The impact of Biomedical Scientists on the bowel cancer patient pathway

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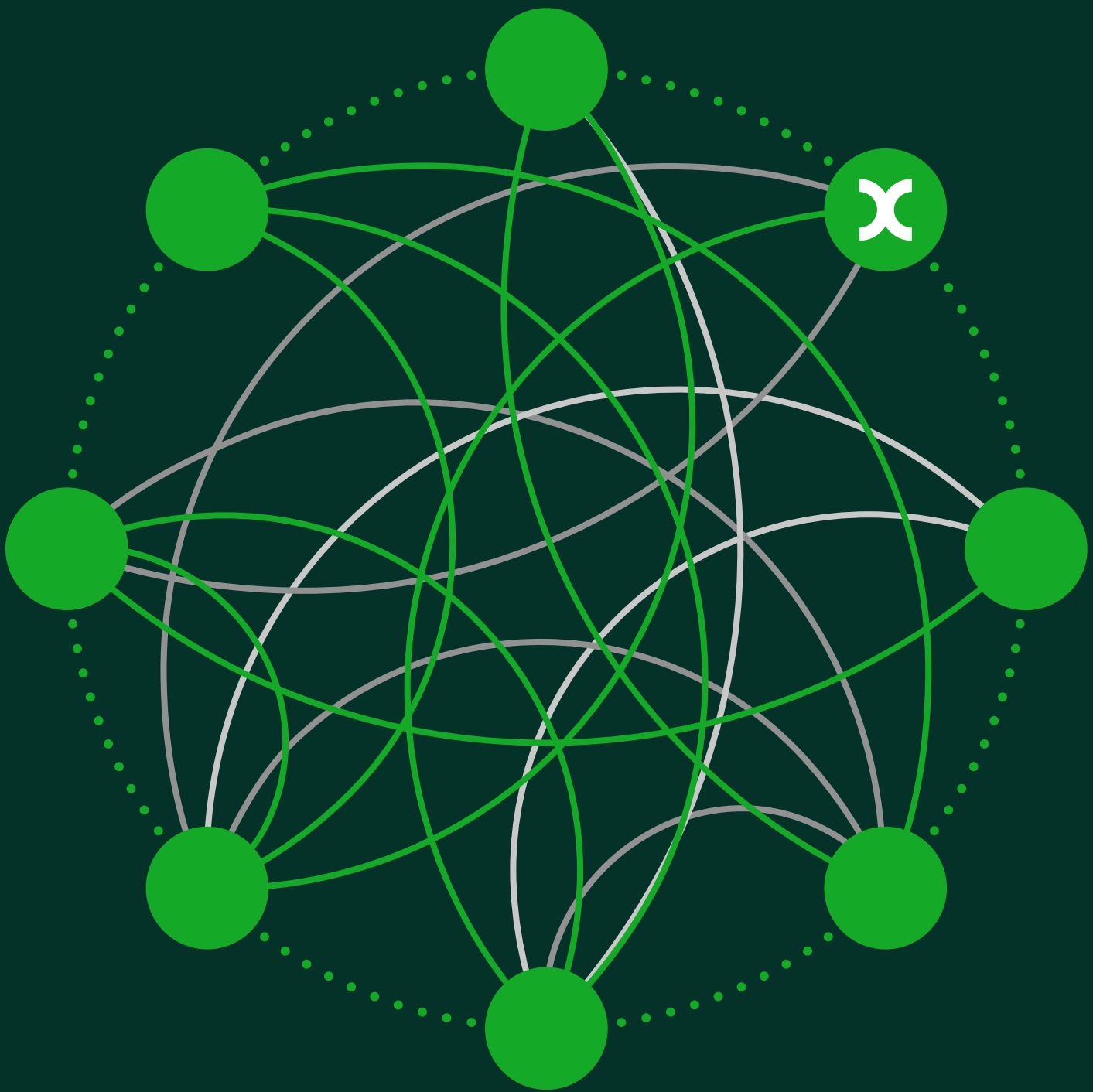

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Executive summary

Oxera has been commissioned by the Institute of Biomedical Science ('IBMS') to assess the impact of the activities of Biomedical Scientists, with particular emphasis on their contributions within the bowel cancer patient pathway in the UK.[1] As Health and Care Professions Council ('HCPC') registrant professionals, Biomedical Scientists play key roles within the healthcare system. We have used bowel cancer as an indicative example of ways that Biomedical Scientists contribute value though Biomedical Scientists' involvement in clinical conditions reaches far beyond bowel cancer; around 95% of clinical pathways rely on access to pathology services.[2] Our assessment therefore captures just a fraction of the value provided by Biomedical Scientists, and serves as an example of how the full impact of Biomedical Scientists could be quantified.

Biomedical Scientists contribute to patient outcomes throughout the bowel cancer patient pathway. Their involvement in the initial testing stages and confirmation and diagnosis stages of the pathways (as discussed below) enables earlier detection of bowel cancer than would otherwise be the case, which drives better health outcomes for patients by increasing their probability of survival; we term this contribution as health-based outcome.[3] Biomedical Scientists also contribute to cost savings within the healthcare system by enabling more affordable screening options compared to alternatives; we term this contribution as efficiency-based outcome.

[1] While this assessment focuses on the impact that Biomedical Scientists provide in the UK, using UK data, the framework that we use would also be applicable in calculating the value provided by Biomedical Scientists in other jurisdictions. While Biomedical Scientists are likely to provide similar value in other jurisdictions, the value may vary depending on factors such as i) whether a screening programme for bowel cancer is offered; ii) the uptake of such a screening programme; and iii) the availability of alternative screening for bowel cancer.
[2] National Institute of Health and Social Care (2021), 'NICE impact of diagnostic pathology', May.
[3] Specifically, one study finds that patients who are diagnosed via the screening process have a five-year colorectal cancer (CRC)-specific survival rate of 83%, whereas patients who are not diagnosed via the screening process have a five-year CRC-specific survival rate of 58%. See Cardoso, Guo, F., Heisser, T., De Schutter, H., Van Damme, N., Nilbert, M. C., Christensen,j., Bouvier, A-M., Bouvier,V., Launoy,G., Woronoff, A-S., Cariou, M., Robaszkiewicz, M., Delafosse, P., Pocet, F., Walsh, P. M., Senore, C., Rosso, S., Lemmens, V.E.P.P., Elferink, M.A.G., Tomsic,S., Zagar, T., Lopez de Munain Marquez, A., Marcos-Gragera, R., Puigdemot, M., Galceran, J., Carulla, M., Sanchez-Gil, A., Chirlaque M and Hoffmesieter, M., (2022), 'Overall and stage-specific survival of patients with screen-detected colorectal cancer in European countries: A population-based study in 9 countries', July, in *The Lancet Regional Health – Europe* 2022;21: 100458, Published online 6 July 2022.

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Our assessment focuses on two stages of the patient pathway where the contributions of Biomedical Scientists on both health-based and efficiency-based outcomes are expected to be particularly pronounced.

- **The initial testing stage:** this refers to the stage at which patients undergo screening, which are tests carried out on asymptomatic individuals (individuals who are currently not showing signs of having cancer) to test for bowel cancer. Biomedical Scientists are heavily involved in the tests used to screen patients at this stage.
- **The confirmation and diagnosis stage:** this refers to the stage at which individuals who have been identified as potentially having bowel cancer undergo further tests to confirm their diagnosis. Biomedical Scientists play a crucial role at this stage in analysing and reporting samples collected from biopsies.

Focusing on a specific stage (or in our case, two stages) allows us to quantify the value generated by Biomedical Scientists at that stage of the bowel cancer patient pathway. In reality, Biomedical Scientists also generate value at other stages of the pathway that we do not account for in our assessment. For example, they are involved in monitoring patients at the post-treatment stage to test for recurrence of bowel cancer. Moreover, as noted above, around 95% of clinical pathways rely on access to pathology services.[4] For these reasons, our results capture just a fraction of Biomedical Scientists' overall impact on the bowel cancer pathway and the healthcare system as a whole.

Methodology

At the initial testing stage, Biomedical Scientists contribute value through their involvement in the main screening programme for bowel cancer, the faecal immunochemical test ('FIT'). The FIT serves as the primary screening tool for early detection of bowel cancer.[5] The NHS operates the National Bowel Cancer Screening Programme, through which individuals in a certain age bracket are offered FITs through a home testing kit, and the results of this are analysed in a laboratory. Biomedical Scientists play a vital role in this process, by conducting the

[4] National Institute of Health and Social Care (2021), 'NICE impact of diagnostic pathology', https://www.nice.org.uk/about/what-we-do/into-practice/measuring-the-use-of-nice-guidance/impact-of-our-guidance/nice-impact-diagnostic-pathology, May, last accessed on 7 May 2024.
[5] NHS, 'Overview—Bowel cancer screening', https://www.nhs.uk/conditions/bowel-cancer-screening/, last accessed on 13 March 2024.

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analysis and reporting results themselves and by providing oversight and quality control.

Our assessment of the impact of Biomedical Scientists in the initial testing stage focuses on exploring their contributions to the current screening programme. We measure their impact by comparing outcome metrics that measure health and economic impact (see below), between situations where Biomedical Scientists are present (the 'factual scenario') and a hypothetical scenario where they are absent (the 'counterfactual scenario'). The difference in these metrics between the factual and counterfactual scenarios allows us to estimate the impact that Biomedical Scientists have on the bowel cancer patient pathway through both health-based and efficiency-based outcomes.

We measure the impact of Biomedical Scientists on the following outcome metrics.

1 The average cost incurred per individual in the screening sample.
2 The total cost to the healthcare system (calculated by multiplying the average cost per individual in the screening sample by the number of individuals in the total sample).[6]
3 The average cost incurred per bowel cancer patient.
4 The number of lost life years across all bowel cancer patients in the relevant yearly cohort.[7]

The first two metrics focus mainly on efficiency-based outcomes, while the third and fourth metrics focus on health-based outcomes. The cost metrics comprise both health-based costs including the economic value of Quality Adjusted Life Years ('QALYs'), and financial costs saved, such as the saved cost of alternative screening.

Choosing the right counterfactual scenario is therefore important in order to robustly quantify the impact of Biomedical Scientists.

[6] We have assumed that the total sample consists of 3.8m individuals, based on statistics from Office of Health Improvement & Disparities (2023), 'Corporate report, NHS screening programme in England: 2020 to 2021', https://www.gov.uk/government/publications/nhs-screening-programmes-annual-report/nhs-screening-programmes-in-england-2020-to-2021#nhs-bowel-cancer-screening-programme-bcsp, 16 February, last accessed 12 March 2024.
[7] This refers to lost life years across an annual cohort of people who are offered the chance to participate in the National Bowel Cancer Screening Programme. Office of Health Improvement & Disparities (2023), 'Corporate report, NHS screening programme in England: 2020 to 2021', https://www.gov.uk/government/publications/nhs-screening-programmes-annual-report/nhs-screening-programmes-in-england-2020-to-2021#nhs-bowel-cancer-screening-programme-bcsp, 16 February, last accessed 12 March 2024.

