likelihood of this change: High

Timeline: Some of these treatments are already in use for some cancer types but immunotherapy is likely to become used for a broader range in the next 10 years.

Any cancer types highlighted: Currently some types are used (not as the first line therapy) for metastatic melanoma, metastatic NSC lung, advanced kidney, squamous head and neck, bladder, Hodgkin lymphoma but likely would end up being used for a selection of patients within most cancer types. Cell therapies are currently being used in haematological cancers and research is underway to explore whether they could also be of benefit in others.

Impact on workforce demand: Immunotherapy treatments create workforce implications for the ongoing and future use of systemic anti-cancer therapy services: regular monitoring of treatment response and side effects is essential, and additional workforce capacity and specialist training may be needed for treatment delivery and the management of serious side-effects. For advanced cell therapies such as CAR T, treatment will only be given in certain specialist centres and so there may need to be further centralisation of some specialised workforce. There could also be increased demand on nursing, pharmacy, and specialised services if there are more specific side effects. Training for staff on the management of immunotherapy-related side effects should be increased beyond oncology, since a wide range of side effects can be experienced (requiring input from, for example, gastroenterology and emergency medicine and intensive care).

Increased use of radiotherapy, including more innovative methods

Description of change:
Radiotherapy uses radiation to kill cancer cells. Analysis has shown that around 27% of tumours diagnosed in England were treated with radiotherapy as their primary treatment in 2013-14[xl], although this does not take into account the use of radiotherapy as part of their treatment rather than first line treatment. Previous modelling has suggested that future demand for radiotherapy will be relatively stable, suggesting that just over 40% of patients should receive radiotherapy over the next ten years[xli].

There are several different innovations within radiotherapy. Many of these will require better planning, which takes more time. These include:

Hypofractionation

Radiotherapy given over a shorter period of time (i.e. via fewer 'fractions') than standard radiotherapy, which is effective in breast and prostate cancer. For prostate, the recommended number of fractions per patient was changed in 2017, from up to 37 fractions to 20 fractions[xlii]. In breast cancer it is now standard practice to deliver 15 fractions per patient rather than 25[xliii]. Trials are also ongoing to test the use of just 5 fractions for breast cancer patients.

Intensity Modulated Radiotherapy Treatment (IMRT)

IMRT precisely targets tumours, making it more effective and producing fewer side effects for patients. Cancer Research UK wants all patients that would benefit to receive IMRT. It is often used to treat head and neck cancers, but the UK Radiotherapy Board projects that it has the potential to be used in many more areas. The UK Radiotherapy Board also estimates that over 50% of radically treated patients should receive IMRT. However, radiotherapy planning takes longer when planning IMRT.

Stereotactic Radiotherapy (SABR)

SABR is a way of giving radiotherapy to a tumour from many different directions to target the treatment very accurately[xliv] and is often used for smaller areas such as tumours in the lung. It is able to give fewer fractions at a higher dose. This is already being used across the UK in specific types of cancer; further research is ongoing to explore whether this technology could be extended to other groups of cancer.

Proton Beam Therapy

Proton beam is a special type of radiotherapy which uses beams of protons to destroy cancerous cells. It can lead to less radiation hitting the healthy tissue surrounding a tumour. It is particularly valuable in treating cancers close to critical structures such as the brain stem, and for treating some types of cancer in children. There are two high-energy NHS proton beam centres currently being set up in the UK; these will treat specific paediatric tumours routinely and will run clinical trials exploring other indications in both children and adults. Delivery of proton beam therapy requires specialist training for many workforce groups.

MR-LINAC

This new equipment combines imaging and radiotherapy. This could reduce the need for as much imaging to be conducted separately from treatment during radiotherapy planning. It might also be more effective because it allows delivery of the radiotherapy to move in response to the body. For example, using MR-LINAC when a patient has lung cancer means that the movement of the tumour as the patient breathes can be tracked, and the radiotherapy delivered at a higher dose because healthy tissue is avoided.

Likelihood of this change: High

Timeline: Most of these innovations are currently in use but could become more widespread soon as they are being evaluated through clinical trials

Any cancer types highlighted: Breast and prostate cancer to receive fewer fractions, IMRT for head and neck and other cancers. SABR for lung cancer. Proton beam for paediatric cancers.

Impact on workforce demand: Since incidence of cancer is increasing, there will be greater demand for radiotherapy services overall. However, this may partially be offset by more evidence that hypofractionation is beneficial. In the short-term, while the workforce becomes familiar with IMRT it could take twice as long for treatment planning to take place. This is currently dissuading some centres from using IMRT, which is a concern. We could see

increased use of SABR for eligible patients in future, which would also result in increased planning and delivery time. However, impact on demand will vary greatly depending on the cancer type in question: the vast majority of radiotherapy activity is taken up by treatment for breast and prostate cancers and so developments in those cancer types will have a far greater impact than developments in rarer cancer types or sub-types.

New approaches to clinical trials and greater research engagement

Description of change: Participants in clinical trials are likely to be given more personalised options – stratifying the 'experimental' arm of the trial into more segments. This is likely to be based on molecular diagnostics to determine the specific cancer sub-type and therefore what treatment would be most appropriate to try. One example is the Cancer Research UK funded National Lung Matrix Trial which identifies which patients benefit most from treatments based on the genetic signature of their tumour. There are also potentially more fundamental changes to clinical trials – which will depend on how comfortable regulators feel about using evidence that measures the impact of an intervention against 'real world' data, rather than recruiting a 'control arm' cohort of patient receiving standard care.

More generally there is a drive to give more patients the opportunity to take part in research, which may increase demand for staff time across the board. Similarly, it is very important for there to be sufficient time for health professionals to engage in research: at the moment, this is not the case so there is an existing gap which needs addressing.

Likelihood of this change: High in terms of molecular stratification of participants, some chance in terms of further changes to clinical trials in future.

Timeline: May take 15 years to be very different

Any cancer types highlighted: All

Impact on workforce demand: Molecular stratification will increase demand on molecular pathologists and related workforce, and the increased complexities of clinical trials are likely to require more time from research nurses as well as the wider oncology and diagnostic workforce. However, it is unlikely to result in a larger shift in demand for staff time more generally. But staff must be given sufficient time to conduct reseach – and therefore this should be built into overall capacity considerations.

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