

Saving lives, averting costs

An analysis of the financial implications of achieving earlier diagnosis of colorectal, lung and ovarian cancer

A report prepared for Cancer Research UK

September 2014

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Acknowledgements

Incisive Health was commissioned by Cancer Research UK to deliver the project documented in this report.

The analysis contained has only been possible because of the expert input of members of the Cancer Research UK team, including:

- Martine Bomb
- Sara Hiom
- Harpal Kumar
- Jodie Moffat
- Nick Ormiston-Smith
- Liz Woolf
- Sarah Woolnough

We are also extremely grateful to the clinicians who freely gave their time to comment on, amend and improve the model treatment pathways:

- John Butler, Gynaecological Oncology Fellow, Royal Marsden Hospital
- Robin Crawford, Consultant Gynaecological Oncologist, Cambridge University Hospitals NHS Foundation Trust
- David Gilligan, Consultant Clinical Oncologist, Cambridge University Hospitals NHS Foundation Trust
- Eric Lim, Consultant Thoracic Surgeon, Royal Brompton Hospital
- Michael Machesney, Consultant Colorectal Surgeon, Barts Health NHS Trust
- Mark Saunders, Consultant Oncologist, The Christie NHS Foundation Trust
- Harriet Watson, Colorectal Nurse Consultant, Guy's and St Thomas' NHS Foundation Trust

The analytical model is based on staging data for colorectal, lung and ovarian cancer that were collected, analysed and provided by Public Health England's National Cancer Intelligence Network, as well as information on survival by stage provided by the National Cancer Registration Service.

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Executive Summary

Important progress has been made in improving cancer outcomes in the last couple of decades. Yet, despite this, cancer survival in England continues to be poorer than in some other countries. The reasons for this enduring gap are complex, but include later diagnosis – with more people being diagnosed when their cancer has already spread and is therefore less treatable – and differences in the approach to – and effectiveness of – treatment.

The focus of this report is early diagnosis. Earlier diagnosis does not guarantee a better cancer outcome but it does open up a greater range of treatment options, many of which impact less negatively on a person's quality of life.

Report objectives

There is now good evidence that earlier diagnosis can be effectively encouraged, through a combination of screening, public awareness, clinician education and better access to diagnostics. However, the financial implications of achieving earlier diagnosis are less well understood. This report seeks to consider the cost impact of earlier diagnosis on cancer treatment services.

Clinical Commissioning Groups (CCGs) and others will need to consider the financial consequences of earlier diagnosis in planning cancer services. The analysis presented in this report is designed to help them assess the 'downstream' consequences of earlier diagnosis.

Methodology

This report analyses colon, rectal, non-small cell lung and ovarian cancers. The treatment pathways for each cancer have then been mapped, based on published national guidance. Pathways were then costed based on publically available national data sources. Within each stage of the pathway, the proportion of patients receiving each option has been estimated using information from national datasets and clinical audits, as well as feedback from clinical experts.

Patient numbers for each stage of the pathway were estimated using published information on the stage distribution of cancer patients. Some patients will unfortunately experience a recurrence of their cancer. From a patient perspective, this means that their cancer is unlikely to be cured and that they will need to go through further treatment to manage it. From a financial perspective, they will therefore incur the costs associated with treatment for more advanced cancer, as well as for their initial stage of cancer. For the purposes of the model, it has been assumed that all patients who experience recurrence will go on to receive stage 4 treatment.

Further information on the methodology used to develop the pathways and to model the costs associated with them is included in Chapter 2. The cost analysis itself is presented in Chapter 3.

In order to model the cost impact of changes in stage of diagnosis, different scenarios were then considered, ranging from the impact of growing cancer incidence to the implication of all commissioners achieving the stage distribution of the current best in England. This analysis is presented in Chapter 4. Chapter 5 examines whether it would be possible to go further than the scenarios presented in this report.

It is important to note that the analysis presented in this report is only as accurate as the information on which it is based. Every effort has been made to verify the data used, but the following caveats should be taken into account:

- Local pathways do vary and so the treatment pathways presented in this report may not reflect local circumstances in every area of England
- Cancer is a fast moving area of medicine and therefore clinical practice can rapidly change
- Every patient's treatment will differ and so the pathways described in this report may not match those experienced by individual patients
- The costing information used in this report is the best available to the NHS, but may not fully reflect the local variations in cost which can occur
- Recurrences can be complex and rarely follow a clear pathway. The approach used in the model represents a simplification of what happens in clinical practice
- Staging data in England are incomplete and require further improvement
- Information on the use of some clinical interventions – such as chemotherapy – is still maturing and requires interpretation
- Future cost estimates have been based on the clinical practice (and costs) of today. It is likely that the cost of some existing interventions will reduce and that newer, potentially more expensive but also more effective treatments will become available

Given these issues, the financial implications identified in this report should be treated as estimates based on the data and literature available rather than as definitive projections.

Nonetheless, the clinical pathways, costs and assumptions have been tested with clinical experts and amended on the basis of their feedback. They are considered to be sufficiently accurate to inform discussions and planning about the treatment cost implications of earlier diagnosis.

Key findings

1. Within England there are marked variations in the proportion of patients who are diagnosed with cancer at an early stage. For colorectal cancer, there is a nearly a threefold variation between the highest and lowest performing CCGs, for lung cancer the variation is nearly fourfold and for ovarian cancer it is nearly fivefold.

2. Early stage cancer treatment is significantly less expensive than treatment for advanced disease:
 - For colon cancer, stage 1 treatment costs £3,373, whereas stage 4 treatment costs £12,519
 - For rectal cancer, stage 1 treatment costs £4,449, whereas stage 4 treatment costs £11,815
 - For lung cancer, stage 1 treatment costs £7,952, whereas stage 4 treatment costs £13,078
 - For ovarian cancer, stage 1 treatment costs £5,328, whereas stage 4 treatment costs £15,081

3. However, the costs of recurrence can be significant and should be taken into account when modelling overall cancer treatment costs. The financial as well as health impact of recurrence reemphasises the importance of ensuring that all patients are offered the most effective treatment possible.

4. Overall, late diagnosis is a major driver of NHS cancer treatment costs. Treatment for stage 3 and 4 colon, rectal, lung and ovarian cancer costs the NHS nearly two and a half times the amount spent on stage 1 and 2 services.

5. Significant savings could be realised if all CCGs were able to achieve the level of early diagnosis of the best:
 - For colon cancer, savings of over £24 million could be realised (benefitting over 4,500 patients)
 - For rectal cancer, savings of nearly £10 million could be realised (benefitting over 1,700 patients)
 - For ovarian cancer, savings of over £16 million could be realised (benefitting over 1,400 patients)
 - For lung cancer, over 3,400 patients would benefit. Due to the higher level of recurrence that occurs in lung cancer, achieving this level of earlier diagnosis would incur a cost of £6.4 million

6. Although delivering earlier diagnosis for lung cancer would not be cost saving, it would be highly cost-effective. Achieving the stage distribution of the best CCG in England could generate an additional 4,275 years of life. This equates to a cost of £1,515 per year of life gained.

7. Taking the four cancers together, achieving the level of early diagnosis comparable with the best in England could deliver savings of over £44 million, benefitting nearly 11,100 patients.

8. The financial dividend of earlier diagnosis amounts to five per cent of the total treatment budget for these four cancers.

9. Colon, rectal, lung and ovarian cancers account for approximately 21 per cent of overall cancer diagnoses in England¹. If the findings for these cancers were replicated for all cancers, then savings in treatment costs of just under £210 million would be realised, resulting in over 52,000 people being diagnosed with earlier stage cancer. This suggests that commissioners should develop plans in the expectation of being able to realise significant savings if they can deliver earlier diagnosis.
10. Even before new and potentially more expensive therapies are taken into account the costs associated with treating cancer will increase, as a result of rising incidence in the next ten years. Without action to reduce late diagnosis, treatment costs for the four cancers will rise by approximately £165 million. Yet, if the number of cancers diagnosed at a late stage was halved, then this cost increase would reduce to £111 million, helping over 27,000 patients in the process.
11. Developments in early diagnosis offer the potential to go further in saving lives and averting costs. Further work is required to quantify the potential outcomes and financial benefit.
12. The analysis presented in this report demonstrates that earlier diagnosis of cancer will deliver both an outcomes premium for patients and a financial dividend for the NHS through averted treatment costs. These findings create a compelling case for commissioners of NHS and public health services to act now to encourage earlier stage diagnosis.

Recommendations

Based on the findings presented in this report, we make the following recommendations:

1. Given the potential health and financial benefits associated with it, all those in a position of national leadership – the Department of Health, NHS England, Public Health England and the royal colleges – should reaffirm their commitment to delivering earlier diagnosis of cancer.
2. Earlier diagnosis of cancer should be viewed as an efficiency as well as a quality priority for the NHS. Future assessments of the costs and benefits of early diagnosis programmes, such as awareness interventions and efforts to expand access to diagnostics, should explicitly take into account the potential to avert treatment costs.
3. All CCGs and local health and wellbeing boards should set out plans to encourage earlier diagnosis of cancer as part of their joint health and wellbeing strategies. These strategies should set clear levels of ambition for earlier diagnosis and averted treatment costs, demonstrating how progress will be measured against these objectives and how averted costs will be reinvested in services. CCGs in areas of the country where levels of late stage diagnosis are significantly higher than the best in England should give particular priority to this issue.

4. NHS England should hold commissioners to account for their progress through the CCG assurance process, as well as working with Public Health England to establish joint accountability measures at a local and national level for the earlier diagnosis of cancer.
5. Without knowledge of stage, it is difficult to monitor the quality or effectiveness of the interventions delivered. Yet too many patients in England do not have the stage of their cancer recorded. This requires urgent attention. The recording of stage of cancer should be required as a key marker of quality in services by commissioners, who should work with providers of cancer services to improve the completeness of staging information that is reported for the populations they serve.
6. Local information on stage of cancer at the point of diagnosis should be interrogated to identify examples of high performance and to explore the good practice that leads to this. Where good practice is identified, it should be applauded and replicated by other commissioners.
7. There is a very strong health and financial case for limiting recurrence rates. Given this, it is imperative that the NHS does all it can to ensure transparency in variations in outcome by hospital and – where possible – by clinical team. Commissioners should design incentives to encourage reductions in risk-adjusted recurrence, encouraging all providers to aim for the standards achieved by the best.
8. Further work should be undertaken to quantify the advances in terms of early diagnosis which might be possible over a five, ten and twenty year period to assist the NHS in planning resources and capacity.
9. Efforts should be redoubled to invest in and facilitate world class research into both earlier diagnosis and improved treatments for cancer. The Government should play a central role in funding and facilitating this research, ensuring that the NHS is a leading location for cancer research.
10. NHS England should consider the case for using cancer as a pilot for a multi-disease early diagnosis strategy, with the intention of both improving health outcomes and averting treatment costs. The analytical approach used in this report should be refined and repeated for other cancers, as well as potentially other conditions, building a more comprehensive picture of the cost implications of earlier diagnosis.

The analysis contained in this report is based on data from England and therefore the recommendations are directed at the English health system. However, the conclusions and therefore necessary actions are likely to also apply in Scotland, Wales and Northern Ireland.

Introduction

Important progress has been made in improving cancer survival. The number of people living for at least a decade after a cancer diagnosis has doubled over the last forty years². Thanks to breakthroughs in cancer research and the hard work of clinical teams, we have better ways of diagnosing cancer and more effective treatments, with fewer side effects. Cancer waiting times are much shorter and equipment and facilities are better.

The progress made on cancer is a success story for the United Kingdom, showing what can happen when the generosity of the public is combined with the ingenuity of scientists and the commitment of NHS staff. However there is much more to do. Approximately half of patients will not live for a decade after being diagnosed with cancer and the number of people receiving a diagnosis of cancer continues to increase³.

Although important advances have been made in cancer services, cancer survival in England is still poorer than in some other countries⁴. It has been estimated that, by achieving outcomes comparable with the European average, an extra 5,000 lives could be saved each year in England. By achieving outcomes comparable with the best, an extra 10,000 lives could be saved⁵.

The gap in outcomes most clearly manifests itself in five-year survival. Although survival in England has improved, studies show that a significant survival gap remains, compared with other countries⁶. The reasons for poorer survival in England are complex, but include⁷:

- Later diagnosis, resulting in more people being diagnosed when their cancer has already spread
- Differences in treatment, resulting in people receiving less intensive or effective treatment for their cancer

The focus of this report is on stage of diagnosis. Earlier diagnosis does not guarantee a better cancer outcome. However, it does open up a greater range of treatment options, many of which have less impact on a person's quality of life. Furthermore, treating a cancer before it has spread increases the chance of helping a patient achieve long-term survival.

If the case for earlier diagnosis with respect to outcomes is well made, then the financial implications are less well understood. In planning early diagnosis initiatives, it will be important that Clinical Commissioning Groups (CCGs) and others are able to consider the financial consequences of any change in the stage of cancer diagnosis.

Taking colorectal, ovarian and non-small cell lung cancers as case studies, the report:

- Sets out the current treatment pathways for each cancer, informed by national guidelines and expert clinical advice

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- Estimates the costs associated with treatment at each stage of the pathway, using national NHS reference costs
 - Profiles the current distribution of patients by stage of diagnosis and treatment
 - Models the financial impact of changes in diagnosis over time

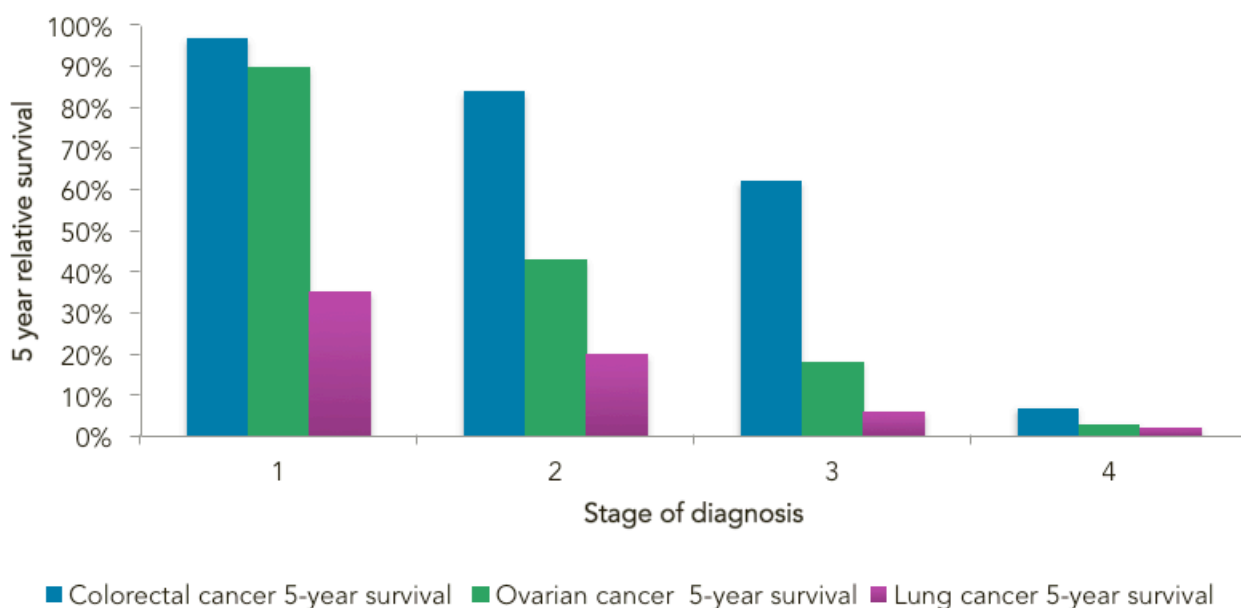
The report does not consider the cost-effectiveness – measured in QALYs generated or the cost of generating these QALYs – of early diagnosis intervention or the costs associated with delivering it.

Chapter 1: background – the case for earlier diagnosis

When a cancer is initially diagnosed, it is important to understand whether it has spread from its initial location and, if so, how far. This process is known as staging. In broad terms, early stage cancers are those that have not spread beyond the initial organ, whereas advanced stage cancers have spread to other parts of the body. A more detailed explanation of staging for colorectal, non-small cell lung and ovarian cancer is included in Annex 1.

Although survival varies by cancer, diagnosis at an earlier stage is consistently associated with better survival, as set out in the figure below⁸. Therefore the potential survival gain from earlier diagnosis is significant.