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We do not have real-world cases where Biomedical Scientists have been completely absent from the bowel cancer patient pathway. Instead, we have collaborated with IBMS to construct scenarios illustrating how the healthcare system would respond in the absence of Biomedical Scientists. We explore a range of potential counterfactual scenarios to provide a reasonable estimate of the likely impact.

- In **counterfactual scenario one**, in the absence of the FIT, colonoscopy is offered as an alternative screening method. This scenario highlights Biomedical Scientists' contribution to both health-based and efficiency-based outcomes in the healthcare system by increasing the uptake and reducing the cost of screening relative to colonoscopy.
- In **counterfactual scenario two**, no screening programme is offered. Individuals who suspect cancer symptoms visit their GP, leading to individuals with bowel cancer being diagnosed after they become symptomatic. This counterfactual scenario highlights Biomedical Scientists' role in improving health outcomes in the bowel cancer patient pathway, by enabling earlier diagnosis.
- In **counterfactual scenario three**, a lower-quality test, the guaiac-based faecal occult blood test ('gFOBT'), is used instead of the FIT. This older, less accurate test was used in the National Bowel Cancer Screening programme prior to the FIT. This counterfactual scenario highlights the impact of reduced testing quality on patient outcomes. We use this to approximate Biomedical Scientists' impact on the healthcare system through improving testing quality.

These counterfactual scenarios outline different aspects of Biomedical Scientists' impact on the bowel cancer patient pathway, including both health-based and efficiency-based outcomes. Some counterfactuals demonstrate greater health-based outcomes, and others demonstrate greater financial or efficiency-based outcomes.

Approach to quantification

We quantify the impact of Biomedical Scientists by estimating costs in the factual and counterfactual scenarios. This allows us to assess the value that they contribute to the healthcare system relative to scenarios that do not involve Biomedical Scientists. We utilise a decision tree model for this purpose. Decision trees are set up for both the factual and counterfactual scenarios, each providing an expected cost, and we compare the two expected costs to estimate the overall impact of Biomedical Scientists.

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The decision tree model summarises the possible routes a patient could follow through a particular stage of the patient pathway. Each route is assigned a probability and costs (both health-based and efficiency-based). We estimate these probabilities and costs using statistics from the medical literature as well as insights from IBMS colleagues, particularly members of the Strategic Research Group. Finally, we calculate the expected cost for each scenario by aggregating the probabilities and costs from each route.

Importantly, models are simplified versions of reality. We use simplifying assumptions based on informed judgments and expert opinions, consulting with the IBMS Strategic Research Group to ensure a valid analytical approach.

Results

As discussed above, we estimate the impact of Biomedical Scientists against several counterfactuals, using various metrics focused on health-based and efficiency-based outcomes. The relative impact of Biomedical Scientists, expressed against different outcome metrics, is illustrated in the figure below.

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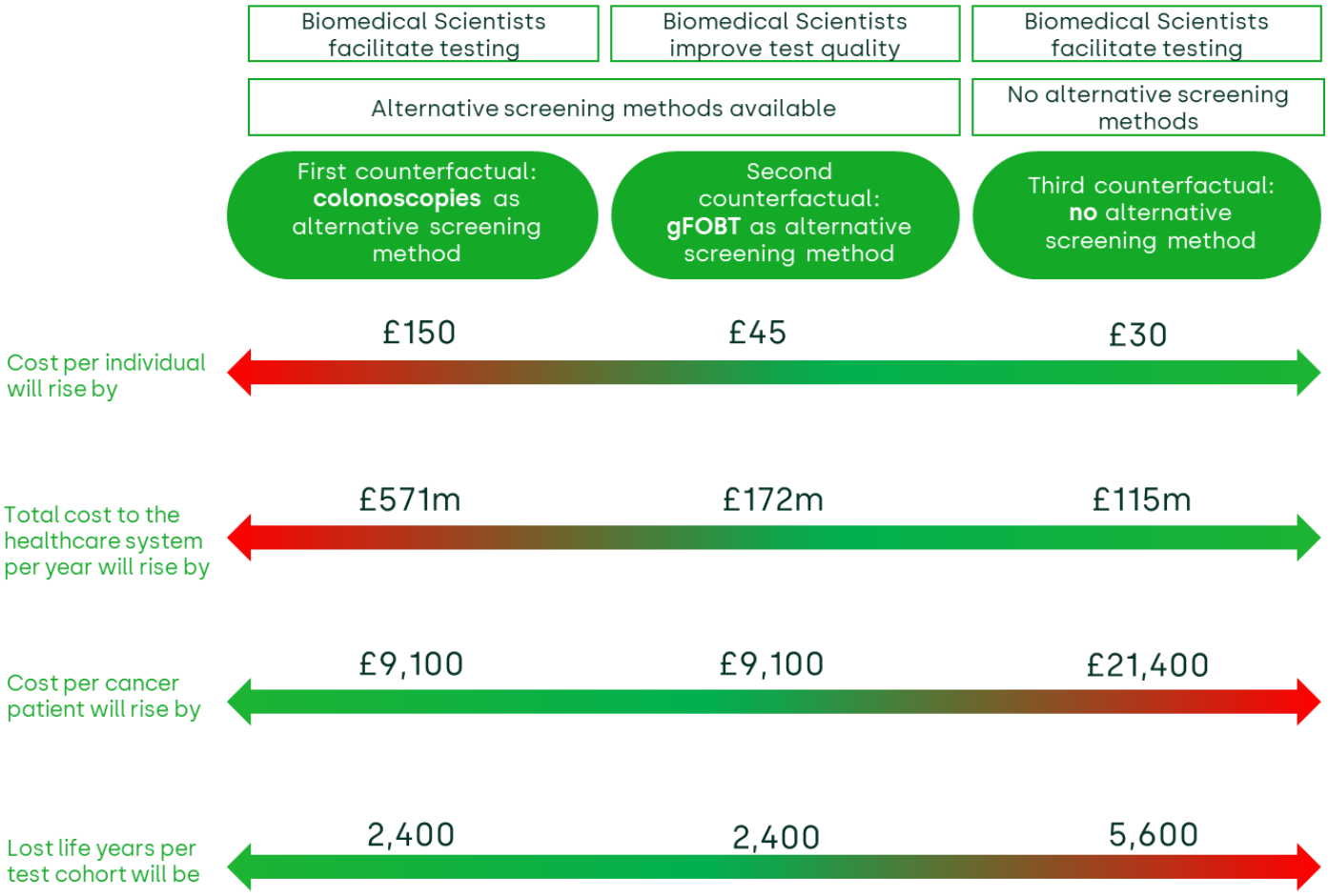
Estimated results in the initial testing stage



Note: All costs are relative to a factual case with the FIT as the screening methodology. Costs quoted are the average costs per individual in the cohort and per bowel cancer patient.
Source: Oxera estimation.

The impact of Biomedical Scientists at the initial testing stage of the bowel cancer patient pathway varies between **£30 and £150 per average individual**, depending on the counterfactual. This indicates that the presence of Biomedical Scientists in this stage of the bowel cancer patient pathway benefits the NHS by **between £115m and £571m per year**. This is equivalent to between 1,700 and 8,500 specialist doctors' salaries or between 3,400 and 17,000 nurses' salaries per year.[8] These

[8] Calculation based on 2023 NHS pay scales: NHS (2023), 'Pay for Doctors', https://www.healthcareers.nhs.uk/explore-roles/doctors/pay-doctors#:~:text=Specialty%20doctors%20and%20specialist%20payscale,%C2%A383%2C945%20to%20%C2%A392%2C275, last accessed 27 March 2024; and NHS, 'Working for the NHS in England', https://www.healthcareers.nhs.uk/we-are-the-nhs/nursing-careers/international-recruitment/working-nhs-england, last accessed 27 March 2024.

costs comprise both health-based costs (including the value of QALYs from lost life years in the absence of Biomedical Scientists) and efficiency-based costs. The difference between these figures is driven by the assumptions about how the healthcare system would react to the absence of Biomedical Scientists. Specifically, providing every patient with a colonoscopy, although improving health outcomes, would lead to a higher cost per average individual relative to no screening whatsoever.[9]

Our models suggest that Biomedical Scientists' work in the initial testing stage for bowel cancer results in between **2,400 and 5,600 additional quality adjusted life years per yearly cohort that benefits from the FIT**. The counterfactual where no screening programme is offered results in the highest cost per cancer patient and number of lost life years out of the counterfactual scenarios considered, as the greatest number of people would have their cancer detected at a late stage under this scenario.

We also estimate that the impact of Biomedical Scientists at this stage of the pathway per cancer patient is significantly higher, as expected, and varies between **£9,100 and £21,400** depending on the counterfactual used. Again, these figures include both health-based and efficiency-based costs but are driven mainly by health-based costs. As with the lost life years, the highest cost per cancer patient is found in the counterfactual with no screening programme.

Health systems are complex and modelling them requires simplifying assumptions. To estimate these impacts, we have used several assumptions. These assumptions therefore make our model a simplified version of reality. For this reason, the results should be interpreted at an

We note that comparing the estimated impact of Biomedical Scientists from our model to the yearly salary of NHS medical staff is not directly comparable. Our estimation assesses the health-based and efficiency-based outcomes of a patient in a screening cohort throughout their journey, rather than focusing solely on their yearly outcomes. These figures are included to provide context and to aid understanding, particularly given the large scale of the estimated impact.

[9] Here we make a simplifying assumption that colonoscopy is offered to every individual who is currently invited to screening in a timely manner, and that there are no reductions or delays in the priority testing which is currently offered to patients deemed to be at high risk of bowel cancer. We note that this is presented as a theoretical scenario only, and implementing this in practise is unlikely to be feasible due to constraints on the NHS. If colonoscopies were to be offered to more patients, a side effect might be an increase in waiting lists, so that high-priority patients do not receive colonoscopies in the relevant timescales, or a shortage of resource elsewhere in the healthcare system, impacting patient pathways for other conditions. As our simplifying assumption provides a baseline scenario for healthcare outcomes, such as no delays in colonoscopies for high-risk patients, it is important to note that this assumption offers a conservative estimate of Biomedical Scientists' contribution.

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orders-of-magnitude level, rather than as precise point estimates, when examining the impact of Biomedical Scientists.

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1 Introduction

Biomedical Scientists play a crucial role in the healthcare system by establishing laboratory tests, analysing samples, and interpreting results to aid in the diagnosis, treatment and monitoring of various conditions.

Oxera has been commissioned by the Institute of Biomedical Science ('IBMS') to assess the impact of the activities of Biomedical Scientists, with particular focus on their contributions within the bowel cancer patient pathway.

The bowel cancer patient pathway is complex,[10] and Biomedical Scientists contribute in multiple ways across its various stages. Our analysis does not capture the impact of all the roles the Biomedical Scientists play across the pathway, but rather concentrates on those areas where their contributions are expected to be particularly pronounced.

Quantifying the value attributable to Biomedical Scientists demands both expertise in economics and medical and clinical knowledge. We have therefore collaborated closely with IBMS, particularly members of the IBMS Strategic Research Group, throughout our work.

The remainder of this report is structured as follows.

- Section 2 describes the overall conceptual approach that we have taken to measure the impact of Biomedical Scientists.
- Section 3 describes the quantification methods and calculations used to implement the conceptual approach.
- Section 4 presents the results from our analysis.

[10] Public Health England (2021), 'Guidance—Bowel cancer screening care pathway', https://www.gov.uk/government/publications/bowel-cancer-screening-care-pathway/bowel-cancer-screening-care-pathway, 16 June, last accessed on 13 March 2024.

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2 Overall approach

2.1 Scope and focus of our assessment

As discussed in section 1, Biomedical Scientists add value in multiple areas of the healthcare system. To understand their contributions and determine the areas to focus on in our analysis, we have worked closely with colleagues at IBMS. In this assessment, we focus specifically on bowel cancer.

Within the bowel cancer patient pathway, Biomedical Scientists add value at multiple stages.

- **The initial testing stage:** this is the stage at which patients undergo screening tests, which are tests carried out on asymptomatic individuals (individuals who are not currently showing signs of having cancer) to test for bowel cancer. Biomedical Scientists are heavily involved in analysing these tests.
- **The confirmation and diagnosis stage:** this is the stage at which individuals who have been identified as potentially having bowel cancer receive further tests and a diagnosis is made. Biomedical Scientists play a crucial role here in overseeing and carrying out part of the biopsy process.
- **Post-treatment stage:** Biomedical Scientists play a crucial role in the ongoing surveillance of patients following the completion of their treatment, including monitoring through tests. They also play a role in stoma care, carrying out tests for patients with suspected infection.

Biomedical Scientists also play a role in the incidental diagnosis of patients via co-morbidity. When Biomedical Scientists are carrying out blood tests for other conditions, they may determine that a patient has signs of bowel cancer, which triggers referral of the patient onto the bowel cancer patient pathway.

Given the importance of Biomedical Scientists in the diagnosis and treatment of bowel cancer, conducting an assessment of the full extent of their impact would be challenging. Instead, following discussions with IBMS, we have focused on two key stages of the bowel cancer patient pathway where the value of Biomedical Scientists is likely to be clear and extensive. It is important to note that these stages form just a small part of Biomedical Scientists' overall impact on the bowel cancer pathway and the healthcare system as a whole.

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1 The initial testing stage (please refer to section 3.1 for details of our modelling approach)

The initial testing stage involves detecting potential signs of bowel cancer and polyps in asymptomatic individuals. This is normally conducted through screening, which involves testing a large number of apparently healthy people to identify whether they are at risk from a condition.[11] Currently, the NHS carries out initial testing through the National Bowel Cancer Screening Programme. Between 1 April 2020 and 31 March 2021 the NHS invited 3.8m individuals to participate in the Bowel Cancer Screening Programme.[12] Individuals receive a home test kit, known as the faecal immunochemical test ('FIT'), which serves as the primary screening tool for the early detection of bowel cancer.[13]

Biomedical Scientists' involvement at this stage includes facilitating the initial testing and screening procedure. Biomedical Scientists also play an important role in the testing itself, providing quality assurance ('QA'), developing testing protocols and contributing to the evolution of testing technology.

Our analysis focuses on the initial testing stage, as screening tests are offered to a large number of individuals and can have a substantial impact on health outcomes for those who have cancer.

2 The confirmation and diagnosis stage (please refer to section 3.2 for details of our modelling approach)

The confirmation and diagnosis stage refers to the stage at which patients who are suspected of having bowel cancer undergo further examination and procedures to confirm its presence. Patients may reach this stage if they have a positive test result at the initial testing stage, or if they have been referred by their GP following the presentation of symptoms. Diagnosis and confirmation typically happen by way of a procedure such as a colonoscopy and/or a sigmoidoscopy, both of which involve using a camera to examine all or some of the large intestine, and taking a sample of tissue for analysis, known as a biopsy.

[11] See Gov.UK (2023), 'Guidance: population screening explained', https://www.gov.uk/guidance/population-screening-explained, November 2023, last accessed 26 February 2024.
[12] Office for Health Improvement & Disparities (2023), 'NHS screening programmes in England: 2020 to 2021', https://www.gov.uk/government/publications/nhs-screening-programmes-annual-report/nhs-screening-programmes-in-england-2020-to-2021, last accessed 26 February 2024.
[13] NHS, 'Overview—Bowel cancer screening', https://www.nhs.uk/conditions/bowel-cancer-screening/, last accessed 13 March 2024.

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Based on our discussions with IBMS, we understand that one notable area of Biomedical Scientists' contribution is their involvement in analysing the biopsy samples retrieved during the colonoscopy and sigmoidoscopy processes. Biomedical Scientists play a crucial role in the biopsy process, overseeing it and ensuring that quality standards are adhered to throughout. We therefore also assess the impact of Biomedical Scientists at this stage of the bowel cancer patient pathway.

2.2 How Biomedical Scientists drive outcomes

As well as contributing value at several stages of the bowel cancer patient pathway (see section 2.1), Biomedical Scientists add value in other ways ('dimensions'). In our assessment, we explore various dimensions through which Biomedical Scientists contribute to both initial testing and the confirmation of diagnosis—in particular, as follows.

- **Facilitating testing: Biomedical Scientists** contribute to the initial testing stage by analysing test results from the National Bowel Cancer Screening Programme.
- **Improving testing quality: Biomedical Scientists** drive better testing quality through their specialist knowledge and by implementing quality control processes.
- **Health-based vs efficiency-based outcomes:** the impact of Biomedical Scientists on participants in the screening programme can be broadly categorised into (1) health-based outcomes; and (2) efficiency-based outcomes within the healthcare system.

2.2.1 Facilitating testing

Biomedical Scientists play a key role in facilitating testing at the initial screening stage. Although FITs are taken at home by individuals who are participating in the screening programme, the results are analysed in a lab. Biomedical Scientists, all of whom are Health Care and Professional Council ('HCPC') registered, are heavily involved in carrying out and overseeing the FIT testing.[14] UK regulation stipulates that Biomedical

[14] Johnstone, M., Miller, G., Pang, G., Burton, P., Kourounis, G., Winter, J., Crighton, E., Mansouri, D., Witherspoon, P., Smith, K. and McSorley, S.T. (2022), 'Alternative diagnoses and demographics associated with a raised quantitative faecal immunochemical test in symptomatic patients', July, in Sage Annals of Clinical Biochemistry, PMCID: PMC9280700, PMID: 35044264, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9280700/, last accessed 25 March 2024.

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Scientists analysis, reporting and supervision in the FIT testing process must be carried out by HCPC registered Biomedical Scientists.[15]

As FITs cannot be analysed without Biomedical Scientists, one way to assess the impact of Biomedical Scientists is to consider alternative scenarios where, because of their absence, the FIT cannot be conducted. We can then compare the outcomes between the current scenario, where Biomedical Scientists are involved, and these alternative scenarios. Under these scenarios, individuals would have to be screened using an alternative screening process or receive no screening. We discuss these scenarios in more detail in sections 3.1.3, and 3.1.4.

2.2.2 Improving testing quality

As well as facilitating the testing itself, Biomedical Scientists affect the bowel cancer patient pathway by driving better testing quality than would be possible in a scenario in which they are not involved in the FIT testing process. This is due to their specialist training and knowledge, as well as the QA that they provide.

These improvements in quality are difficult to quantify, and we have not been able to identify datapoints that directly measure improvements in testing quality when comparing instances where Biomedical Scientists are involved in the patient pathway, relative to not having them involved.[16] We therefore approximate the impact of Biomedical Scientists on testing quality by assessing the impact of Biomedical Scientists conducting FITs relative to a lower-quality test—the guaiac-based faecal occult blood test ('gFOBT') (see section 3.1.5 for more details).[17] While this is not a perfect proxy for the impact of Biomedical Scientists on testing quality, it nonetheless captures the impact of

[15] Specifically, the Health and Social Care Act (2008) stipulates that certain activities, including screening and diagnostic testing, are prescribed as regulated activities, which must be carried out by specific personnel. See Health and Social Care Act (2008), Part 2; Health and Social Care Act (2008), schedule 1; Health and Social Care Act (2008), section 7(1).

[16] This is because in the UK, as in most other countries, Biomedical Scientists are heavily involved in the bowel cancer patient pathway. There are some examples of cases where tests for other conditions that are normally carried out by Biomedical Scientists have been carried out by less qualified professionals, as was the case with testing for COVID-19 during the recent pandemic. We have not used metrics on Biomedical Scientists' impact on testing quality from the COVID-19 testing, as this is a very different type of test and data on this would not be applicable to the bowel cancer patient pathway.

[17] There have been 13 population-based screening studies comparing performance characteristics of gFOBT and FIT. Although the studies used different tests and slightly different protocols, the results of all studies consistently showed that FIT has significantly higher sensitivity for advanced adenomas and cancer than the gFOBT, according to the following reference. Mackie, A. (2015), 'Moving from guaiac faecal occult blood test (gFOBT) to a faecal immunochemical test for haemoglobin (FIT) in the bowel screening programme: A consultation', https://legacyscreening.phe.org.uk/policydb_download.php?doc=802, pp. 3–4, last accessed 15 March.

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differentials in test quality in the context of bowel cancer screening. This is discussed further in section 3.1.5.

Biomedical Scientists are not the sole contributors to testing quality. While Biomedical Scientists play a significant role in the development, implementation and improvement of testing protocols and procedures, various other stakeholders and factors contribute to the advancement of diagnostic technologies in bowel cancer screening.[18]

2.2.3 Health-based vs efficiency-based outcomes

To assess the value of Biomedical Scientists within the bowel cancer patient pathway, we focus on the value they generate within the healthcare system. Biomedical Scientists contribute to both health-based and efficiency-based outcomes, as detailed below.

Health-based outcomes

At the initial testing stage, Biomedical Scientists analyse FIT results, enabling patients with cancer to be diagnosed while still asymptomatic, at which point their cancer is likely to be at an earlier stage. This improves patient survival probabilities and therefore patient outcomes.

We measure this impact by assessing the cost in life years if Biomedical Scientists were not involved. We also quantify the economic cost of this health-based outcome by using the quality-adjusted life year ('QALY') concept, which is a 'measure of the state of health of a person or group in which the benefits, in terms of length of life, are adjusted to reflect the quality of life. One QALY is equal to 1 year of life in perfect health'.[19]

Efficiency-based outcomes

As well as driving health outcomes, Biomedical Scientists contribute to the efficiency of the healthcare system, resulting in financial cost reductions. For example, FIT provide a relatively low-cost method of screening for bowel cancer, if screening were to rely predominantly on coloscopies, the cost to the healthcare system would be significantly higher.

[18] These contributors include researchers, clinicians, healthcare institutions, pharmaceutical companies, regulatory bodies and government agencies. Research and development efforts, technological innovations, clinical trials, funding initiatives, policy changes and advancements in medical science and technology all play crucial roles in driving the transition from older, less accurate screening methods such as gFOBT to more sensitive and specific tests such as the FIT.
[19] National Institute for Health and Care Excellence, https://www.nice.org.uk/glossary?letter=q, last accessed 24 March 2024.