Figure 1: 5-year relative survival by stage of diagnosis East of England Data, 2002 – 2006*



There are a number of important enablers for achieving earlier diagnosis:

- Where they exist, effective screening programmes need to be put in place to identify people with cancer who do not yet have symptoms
- High levels of participation in cancer screening need to be encouraged, maximising the opportunity for early diagnosis, whilst supporting informed choice
- The public need to be aware of the signs and symptoms of potential cancer
- Awareness and knowledge of symptoms need to be translated into a motivation to seek help

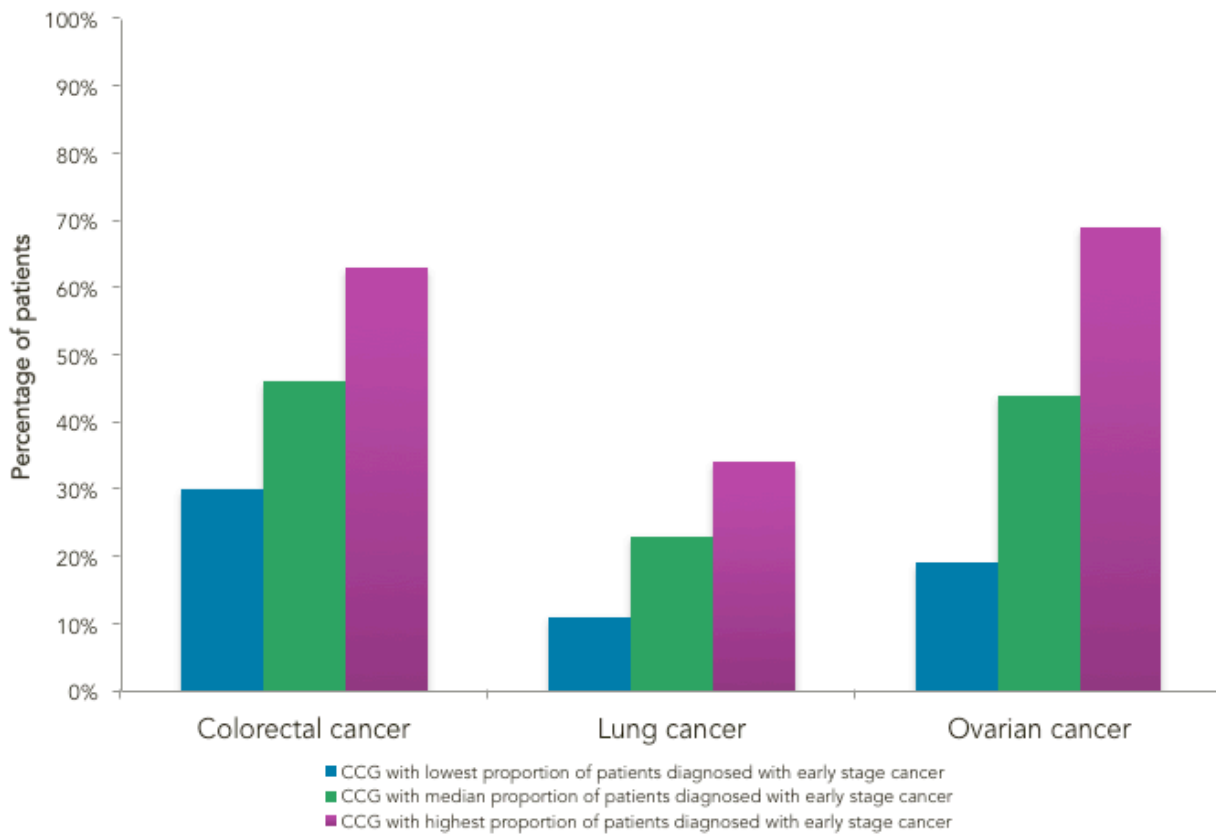
* Lung cancer 5-year relative survival by stage based on 2003 – 2006 East of England data

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- Primary care professionals need to be educated on the signs and symptoms of potential cancer and supported in investigating signs and symptoms and referring patients promptly
 - There needs to be rapid access to diagnostics and specialist expertise, ensuring that the system does not impose delays once cancer is suspected

This report does not seek to investigate the steps required to enable earlier diagnosis, rather it examines the financial implications for cancer treatment of doing so. However analysis of variations in cancer diagnosis suggests that achieving earlier diagnosis should be possible:

- Other countries diagnose a higher proportion of patients with early stage cancer⁹
- Within England, some areas of the country are able to diagnose substantially higher proportions of patients with early stage cancer, as set out in the figure below¹⁰

Figure 2: variations in proportion of patients diagnosed with early stage cancer, by CCG[†]



Early stage cancer is defined as stage 1 and stage 2 combined

These findings are significant in that they demonstrate that improvement is possible. They suggest that earlier diagnosis should be a priority for all those seeking to improve cancer outcomes.

[†] In line with the methodology described later in this report, CCGs with small numbers of patients and / or low levels of staging completeness have been removed

Chapter 2: methodology

Health service budgets are under increasing pressure and hospital capacity is under strain. It is therefore important that commissioners of health services consider the downstream financial consequences of early diagnosis initiatives, as well as the potential health benefits. To date there has been little evidence about the financial implications of earlier diagnosis. The costs of individual interventions (such as the extension of a screening programme or the introduction of an awareness programme) have been evaluated, but there has been no attempt to assess the financial implications on treatment services of earlier diagnosis. This report attempts to begin to fill that gap.

It is important to stress that this report attempts to draw together a large amount of data from disparate sources into a unified model. Much of the data were not collected with this purpose in mind and therefore the findings need to be treated with a degree of caution. The financial implications identified in this report should be treated as estimates based on the data and literature available rather than as definitive projections.

The analysis is based on England, as more data are available on different aspects of cancer diagnoses, services and costs.

In preparing this report, we have undertaken a seven-step process:

1. Identifying cancers to use in the modelling process
2. Mapping treatment pathways by stage
3. Costing each treatment pathway by stage
4. Assigning patient numbers to each stage of each pathway
5. Producing overall cost estimates for treatment by stage
6. Assessing the financial impact of changes in the proportions of patients diagnosed at each stage
7. Producing forward-looking projections of financial impact, based on cancer incidence

1. Identifying cancers to use in the modelling process

Colorectal, ovarian and non-small cell lung cancer were selected for this project because they each have:

- A clinical consensus that earlier diagnosis can make a positive impact on outcomes
- Been the subject of activity to encourage earlier diagnosis through – for example – the *Be Clear on Cancer* campaigns, indicating a strong level of stakeholder support
- Relatively high incidence, meaning that the project’s findings will be relevant to all CCGs – taken together these cancers accounted for just over 76,000 thousand new diagnoses of cancer in 2012, accounting for 21 per cent of all cancer incidence

- Clear national guidance on treatment, meaning that treatment pathways can be expected to be relatively consistent
- Good sources of data to inform the modelling process
- An active and engaged clinical community willing to contribute to and critique the model

2. Mapping treatment pathways by stage

Model treatment pathways were developed, using published sources of clinical guidance and advice on pathway development. A full list of the sources used can be found in Annex 2.

It is important to note that clinical guidance, although robust and authoritative, may vary from actual clinical practice for a range of reasons:

- Evidence on effectiveness will evolve and guidance may not keep pace with clinical practice
- Local circumstances may necessitate a different approach being taken
- Clinicians may prefer alternative approaches in any case

Therefore the model pathways were tested and amended through the input of a number of clinical experts.

Given that the treatment approaches for colon and rectal cancer are very different, separate pathways have been developed for each. Simplified versions of the model pathways are included in Annex 3 and detailed descriptions of each pathway in Annex 4.

3. Costing each cancer pathway by stage

Each pathway was then costed using NICE guidelines, NHS reference costs and Healthcare Resource Group (HRG) costs as appropriate. For drug treatments, which are often excluded from tariffs, NICE technology appraisals or British National Formulary costs were used. It is important to note that there will be some local variations in costs. However, national reference costs are the basis on which NHS commissioners and providers plan and negotiate resources, so they should represent a realistic estimate.

4. Assigning patient numbers to each stage of each pathway

It is then necessary to estimate the number of patients who will receive treatment at each stage of the pathway and, within each stage, which treatment option they are likely to receive. This latter point is particularly important for the purposes of the model, given that different treatment options will be associated with different costs.

The proportion of patients receiving treatment at each stage has been calculated using staging data published by Public Health England in July 2014. Data from the ICBP benchmarking partnership^{11,12} was used to identify the stage distribution for colon, rectal and non-small cell lung cancer as this was not available from Public Health England. Unstaged patients were allocated to each stage in accordance with the proportions observed with staged patients[‡]. The proportion of patients diagnosed at each stage is set out in the table below.

Table 1: proportion of patients diagnosed at each stage

Stage	Colon cancer	Rectal cancer	Non-small cell lung cancer	Ovarian cancer
1	13%	26%	15%	38%
2	31%	22%	8%	6%
3	32%	29%	22%	35%
4	24%	23%	55%	21%

It is also important to recognise that, unfortunately, at each stage some people will suffer a recurrence of their cancer. From a patient perspective, this means that their cancer is unlikely to be cured and that they will need to go through further treatment to manage it. From a financial perspective, they will therefore incur the costs associated with treatment for more advanced cancer, as well as for their initial stage of cancer.

Reflecting recurrence rates in the model has not been straightforward:

- The NHS does not record recurrence rates consistently, making it difficult to assess how many patients will require further treatment or indeed what treatment they will require
- The nature of a recurrence will determine what form of treatment and support a patient will require. For example a patient (re)diagnosed following an emergency admission for spinal cord compression, will have very different needs than a patient (re)diagnosed with a localised metastasis following routine follow-up

In order to incorporate the costs of recurrence into the model, the following assumptions have been made:

- The proportion of patients with stage 1, 2 or 3 cancer that relative survival statistics show do not live to five years beyond diagnosis are considered to have suffered a recurrence
- Patients with a recurrence are considered to have (re)presented with stage 4 cancer and will receive the entire stage 4 pathway of treatment
- Patients initially diagnosed with stage 4 cancer will only receive the stage 4 pathway of treatment

[‡] The following proportion of patients were reported as unstaged for each cancer – colorectal 12%, lung 15% and ovarian cancer 20%

Not all patients will receive the same treatment. For example, older people have been shown to receive less intensive treatment than younger people, even when their clinical characteristics are the same¹³. Estimates for the proportion of patients who will receive different treatments within each pathway have been developed using the following sources of intelligence:

- Data from national clinical audits or national datasets, such as the Hospital Episode Statistics (where available)
- Estimates from national clinical guidelines or technology appraisals
- Feedback from clinicians

The proportion of patients who will receive cancer drugs at each stage of treatment, as well as the drugs they will receive, has been estimated using data from the Systemic Anti-Cancer Therapy (SACT) Dataset. This dataset is the largest of its kind in the world, but is still maturing with not all submissions being complete. Information on stage has been derived from the treatment intent field with 'neo-adjuvant', 'adjuvant' and 'curative' being assessed as early stage and 'palliative' being assessed as advanced stage. This is in line with the methodology used by NHS England in its own analyses using SACT data.

Most stage 1 cancer patients will not receive chemotherapy, so early stage treatment has been ascribed to stage 2. Where drugs were only used for treatment at either stage 3 or 4 these were attributed as such and when a drug can be used to treat both stage 3 and stage 4, guidance from clinicians and available literature was sought to estimate proportions.

A detailed breakdown of the numbers of patients estimated to receive each treatment is included in Annex 4.

5. Producing overall cost estimates for treatment by stage

Based on the costed pathways and the methodology for estimating the numbers of patients who will receive treatment at each stage, as well as which treatment they will receive, two key estimates have been produced:

- Cost of treatment per patient at each stage for colon, rectal, non-small cell lung and ovarian cancer
- Overall cost to the NHS of treatment at each stage for colon, rectal, non-small cell lung and ovarian cancer

Both estimates are based on a blended cost, informed by the proportion of patients who will receive each treatment at each stage. They also take into account the estimated costs of recurrence, as set out above.

Chapter 3 sets out the findings on the costs associated with each stage of treatment.

6. Assessing the financial impact of changes in the proportions of patients diagnosed at each stage

Using the cost estimates for each stage of treatment, it is possible to calculate the financial implications for cancer treatment, of changes to the proportion of people diagnosed with cancer at an early stage. Chapter 4 sets out the scenarios considered and the cost implications associated with them.

7. Producing forward-looking projections of financial impact, based on cancer incidence

The incidence of most cancers increases with age. As the population grows older, it is likely that the number of people who receive a cancer diagnosis will continue to increase. Previous cancer-specific projections for changes in incidence in the UK have been adapted for use in this analysis¹⁴. Based on the model developed, it is possible to use these estimates to make projections about the future costs of cancer treatment, based on the different scenarios, which are considered in Chapter 4.

There are some important caveats to this approach. The projections are based on today's costs. They do not take into account any health service inflation, nor changes to the costs of delivering cancer care. It is likely that two conflicting forces will impact upon the costs of cancer treatment in the future:

- Existing treatments may become cheaper as more efficient ways of delivering them are developed and/or they are subjected to greater competition due to loss of intellectual property rights
- New surgical, radiotherapy and drugs treatments will be developed which are likely to rely on more advanced technology and so be more expensive

Nonetheless, the projections for future costs are a useful way of considering the medium to long-term financial implications of strategies to achieve earlier diagnosis.

Chapter 3: the costs associated with treating different stages of cancer

Treatment for the earlier stages of cancer is often less intensive or invasive than treatment for more advanced disease. This is reflected in the costs of treatment, as this chapter demonstrates. Full details of the cost calculations are included in Annex 5.

Treatment costs per individual

For colon, rectal, non-small cell lung and ovarian cancer, the costs of treating a person with early stage disease are significantly lower than the costs of treating someone with advanced disease, as set out in the table below.

Table 2: cost of treatment by stage, excluding the costs of recurrence

	Colon cancer	Rectal cancer	Non-small cell lung cancer	Ovarian cancer
Stage 1	£3,373	£4,449	£7,952	£5,328
Stage 2	£7,809	£6,944	£8,349	£10,217
Stage 3	£9,220	£8,302	£8,733	£11,207
Stage 4	£12,519	£11,815	£13,078	£15,081

This estimate may overstate the costs associated with treating stage 4 lung cancer. Many patients with stage 4 lung cancer only live for a very short period of time and receive little or now active treatment. For these patients, it is likely that treatment costs will be significantly lower. However, these patients often do not have their cancer staged and so will be underrepresented in the weighted cost estimates used in this study.

The costs associated with recurrence can be significant and also need to be taken into account when planning service costs, as demonstrated in the following table. The table shows the additional average cost per patient of recurrence.

Table 3: average cost per patient of recurrence, by stage

	Colon cancer	Rectal cancer	Non-small cell lung cancer	Ovarian cancer
Stage 1	£376	£354	£8,457	£1,504
Stage 2	£2,003	£1,890	£10,346	£8,623
Stage 3	£4,757	£4,490	£12,251	£12,276
Stage 4	n/a	n/a	n/a	n/a

This reinforces the importance of ensuring that initial treatment for cancer – which is usually surgery, sometimes combined with radiotherapy and / or drug treatment – is of the highest quality and available to all who might need it.

Figures 3, 4, 5 and 6 below demonstrate that in particular for non-small cell lung cancer the cost of recurrence is a major driver of overall cost.

Figure 3: comparison of costs of treatment and recurrence for stage 1 colon, rectal, lung and ovarian cancer

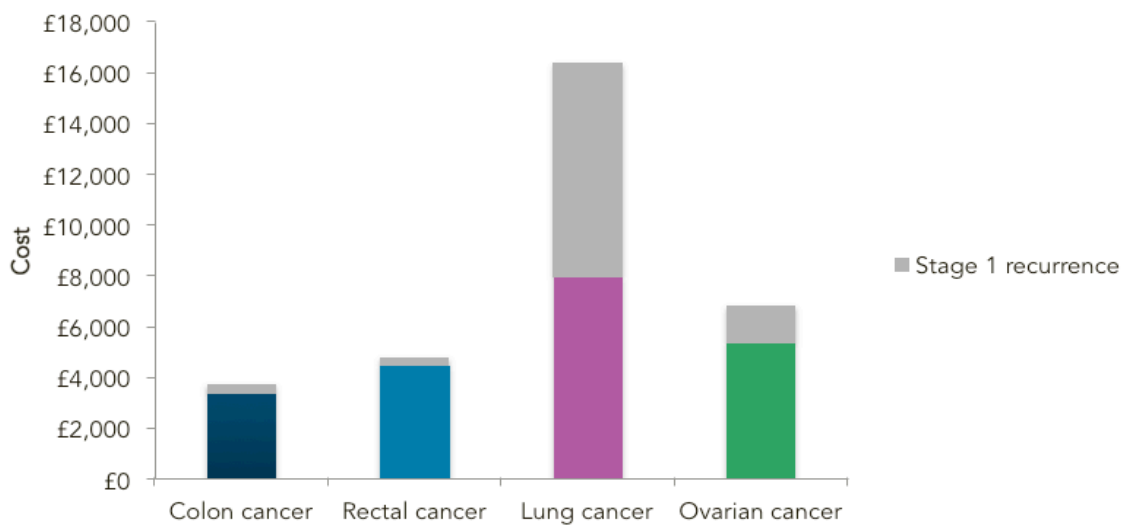


Figure 4: comparison of costs of treatment and recurrence for stage 2 for colon, rectal, lung and ovarian cancer

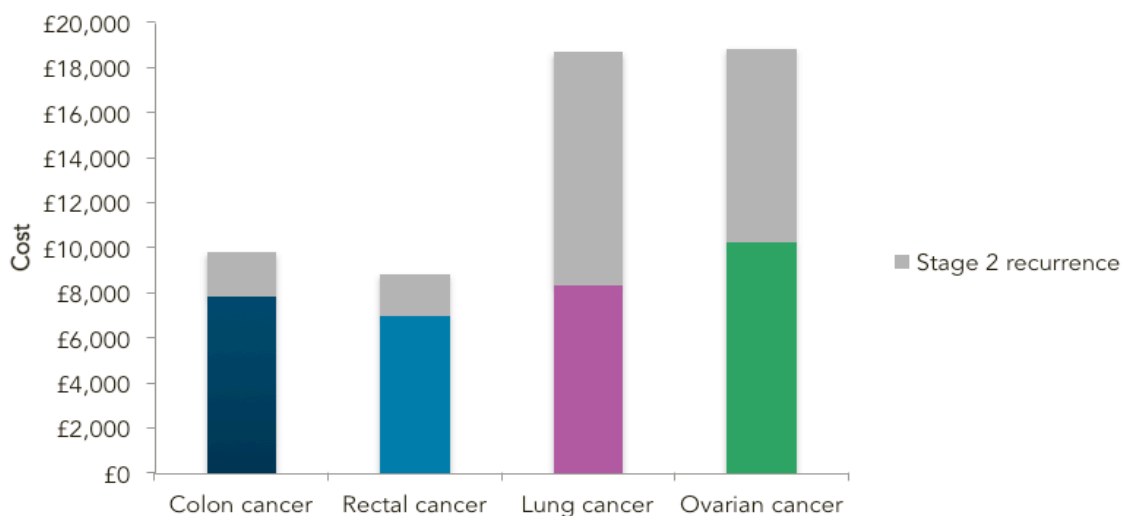


Figure 5: comparison of costs of treatment and recurrence for stage 3 for colon, rectal, lung and ovarian cancer