We quantify the impact of Biomedical Scientists on the healthcare system using four outcome metrics, which together quantify the health-based and efficiency-based outcomes. Section 4 details these metrics.

We calculate the impact of Biomedical Scientists as an average cost per individual. This reflects the average cost associated with each individual in the relevant cohort.[20] It includes both health-based costs (such as the economic costs of lost life years calculated using QALYs) and financial costs (such as treatment costs and savings achieved by using the FIT rather than alternative screening methods).

The methodology outlined in sections 2.3 and 3 below outlines how we estimate the impact of Biomedical Scientists, measured by the average cost per individual. The same methodology is used to estimate the other outcome metrics discussed in section 4.

2.3 Approach to quantification

Our methodology involves a comparative analysis of the costs incurred by individuals invited to participate in the bowel cancer screening programme (the 'total sample,' or an 'individual in the screening sample' when discussing single cases):

- in the current scenario with Biomedical Scientists present (the 'factual scenario'); and
- in a hypothetical scenario where Biomedical Scientists are absent (the 'counterfactual scenario').

2.3.1 Estimating expected costs for each scenario

To estimate costs for each scenario, we consider the routes that individuals may follow as they progress through screening, diagnosis and treatment. These routes are simplified for modelling and computational feasibility.

Our modelling framework involves simplifying assumptions based on informed judgments and expert opinions. We have consulted with IBMS colleagues, particularly the Strategic Research Group, to ensure our assumptions are sensible and maintain the validity of our analytical approach.

[20] This is the cohort to which FIT screening is offered—i.e. all individuals in the UK who are invited to participate in the National Bowel Cancer Screening Programme, in a given year. This was 3.8m individuals between 1 April 2020 and 31 March 2021. See Gov.UK (2023), 'Corporate Report: NHS screening programmes in England: 2020 to 2021', February.

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Acknowledging that models are a simplified representation of reality, results should be interpreted at an orders-of-magnitude rather than as precise point estimates.

Steps to calculate the costs for each scenario

For each route, we apply the following steps.

1 Estimate the probability that an individual in the screening sample will take each route.
2 Estimate the financial cost and health outcome costs associated with each route.
3 Multiply the probabilities and costs above to estimate the average expected cost for each route.
4 Sum the expected costs for all routes to calculate the total expected cost for the scenario.

For all scenarios, we use these steps to calculate the expected cost. Comparing factual and counterfactual scenarios allows us to estimate the overall benefits and/or cost savings.

2.3.2 Selecting counterfactual scenarios

Defining a suitable counterfactual scenario is a key aspect of the analysis. Our approach requires us to envision scenarios where Biomedical Scientists are absent from the healthcare system. It is important to clarify that our objective is not to precisely predict how the system would function without Biomedical Scientists. Rather, our aim is to present various hypothetical cases that could arise in the absence of Biomedical Scientists, providing a framework for evaluating their value within the current healthcare system.

Throughout this assessment, we quantify the tangible value generated by Biomedical Scientists and highlight the various areas of impact that Biomedical Scientists have within the healthcare system, specifically the bowel cancer patient pathway.

In the next section, we describe how we model the factual and counterfactual scenarios to illustrate our conceptual approach.

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3 Quantification

Our modelling approximates the impact of Biomedical Scientists. In this process, we have made several simplifying assumptions, mainly when the inclusion of additional detail in the model was unlikely to significantly affect the result. Throughout section 3 we mention relevant simplifying assumptions where appropriate.

3.1 Biomedical Scientists' impact at the initial testing stage

Early detection of bowel cancer plays an important role in improving patient outcomes.[21] As discussed in section 2.1, Biomedical Scientists contribute to early detection by facilitating FITs, the primary screening tool.[22] In this section, we focus on their role in enabling and enhancing the effectiveness of FIT testing.

3.1.1 Factual scenario

Decision tree

The factual case is the existing screening process, in which FITs are used to screen invited individuals. Figure 3.1 is a simplified representation of the decision tree in the factual case, which shows the possible routes that an individual who is invited onto the screening programme could progress through, with each route involving multiple steps. The boxes in the diagram represent decisions or outcomes at each step of the process.

For each individual in the screening programme, the first decision point, determined by the individuals invited to the screening, is whether to participate in the programme by taking the FIT (depicted in a dark green round box in Figure 3.1 below). Depending on their decision, they receive a different possible set of outcomes, illustrated by the branches leading out from the boxes. They will then receive one of the intermediate outcomes beneath the boxes (presented in the round white boxes). These outcomes are discussed in detail below.

[21] See, for example, Cancer Research UK, 'Why is early cancer diagnosis important?', https://www.cancerresearchuk.org/about-cancer/cancer-symptoms/why-is-early-diagnosis-important/1000#:~:text=More%20than%209%20in%2010,UK%20for%20people%20without%20symptoms , last accessed 22 March 2024; and Cardosa et al. (2022), 'Overall and stage-specific survival of patients with screen-detected colorectal cancer in European countries: A population-based study in 9 countries', July, in *The Lancet Regional Health – Europe* 2022;21: 100458, Published online 6 July 2022.

[22] NHS, 'Overview—Bowel cancer screening', https://www.nhs.uk/conditions/bowel-cancer-screening/, last accessed on 13 March 2024.

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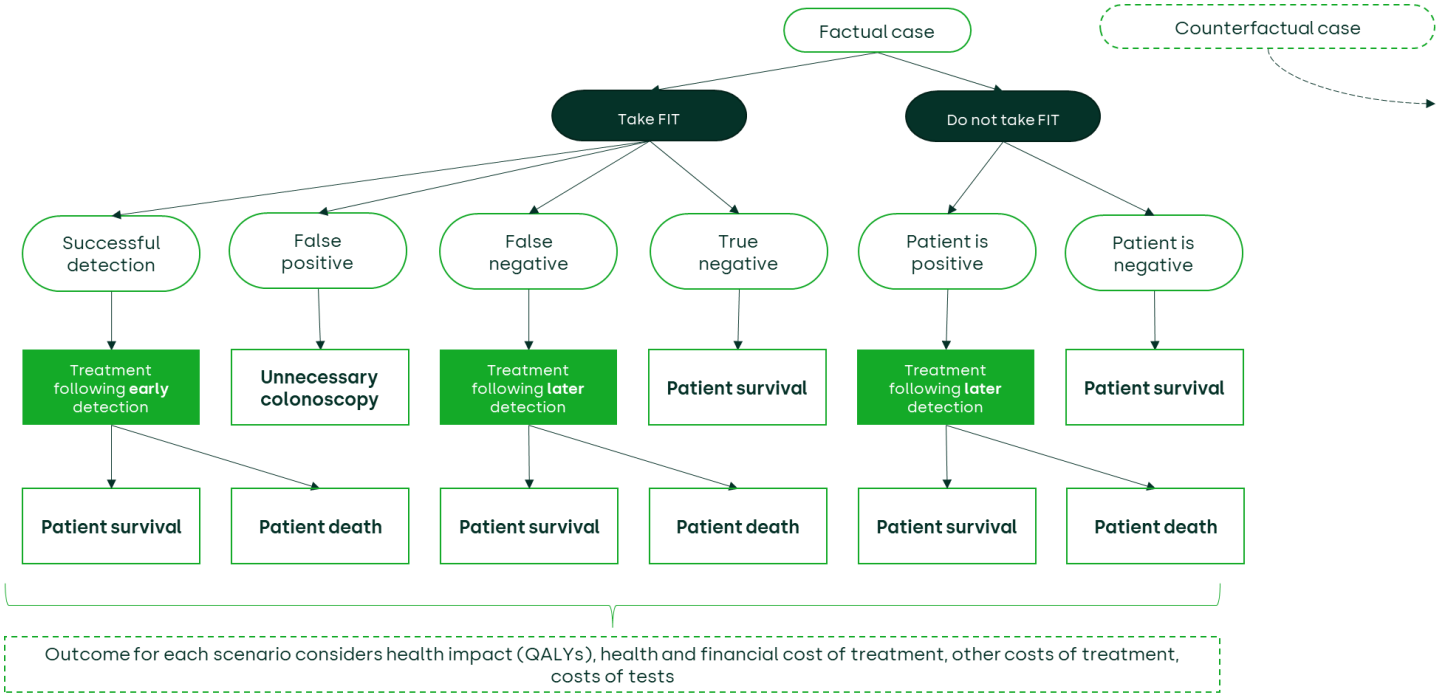
Figure 3.1 Factual case decision tree



Source: Oxera visualisation.

Individual in the screening sample takes the FIT

An individual in the screening sample participates in the screening programme when they are asymptomatic. They will receive one of four outcomes at this stage.

- **Successful detection, or true positive:** the FIT correctly identifies that the individual has bowel cancer.
- **False positive:** the FIT indicates that the individual has bowel cancer, but subsequent confirmation reveals that they do not.
- **False negative:** the FIT fails to detect the presence of bowel cancer.
- **True negative:** the FIT correctly identifies that the individual is free of bowel cancer.

If an individual in the screening programme receives a positive FIT result (true or false positive), our model assumes that the individual undergoes further testing (assumed to be colonoscopy) to confirm the diagnosis. If bowel cancer is confirmed after this additional testing, the patient follows the route for a patient who is positive. As these patients are diagnosed while asymptomatic, they are more likely to be at an early stage of bowel cancer than if they had been diagnosed when symptomatic. As a result, we assume that they have a higher probability

of survival than those diagnosed when symptomatic.[23] This reflects the importance of early detection through screening programmes such as the FIT.

If an individual in the screened group receives a negative FIT result, this could be either a true negative or a false negative. The ratio of true negatives to false negatives among cancer patients depends on the sensitivity of the test. Although the majority of individuals with a negative FIT result do not have bowel cancer, there remains a possibility that the patient has undetected bowel cancer (a false negative).

In the event that the FIT fails to detect bowel cancer at the asymptomatic stage, we assume that the cancer is not identified until the individual becomes symptomatic at a later stage. In reality, it is possible that a patient who receives a false negative in their FIT may have their cancer successfully identified in the next round of screening (individuals are invited to take the FIT every two years[24]) before they become symptomatic. As the probability of a false negative is estimated to be relatively small, these cases are unlikely to have a significant impact on our results. However, we still note that our model assumes a worse health outcome for these individuals than may be the case in reality, potentially leading to an underestimation of the impact of Biomedical Scientists. Similar assumption might exist in certain counterfactual scenarios, for instance the third counterfactual scenario, which may mitigate the underestimation in net terms.

Individual in the screening sample does not take the FIT

A significant number of individuals do not participate in the screening programme despite being invited. Of these, a substantial proportion do not have bowel cancer. In these cases, the cost of the FIT is avoided and there are no negative health outcomes. However, for those who do have cancer, we assume that the cancer is detected at a later stage when they become symptomatic. Consequently, our model indicates that individuals with cancer that is detected at a later stage experience

[23] In a population-based study conducted in several European countries, the five-year overall survival rates for patients with screen-detected cancer was 83.4%, while for patients with non-screen-detected cancer the survival rate was much lower at 57.5%. Cardoso, R., Guo, F., Heisser, T., De Schutter, H., Van Damme, N. and Nilbert, M.C. (2022), 'Overall and stage-specific survival of patients with screen-detected colorectal cancer in European countries: A population-based study in 9 countries', *The Lancet Regional Health – Europe*, **21**, October.
[24] Bowel Cancer UK, https://www.bowelcanceruk.org.uk/about-bowel-cancer/screening/#:~:text=If%20you%20are%20aged%20between,test%20before%20you%20turn%2054, last accessed 24 March 2024.

worse health outcomes, facing lower probabilities of survival than those detected at an early stage.

We acknowledge a simplifying assumption here: if an individual has cancer but does not take the FIT, their cancer will not be identified until they become symptomatic. However, it is possible that, as the FIT screening programme is offered every two years, the patient may take the FIT later and their cancer may still be identified when asymptomatic. This would lead to this patient having a higher probability of survival than modelled here, leading to a better outcome in the factual case than our modelling would suggest. This means that our model may be conservative in estimating the benefits of Biomedical Scientists. However, we consider this unlikely to have a large impact on our results; since the cancer is still identified two years after it could have been, it is likely that the patient would still have a worse health outcome than they would have done had they taken the FIT.

In total, our factual scenario includes nine distinct routes. If an individual in the screening sample opts to undergo FIT screening, there are six potential routes, each with its own set of potential outcomes. If an individual chooses not to undergo FIT screening, our model includes three alternative routes.

Estimating costs

Each of these nine routes comprises the following components.

- The decision regarding participation in the screening programme and undergoing the FIT, and the subsequent outcome of this decision.
- The probabilities associated with the potential outcomes of this decision.
- Subsequent diagnostic and treatment options, and their associated costs.

Based on these decisions, we estimate their probabilities and subsequent costs.

Table 3.1 and Table 3.2 show the probabilities used in our analysis with potential outcomes, and the costs associated with subsequent diagnostic and treatment options.

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Table 3.1 Probabilities

Description	Probability	Source
Probability that an individual from the sample takes FIT	70.95%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities
True positive rate for FIT	0.16%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities
False positive rate for FIT	2.01%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities
False negative rate for FIT	0.02%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities
True negative rate for FIT	97.81%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities
Rate of bowel cancer among the invited	0.18%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities
Five-year overall survival rate for patients with screen-detected cancer	83.4%	The Lancet Regional Health – Europe
Five-year overall survival rate for patients with non-screen-detected cancer	57.5%	The Lancet Regional Health – Europe

Source: Oxera calculations based on the statistics found in the following sources: Office of Health Improvement & Disparities (2023), 'Corporate report, NHS screening Programmes in England: 2020 to 2021', https://www.gov.uk/government/publications/nhs-screening-Programmes-annual-report/nhs-screening-Programmes-in-england-2020-to-2021#nhs-bowel-cancer-screening-Programme-bcsp, 16 February, last accessed 12 March 2024; Cardoso, R., Guo, F., Heisser, T., De Schutter, H., Van Damme, N. and Nilbert, M.C. (2022), 'Overall and stage-specific survival of patients with screen-detected colorectal cancer in European countries: A population-based study in 9 countries', The Lancet Regional Health – Europe, 21, October.

Table 3.2 Costs

Description	Value	Source
Cost of FIT and gFOBT	£5	NHS
Cost of colonoscopy	£372	NHS
Cost of treatment at early-stage detection	£3,458	Oxera calculation based on statistics from Public Health England
Cost of treatment at later-stage detection	£4,646	Oxera calculation based on statistics from Public Health England
Cost of palliative care	£9,760	Palliative Medicine
Value of healthy QALY	£25,000[1]	National Institute for Health and Care Excellence (NICE) statistics presented in the Guidance document of the Office of Health Improvement & Disparities

Source: NHS (2017), 'Home-testing kits that detect bowel cancer could almost halve invasive examinations by 2020', https://www.england.nhs.uk/2017/09/home-testing-kits-that-detect-bowel-cancer-could-almost-halve-invasive-examinations-by-2020/#:~:text=It%20could%20also%20save%20the,just%20one%20gram%20of%20poo, 29 September, last accessed 13 March 2024; Public Health England (2016), 'Cost-effective commissioning of colorectal cancer care. An assessment of the cost-effectiveness of improving early diagnosis', https://assets.publishing.service.gov.uk/media/5a821a44ed915d74e6235cc1/cost-effectiveness-early-diagnosis-colorectal-cancer.pdf, October, last accessed 4 March 2024; Round, J., Jones, L. and Morris, S. (2015), 'Estimating the cost of caring for people with cancer at the end of life: A modelling study', *Palliative Medicine*, **29**:10, pp. 899–907; Office for Health Improvement and Disparities (2020), 'Guidance Cost utility analysis: health economic studies', https://www.gov.uk/guidance/cost-utility-analysis-health-economic-studies#:~:text=For%20example%2C%20the%20cost%20per,is%20well%20below%20this%20threshold.

In our model, there are few key assumptions that have a significant role in driving our results. First, we assume that individuals who do and do not take the FIT all have the same probability of having bowel cancer.[25] In reality, it is possible that the probabilities of having cancer differs between the groups. On the one hand, individuals who take the test may be worried about cancer for a legitimate reason (e.g. a medical pre-disposition to the condition), which would lead to these individuals having a higher probability of having cancer. On the other hand, those individuals who take the test may be generally more health-conscious

[25] We assume that 0.18% of the individuals in the total sample have bowel cancer. This is calculated by adding together the true positive rate and false negative rate for the FIT in Table 3.1.

people who are less likely to have cancer because of their lifestyles. This could affect our results in either direction.

Second, because we use the five-year survival rate in our model (see Table 3.1), we estimate the value of survival to be five times that of QALY; this translates to £125,000, plus the cost of palliative care. We note this is a simplifying assumption for ease of calculation. If one perceives the value of survival to be higher, our estimated health-based outcomes are likely to increase, and vice versa.

Finally, we do not consider additional FITs offered to high-risk individuals outside of the National Bowel Screening Programme. We understand from IBMS that additional FITs may be offered to individuals who are pre-disposed to bowel cancer. If the FIT were not available, it is likely that these individuals would face a disproportionate impact. This suggests our estimate of the impact of Biomedical Scientists on the bowel cancer patient pathway understates their actual impact.

Using these probabilities and costs, we follow the steps in section 2.3.1 to estimate the costs for the factual scenario.

3.1.2 Construction of the counterfactual scenarios

The counterfactuals represent a range of scenarios that might occur without Biomedical Scientists' involvement in the healthcare system. Our goal in constructing the counterfactuals is not solely to quantify their value but also to underscore the various areas of impact that they have within the healthcare system. The counterfactuals outline different ways in which Biomedical Scientists drive value, both by facilitating testing itself and driving testing quality, and by driving health-based and efficiency-based outcomes (see section 2.2).

Dimension 1: impact of Biomedical Scientists in facilitating the FIT

Our first two models explore the role of Biomedical Scientists in facilitating the testing, and ensuring its efficient administration and implementation within the healthcare system. In both of these models, we make the assumption that, given that Biomedical Scientists are intrinsically tied to the FIT process, the FIT cannot be used as a screening process in the absence of Biomedical Scientists.[26] These

[26] It is worth noting that, in both of these counterfactuals, we make the assumption that in the absence of Biomedical Scientists' involvement in the FIT there would be no other profession that could step in and conduct the tests. While Biomedical Scientists are required to fulfil this role under UK regulations, in the absence of Biomedical Scientists one might argue that these regulations

counterfactual scenarios present different possible courses of action that the NHS might follow in the absence of Biomedical Scientists' involvement in the FIT.

1 **First counterfactual scenario (section 3.1.3).** We consider a counterfactual scenario where the FIT is not used, and instead colonoscopy is used as the primary screening method to detect bowel cancer. This has precedent among people at high risk of bowel cancer in the UK, who are screened using colonoscopy.[27]

2 **Second counterfactual scenario (section 3.1.4).** We consider a counterfactual scenario where no screening for bowel cancer detection is available—reflecting Biomedical Scientists' heavy involvement in bowel cancer screening.

Dimension 2: impact of Biomedical Scientists in improving test quality

In addition to facilitating testing procedures, Biomedical Scientists contribute to improved testing quality throughout the process through their knowledge and training by conducting QA, and by ensuring that testing quality standards and protocols, aimed at enhancing the quality of bowel cancer screening tests, are adhered to (see section 2.2.2). We use the third counterfactual scenario to assess the impact of Biomedical Scientists' contributions to testing.

3 **Third counterfactual scenario (section 3.1.5).** We consider a counterfactual scenario where the FIT is substituted with the gFOBT, representing a lower-quality screening method.[28] This captures differences in outcomes that may arise from differences in testing quality. We use this to proxy for the differences in testing quality that are driven by Biomedical Scientists' involvement in the patient pathway.

would be changed. We note, however, that, if we assume that another group of individuals receives the same training and accreditation as Biomedical Scientists, in order to conduct the FIT, in order to replace Biomedical Scientists in the patient pathway they would in effect become an equivalent to Biomedical Scientists, and this is therefore not a relevant counterfactual.

[27] Cancer research UK, 'Screening for people at high risk of bowel cancer', https://www.cancerresearchuk.org/about-cancer/bowel-cancer/getting-diagnosed/screening-for-people-high-risk, last accessed 19 March 2024.

[28] There have been 13 population-based screening studies comparing performance characteristics of gFOBT and FIT. Although the studies used different tests and slightly different protocols, the results of all studies consistently showed that FIT has significantly higher sensitivity for advanced adenomas and cancer than the gFOBT, according to the following reference. Mackie, A. (2015), 'Moving from guaiac faecal occult blood test (gFOBT) to a faecal immunochemical test for haemoglobin (FIT) in the bowel screening programme: A consultation', https://legacyscreening.phe.org.uk/policydb_download.php?doc=802, pp. 3–4, last accessed 15 March 2024.

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As discussed in section 2.2, Biomedical Scientists are not the only contributors to the testing procedure, and nor are they the sole contributors to the evolution of testing technologies from the gFOBT to the FIT. While they play a significant role in the development, implementation and improvement of testing protocols and procedures, various other stakeholders and factors contribute to the advancement of diagnostic technologies in bowel cancer screening.[29]

Therefore, while Biomedical Scientists contribute, it is important to acknowledge the collaborative efforts of all the stakeholders and factors driving progress and innovation in bowel cancer screening methods.

3.1.3 The first counterfactual scenario

Currently, colonoscopies are used primarily at a later stage to confirm a diagnosis of bowel cancer, rather than as a tool for early detection, owing to (among other things) their higher cost. In this section, we explore the implications of replacing the FIT with colonoscopy as the primary screening tool for bowel cancer.

As with the factual case, our decision tree (Figure 3.2) illustrates the patient pathway under the counterfactual scenario where colonoscopy replaces the FIT as the primary screening tool for bowel cancer detection.

[29] These contributors include researchers, clinicians, healthcare institutions, pharmaceutical companies, regulatory bodies and government agencies. Research and development efforts, technological innovations, clinical trials, funding initiatives, policy changes and advancements in medical science and technology all play crucial roles in driving the transition from older, less accurate screening methods such as the gFOBT to more sensitive and specific tests such as the FIT.