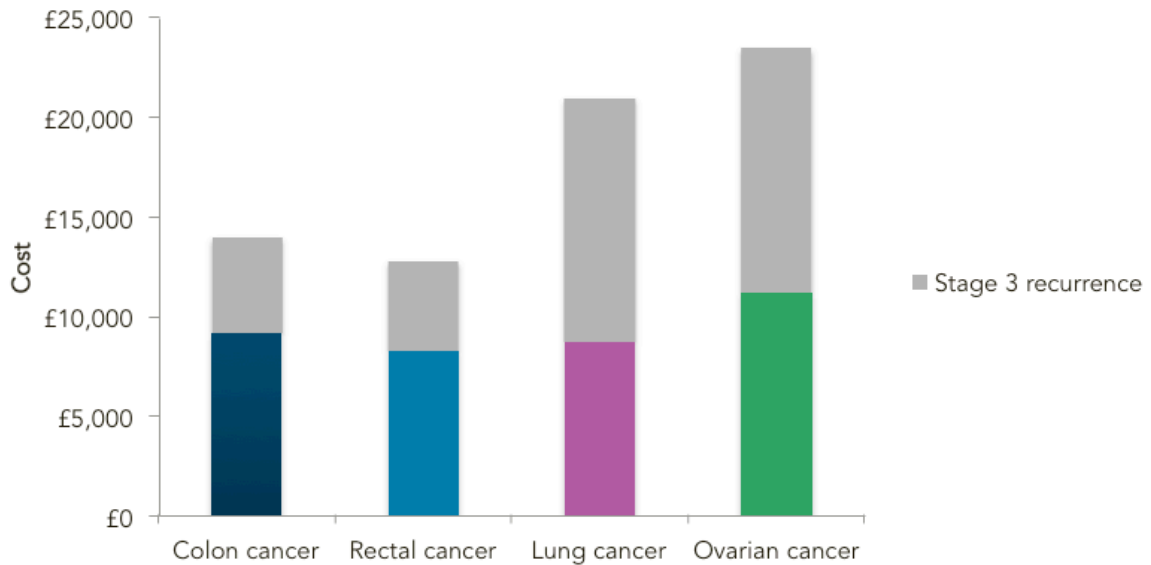
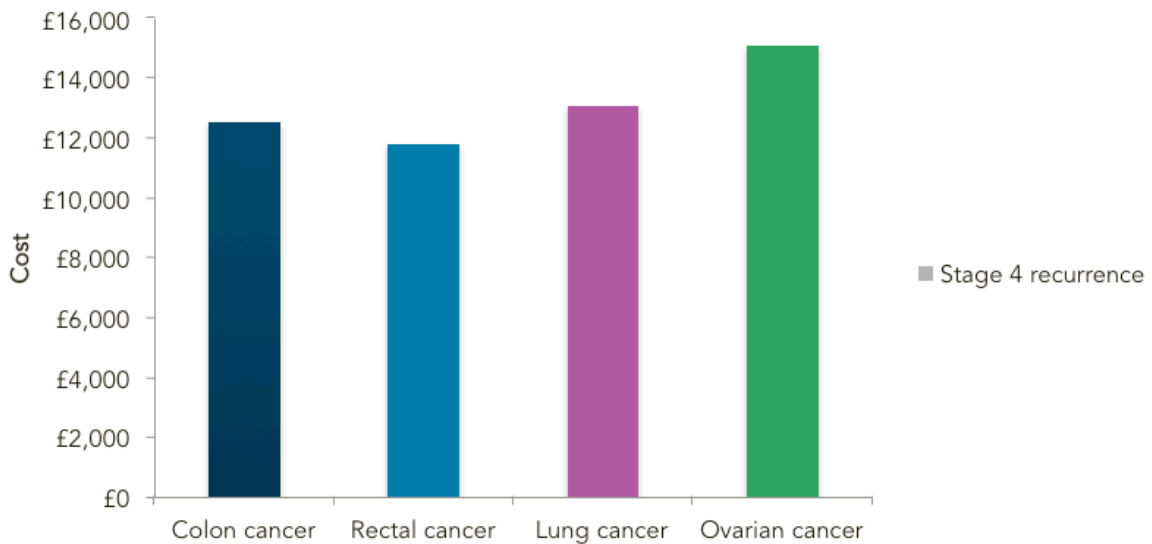
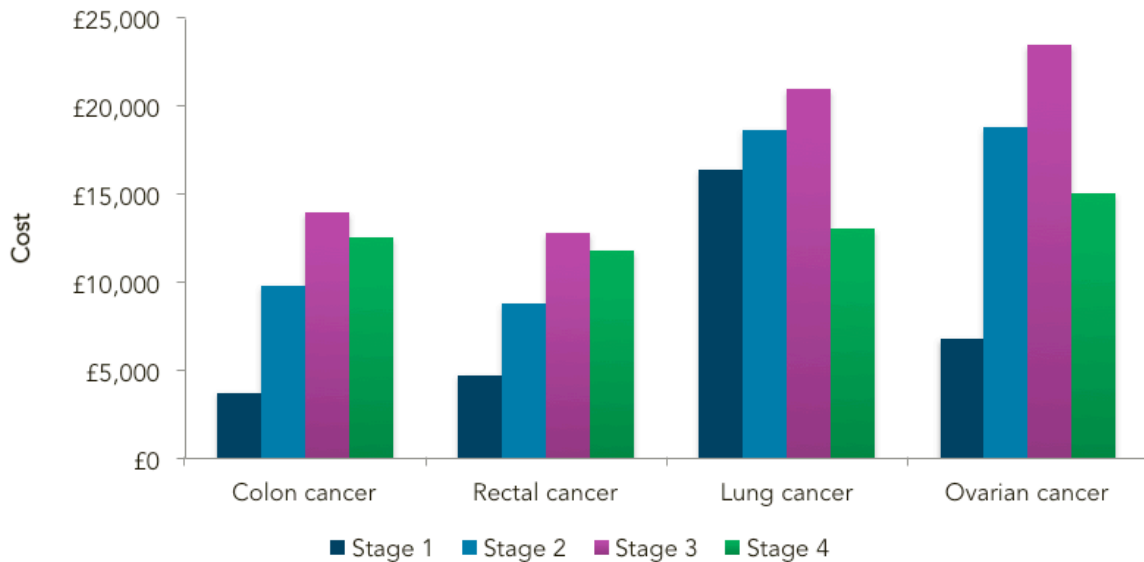


Figure 6: comparison of costs of treatment and recurrence for stage 4 for colon, rectal, lung and ovarian cancer



Nonetheless, the costs of earlier stage treatment, even when the costs of recurrence are taken into consideration, are substantially lower than those of treatment for more advanced cancer, as set out in the figure below.

Figure 7: summary of costs by stage for colon, rectal, lung and ovarian cancer



Overall costs

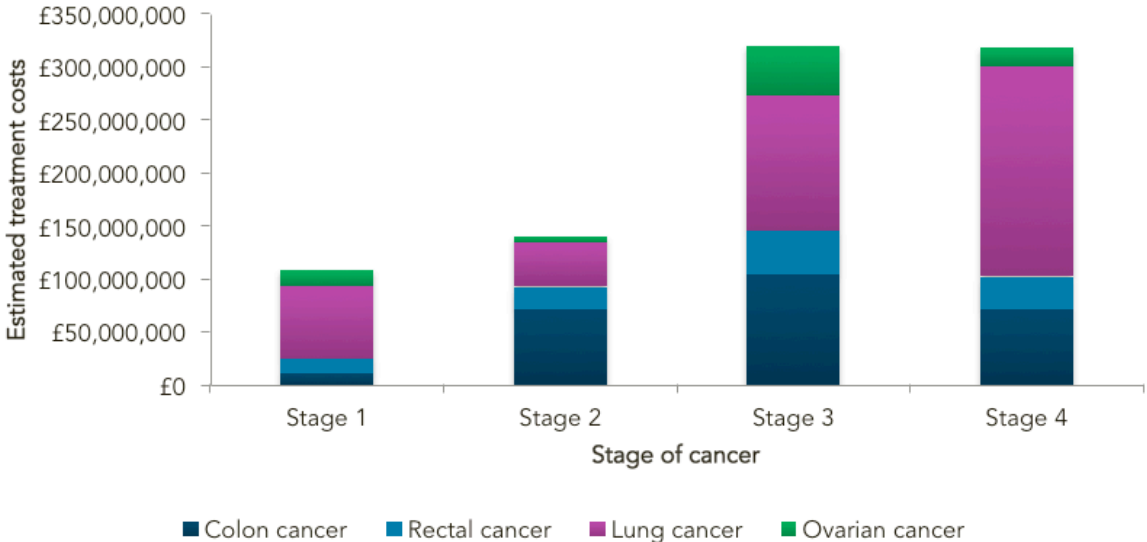
The difference in cost according to stage at an individual level is magnified when an NHS-wide perspective is taken, given the numbers of patients currently diagnosed with more advanced disease, as set out in the table below. The table shows the distribution according to stage as recorded by Public Health England as part of its monitoring of the Public Health Outcomes Framework.

Table 4: estimated numbers of patients diagnosed with each stage of cancer^{15, 16}

	Colon cancer	Rectal cancer	Non-small cell lung cancer	Ovarian cancer
Stage 1	2,931	2,946	4,730	2,136
Stage 2	7,237	2,442	2,523	337
Stage 3	7,450	3,267	6,937	1,968
Stage 4	5,690	2,607	17,342	1,181

Figure 8 demonstrates that late diagnosis is a major driver of NHS treatment costs, with treatment for stage 3 and 4 colon, rectal, non-small cell lung and ovarian cancer costing nearly two and a half times the amount spent on stage 1 and 2 services. In Chapter 4 we explore the potential financial dividend from achieving earlier diagnosis.

Figure 8: summary of treatment costs by stage for colon, rectal, lung and ovarian cancer



Chapter 4: the financial implications of achieving earlier diagnosis

The previous chapter demonstrates that late diagnosis is a major driver of NHS costs. This chapter shows the scale of the benefit that could be delivered by earlier diagnosis, both through the number of patients who could benefit and by realising savings for the NHS.

The chapter examines:

- The scale of the benefit which could be delivered if all clinical commissioning groups were to achieve the proportion of patients diagnosed with early stage cancer currently achieved by the best
- The implications for the future for different scenarios relating to early diagnosis

Full details of these calculations are set out in Annex 6, but the key findings are presented below.

Matching the best in England

Using data published by the National Cancer Intelligence Network (NCIN) as part of Public Health England's reporting on the Public Health Outcomes Framework, it is possible to assess the variation in stage of diagnosis that occurs across the country¹⁷. As set out in Figure 2 in Chapter 1, the variation is considerable.

It is important to note that the recording of stage is still variable in England; nationally one in five patients for ovarian cancer and just over one in ten for colorectal and non-small cell lung cancer do not have stage recorded. However, this masks significant variation. For ovarian cancer, for example, one CCG has nearly two thirds of patients unstaged, whereas others manage to stage all patients. It is notable that some CCGs with a high proportion of patients recorded as having early stage cancer also have a very high proportion of unstaged cancer, suggesting that some of those patients where stage is not recorded may have been diagnosed late. Further work is required to reduce the numbers of patients whose stage is not recorded. Investigating, documenting and recording with the cancer registry the stage of a person's cancer should be seen as a key marker of quality.

In order to eliminate any distortion caused by low recording of stage, CCGs where the number of patients treated was in the lowest quintile and those CCGs that had more than one third of patients not staged have been removed from the analysis. Given that ovarian is a less common cancer, it should be noted that the number of cases per CCG is still relatively low.

The following clinical commissioning groups achieved the highest proportion of patients diagnosed at an early stage:

- Colorectal cancer – Norwich
- Non-small cell lung cancer – Knowsley
- Ovarian cancer – Aylesbury Vale

The table below sets out the implications for patients and NHS finances if every clinical commissioning group were able to achieve the same level of early diagnosis as the current best.

Table 5: summary of patient impact and NHS cost implications of achieving the best in England

Cancer type	Additional patients diagnosed with early stage cancer	Additional costs
Colon cancer	4,516	-£24,435,267
Rectal cancer	1,707	-£9,624,907
Non-small cell lung cancer	3,468	£6,477,471
Ovarian cancer	1,406	-£16,673,157
Total	11,097	-£44,255,861

In summary, having the same stage distribution as the best performing clinical commissioning group in England would realise savings in treatment costs of just over £44 million and would result in nearly 11,100 people being diagnosed with earlier stage cancer.

To put these savings into context, the overall savings for the four cancers amount to five per cent of the overall treatment budget for colon, rectal, non-small cell lung and ovarian cancer. This is a significant saving given the pressures facing health services.

Colon, rectal, non-small cell lung and ovarian cancers account for approximately 21 per cent of overall cancer diagnoses in England. This suggests that if the findings for these cancers were replicated for all cancers, then savings in treatment costs of approximately £210 million would be realised, resulting in over 50,000 people being diagnosed with earlier stage cancer.

Achieving earlier diagnosis for non-small cell lung cancer would not be cost saving. However, it would be highly cost-effective. The table below shows that achieving the stage distribution of the best CCG in England could generate an additional 4,275 years of life for lung cancer. This equates to a cost of £1,515 per year of life gained.

Table 6: calculation of additional years of life gained by achieving the stage distribution of the best CCG in England

Stage	Median survival (months) ¹⁸	% diagnosed at stage (current)	Patient numbers at stage (current)	Years of life (England average)	% diagnosed at stage (best in England)	Patient numbers at stage (best in England)	Years of life (best in England)	Years of life gained
1	22.5	15%	4,730	8,869	22.20%	7,000	13,125	
2	10.9	8%	2,523	2,292	11.80%	3,721	3,380	
3	6.5	22%	6,937	3,758	18.90%	5,960	3,228	
4	2.6	55%	17,342	3,757	47.10%	14,852	3,218	
Total				18,675			22,951	4,275

Looking to the future

As well as considering short-term improvements that could be made, it is important that healthcare commissioners consider the longer-term implications of changes in services. In order to assist with this process, three scenarios have been considered:

1. **No change** – the proportion of patients diagnosed with early stage cancer remains broadly the same
2. **Achieving the current best in England** – all CCGs move to a stage where they are diagnosing the same proportion of patients with early stage disease as being achieved by the current best
3. **Halving diagnosis with advanced disease** – the number of people diagnosed with stage 3 or 4 cancer is reduced by 50%, with a consequent increase in the number of people diagnosed with stage 1 or stage 2 disease

Research has been undertaken to estimate the increase in incidence for 28 different types of cancer in the UK, which has been adapted for use in this analysis¹⁹. Due to the increasing size of the population and ageing, the number of cases is projected to increase for the majority of cancers. The estimated increase in incidence for the cancers included in this analysis is as follows:

- Colon cancer – 1.9% increase in incidence per annum
- Rectal cancer – 1.7% increase in incidence per annum
- Non-small cell lung cancer – 1.7% increase in incidence per annum
- Ovarian cancer – 0.2% decrease in incidence per annum

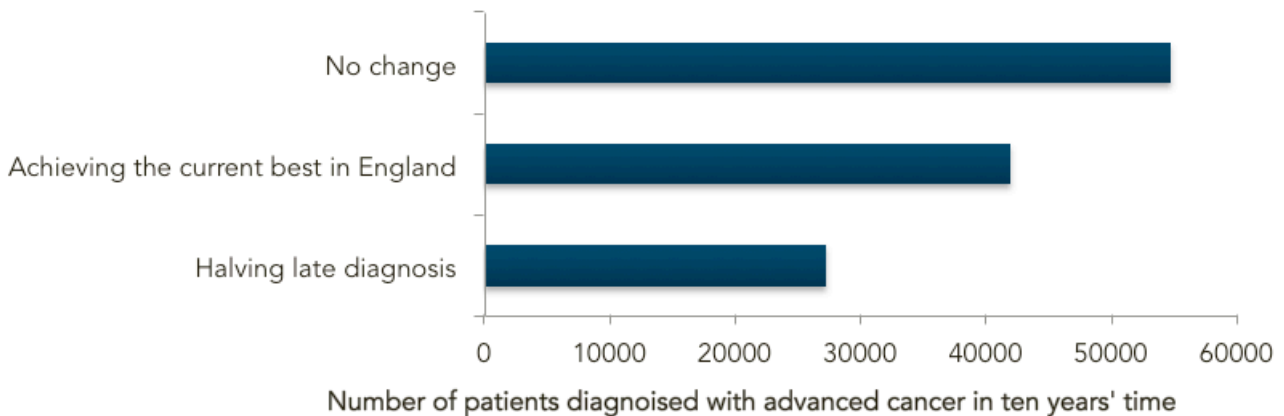
The table below summarises the number of patients who could be expected to be diagnosed with advanced cancer for colon, rectal, non-small cell lung and ovarian cancer, as well as the financial implications of this.