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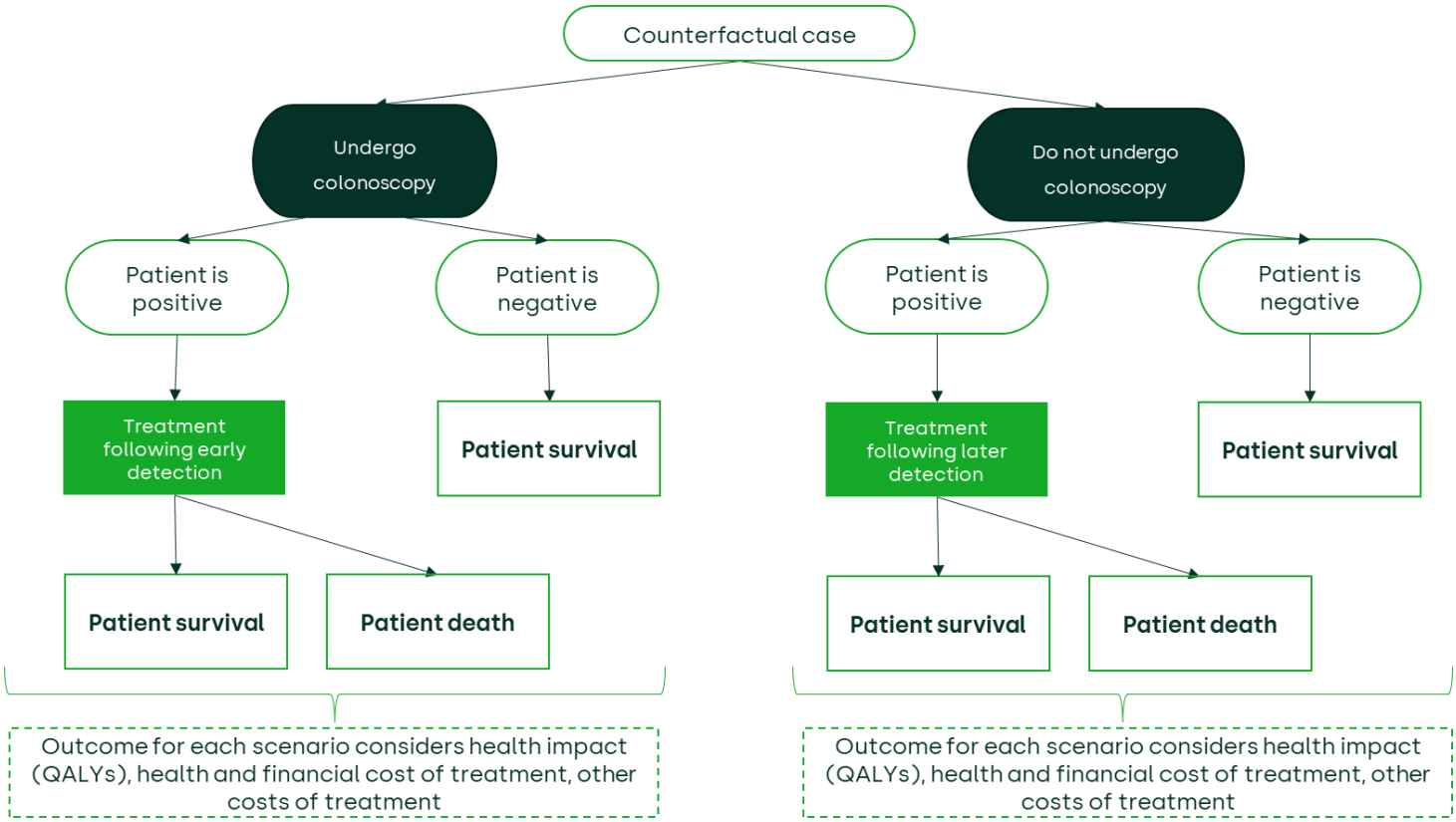
Figure 3.2 Counterfactual case (colonoscopy as a screening tool) decision tree



Source: Oxera.

In this counterfactual scenario, individuals in the screening sample would undergo colonoscopy as the initial means of detecting bowel cancer at the asymptomatic stage. We assume that a colonoscopy would effectively confirm or rule out a diagnosis of bowel cancer with no error rate.[30] For those who undergo colonoscopy as a screening method (the routes in the left half of Figure 3.2), we assume that the this would detect bowel cancer, resulting in a higher rate of survival. Conversely, for those who do not undergo colonoscopy as a screening method (the routes in the right half of Figure 3.2), we assume that the

[30] Colonoscopy is a comprehensive diagnostic procedure that allows healthcare professionals to visually examine the entire length of the colon and rectum using a flexible tube with a camera attached. During the procedure, if any abnormal tissue or growths, such as polyps, are detected, they can be biopsied or removed for further examination. As such, the assumption is that the diagnostic accuracy of colonoscopy is high enough to reliably confirm or exclude the presence of bowel cancer in individuals undergoing screening. However, it is important to note that while colonoscopy is a powerful diagnostic tool, it is not infallible. False negatives (where cancer is present but not detected) and false positives (where no cancer is present but abnormalities are detected) are possible outcomes. Nevertheless, in the context of this counterfactual scenario, the assumption is that colonoscopy would serve as an effective screening tool with a high degree of diagnostic accuracy for detecting bowel cancer.

test would detect bowel cancer at a later stage, leading to a lower rate of survival.

Since colonoscopy is a more invasive and expensive procedure than the FIT, it is in practice unlikely that all individuals currently undergoing the FIT for screening purposes would readily embrace it as an alternative.[31] Accurately predicting the proportion of those who currently take the FIT who would opt for (and be referred for) a colonoscopy instead is challenging. Therefore, we make the assumption that half of those who currently take the FIT would instead receive a colonoscopy. Acknowledging the uncertainty associated with this assumption, we conduct sensitivity analysis by varying the assumed proportions of patients who undergo colonoscopy screening (see section 4.1.3 for details).

One important caveat is that the NHS may not have sufficient capacity to accommodate the increased demand for colonoscopies in this counterfactual scenario. If the demand were met, the additional number of colonoscopies required could strain the healthcare system, potentially incurring additional costs or affecting treatment for other conditions as a consequence. We reiterate that this scenario is not designed to forecast the outcome if the current bowel cancer screening method were discontinued. Instead, its purpose is to illustrate the value that FIT testing and, by extension, Biomedical Scientists produce. Therefore, in this hypothetical scenario we assume that the NHS would have the capability to conduct all necessary colonoscopies with no wider impacts on other patients.

As with the factual scenario, we follow the steps in section 2.3.1 to estimate costs for this counterfactual scenario. Finally, to quantify the impact of Biomedical Scientists, we compare the expected costs of the factual scenario—where, in this case, the FIT serves as the primary screening tool—with the expected costs of the counterfactual

[31] Several studies indicate that there is relatively low uptake of colonoscopy when it is offered in a screening programme. Bretthauer et al. (2022) find that there was 42% uptake in a colonoscopy screening programme offered in Poland, Norway, Sweden and the Netherlands between 2009 and 2014, while Segnan et al. (2007) find a 26.5% attendance rating for a colonoscopy screening programme in Italy between 2002 and 2004. We note that our estimated uptake of the colonoscopy screening programme before conducting sensitivities is 37.5%, which is between these two findings. See Bretthauer, M., Loberg, M., Wieszczy, P., Kalager, M., Emilsson, L., Garborg, K., Rupinski, M., Dekker, E., Spaander, M., Bugajski, M., Holme, O., Zauber, A.G., Pilonis, N.D., Mroz, A., Kuipers, E.J., Shi, J., Hernan, M.A., Adami, H., Regula, J., Hoff, G., Kaminski, M.F. and the NoridICC Study Group (2022), 'Effect of Colonoscopy Screening on Risks of Colorectal Cancer and Related Death', October, *The New England Journal of Medicine*, **387**:17, pp. 1547–1556, doi: 10.1056/NEJMoa2208375, Epub 2022 Oct 9, https://pubmed.ncbi.nlm.nih.gov/36214590/; and Segnan, N., Senore, C., Andreoni, B., et al. (2007), SCORE3 Working Group—Italy, 'Comparing attendance and detection rate of colonoscopy with sigmoidoscopy and FIT for colorectal cancer screening', *Gastroenterology*, **132**:7, pp. 2304–2312, doi:10.1053/j.gastro.2007.03.030.

scenario—where, in this case, colonoscopy partially replaces the FIT as the primary screening tool.

3.1.4 The second counterfactual scenario

In the previous section (section 3.1.3), we explored a counterfactual scenario where colonoscopy was used as an alternative to the FIT for bowel cancer screening. In this section, we explore a counterfactual scenario where there is no screening process in place—that is, where no additional colonoscopies are performed.

In this scenario, we assume that no screening procedure is available to individuals, meaning that bowel cancer cannot be detected in the asymptomatic individuals who are currently invited to the screening process.

Instead, individuals who have cancer are diagnosed only after they become symptomatic, at which point they may present their symptoms to their GP for further evaluation and diagnosis. These individuals would subsequently receive confirmation of their diagnosis and proceed with the treatment plan. As their cancer has been identified once they are symptomatic, they are more likely to be in a later stage of the disease, and therefore have a lower probability of survival.

Figure 3.3 below is a decision tree illustrating the routes under this counterfactual scenario.

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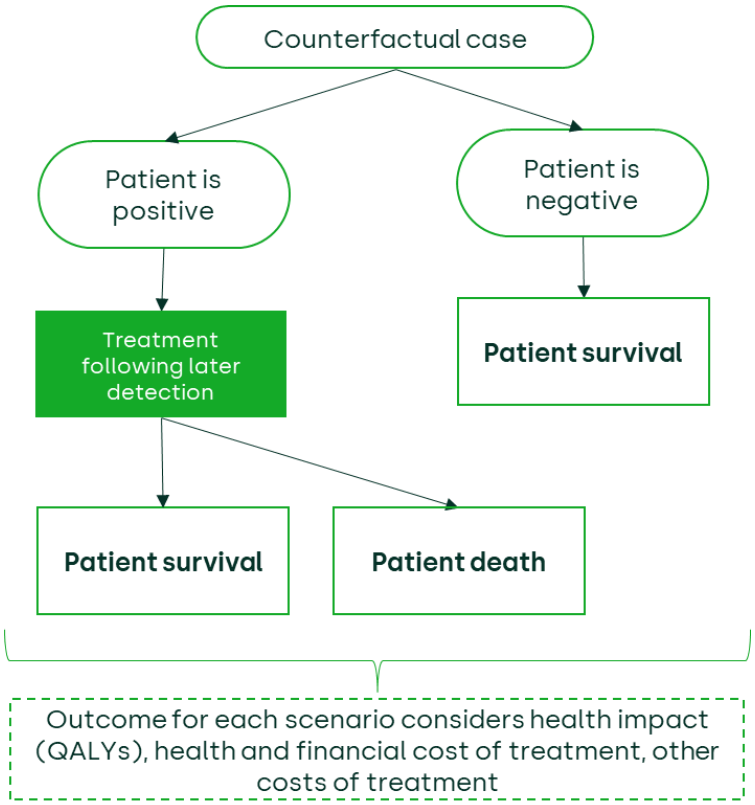
Figure 3.3 Counterfactual case (no screening tool available) decision tree



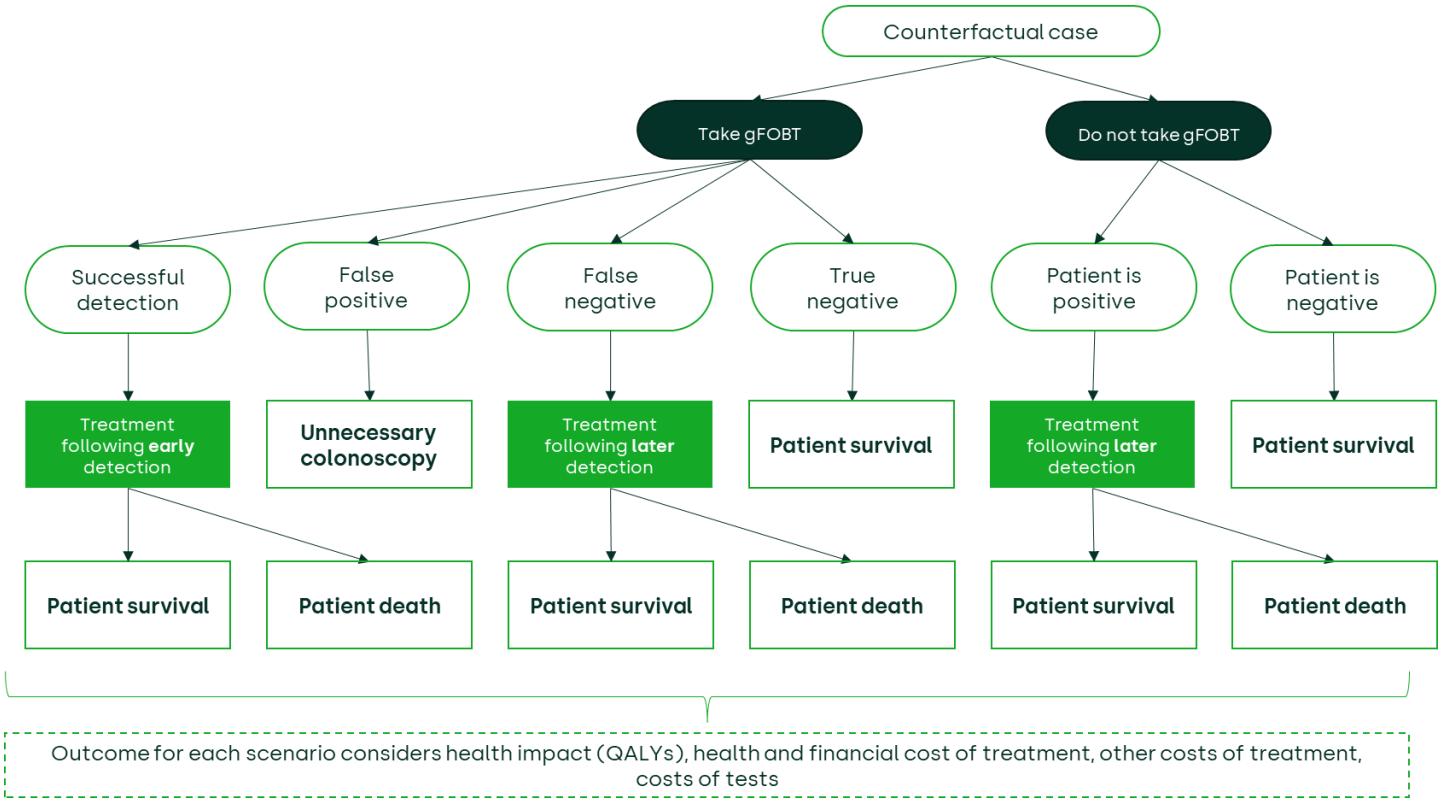
Source: Oxera.

3.1.5 The third counterfactual scenario

In sections 3.1.3 and 3.1.4, we explored how Biomedical Scientists contribute to facilitating testing procedures. In this counterfactual analysis, our objective is to quantify Biomedical Scientists' contributions to improving testing quality standards by examining a scenario where the screening uses the gFOBT, a less-accurate screening method than the FIT. As discussed in section 2.2, this is used to proxy Biomedical Scientists' impact on the bowel cancer patient pathway by improving test quality.

The decision tree for this counterfactual scenario is illustrated in Figure 3.4 below. This decision tree mirrors the one depicted in Figure 3.1, as described in section 3.1.1, as individuals in the sample follow the same routes.

Figure 3.4 Counterfactual case (gFOBT as a screening tool) decision tree



Source: Oxera.

The main difference between the factual scenario and this counterfactual scenario is the accuracy of testing outcomes between the FIT and the gFOBT. This is driven by the fact that the gFOBT, which is an older and lower-quality test, has both a lower sensitivity and specificity than the FIT.[32]

Table 2.3 below shows the rate of testing outcomes between the FIT and the gFOBT. This illustrates that:

- as the gFOBT has lower sensitivity than the FIT, true positives are lower and false negatives are higher;
- as the gFOBT has lower specificity than the FIT, false positives are higher and true negatives are lower.

[32] D'Souza, N., Brzezicki, A. and Abulafi, M. (2019), 'Faecal immunochemical testing in general practice', *British Journal of General Practice*, **69**:679, February, pp. 60–61.

Table 3.3 Probabilities of testing outcomes for FIT and gFOBT

Description	FIT	gFOBT	Source
True positive rate	0.16%	0.09%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities and British Journal of General Practice
False positive rate	2.01%	11.68%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities and British Journal of General Practice
False negative rate	0.02%	0.09%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities and British Journal of General Practice
True negative rate	97.81%	87.84%	Oxera calculation based on the statistics of Office of Health Improvement & Disparities and British Journal of General Practice

Source: Oxera calculations based on the statistics found in the following sources: Office of Health Improvement & Disparities (2023), 'Corporate report, NHS screening Programmes in England: 2020 to 2021', https://www.gov.uk/government/publications/nhs-screening-Programmes-annual-report/nhs-screening-Programmes-in-england-2020-to-2021#nhs-bowel-cancer-screening-Programme-bcsp, 16 February, last accessed 12 March 2024; D'Souza, N., Brzezicki, A. and Abulafi, M. (2019), 'Faecal immunochemical testing in general practice', *British Journal of General Practice*, **69**:679, February, pp. 60–61.

Because the testing accuracy is lower for the gFOBT (counterfactual case) than for the FIT (factual case), the proportion of individuals going through each of the routes differs between the factual case and the counterfactual case. This results in different expected costs (including both health-based and efficiency-based costs). Finally, we compare these expected costs when the FIT is used as a screening tool and when the gFOBT is used as a screening tool.

As discussed in section 2.2, it is important to recognise that we use this counterfactual scenario to approximate the impact of Biomedical Scientists on testing quality. To do so, we would ideally use a evidence that directly addresses the impact on test quality driven by Biomedical Scientists relative to no Biomedical Scientists' involvement in the patient pathway. In the absence of this, we use a comparison of the FIT and the gFOBT as a proxy to show how testing accuracy can vary within the bowel cancer patient pathway. This should be seen as indicative of the impact that Biomedical Scientists may have by driving improvements in testing quality and accuracy.

3.2 Biomedical Scientists' impact at the confirmation and diagnosis stage

In assessing the value that Biomedical Scientists contribute to the bowel cancer patient pathway, our main emphasis has been on their role at

the initial identification stage. This focus is driven by the fact that the initial identification stage involves a large number of individuals.[33] However, it is important to acknowledge that, while fewer individuals progress to later stages, Biomedical Scientists still play a crucial role in those stages.

In this section, we examine the specific roles or tasks of Biomedical Scientists in analysing samples from biopsies obtained during colonoscopy and sigmoidoscopy procedures. To accomplish this, we explore a counterfactual scenario in which the responsibilities currently handled by Biomedical Scientists are assumed by pathologists. Again, this is intended as a hypothetical scenario to illustrate the significance of the work performed by Biomedical Scientists in this later stage of the bowel cancer patient pathway, rather than a prediction of how the absence of Biomedical Scientists would be addressed.

3.2.1 Impact of Biomedical Scientists in enhancing cost-effectiveness in biopsies

We have worked with IBMS colleagues to understand the biopsy process and the role of Biomedical Scientists within it. On the basis of these discussions we understand that, during the confirmation and diagnosis stage, a tissue sample known as a histopathology sample may be collected through biopsy during either colonoscopy or sigmoidoscopy. This histopathology sample is then processed according to the steps outlined inTable 3.4 below.

[33] For the number of patients involved in the National Bowel Cancer Screening Programme 2021, see Office of Health Improvement & Disparities (2023), 'Corporate report, NHS screening Programmes in England: 2020 to 2021', https://www.gov.uk/government/publications/nhs-screening-Programmes-annual-report/nhs-screening-Programmes-in-england-2020-to-2021#nhs-bowel-cancer-screening-Programme-bcsp, 16 February, last accessed 12 March 2024.

Table 3.4 Steps involved in processing a histopathology sample

Biopsy step	Performed by	Time spent
Receiving	Medical Lab Assistant (MLA)	1–2 minutes
Cut up	Biomedical Scientist	2–3 minutes
Wax processing	Machine	2 hours–overnight
Forming a block	Biomedical Scientist	2 minutes
Slide preparation	Biomedical Scientist	5 minutes
Staining	Machine (or MLA)	30 minutes
Covering	Machine (or MLA)	5 minutes
Quality Control	Biomedical Scientist	5 minutes
Reporting	Biomedical Scientist/Pathologist	5 minutes

Note: The table illustrates the average time spent conducting a typical biopsy case.
Light grey cells indicate steps where no human input is required.
Source: Institute of Biomedical Science and Cancer Research UK (2016), 'TESTING TIMES TO COME? AN EVALUATION OF PATHOLOGY CAPACITY ACROSS THE UK', https://www.cancerresearchuk.org/sites/default/files/testing_times_to_come_nov_16_cruk.pdf, p. 56, November, last accessed 28 February 2024.

We consulted with members of IBMS to gain insights into the division of responsibilities and the time required for each step involved in processing a histopathology sample. On average, a histopathology sample consumes approximately 20–22 minutes of medical professionals' time, excluding machine processing time. Notably, Biomedical Scientists are responsible for the majority of this time, accounting for at least 15 minutes per sample. We understand from IBMS colleagues that the reporting stage, which can be carried out by Biomedical Scientists or pathologists, is carried out by pathologists 90% of the time, and we make this assumption in our analysis.