Table 7: projected costs of treatment for colon, rectal, lung and ovarian cancer in ten years' time based on the different scenarios

Scenario	Number of patients diagnosed with advanced cancer in ten years time	Overall costs in ten years time	Cost change compared to now
No change	54,805	£1,113,090,670.41	£165,309,605.47
Achieving the current best in England	41,922	£1,070,533,591.34	£122,752,526.40
Halving late diagnosis	27,255	£1,058,880,489.06	£111,099,424.11

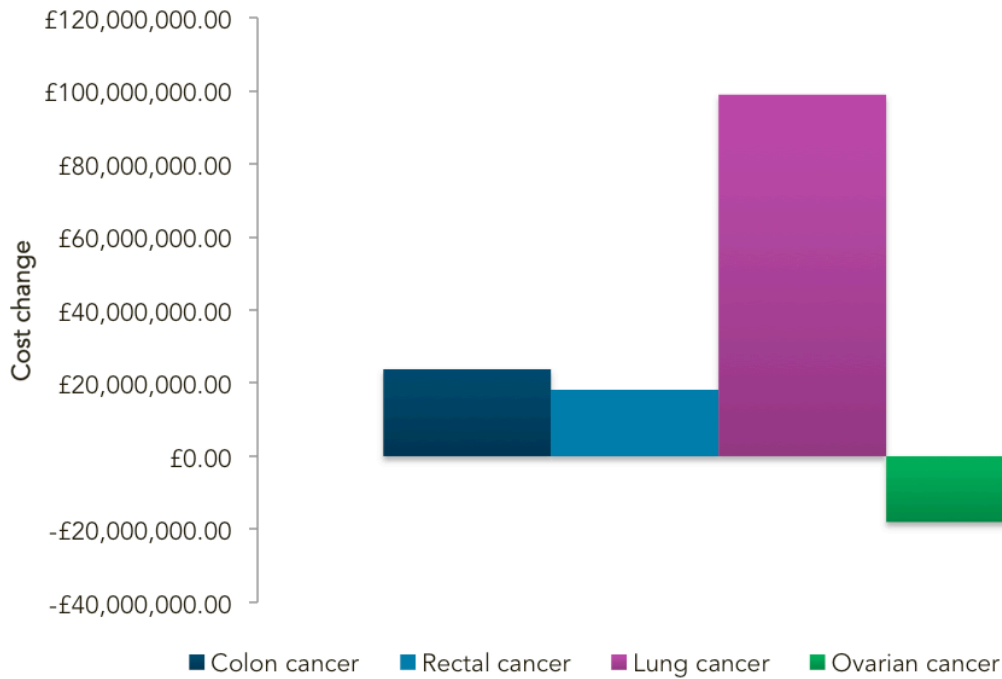
Increases in incidence will drive higher costs in cancer treatment over the next ten years. However, this analysis shows that earlier diagnosis could play a significant role in controlling these costs.

Figure 9: summary of the number of patients that will be diagnosed with advanced cancer in ten years' time based on the different scenarios



If every clinical commissioning group was to achieve the level of early diagnosis currently achieved by the best, then it would actually be possible to reduce costs for ovarian cancer in a decade, even when changes in incidence are taken into account. Colon and rectal cancer costs would increase by a small amount. The situation with non-small cell lung cancer is somewhat different because a high proportion of patients can be expected to suffer a recurrence of their cancer, as set out in the figure below.

Figure 10: national cost implications of every clinical commissioning group achieving the current best in terms of early diagnosis, in ten years' time



This finding re-emphasises the importance of effective treatment in minimising recurrence rates. For example, if the costs of recurrence are removed for non-small cell lung cancer, then the overall increase in costs would be halved.

In addition to improving treatment to minimise recurrence rates, the analysis reaffirms the importance of prevention strategies such as tobacco control to minimise the number of people who develop cancer in the first place.

Chapter 5: the outcomes implications of achieving earlier diagnosis

A person's prognosis is better if their cancer is diagnosed at an earlier stage; they have a better chance of achieving long-term survival. Therefore, as well as delivering a financial dividend to the NHS, earlier diagnosis could be expected to have a significant impact on cancer outcomes. This chapter quantifies the expected benefit of every area of England achieving the stage distribution currently achieved by the best performing CCGs.

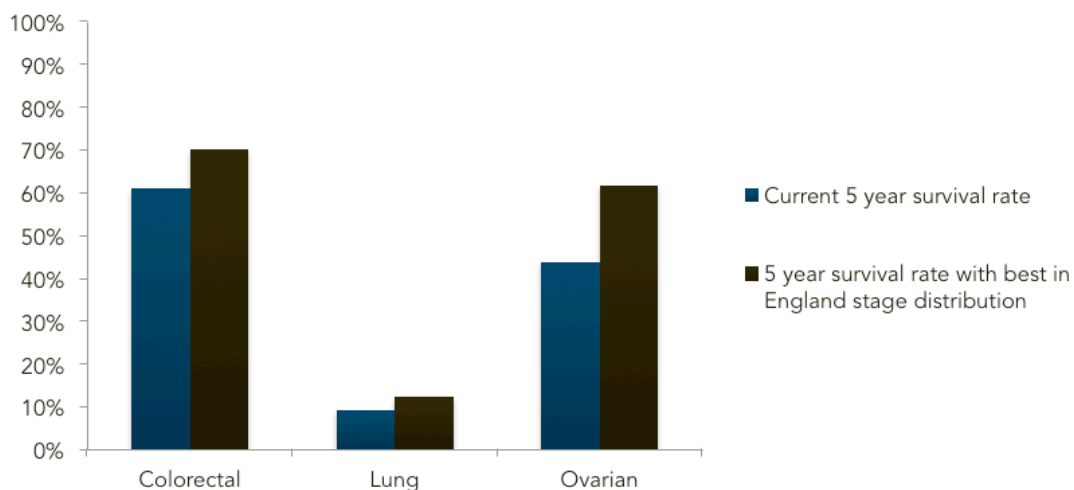
Earlier diagnosis is only one component of the action required to improve outcomes; without effective treatment, cancer survival will still be poor and attention also needs to be devoted to ensuring that all patients receive the most effective clinically-appropriate treatments for them. Findings from the ICBP suggest that differences in treatment approach do account for some of the survival gap observed between England and some other countries. Therefore the outcomes estimates presented in this chapter will only be realistic if patients are provided with high quality treatment, appropriate for their cancer and stage of disease.

Survival gain from achieving the stage distribution of the best in England

As set out in Chapter 1, patients diagnosed with cancer at an earlier stage have significantly higher five-year survival than those diagnosed with more advanced disease for colon, rectal, ovarian and lung cancer. This suggests that reducing the proportion of patients diagnosed with cancer that has already spread would have a substantial survival benefit.

By applying survival observed by stage to the stage distribution achieved by the best-performing CCGs in England, it is possible to project the overall survival impact of all CCGs achieving the stage distribution of the current best. The figure below demonstrates that achieving the stage distribution of the best-performing CCGs in England could be expected to deliver a substantial improvement in five-year survival.

Figure 11: change in five-year survival from achieving the stage distribution of the best-performing CCGs in England



Impact on people

Using these figures, it is also possible to estimate how many additional people would be alive at least five years after receiving a diagnosis of cancer. The estimated improvement in survival described above also translates into significantly more people living for at least five years after a cancer diagnosis, as set out in the table below. In total, it is estimated that achieving the stage distribution of the best CCG in England for colon, rectal, ovarian and lung cancer could mean that over 5,000 additional people per year would be alive five years after diagnosis.

Table 8: projected changes in numbers of people alive after five years per year if the stage distribution of the current best in England was achieved

	Colorectal cancer	Lung cancer	Ovarian cancer
People alive after 5 years based on current stage distribution	21,056	2,923	2,457
People alive after 5 years based on best in England stage distribution	24,233	3,847	3,458
Additional people alive after 5 years with best in England stage distribution	3,177	924	1,001

Comparisons with other countries

It is also possible to estimate the extent to which this shift in stage distribution would impact upon England's relative performance on five-year survival, compared to other countries. It is estimated that, if every area achieved the stage distribution of the best performing CCGs in England:

- For colorectal cancer, English five-year survival would be higher than those reported for the best-performing country (Australia) in the ICBP reports
- For lung cancer, the gap between English five-year survival and those of the best-performing country (Canada) would have reduced by a third
- For ovarian cancer, English five-year survival would be higher than those reported for the best-performing country (Canada) in the ICBP reports

These projections are based on data supplied by the National Cancer Registration Service (Eastern Office) (NCRSEO). It should be noted that data from the NCRSEO records five-year survival that is higher than was included for England as part of the ICBP programme.

It is also highly likely that other countries' performance will also have improved in the interval since the ICBP data were collected. No attempt has been made to model the level of improvement in survival that could be anticipated in other countries. Therefore these estimates should not be used to infer that achieving the stage distribution of the best in England will – alone – lead to outcomes comparable with the highest performing countries in the world.

Nonetheless, it is clear that if all CCGs could achieve the stage distribution of the best in England then it would go a long way towards achieving the Government's cancer survival goals and bridging the survival gap with other countries.

Chapter 6: could we go further?

The previous chapters in this report demonstrate that delivering earlier diagnosis is not only affordable but should save costs from a treatment perspective. Delivering earlier diagnosis therefore has the potential to free up resources to invest in other parts of the cancer pathway or NHS services, delivering both a health premium, in terms of better outcomes, and a financial dividend, in terms of averted costs.

However, the extent of the outcomes and money available for investment delivered will depend upon two factors:

1. The pace and scale at which earlier diagnosis can be achieved
2. The extent to which recurrence can be prevented

This chapter explores the potential to go further and the steps that need to be realised to fulfill this potential.

Achieving earlier diagnosis

The experience of some parts of England, as well as that of other countries, shows that it should be possible to diagnose more people at an earlier stage. Developments in our understanding of different aspects of cancer offer the hope that we should be able to go further, exceeding current good practice:

Screening

Screening programmes are an important way of diagnosing cancer before a person has symptoms. Therefore new screening techniques offer the potential to deliver a step change in the stage of diagnosis, as set out in the box below.

Saving lives through bowel cancer screening

When bowel cancer is found at the earliest stage, there is an excellent chance of survival and more than 90% of people survive at least 5 years. When found late, the chances of survival are dramatically reduced.

Bowel cancer screening has a significant role to play in delivering earlier diagnosis, with the existing screening test reducing the chances of dying from bowel cancer by about 16%²⁰. The Department of Health in England has now committed to adding a second bowel screening test to the programme.

The new Flexi-Scope test bowel screening test uses a camera and light at the end of a flexible tube to detect and remove pre-cancerous growths from the lower parts of the bowel. Cancer Research UK scientists led the trial which showed that the Flexi-Scope test has the potential to prevent a third of bowel cancer cases in people screened, as well as reducing the death rate by over 40%²¹.

Cancer Research UK is currently investing in research into screening techniques for bowel, breast, cervical, oesophageal, ovarian and prostate cancer, in addition to continuing to fund more theoretical research which will hopefully one day lead to further advances in screening.

Screening programmes are only effective if people participate. It is right that people should be able to make an informed decision about whether screening is for them, but it is also important that people are invited to attend and that screening services are accessible, convenient and of high quality. Cancer Research UK supports informed choice by developing information for the public on the implications of screening and by funding studies on how people respond to information on screening.

Awareness of symptoms and motivation to act upon them

Not all cancers can be detected through screening:

- Effective screening programmes do not exist for all cancers
- Even when they do, not all people and all age groups will be covered by screening programmes
- No screening test identifies 100 per cent of cancers
- Many cancers develop in between screening rounds

For these reasons it is important that people are aware of the signs and symptoms of potential cancer and feel motivated to act upon them and know how to do so. Evidence from the International Cancer Benchmarking Programme suggests that people in England may be more reluctant to seek help, even when they fear that something is wrong²². Improving the number of people diagnosed with cancer at an early stage will therefore require not only raising awareness, but also empowering people to act upon increased knowledge.

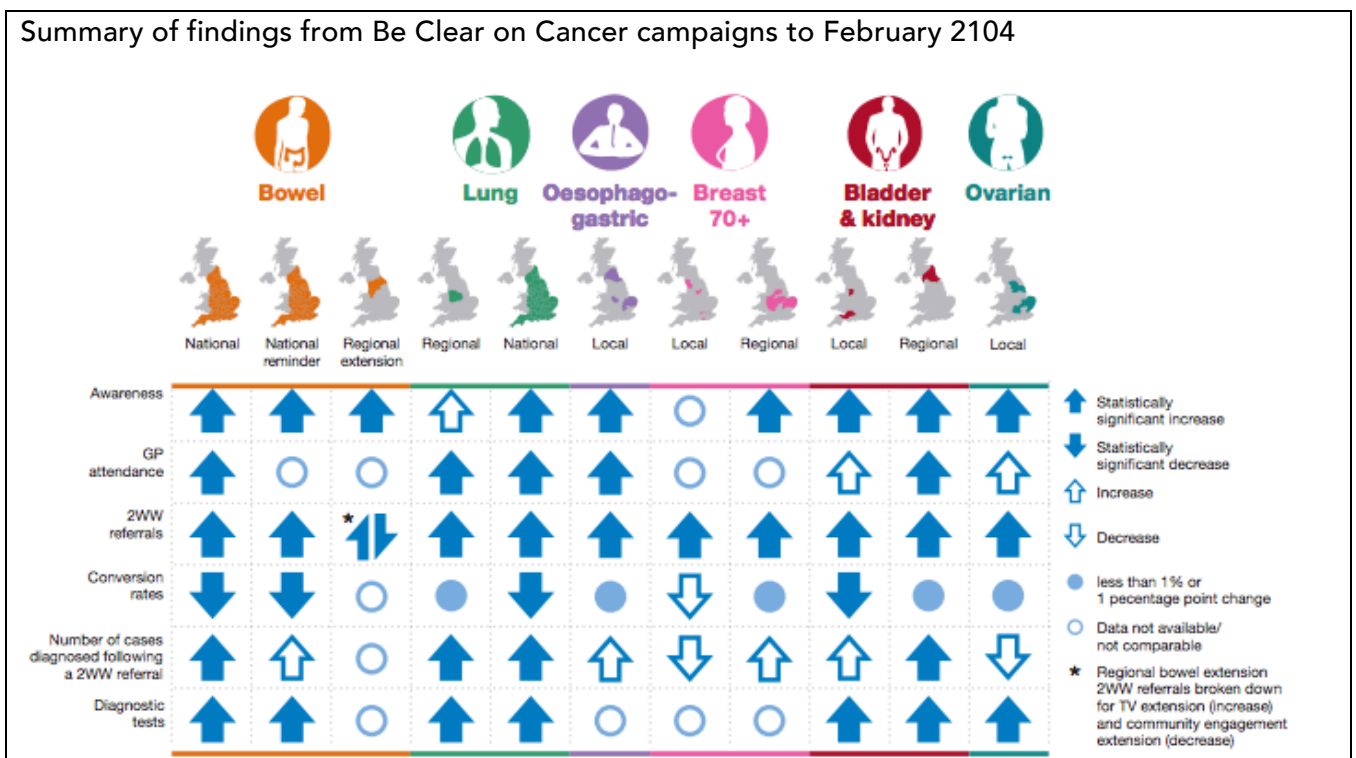
Cancer Research UK works in close partnership with the Department of Health, Public Health England and NHS England on the successful Be Clear on Cancer campaigns. To date national campaigns have been implemented for bowel cancer, kidney and bladder cancer, breast cancer in women over 70 and lung cancer; at a regional level for oesophago-gastric cancer and ovarian cancer; and at a local level for skin cancer and the 'know 4 sure' campaign featuring symptoms relevant to a range of cancers²³.

The campaigns are still being evaluated but have already generated invaluable evidence about how to increase awareness and the effects this can have on health seeking behaviour and NHS activity.

Key findings include²⁴:

- Statistically significant increases in awareness of key signs, symptoms and risk factors for a range of cancers, including bowel, breast, lung, bladder, oesophageal and ovarian cancer
- Statistically significant but manageable increases in GP attendances related to the signs and symptoms of lung, bladder, oesophageal and ovarian cancer
- Statistically significant increases in lung cancer cases diagnosed (equating to 700 additional cases), early stage diagnoses (approximately 400 more cancers) and the proportion of patients receiving surgery (equating to around 300 more patients)

A summary of the campaign findings to February 2014 is included in the box below.



Supporting primary care professionals to spot and investigate potential cancer

For most people with signs and symptoms of cancer, their GP will be the person who they seek help from. GPs see many people with undifferentiated symptoms of ill health that could be cancer. However, the number of people subsequently diagnosed with cancer will be relatively small within the context of a GP's overall caseload.

The current variation in stage of diagnosis, together with the variation in the number of patients who report a high number of repeat visits to their GP before receiving an onward referral suggests that some GPs are more successful than others in diagnosing cancer early. There may be a number of explanations for this, including:

- Patients in some practice areas may be able to articulate their signs and symptoms more clearly
- Some GPs may have a higher threshold of suspicion for cancer than others
- There may be differences in access to, and usage of, primary care diagnostics which may detect cancer, such as chest x-rays, blood tests, endoscopy and ultrasound

Rapid access to specialist expertise

Ensuring that patients do not have to wait for lengthy periods for specialist support is also important for early diagnosis:

- A person's cancer will continue to grow whilst they are waiting for specialist attention and, in some cases, may spread
- Lengthy waiting times may deter primary care clinicians from investigating potential cancer, as they may feel that there is little point in doing so

Over the past decade NHS services in England have made significant strides in reducing cancer waiting times, ensuring people receive faster diagnoses and more rapid treatment. It will be important that this progress is maintained and that recent breaches of waiting time standards are addressed and do not recur.

Reducing the likelihood of recurrence

The analysis presented in this report shows that there is a significant financial as well as health cost associated with recurrence. If recurrence could be eliminated for colon, rectal, ovarian and non-small cell lung cancer, then nearly 18,000 patients would be spared repeated treatment, as well as the health consequences of cancer, which has progressed. In financial terms, the NHS would save over £233 million in treatment costs. There is therefore a dual imperative to ensure that, once cancer is diagnosed, patients receive the most clinically appropriate treatment for them, reducing the chance that their cancer may recur or spread.

Although progress has been made in ensuring access to appropriate treatment, there is some evidence that not all patients in England receive the optimum treatment for them:

- Access to the latest radiotherapy²⁵ and drug treatments²⁶ is variable

- Active treatment rates for older people decline significantly and to an extent which is unlikely to be explained by comorbidities or patient preference alone²⁷

Of course there is also a pressing need for more effective surgery, radiotherapy and drug treatments, which reduce still further the risk of recurrence or – when it does occur – improve the quantity and quality of life delivered to patients. Cancer Research UK invested £351 million in 2013/14 in research, much of it focused on treatment or the scientific research that underpins the development of improved treatments. Over 33,000 patients join Cancer Research UK trials every year, testing the fruits of research²⁸. In total, over 4,000 scientists, doctors and nurses are funded across the UK.

Cancer Research UK receives no funding from the Government for its research. Therefore this investment is the public's investment. It offers the prospect that in years to come it will be possible to go significantly further in delivering the earlier diagnosis and improved treatments which are required to save and improve more lives.

Chapter 7: recommendations

This report demonstrates the potential to avert substantial treatment costs, as well as the potential to benefit thousands of patients, by achieving earlier diagnosis. Earlier diagnosis could also be an important way of reducing the future costs associated with cancer treatment.

Although the report focuses on colon, rectal, ovarian and non-small cell lung cancer, there is no reason to suggest that the findings would not apply to other cancers. Taken together, these four cancers represent 21 per cent of overall cancer incidence. This gives some idea of the overall potential opportunity presented by early diagnosis.

The analysis presented demonstrates that, not only could early diagnosis play an important part in improving cancer outcomes, but it can reduce the costs associated with cancer treatment, freeing up resources for other elements of cancer services and to ensure that those who do require treatment receive the best possible interventions. This latter point is important; the analysis shows that recurrence is a substantial driver of cost in cancer treatment, as well as having a devastating impact on the lives of people affected by cancer.

Based on the findings presented in this report, we make the following recommendations:

1. Given the potential health and financial benefits associated with it, all those in a position of national leadership – the Department of Health, NHS England, Public Health England and the royal colleges – should reaffirm their commitment to delivering earlier diagnosis of cancer.
2. Earlier diagnosis of cancer should be viewed as an efficiency as well as a quality priority for the NHS. Future assessments of the costs and benefits of early diagnosis programmes, such as awareness interventions and efforts to expand access to diagnostics, should explicitly take into account the potential to avert treatment costs.
3. All CCGs and local health and wellbeing boards should set out plans to encourage earlier diagnosis of cancer as part of their joint health and wellbeing strategies. These strategies should set clear levels of ambition for earlier diagnosis and averted treatment costs, demonstrating how progress will be measured against these objectives and how averted costs will be reinvested in services. CCGs in areas of the country where levels of late stage diagnosis are significantly higher than the best in England should give particular priority to this issue.
4. NHS England should hold commissioners to account for their progress through the CCG assurance process, as well as working with Public Health England to establish joint accountability measures at a local and national level for the earlier diagnosis of cancer.

5. Without knowledge of stage, it is difficult to monitor the quality or effectiveness of the interventions delivered. Yet too many patients in England do not have the stage of their cancer recorded. This requires urgent attention. The recording of stage of cancer should be required as a key marker of quality in services by commissioners, who should work with providers of cancer services to improve the completeness of staging information that is reported for the populations they serve.
6. Local information on stage of cancer at the point of diagnosis should be interrogated to identify examples of high performance and to explore the good practice that leads to this. Where good practice is identified, it should be applauded and replicated by other commissioners.
7. There is a very strong health and financial case for limiting recurrence rates. Given this, it is imperative that the NHS does all it can to ensure transparency in variations in outcome by hospital and – where possible – by clinical team. Commissioners should design incentives to encourage reductions in risk-adjusted recurrence, encouraging all providers to aim for the standards achieved by the best.
8. Further work should be undertaken to quantify the advances in terms of early diagnosis which might be possible over a five, ten and twenty year period to assist the NHS in planning resources and capacity.
9. Efforts should be redoubled to invest in and facilitate world class research into both earlier diagnosis and improved treatments for cancer. The Government should play a central role in funding and facilitating this research, ensuring that the NHS is a leading location for cancer research.
10. NHS England should consider the case for using cancer as a pilot for a multi-disease early diagnosis strategy, with the intention of both improving health outcomes and averting treatment costs. The analytical approach used in this report should be refined and repeated for other cancers, as well as potentially other conditions, building a more comprehensive picture of the cost implications of earlier diagnosis.

The analysis presented in this report is based on the costs of today's treatment pathways. Rapid therapeutic advances are occurring in the field of cancer that may radically alter treatment paradigms. These changes offer the hope of improved outcomes and reduced recurrence rates. They will, however, come at a high financial cost, particularly for advanced disease. These likely developments reaffirm the importance of encouraging earlier diagnosis wherever possible, saving resources which can then be made available to ensure that the – hopefully fewer – patients who do develop advanced cancer can receive the best treatment possible.

Annex 1 – the different stages of cancer

Overview of the stages of bowel cancer²⁹

Bowel cancer, also called colorectal cancer, includes large bowel cancer (colon cancer) and cancer of the back passage (rectal cancer). The recognised staging of bowel cancer is the TMN staging which stands for Tumour, Node, Metastases and describes the size of a primary tumour (T), whether any lymph nodes contain cancer cells (N), and whether the cancer has spread to another part of the body (M). There are four stages of bowel cancer 1 – 4, which are explained in more detail below.

Stage 1

Stage 1 indicates that the cancer has grown through the inner lining of the bowel or into the muscle wall. No cancer has spread to the lymph nodes. (T1, N0, M0 or T2, N0, M0).

Stage 2

Stage 2 is divided into 2a and 2b:

- 2a indicates that the cancer has grown into the outer covering of the bowel wall, but there are no cancer cells in the lymph nodes (T3, N0, M0)
- 2b means that the cancer has grown through the outer covering of the bowel wall and into the tissues or organs next to the bowel. No lymph nodes have been affected and the cancer has not spread to other areas of the body (T4, N0, M0)

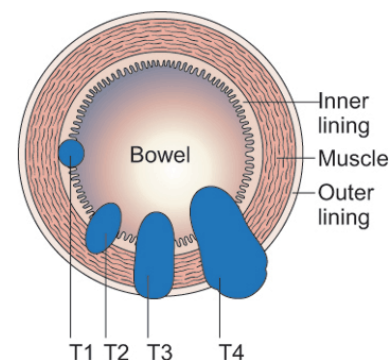


Diagram showing T stages of bowel cancer
Copyright © CancerHelp UK

Stage 3

Stage 3 is divided into three stages:

- 3a means that the cancer is still in the inner layer of the bowel wall or has grown into the muscle layer and between 1 and 3 nearby lymph nodes contain the cancer cells (T1, N1, M0 or T2, N1, M0)
- 3b indicates that the cancer has grown into the outer lining of the bowel wall or into surrounding body tissues or organs, and between 1 and 3 nearby lymph nodes contain cancer cells (T3, N1, M0 or T4, N1, M0)
- 3c means that the cancer can be any size, has spread to 4 or more nearby lymph nodes, but there is no cancer spread to any other part of the body (any T, N2, M0)

Stage 4

This means the cancer has spread to other parts of the body (such as the liver or lungs) through the lymphatic system or bloodstream (any T, any N, M1).

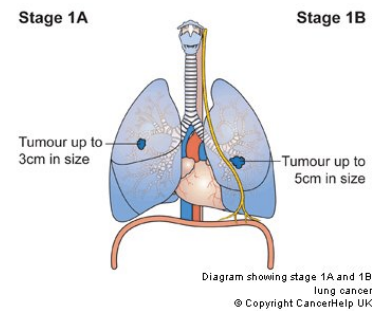
Overview of the stages of non-small cell lung cancer³⁰

There are two main groups of lung cancer, small cell and non-small cell lung cancer. Non-small cell lung cancer makes up about 87% of the lung cancers in the UK.

Stage 1

At stage 1 the cancer is small and localised and there is no cancer in any lymph nodes. Stage 1 can be divided into 1a and 1b:

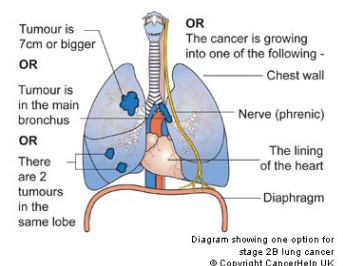
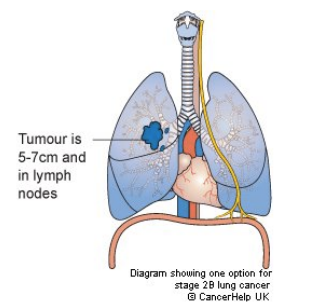
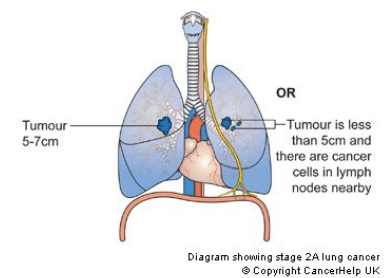
- Stage 1a means the tumour is small (up to 3cm)
- Stage 1b means the cancer is between 3 to 5cm. It may have spread into nearby structures such as the main airway of the lung (bronchus) or the membrane covering the lung (pleura). Or the lung may have partly collapsed



Stage 2

Stage 2 is divided into 2A and 2B:

- Stage 2A means:
 - The cancer is between 5 and 7cm but there are no cancer cells in any lymph nodes. Or it is 5cm or less and there are cancer cells in the lymph nodes close to the affected lung
 - In either case it may have spread into nearby structures such as the main airway of the lung (bronchus) or the membrane covering the lung (pleura). Or the lung may have partly collapsed
- Stage 2B means:
 - The cancer is between 5 and 7cm and there are cancer cells in the lymph nodes close to the affected lung
 - Larger than 7cm but there are no cancer cells in any lymph nodes
 - Not in any lymph nodes but has spread into one or more of the following areas – the chest wall, the muscle under the lung (diaphragm), the phrenic nerve, or the layers that cover the heart (mediastinal pleura and parietal pericardium)
 - In the main airway (bronchus) close to where it divides to go into each lung
 - Making part of the lung collapse
 - Any size but there is more than one tumour in the same lobe of the lung



Stage 3

In this stage, the whole of the affected lung may have collapsed or may be inflamed due to the build up of mucus. Stage 3 is divided into stages 3A and 3B.

- Stage 3A can mean a number of different things:
 - The cancer is in the lymph nodes close to the lung and the cancer is bigger than 7cm
 - The cancer has spread into one or more of the following areas: the chest wall, the muscle under the lung (diaphragm), or the layers that cover the heart
 - The cancer has spread into lymph nodes close to the main airway or in the centre of the chest on the same side as the affected lung
 - The cancer is any size but has grown into another major structure in the chest, such as the heart, the trachea, the oesophagus, the nerve that goes to the larynx, a spinal bone, or main blood vessel. There may also be cancer cells in lymph nodes close to the affected lung
 - The cancer is in more than one lobe of the same lung and may have spread into lymph nodes close to the affected lung

- Stage 3B cancer can mean the following:
 - The cancer has spread into lymph nodes on the opposite side of the chest from the affected lung
 - The cancer is in the lymph nodes at the centre of the chest (mediastinum) and has spread into one or more of the following areas – the chest wall, the diaphragm, the layers that cover the heart or a major structure in the chest – such as the heart, the trachea, oesophagus or a main blood vessel

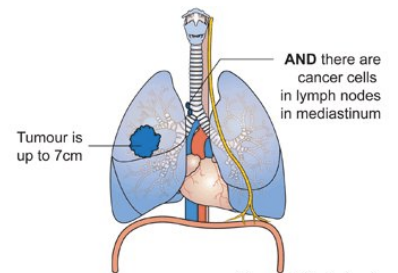


Diagram 1 of 3 showing stage 3A lung cancer © Copyright CancerHelp UK

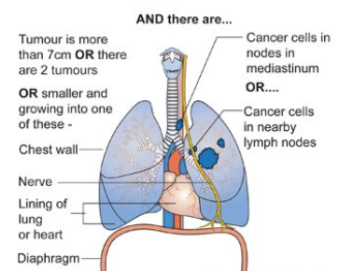


Diagram 2 of 3 showing stage 3A lung cancer © Copyright CancerHelp UK

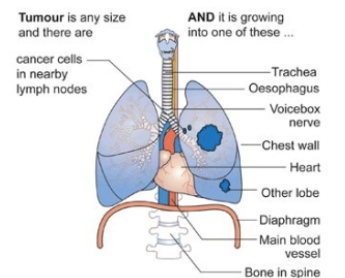


Diagram 3 of 3 showing stage 3A lung cancer © Copyright CancerHelp UK

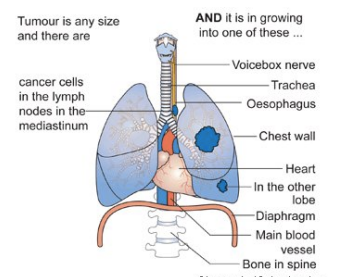


Diagram 1 of 2 showing stage 3B lung cancer © Copyright CancerHelp UK

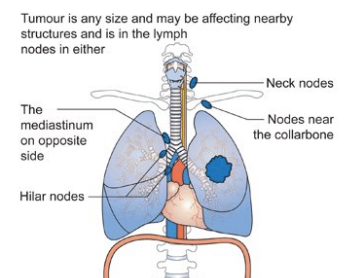
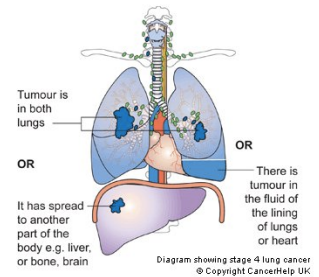


Diagram 2 of 2 showing stage 3B © Copyright CancerHelp UK

Stage 4

- Stage 4 means that the cancer:
 - Is in both lungs
 - Has spread to another part of the body – for example, the liver or bones
 - Has caused a fluid collection around the lung or heart that contains cancer cells – (a malignant pleural effusion) or pericardial effusion



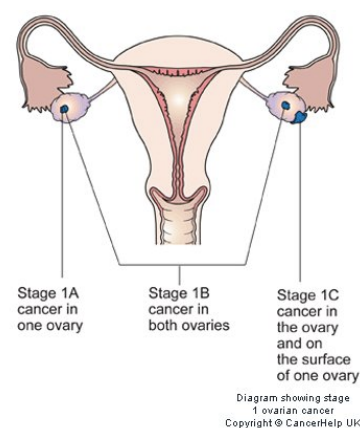
Overview of the stages of ovarian cancer³¹

A simple 1-4 staging system is used for ovarian cancer and it is called the FIGO system after its authors, the International Federation of Gynaecological Oncologists.

Stage 1

Stage 1 ovarian cancer means the cancer is only present in the ovaries. It is divided into 3 groups:

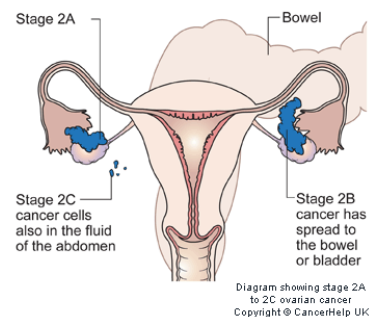
- Stage 1a means that the cancer is completely inside one ovary
- Stage 1b indicates that the cancer is completely inside both ovaries
- Stage 1c means that as well as cancer in one or both ovaries, there is some cancer on the surface of an ovary or there are cancer cells in fluid taken from inside the abdomen during surgery or the ovary bursts before or during surgery



Stage 2

Stage 2 means the cancer has grown outside the ovary or ovaries and is growing within the area circled by the pelvis. There may also be cancer cells in the abdomen. Stage 2 cancer can also be divided into the following groups:

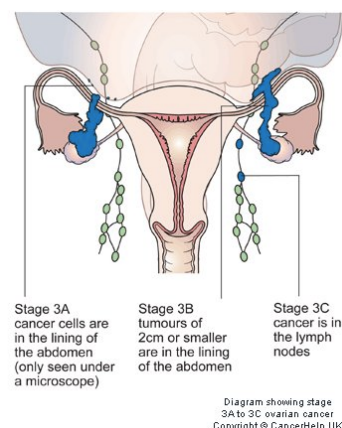
- 2a means that the cancer has grown into the fallopian tubes or the womb
- 2b means that the cancer has grown into other tissues in the pelvis, for example the bladder or rectum
- 2c indicates that the cancer has grown into other tissues in the pelvis and there are cancer cells in fluid taken from inside the abdomen



Stage 3

Stage 3 cancer of the ovary means the cancer has spread outside the area surrounded by the pelvis into the abdominal cavity. The cancer is also stage 3 if cancer is found in the lymph nodes in the upper abdomen, groin or behind the womb. Stage 3 cancer can be described as the following:

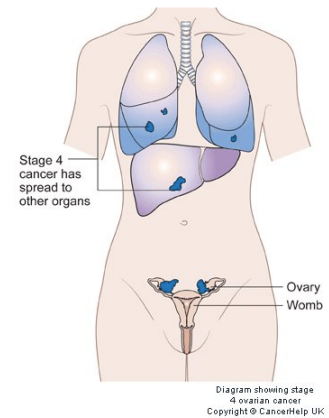
- 3a means that using a microscope, cancer growths can be seen in tissue taken from the lining of the abdomen



- 3b indicates that there are visible tumour growths on the lining of the abdomen that are 2cm across or smaller
- 3c means that there are tumour growths larger than 2cm on the lining of the abdomen, or cancer in lymph nodes in the upper abdomen, groin or behind the womb, or both

Stage 4

Stage 4 ovarian cancer means the cancer has spread to other body organs some distance from the ovaries, such as the liver or lungs. This is called metastatic cancer. But if ovarian cancer is only found on the surface of the liver and not within the liver itself, then the cancer is still described as stage 3.



Annex 2 – sources of information used to develop and cost treatment pathways

Table 9: sources of information used in developing and costing treatment pathways

Colorectal cancer	Non-small cell lung cancer	Ovarian cancer
Health and Social Care Information Centre, <i>National Bowel Cancer Audit Annual Report, 2013, 2012 and 2011</i>	Health and Social Care Information Centre, <i>National Lung Cancer Audit, 2013, 2012 and 2011</i>	Health and Social Care Information Centre, <i>OPCS-4.7, 2013/14</i>
Health and Social Care Information Centre, <i>OPCS-4.7, 2013/14</i>	Health and Social Care Information Centre, <i>OPCS-4.7, 2013/14</i>	Map of Medicine, <i>Ovarian Cancer, 2014</i>
Map of Medicine, <i>Colorectal Cancer, 2014</i>	Map of Medicine, <i>Lung Cancer, 2014</i>	Maringe C, et al., <i>Stage at diagnosis and ovarian cancer survival: Evidence from the International Cancer Benchmarking Partnership, Gynecol Oncol (2012)</i>
Maringe C, et al., <i>Stage at diagnosis and colorectal cancer survival in six high-income countries: A population-based study of patients diagnosed during 2000 – 2007, Acta Oncologica (2013)</i>	National Institute for Health and Care Excellence, <i>Crizotinib for previously treated non-small-cell lung cancer associated with an anaplastic lymphoma kinase fusion gene (TAZ46), September 2013</i>	National Institute for Health and Care Excellence, <i>Bevacizumab in combination with paclitaxel and carboplatin for first-line treatment of advanced ovarian cancer (TAZ84), May 2013</i>
National Institute for Health and Care Excellence, <i>Bevacizumab in combination with oxaliplatin and either fluorouracil plus folinic acid or capecitabine for the treatment of metastatic colorectal cancer (TA212), December 2010</i>	National Institute for Health and Care Excellence, <i>EGFR-TK mutation testing in adults with locally advanced or metastatic non-small-cell lung cancer (DG9), August 2013</i>	National Institute for Health and Care Excellence, <i>Guidance on the use of paclitaxel in the treatment of ovarian cancer (TA55), January 2003</i>
National Institute for Health and Care Excellence, <i>Capecitabine and oxaliplatin in the adjuvant treatment of stage</i>	National Institute for Health and Care Excellence, <i>Erlotinib for the treatment of non-small cell lung cancer (TA162), December 2012</i>	National Institute for Health and Care Excellence, <i>Ovarian cancer: the recognition and initial management of ovarian cancer, April 2011</i>
	National Institute for Health	

<p><i>III (Dukes' C) colon cancer (TA100)</i>, April 2006</p> <p>National Institute for Health and Care Excellence, <i>Colorectal cancer: The diagnosis and management of colorectal cancer (CG131)</i>, November 2011</p> <p>National Institute for Health and Care Excellence, <i>CG131 Colorectal cancer: costing report</i>, November 2011</p> <p>National Institute for Health and Care Excellence, <i>Laparoscopic surgery for colorectal cancer (TA105)</i>, August 2006</p> <p>NHS England, <i>Cancer drugs fund reporting</i>, Period: April 2013 - March 2014</p> <p>Systematic Anti-Cancer Therapy dataset, <i>Top Regimens by Diagnostic Group</i>, March 2013 – April 2014</p> <p>York Health Economics Consortium, <i>Bowel Cancer Services: Costs and Benefits</i>, April 2007</p>	<p>and Care Excellence, <i>Endobronchial ultrasound-guided transbronchial biopsy for peripheral lung lesions (IPG337)</i>, March 2010</p> <p>National Institute for Health and Care Excellence, <i>Gefitinib for the first-line treatment of locally advanced or metastatic non-small-cell lung cancer (TA192)</i>, July 2010</p> <p>National Institute for Health and Care Excellence, <i>Lung cancer: The diagnosis and treatment of lung cancer (CG121)</i>, April 2011</p> <p>National Institute for Health and Care Excellence, <i>CG121 Lung cancer: costing template</i>, April 2011</p> <p>National Institute for Health and Care Excellence, <i>Pemetrexed for the first-line treatment of non-small-cell lung cancer (TA181)</i>, September 2009</p> <p>NHS England, <i>Cancer Drugs Fund medicines list</i>, March 2014</p> <p>Systematic Anti-Cancer Therapy dataset, <i>Top Regimens by Diagnostic Group</i>, March 2013 – April 2014</p> <p>University College London</p>	<p>National Institute for Health and Care Excellence, <i>Ovarian cancer: costing template</i>, April 2011</p> <p>National Institute for Health and Care Excellence, <i>Ultra-radical (extensive) surgery for advanced ovarian cancer (IPG470)</i>, November 2013</p> <p>Systematic Anti-Cancer Therapy dataset, <i>Top Regimens by Diagnostic Group</i>, March 2013 – April 2014</p>
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	<p>Hospitals, <i>Provider to provider services 2012 - 13 tariff</i></p> <p>Walters S, et al., Lung Cancer Survival and stage at diagnosis in Australia, Canada, Denmark, Norway, Sweden and the UK: a population-based study, 2004 – 2007, Thorax (2012)</p>	
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Annex 3 – simplified treatment pathway models

Figure 12: overview of the colon cancer treatment pathway

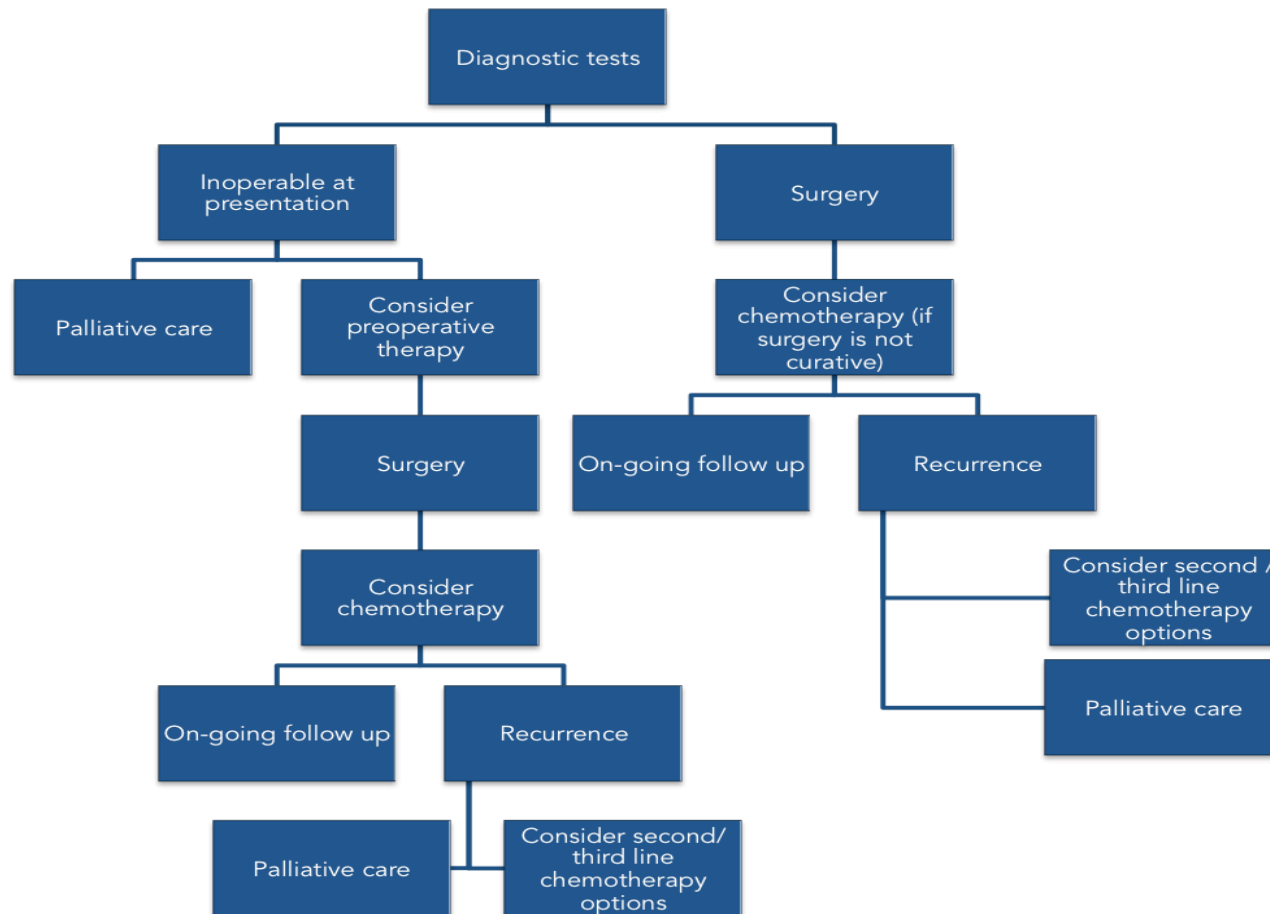


Figure 13: overview of the rectal cancer pathway

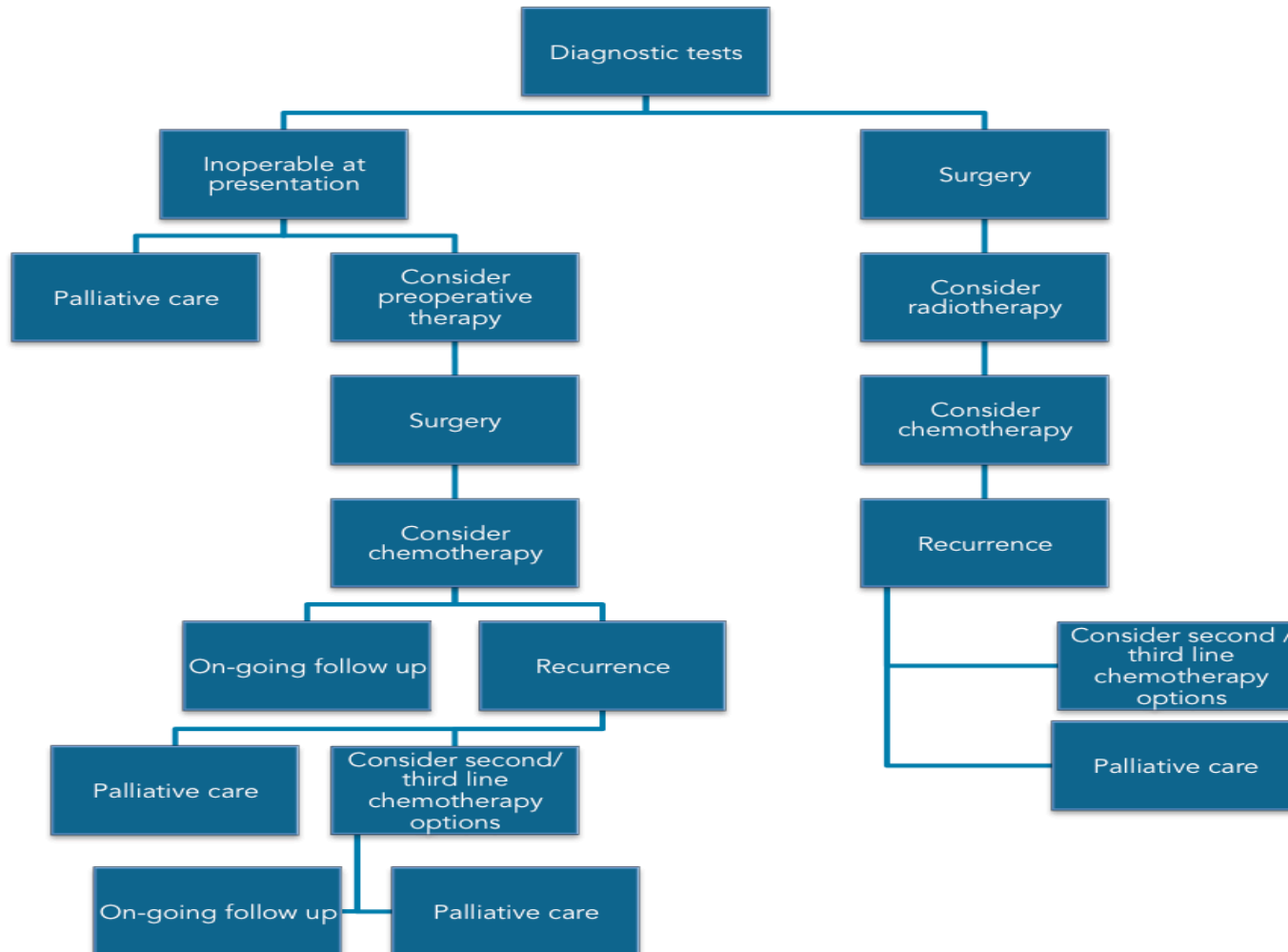


Figure 14: overview of the non-small cell lung cancer pathway

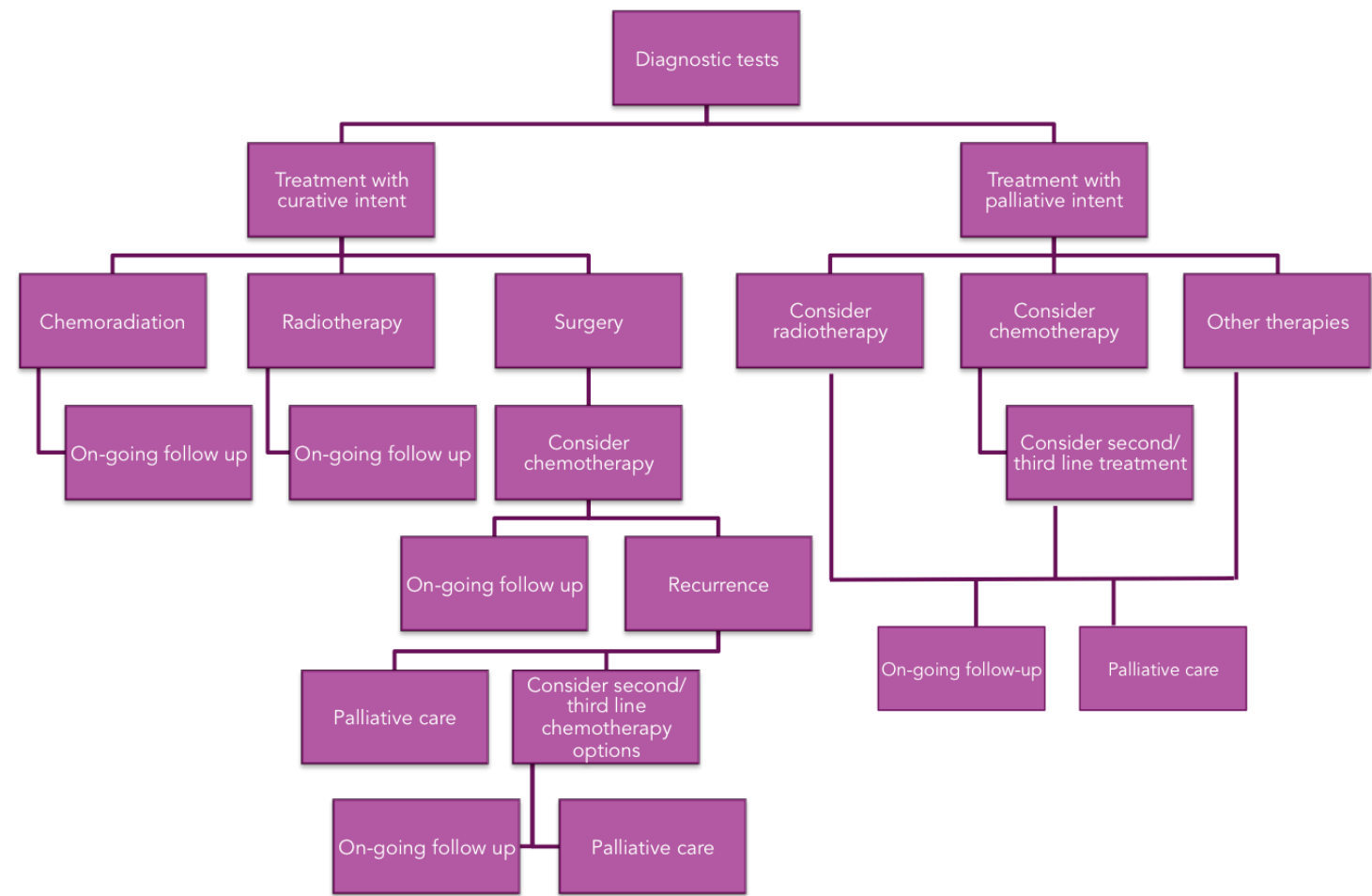
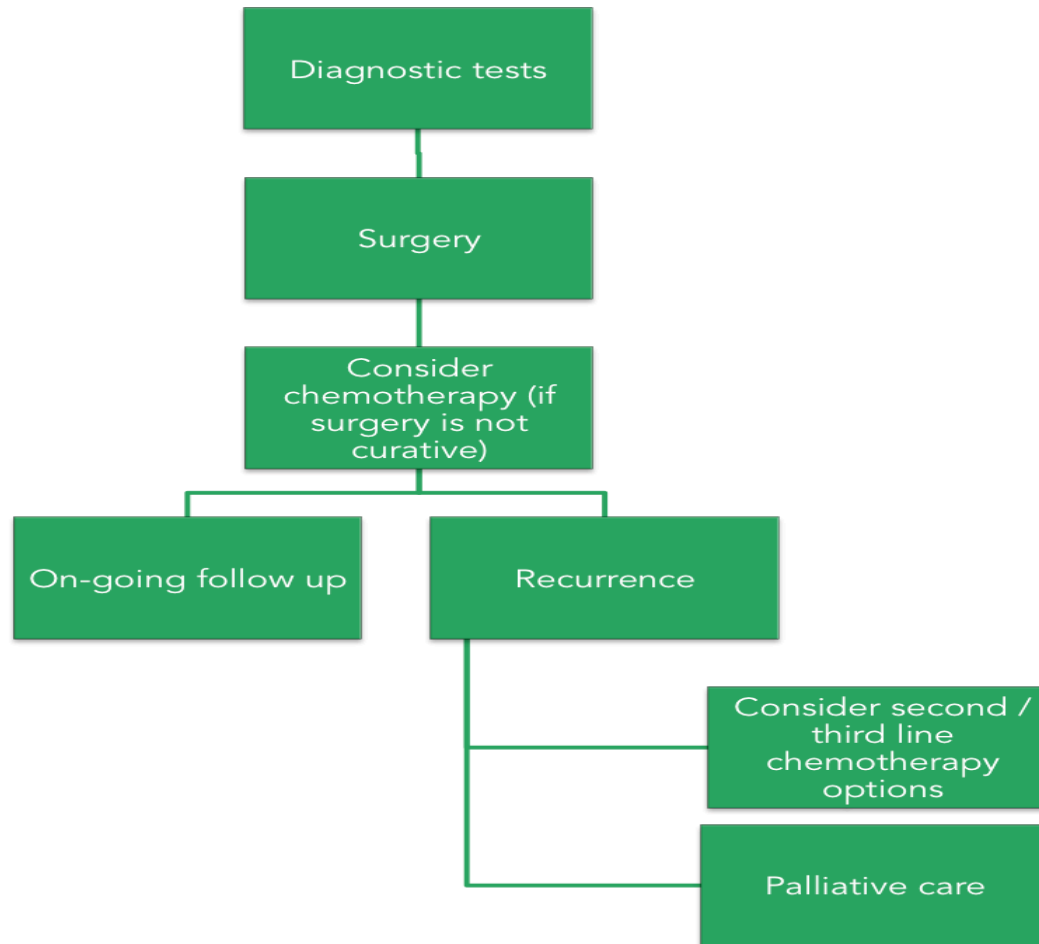


Figure 15: overview of the ovarian cancer pathway



Annex 4 – model pathways and estimates of costs per treatment

Colon cancer

Table 10: summary of costs of treatments for stage 1 colon cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics ³²	Colonoscopy	£398.00	75%	£298.50
	Flexible sigmoidoscopy	£398.00	15%	£59.70
	CT scan	£144.00	83%	£119.09
	Computed tomographic colonography	£172.00	25%	£43.00
Surgery ³³	Right hemicolectomy	£4,727.00	10%	£472.70
	Transverse colectomy	£5,171.00	2%	£103.42
	Left hemicolectomy	£5,171.00	5%	£258.55
	Sigmoid colectomy	£2,620.00	5%	£131.00
	Total colectomy	£5,784.00	2%	£115.68
	Anterior resection	£5,784.00	7%	£404.88
	Colonic polypectomy	£605.00	20%	£121.00
Chemotherapy ³⁴	Pre-operative short course chemotherapy Capecitabine	£3,974.00	0%	£0.00
Other ³⁵	Follow-up	£1,245.90	100%	£1,245.90

Table 11: summary of costs of treatments for stage 2 colon cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Colonoscopy	£398.00	75%	£298.50
	Flexible sigmoidoscopy	£398.00	15%	£59.70
	CT scan	£144.00	83%	£119.09
	Computed tomographic colonography	£172.00	25%	£43.00
Surgery	Right hemicolectomy	£4,727.00	23.22%	£1,097.76
	Transverse colectomy	£5,171.00	0.28%	£14.70
	Left hemicolectomy	£5,171.00	3.41%	£176.35
	Sigmoid colectomy	£2,620.00	4.06%	£106.37
	Total colectomy	£5,784.00	1.14%	£65.75
	Anterior resection	£5,784.00	6.70%	£387.47
Chemotherapy	Pre-operative short course chemotherapy	£3,617.52	23%	£832.03
	Capecitabine FOLFOX	£20,264.00	15%	£3,039.60
Other	Follow-up	£1,245.90	95%	£1,183.61
	Palliative care	£7,703.00	5%	£385.15

Table 12: summary of costs of treatments for stage 3 colon cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Colonoscopy	£398.00	50%	£199.00
	Flexible sigmoidoscopy	£398.00	25%	£99.50
	CT scan	£144.00	60%	£86.40
	Computed	£172.00	25%	£43.00

	tomographic colonography CT of chest, abdomen and pelvis	£144.00	35%	£50.40
Surgery	Right hemicolectomy	£4,727.00	18.08%	£854.41
	Transverse colectomy	£5,171.00	0.22%	£11.44
	Left hemicolectomy	£5,171.00	2.65%	£137.26
	Sigmoid colectomy	£2,620.00	3.16%	£82.79
	Total colectomy	£5,784.00	0.88%	£51.18
	Anterior resection	£5,784.00	5.21%	£301.58
Chemotherapy	Capecitabine and oxaliplatin (XELOX)	£10,514.00	15%	£1,577.10
	FOLFOX	£20,264.00	10%	£2,026.40
Other	Follow-up	£1,245.90	62%	£772.46
	Palliative care	£7,703.00	38%	£2,927.14

Table 13: summary of costs of treatments for stage 4 colon cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Colonoscopy	£398.00	40%	£159.20
	Flexible sigmoidoscopy	£398.00	10%	£39.80
	CT scan	£144.00	50%	£72.00
	Computed tomographic colonography	£172.00	10%	£17.20
	PET – CT	£356.00	25%	£89.00
	MRI of pelvis	£153.00	25%	£38.25
	Surgery	Right hemicolectomy	£4,727.00	8.35%
Transverse colectomy		£5,171.00	0.10%	£5.28
Left hemicolectomy		£5,171.00	1.23%	£63.42
Sigmoid colectomy		£2,620.00	1.46%	£38.25

	Total colectomy	£5,784.00	0.41%	£23.64
	Anterior resection	£5,784.00	2.41%	£139.34
	Liver resection	£5,181.00	12.00%	£621.72
Chemotherapy	Capecitabine and oxaliplatin (XELOX)	£10,514.00	15%	£1,577.10
	FOLFOX	£20,264.00	13%	£2,634.32
	Tegafur in combination with uracil	£3,375.00	1%	£33.75
	Raltitrexed	£6,142.00	1%	£61.42
	Bevacizumab in combination with oxaliplatin	£16,824.08	7%	£1,177.69
	Cetuximab with Irinotecan-based combination chemotherapy	£11,739.00	5%	£586.95
Other	Follow-up	£1,245.90	10%	£124.59
	Palliative care	£7,703.00	60%	£4,621.80

Rectal cancer

Table 14: summary of costs of treatments for stage 1 rectal cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics ³⁶	Colonoscopy	£398.00	75%	£298.50
	Flexible sigmoidoscopy	£398.00	15%	£59.70
	CT scan	£144.00	84%	£121.54
	Computed tomographic colonography	£172.00	25%	£43.00
	MRI scan	£153.00	82%	£125.46
	Surgery ³⁷	Right hemicolectomy	£4,727.00	0.08%

	Transverse colectomy	£5,171.00	0.00%	£0.00
	Left hemicolectomy	£5,171.00	0.06%	£2.93
	Sigmoid colectomy	£2,620.00	0.25%	£6.67
	Total colectomy	£5,784.00	0.51%	£29.46
	Anterior resection	£5,784.00	18.25%	£1,055.78
	Abdominoperineal excision of the rectum (APER)	£5,171.00	7.19%	£371.70
	Permanent stoma	£1,279.00	15.00%	£191.85
Radiotherapy ³⁸	Short course radiotherapy	£1,925.00	15%	£296.45
Chemotherapy ³⁹	Pre-operative short course chemotherapy Capecitabine	£3,974.00	15%	£596.10
Other ⁴⁰	Follow-up	£1,245.90	100%	£1,245.90

Table 15: summary of costs of treatments for stage 2 rectal cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Colonoscopy	£398.00	75%	£298.50
	Flexible sigmoidoscopy	£398.00	15%	£59.70
	CT scan	£144.00	84%	£121.54
	Computed tomographic colonography	£172.00	25%	£43.00
	MRI scan	£153.00	82%	£125.46
	Surgery	Right hemicolectomy	£4,727.00	0.09%
Transverse colectomy		£5,171.00	0.00%	£0.00
Left hemicolectomy		£5,171.00	0.06%	£3.22
Sigmoid colectomy		£2,620.00	0.28%	£7.33
Total colectomy		£5,784.00	0.56%	£32.38
Anterior resection		£5,784.00	20.06%	£1,160.24

	Abdominoperineal excision of the rectum (APER)	£5,171.00	7.90%	£408.48
	Permanent stoma	£1,279.00	15%	£191.85
Radiotherapy	Short course radiotherapy	£1,925.00	15%	£296.45
Chemotherapy	Pre-operative short course chemotherapy	£3,974.00	15%	£596.10
	Capecitabine FOLFOX	£20,264.00	10%	£2,026.40
Other	Follow-up	£1,245.90	95%	£1,183.61
	Palliative care	£7,703.00	5%	£385.15

Table 16: summary of costs of treatments for stage 3 rectal cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Colonoscopy	£398.00	50%	£199.00
	Flexible sigmoidoscopy	£398.00	10%	£39.80
	CT scan	£144.00	25%	£36.00
	Computed tomographic colonography	£172.00	25%	£43.00
	MRI scan	£153.00	50%	£76.50
	PET-CT scan	£356.00	30%	£106.80
	MRI of the pelvis	£153.00	25%	£38.25
	Surgery	Right hemicolectomy	£4,727.00	0.10%
Transverse colectomy		£5,171.00	0.00%	£0.00
Left hemicolectomy		£5,171.00	0.06%	£3.35
Sigmoid colectomy		£2,620.00	0.29%	£7.64
Total colectomy		£5,784.00	0.58%	£33.73
Anterior resection		£5,784.00	20.90%	£1,208.74
Abdominoperineal		£5,171.00	8.23%	£425.55

	excision of the rectum (APER) Permanent stoma	£1,279.00	20%	£255.80
Radiotherapy	Pre-operative chemoradiation	£5,899.00	25%	£1,492.45
	Postoperative radiotherapy	£1,925.00	19%	£365.75
Chemotherapy	Capecitabine and oxaliplatin (XELOX)	£10,514.00	7%	£735.98
	FOLFOX	£20,264.00	10%	£2,026.40
Other	Follow-up	£1,245.90	62%	£772.46
	Palliative care	£7,703.00	38%	£2,927.14

Table 17: summary of costs of treatments for stage 4 rectal cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Colonoscopy	£398.00	40%	£159.20
	Flexible sigmoidoscopy	£398.00	10%	£39.80
	CT scan	£144.00	35%	£50.40
	Computed tomographic colonography	£172.00	25%	£43.00
	MRI scan	£153.00	50%	£76.50
	PET-CT scan	£356.00	40%	£142.40
	MRI of the pelvis	£153.00	25%	£38.25
	MRI of the brain	£153.00	10%	£15.30
	Surgery	Right hemicolectomy	£4,727.00	0.02%
Transverse colectomy		£5,171.00	0.00%	£0.00
Left hemicolectomy		£5,171.00	0.02%	£0.85
Sigmoid colectomy		£2,620.00	0.07%	£1.93
Total colectomy		£5,784.00	0.15%	£8.54
Anterior resection		£5,784.00	5.29%	£305.92
Abdominoperineal		£5,171.00	2.08%	£107.70

	excision of the rectum (APER) Permanent stoma Liver resection	£1,279.00 £5,181.00	26.10% 12.00%	£333.82 £621.72
Radiotherapy	Pre-operative chemoradiation	£5,899.00	20%	£1,179.80
Chemotherapy	Capecitabine and oxaliplatin (XELOX)	£10,514.00	1%	£105.14
	FOLFOX	£20,264.00	1%	£202.64
	Tegafur in combination with uracil	£3,375.00	1%	£33.75
	Raltitrexed	£6,142.00	1%	£61.42
	Bevacizumab in combination with oxaliplatin	£16,824.08	7%	£1,244.98
	Cetuximab with Irinotecan-based combination chemotherapy Aflibercept	£11,739.00 £36,500.00	2% 3%	£234.78 £949.00
Other	Follow-up	£1,245.90	10%	£124.59
	Palliative care	£7,703.00	75%	£5,777.25

Non-small cell lung cancer

Table 18: summary of costs of treatments for stage 1 non-small cell lung cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics ⁴¹	Chest x-ray	£31.00	100%	£31.00
	Contrast enhanced chest CT scan	£359.00	75%	£269.25
	PET-CT	£423.00	40%	£169.20
	Spirometry	£60.00	50%	£30.00

	T _L CO	£154.00	20%	£30.80
	Fiber optic bronchoscopy	£501.00	36%	£180.36
	EBUS-guided TBNA	£1,365.00	12%	£163.80
	CT biopsy	£3,824.15	54%	£2,065.04
Surgery ⁴²	Elective – Lobectomy, wedge resection, pneumonectomy, Segmental Resection, Sleeve Resection	£5,113.00	49%	£2,505.37
	Emergency - Lobectomy, wedge resection, pneumonectomy, Segmental Resection, Sleeve Resection	£5,605.00	1%	£56.05
Radiotherapy ⁴³	Radiotherapy for curative intent	£2,840.00	8%	£227.20
	CHART	£6,296.00	8%	£503.68
Chemotherapy ⁴⁴	Cisplatin and vinorelbine	£3,629.00	0%	£0.00
Other ⁴⁵	Follow up	£1,720.00	100%	£1,720.00

Table 19: summary of costs of treatments for stage 2 non-small cell lung cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Chest x-ray	£31.00	100%	£31.00
	Contrast enhanced chest CT scan	£359.00	75%	£269.25
	PET-CT	£423.00	40%	£169.20
	Spirometry	£60.00	50%	£30.00
	T _L CO	£154.00	20%	£30.80

	Fiber optic bronchoscopy	£501.00	36%	£180.36
	EBUS-guided TBNA	£1,365.00	12%	£163.80
	CT biopsy	£3,824.15	54%	£2,065.04
Surgery	Elective – Lobectomy, wedge resection, pneumonectomy, Segmental Resection, Sleeve Resection	£5,113.00	49%	£2,505.37
	Emergency - Lobectomy, wedge resection, pneumonectomy, Segmental Resection, Sleeve Resection	£5,605.00	1%	£56.05
Radiotherapy	Radiotherapy for curative intent	£2,840.00	8%	£227.20
	CHART	£6,296.00	8%	£503.68
Chemotherapy	Cisplatin and vinorelbine	£3,629.00	8%	£290.32
Other	Follow up	£1,720.00	75%	£1,290.00
	Palliative care	£3,581.00	15%	£537.15

Table 20: summary of costs of treatments for stage 3 non-small cell lung cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Chest x-ray	£31.00	100%	£31.00
	Contrast enhanced chest CT scan	£359.00	75%	£269.25
	PET-CT	£423.00	40%	£169.20
	Spirometry	£60.00	50%	£30.00
	T _L CO	£154.00	25%	£38.50
	Fiber optic	£501.00	36%	£180.36

	bronchoscopy EBUS-guided TBNA CT biopsy Neck CT	£1,365.00 £3,824.15 £53.00.00	24% 54% 24%	£327.60 £2,065.04 £12.99
Surgery	Elective – Lobectomy, wedge resection, pneumonectomy, Segmental Resection, Sleeve Resection Emergency - Lobectomy, wedge resection, pneumonectomy, Segmental Resection, Sleeve Resection	£5,113.00 £5,605.00	24% 1%	£1,227.12 £56.05
Radiotherapy	Radiotherapy for curative intent CHART Palliative radiotherapy	£2,840.00 £6,296.00 £1,940.00	11% 11% 10%	£312.40 £692.56 £194.00
Chemotherapy	Cisplatin and vinorelbine	£3,629.00	8%	£290.32
Other	Follow up Palliative care	£1,720.00 £3,581.00	40% 60%	£688.00 £2,148.60

Table 21: summary of costs of treatments for stage 4 non-small cell lung cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	Chest x-ray	£31.00	100%	£31.00
	Contrast enhanced chest CT scan	£359.00	75%	£269.25
	PET-CT	£423.00	40%	£169.20
	Spirometry	£60.00	11%	£6.60
	T _L CO	£154.00	5%	£7.70

	Fiber optic bronchoscopy	£501.00	36%	£180.36
	EBUS-guided TBNA	£1,365.00	12%	£163.80
	CT biopsy	£3,824.15	54%	£2,065.04
	Neck CT	£53.00	24%	£12.99
Surgery	Airway stents for endobronchial obstruction	£1,282.00	5%	£64.10
	Endobronchial debulking	£1,282.00	5%	£64.10
	Intracranial procedures	£5,287.00	1%	£52.87
Radiotherapy	Palliative radiotherapy	£1,940.00	71%	£1,377.40
Chemotherapy	Gemcitabine + carboplatin	£3,918.00	17%	£671.55
	Gemcitabine + cisplatin	£3,668.00	5%	£165.06
	vinorelbine + cisplatin	£3,243.00	13%	£416.73
	pemetrexed + cisplatin	£4,798.00	12%	£582.00
	Docetaxel monotherapy	£6,714.00	7%	£437.75
	Gefitinib			
	Erlotinib	£12,200.00	5%	£639.28
	Crizotinib	£6,128.00	13%	£827.28
	Pemetrexed maintenance treatment	£37,512.00	3%	£1,237.90
		£12,076.00	6%	£691.90
Other	Follow up	£1,720.00	15%	£258
	Palliative care	£3,581.00	75%	£2,685.75

Ovarian cancer

Table 22: summary of costs of treatments for stage 1 ovarian cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics ⁴⁶	CA125 serum	£23.00	100%	£23.00
	Alfa fetoprotein (AFP)	£23.00	10%	£2.30
	Beta human chorionic gonadotrophin (beta-hCG)	£23.00	10%	£2.30
	MRI of pelvis	£284.00	85%	£241.40
	CT scan	£128.00	85%	£108.80
	PET-CT	£423.00	20%	£84.60
	Surgery ⁴⁷	Total hysterectomy	£2,861.00	40%
Bilateral salpingo-oophorectomy		£1,418.00	10%	£141.80
Pelvic and para-aortic lymph node sampling		£2,059.00	20%	£411.80
Infracolic omentectomy		£1,909.00	5%	£95.45
Pelvic and peritoneal washings and biopsies		£1,909.00	5%	£95.45
Ultra-radical (extensive) surgery		£4,100.00	0%	£0.00
Retroperitoneal lymph node dissection		£3,975.00	0%	£0.00
Chemotherapy ⁴⁸		Carboplatin	£2,654.68	10%
Other ⁴⁹	Follow up	£2,480.00	90%	£2,232.00
	Palliative care	£4,789.00	10%	£478.90

Table 23: summary of costs of treatments for stage 2 ovarian cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	CA125 serum	£23.00	100%	£23.00
	Alfa fetoprotein (AFP)	£23.00	10%	£2.30
	Beta human chorionic gonadotrophin (beta-hCG)	£23.00	10%	£2.30
	MRI of pelvis	£284.00	85%	£241.40
	CT scan	£128.00	85%	£108.80
	PET-CT	£423.00	30%	£126.90
	Surgery	Total hysterectomy	£2,861.00	40%
Bilateral salpingo-oophorectomy		£1,418.00	10%	£141.80
Pelvic and para-aortic lymph node sampling		£2,059.00	20%	£411.80
Infracolic omentectomy		£1,909.00	5%	£95.45
Pelvic and peritoneal washings and biopsies		£1,909.00	5%	£95.45
Ultra-radical (extensive) surgery		£4,100.00	0%	£0.00
Retroperitoneal lymph node dissection		£3,975.00	10%	£397.50
Chemotherapy		Pre-surgery chemotherapy	£6,600.00	25%
	Paclitaxel in combination with carboplatin	£6,600.00	30%	£1,980.00

Other	Follow up	£2,480.00	43%	£1,066.40
	Palliative care	£4,789.00	57%	£2,729.73

Table 24: summary of costs of treatments for stage 3 ovarian cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	CA125 serum	£23.00	100%	£23.00
	Alfa fetoprotein (AFP)	£23.00	10%	£2.30
	Beta human chorionic gonadotrophin (beta-hCG)	£23.00	10%	£2.30
	MRI of pelvis	£284.00	60%	£170.40
	CT scan	£128.00	75%	£96.00
	PET-CT	£423.00	60%	£253.80
	Surgery	Total hysterectomy	£2,861.00	15%
Bilateral salpingo-oophorectomy		£1,418.00	15%	£212.70
Pelvic and para-aortic lymph node sampling		£2,059.00	5%	£102.95
Infracolic omentectomy		£1,909.00	15%	£286.35
Pelvic and peritoneal washings and biopsies		£1,909.00	5%	£95.45
Ultra-radical (extensive) surgery		£4,100.00	5%	£205.00
Retroperitoneal lymph node dissection		£3,975.00	25%	£993.75
Chemotherapy	Pre-surgery chemotherapy	£6,600.00	40%	£2,640.00
	Paclitaxel in combination with carboplatin	£6,600.00	20%	£1,320.00

	combination with carboplatin			
Other	Follow up Palliative care	£2,480.00 £4,789.00	18% 82%	£446.40 £3,927.00

Table 25: summary of costs of treatments for stage 4 ovarian cancer

	Intervention	Cost of intervention	Estimated proportion of patients receiving intervention	Estimated weighted cost of intervention
Diagnostics	CA125 serum	£23.00	100%	£23.00
	Alfa fetoprotein (AFP)	£23.00	10%	£2.30
	Beta human chorionic gonadotrophin (beta-hCG)	£23.00	10%	£2.30
	MRI of pelvis	£284.00	10%	£28.40
	CT scan	£128.00	40%	£51.20
	PET-CT	£423.00	60%	£253.80
Surgery	Total hysterectomy	£2,861.00	10%	£286.10
	Bilateral salpingo-oophorectomy	£1,418.00	5%	£70.90
	Pelvic and para-aortic lymph node sampling	£2,059.00	5%	£102.95
	Infracolic omentectomy	£1,909.00	2%	£38.18
	Pelvic and peritoneal washings and biopsies	£1,909.00	2%	£38.18
	Ultra-radical (extensive) surgery	£4,100.00	20%	£820.00
	Retroperitoneal lymph node dissection	£3,975.00	15%	£596.25
Chemotherapy	Pre-surgery chemotherapy Paclitaxel in	£6,600.00	60%	£3,960.00

	combination with carboplatin			
	Paclitaxel in combination with carboplatin	£6,600.00	20%	£1,320.00
	Bevacizumab	£36,078.00	8%	£2,886.24
Other	Follow up	£2,480.00	4%	£99.20.00
	Palliative care	£4,789.00	94%	£4,502.00

Annex 5 – estimates of the cost of each treatment pathway

Colon cancer – individual

Table 26: summary of costs per stage for colon cancer, excluding the cost of recurrence

	Diagnostics	Surgery	Cancer drugs	Other	Total
Stage 1	£520.29	£1,607.23	£0.00	£1,245.90	£3,373.42
Stage 2	£520.29	£1,848.40	£3,871.63	£1,568.76	£7,809.08
Stage 3	£478.30	£1,438.66	£3,603.50	£3,699.60	£9,220.06
Stage 4	£415.45	£1,286.42	£6,071.23	£4,746.39	£12,519.48

Table 27: estimate of costs associated with recurrence for colon cancer

	Estimated proportion of patients with recurrent colon cancer	Cost of stage 4 treatment	Allowance for cost of recurrence
Stage 1	10.00%	£12,519.48	£375.58
Stage 2	20.00%	£12,519.48	£2,003.12
Stage 3	34.00%	£12,519.48	£4,757.40
Stage 4	n/a	n/a	n/a

Table 28: overall costs associated with the colon cancer treatment pathway, including recurrence

	Treatment cost	Allowance for cost of recurrence	Total cost
Stage 1	£3,372.07	£375.56	£3,747.63
Stage 2	£7,807.73	£2,002.97	£9,810.70
Stage 3	£9,217.81	£4,757.06	£13,974.87
Stage 4	£12,518.58	n/a	£12,518.58

Colon cancer – NHS-wide

Table 29: NHS-wide costs associated with the colon cancer treatment pathway, including recurrence

	Total cost per-patient	Number of patients	Total cost to the NHS
Stage 1	£3,747.63	2,931	£10,988,326.24
Stage 2	£9,810.70	7,237	£71,010,839.78
Stage 3	£13,974.87	7,450	£104,132,075.80
Stage 4	£12,518.58	5,690	£71,235,854.18

Rectal cancer – individual

Table 30: summary of costs per stage for rectal cancer, excluding the cost of recurrence

	Diagnostics	Surgery	Radiotherapy	Cancer drugs	Other	Total
Stage 1	£648.20	£1,662.41	£296.45	£596.10	£1,245.90	£4,449.06
Stage 2	£648.20	£1,807.91	£296.45	£2,622.50	£1,568.76	£6,943.81
Stage 3	£496.35	£1,939.41	£1,858.20	£2,762.38	£1,245.90	£8,302.24
Stage 4	£520.29	£1,381.64	£1,179.80	£2,831.71	£5,901.84	£11,815.28

Table 31: estimate of costs associated with recurrence for rectal cancer

	Estimated proportion of patients with recurrent rectal cancer	Cost of stage 4 treatment	Allowance for cost of recurrence
Stage 1	3.00%	£11,815.28	£354.46
Stage 2	16.00%	£11,815.28	£1,890.44
Stage 3	38.00%	£11,815.28	£4,489.81
Stage 4	n/a	n/a	n/a

Table 32: overall costs associated with the rectal cancer treatment pathway, including recurrence

	Treatment cost	Allowance for cost of recurrence	Total cost
Stage 1	£4,449.06	£354.46	£4,803.52
Stage 2	£6,943.81	£1,890.44	£8,834.25
Stage 3	£8,302.24	£4,489.81	£12,792.04
Stage 4	£11,815.28	n/a	£11,815.28

Rectal cancer – NHS-wide

Table 33: NHS-wide costs associated with the rectal cancer treatment pathway, including recurrence

	Total cost per-patient	Number of patients	Total cost to the NHS
Stage 1	£4,803.52	2,946	£14,151,156.50
Stage 2	£8,834.25	2,442	£21,573,247.74
Stage 3	£12,792.04	3,267	£41,791,605.13
Stage 4	£11,815.28	2,607	£30,802,429.48

Non-small cell lung cancer – individual

Table 34: summary of costs per stage for non-small cell lung cancer, excluding the cost of recurrence

	Diagnostics	Surgery	Radiotherapy	Cancer drugs	Other	Total
Stage 1	£2,939.45	£2,561.42	£730.88	£0.00	£1,720.00	£7,951.75
Stage 2	£2,939.45	£2,561.42	£730.88	£290.32	£1,827.15	£8,349.22
Stage 3	£3,123.94	£1,283.17	£1,198.96	£290.32	£2,836.60	£8,732.99
Stage 4	£2,905.94	£181.07	£1,377.40	£5,669.49	£2,943.75	£13,077.65

Table 35: estimate of costs associated with recurrence for non-small cell lung cancer

	Estimated proportion of patients with recurrent lung cancer	Cost of stage 4 treatment	Allowance for cost of recurrence
Stage 1	52.00%	£13,077.65	£8,457.31
Stage 2	55.00%	£13,077.65	£10,345.73
Stage 3	58.00%	£13,077.65	£12,251.14
Stage 4	n/a	n/a	n/a

Table 36: overall costs associated with non-small cell lung cancer treatment pathway, including recurrence

	Treatment cost	Allowance for cost of recurrence	Total cost
Stage 1	£7,951.75	£8,457.31	£16,409.07
Stage 2	£8,349.22	£10,345.73	£18,694.95
Stage 3	£8,732.99	£12,251.14	£20,984.13
Stage 4	£13,077.65	n/a	£13,077.65

Lung cancer – NHS-wide

Table 37: NHS-wide costs associated with non-small cell lung cancer treatment pathway, including recurrence

	Total cost per-patient	Number of patients	Total cost to the NHS
Stage 1	£16,409.07	4,730	£77,611,144.39
Stage 2	£18,694.95	2,523	£47,158,851.87
Stage 3	£20,984.13	6,937	£145,566,870.79
Stage 4	£13,077.65	17,342	£226,799,083.72

Ovarian cancer – individual

Table 38: summary of costs per stage for ovarian cancer, excluding the cost of recurrence

	Diagnostics	Surgery	Cancer drugs	Other	Total
Stage 1	£462.40	£1,888.90	£265.47	£2,710.90	£5,327.67
Stage 2	£504.70	£2,286.40	£3,630.00	£3,796.13	£10,217.23
Stage 3	£547.80	£2,325.35	£3,960.00	£4,373.38	£11,206.53
Stage 4	£361.00	£1,952.56	£8,166.24	£4,600.86	£15,080.66

Table 39: estimate of costs associated with recurrence for ovarian cancer

	Estimated proportion of patients with recurrent ovarian cancer	Cost of stage 4 treatment	Allowance for cost of recurrence
Stage 1	22.00%	£15,080.66	£1,503.54
Stage 2	46.00%	£15,080.66	£8,623.12
Stage 3	52.00%	£15,080.66	£12,275.66
Stage 4	n/a	n/a	n/a

Table 40: overall costs associated with the ovarian cancer treatment pathway, including recurrence

	Treatment cost	Allowance for cost of recurrence	Total cost
Stage 1	£5,327.67	£1,503.54	£6,831.21
Stage 2	£10,217.23	£8,623.12	£18,840.35
Stage 3	£11,206.53	£12,275.66	£23,482.19
Stage 4	£15,080.66	n/a	£15,080.66

Ovarian cancer – NHS-wide

Table 41: NHS-wide costs associated with the ovarian cancer treatment pathway, including recurrence

	Total cost per-patient	Number of patients	Total cost to the NHS
Stage 1	£6,831.21	2,136	£14,593,923.37
Stage 2	£18,840.35	337	£6,355,227.33
Stage 3	£23,482.19	1,968	£46,205,899.83
Stage 4	£15,080.66	1,181	£17,804,528.81

Annex 6 – estimates of the financial impact of earlier diagnosis

Best in England scenario

Colon cancer

Table 42: estimated cost difference if best in England staging proportions were achieved everywhere

	Current percentage of patients diagnosed at stage	Best in England percentage	Additional patients diagnosed at stage in scenario	Current cost	Best in England scenario cost	Cost difference – additional costs compared with current situation
Stage 1	13.00%	18.6%	1,407	£10,988,326.24	£16,264,921.11	£5,276,594.87
Stage 2	31.00%	44.4%	3,109	£71,010,839.78	£101,512,763.84	£30,501,924.06
Stage 3	32.00%	21.1%	-2,522	£104,132,075.80	£68,880,602.60	£35,251,473.20
Stage 4	24.00%	15.9%	-1,994	£71,235,854.18	£46,271,791.89	£24,964,062.29

Rectal cancer

Table 43: estimated cost difference if best in England staging proportions were achieved everywhere

	Current percentage of patients diagnosed at stage	Best in England percentage	Additional patients diagnosed at stage in scenario	Current cost	Best in England scenario cost	Cost difference – additional costs compared with current situation
Stage 1	26.00%	34.10%	897	£14,151,156.50	£18,460,666.40	£4,309,509.91
Stage 2	22.00%	28.90%	810	£21,573,247.74	£28,728,131.96	£7,154,884.22
Stage 3	29.00%	20.60%	-943	£41,791,605.13	£29,727,050.34	£12,064,554.78
Stage 4	23.00%	16.40%	-764	£30,802,429.48	£21,776,379.69	£9,026,049.79

Non-small cell lung cancer

Table 44: estimated cost difference if best in England staging proportions were achieved everywhere

	Current percentage of patients diagnosed at stage	Best in England percentage	Additional patients diagnosed at stage in scenario	Current cost	Best in England scenario cost	Cost difference – additional costs compared with current situation
Stage 1	15.00%	22.20%	2,262	£77,611,144.39	£114,729,517.79	£37,118,373.40
Stage 2	8.00%	11.80%	1,206	£47,158,851.87	£69,713,085.37	£22,554,233.50
Stage 3	22.00%	18.90%	-991	£145,566,870.79	£124,771,603.53	£20,795,267.26
Stage 4	55.00%	47.10%	-2,477	£226,799,083.72	£194,399,214.62	£32,399,869.10

Ovarian cancer

Table 45: estimated cost difference if best in England staging proportions were achieved everywhere

	Current percentage of patients diagnosed at stage	Best in England percentage	Additional patients diagnosed at stage in scenario	Current cost	Best in England scenario cost	Cost difference – additional costs compared with current situation
Stage 1	38.00%	59.60%	1,214	£14,593,923.37	£22,885,925.29	£8,292,001.92
Stage 2	6.00%	9.40%	192	£6,355,227.33	£9,966,151.95	£3,610,924.62
Stage 3	35.00%	19.40%	-878	£46,205,899.83	£25,578,265.98	£20,627,633.85
Stage 4	21.00%	11.60%	-527	£17,804,528.81	£9,856,078.45	£7,948,450.36

Looking to the future

Table 46: projections of costs and benefits using different scenarios for early diagnosis

	Number of patients diagnosed with advanced cancer in ten years time	Overall costs in ten years time	Cost change compared to now
No change			
Colon cancer	15,861	£310,666,813.06	£53,299,717.06
Rectal cancer	6,953	£128,207,054.11	£19,888,615.27
Non-small cell lung cancer	28,738	£588,416,306.80	£91,280,356.03
Ovarian cancer	3,253	£85,800,496.45	£840,917.10

Current best in England			
<i>Colon cancer</i>	10,410	£281,168,986.13	£23,801,890.13
<i>Rectal cancer</i>	5,172	£126,348,564.10	£18,030,125.26
<i>Non-small cell lung cancer</i>	24,632	£596,083,121.66	£98,947,170.89
<i>Ovarian cancer</i>	1,708	£66,932,919.46	-£18,026,659.88
Halving late diagnosis			
<i>Colon cancer</i>	7,878	£257,897,998.36	£530,902.36
<i>Rectal cancer</i>	3,466	£109,024,298.12	£705,859.28
<i>Non-small cell lung cancer</i>	14,369	£620,248,355.12	£123,112,404.36
<i>Ovarian cancer</i>	1,543	£71,709,837.46	-£13,249,741.89

Advanced cancer is defined as stage 3 and stage 4 combined

Glossary

- **Active treatment** – interventions given with a view to managing a person's cancer, thereby extending their life and improving its quality
- **Averted costs** – the costs that can be avoided if certain changes are made
- **Commissioning** – the process by which services are planned, organised and contracted
- **Cost effectiveness** – comparison of the costs and health effects of an intervention or service to assess the extent to which it can be regarded as providing value for money
- **Diagnosis** – the determination of the cause of a patient's illness or suffering by the combined use of physical examination, patient interview, laboratory tests, review of the patient's medical records, knowledge of the cause of observed signs and symptoms, and differential elimination of similar possible causes
- **Incidence** – the number of new cases of cancer diagnosed in an identified population within a specified time period
- **Recurrence** – the return of cancer after an apparently successful course of treatment
- **Relative survival** – a comparison of the survival experience of individuals with cancer to those in the general population, calculated by dividing the observed survival by the expected survival of a similar group of people from the general population
- **Palliative care** – support provided to a person to alleviate or manage the symptoms of their cancer or the side effects of its treatment
- **Pathway** – the sequence of interventions that a patient will receive in normal circumstances
- **Quality adjusted life years** – the number of years of life generated by an intervention or service, adjusted for quality of life
- **Screening** – the process of testing a defined population of people who do not have symptoms of a disease with a view to diagnosing a condition at an earlier and more manageable stage
- **Stage** – a way of describing the size of a cancer and how far it has grown

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- **Survival** – the percentage of people still alive after a specified period of time, usually one year, three years and five years, following a diagnosis of cancer in an identified population within a specified time period

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- ⁴⁴ Patient proportions for lung cancer chemotherapy informed by the Systemic Anti-Cancer Therapy Dataset and clinician input
- ⁴⁵ Patient proportions for follow-up and palliative care for lung cancer informed by clinician input
- ⁴⁶ Patient proportions for ovarian cancer diagnostic tests informed by clinician input
- ⁴⁷ Patient proportions for ovarian cancer surgery informed by clinician input
- ⁴⁸ Patient proportions for ovarian cancer chemotherapy informed by the Systemic Anti-Cancer Therapy Dataset and clinician input
- ⁴⁹ Patient proportions for follow-up and palliative care for ovarian cancer informed by clinician input