Given this information, we analysed what might happen if the tasks currently handled by Biomedical Scientists were assumed by pathologists.[34] This would impact efficiency-based costs to the healthcare system because a full-time pathologist is more costly to the healthcare system than a full-time Biomedical Scientist. In our analysis,

[34] Where roles can be conducted either by Biomedical Scientists or by pathologists, we assume that roles are currently conducted by pathologists. This means that our estimate of the number of additional pathologists required in the counterfactual may be conservative, as we may be underestimating the amount of time which Biomedical Scientists currently spend.

we assume that pathologists produce at least the same quality of work as Biomedical Scientists in conducting and overseeing testing.

To estimate the efficiency-driven impacts of Biomedical Scientists at this stage of the bowel cancer patient pathway, we first estimate the number of hours spent by Biomedical Scientists in performing biopsies from the colonoscopies and sigmoidoscopies. We then estimate the additional number of full-time equivalent ('FTE') pathologists in the absence of Biomedical Scientists by multiplying the time it takes for a pathologist to perform each biopsy by the total number of biopsies conducted within NHS England in a year.[35]

To meet the demands of additional FTE pathologists, introducing more pathologists into the system would be necessary, which would incur additional expenses relating to their educational training and onboarding.

Moreover, if additional pathologists could not be promptly introduced into the system, the delayed analysis of biopsies from colonoscopies and sigmoidoscopies could significantly affect the workflow of the healthcare system. The delayed analysis could result in prolonged waiting times for patients awaiting diagnosis and subsequent treatment, potentially affecting patient outcomes and satisfaction. Moreover, the backlog of biopsies awaiting analysis could strain the resources and efficiency of the healthcare system, leading to increased costs and operational challenges.

While these factors could have further implications for outcomes, we do not consider these further for the purpose of this analysis in order to focus solely on the shortfall of full-time employees that would arise from the lack of Biomedical Scientists' involvement in this stage of the bowel cancer patient pathway.

[35] NHS, 'National Schedule of NHS Costs—FY19-20', https://www.england.nhs.uk/wp-content/uploads/2021/06/2_National_schedule_of_NHS_costs_FY19_20_V2.xlsx , last accessed 15 March 2024.

4 Results

In the previous section, we have described the methodology to estimate the impact of Biomedical Scientists. In this section, we present the estimated impact of Biomedical Scientists at the initial testing stage and at the confirmation and diagnosis stage.

As described in section 3, the model used to estimate the result is a simplified representation with a number of assumptions required. Hence, we note that the results should be interpreted as illustrative rather than viewed as a precise point estimate.

4.1 Impact of Biomedical Scientists at the initial testing stage

4.1.1 Outcome metrics

As discussed in section 2.2.3, we have considered the impact of Biomedical Scientists through both health-based and efficiency-based outcomes. Within these two categories of impact we define four outcome metrics, as listed below.

1. Average cost incurred per individual in the screening sample.
2. Total healthcare system cost (average cost per individual in the screening sample multiplied by the number of individuals in the total sample).[36]
3. Average cost incurred per bowel cancer patient.
4. Number of lost life years for bowel cancer patients in the healthcare system.[37]

The first two metrics focus on efficiency-based outcomes, while the third and fourth metrics focus on health-based outcomes.

We use five-year survival rate from a peer-reviewed journal in our model.[38] In instances where a patient does not survive, we assume a loss of five QALYs. This approach offers a computationally parsimonious method to integrate health outcomes into our analysis. However, it's

[36] We have assumed that the total sample consists of 3.8m individuals, based on statistics from Office of Health Improvement & Disparities (2023), 'Corporate report, NHS screening programme in England: 2020 to 2021', https://www.gov.uk/government/publications/nhs-screening-programmes-annual-report/nhs-screening-programmes-in-england-2020-to-2021#nhs-bowel-cancer-screening-programme-bcsp, 16 February, last accessed 12 March 2024.
[37] Because we use the five-year survival rate in our model, when a patient does not survive, we assume that the life years lost are five years.
[38] See Table 3.1.

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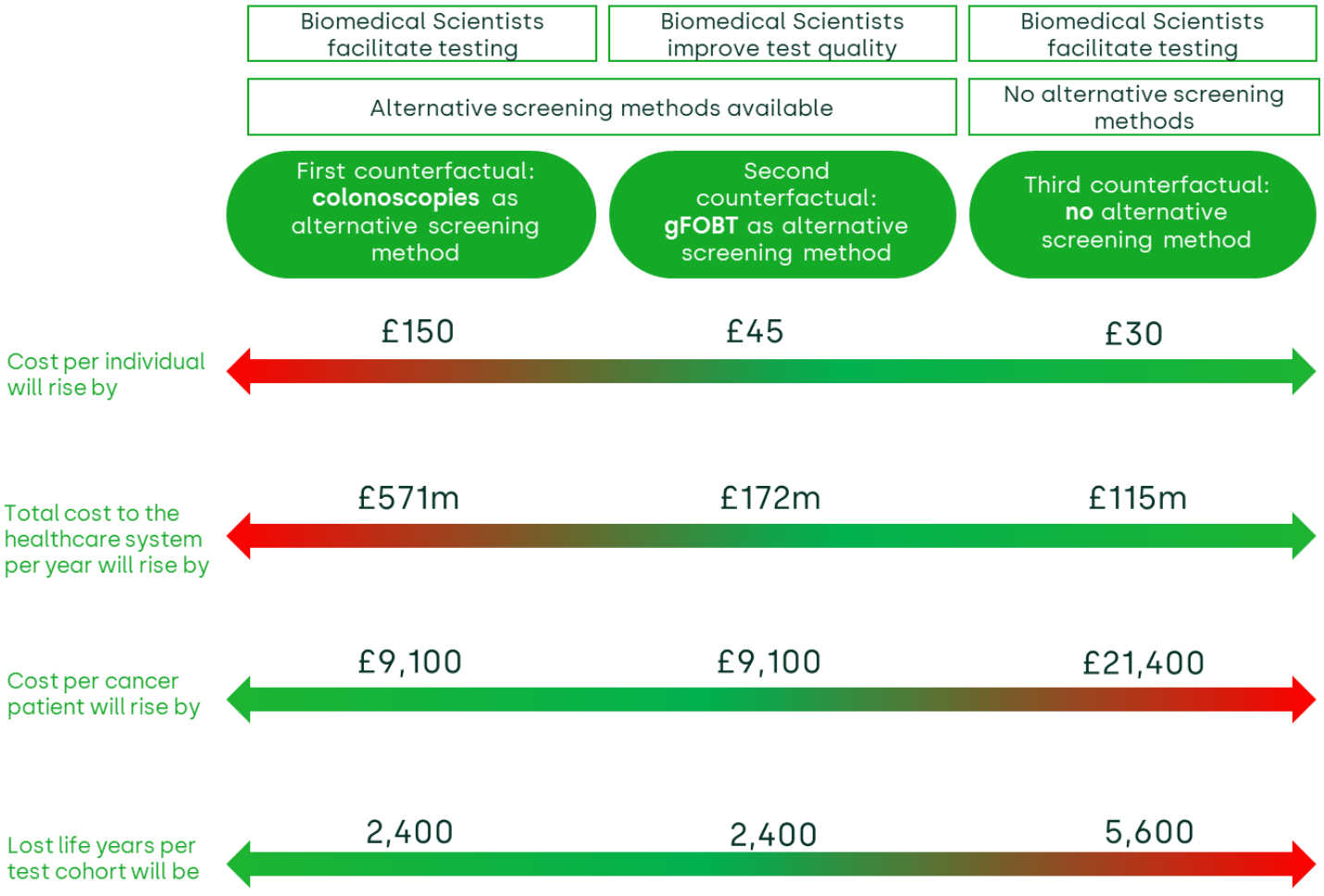
worth noting that this would understate the impact of Biomedical Scientists for patients surviving longer than five years after diagnosis.

4.1.2 Overall results

In section 3.1, we introduce our approach to modelling the four scenarios: factual, first counterfactual, second counterfactual, and third counterfactual. To estimate the impact of Biomedical Scientists, we first calculate the four metrics above for each scenario. We then compare the corresponding metrics of each counterfactual scenario with those of the factual situation.

Figure 4.1 below summarises the results from the initial testing stage. In the following subsections, we describe these results in more detail.

Figure 4.1 Estimated results in the initial testing stage



Note: All costs are relative to a factual case with the FIT as the screening methodology. Costs quoted are the average costs per individual in the cohort and per bowel cancer patient.
Source: Oxera estimation.

4.1.3 Impact of Biomedical Scientists in the first counterfactual scenario

In the first counterfactual scenario, in the absence of Biomedical Scientists' involvement in FITs, colonoscopies become the main screening tool used at the asymptomatic stage. As discussed in section 2.3.3, the uptake of colonoscopies at the asymptomatic stage is assumed to be between the current uptake of the FIT at this stage and zero.

In this scenario, **the cost per individual of not having Biomedical Scientists at the initial testing stage is £150**. This is the highest cost of all the counterfactual scenarios. The additional cost in the counterfactual scenario relative to the factual situation is driven by two factors.

First, the higher cost is driven by a higher proportion of patients undergoing colonoscopy, rather than the much cheaper FIT that they would take in the factual situation. Colonoscopies, with their significantly higher cost (£375) and therefore lower cost-effectiveness than the FIT (£5), would substantially increase expenses for each patient undergoing screening. If, as is assumed in this model, the average patient cost would increase by £150, this would lead to a **total cost increase of £571m** for the healthcare system.

Second, the higher cost is driven by worse health outcomes for those patients who do not opt to have a colonoscopy at the asymptomatic stage. Since in this model only half of the patients undergo screening than is currently the case, there are more cancer patients whose cancer is not caught early, and who subsequently have both higher treatment costs and a higher probability of death. This drives an additional **cost per cancer patient of £9,100** relative to the factual situation. This incorporates the financial cost of treatment if diagnosed at a later stage, the cost of palliative care, and the cost of the expected lost life years. We also estimate that there are an **additional 2,400 lost life years** for each annual cohort of individuals in the relevant age group relative to the factual scenario.

Sensitivity analysis

As discussed in section 3.1.3, we make the assumption that the uptake of colonoscopies by individuals in the screening sample lies at the midpoint between two extremes. At present, 71% of individuals who are

invited to be screened undergo a FIT at the asymptomatic stage.[39] It is likely that not all of these individuals would undergo colonoscopies instead. In our base case, in the absence of further evidence, we have assumed that half of the screened individuals would instead undergo a colonoscopy.

Acknowledging that this assumption is a crucial driver of the results, and that we cannot accurately predict the uptake of colonoscopies by individuals in the screening sample, we perform a sensitivity analysis on both extremes to provide a range for our estimates.

- Lower bound: there is no uptake of colonoscopy in screening

In the extreme case of the lower bound sensitivity, where no individuals choose to have, or are referred for, a colonoscopy, the impact will be, in effect, the same as we see in the second counterfactual scenario. This is because, if there is no uptake of screening at the initial testing stage, this is in effect the same outcome as having no screening at the initial testing stage. Under this assumption, costs per cancer patient and lost life years are higher than under baseline assumptions for the first counterfactual scenario, due to fewer patients being diagnosed while asymptomatic and referred for treatment. At the same time, the cost per individual and the overall cost to the NHS would be lower than under baseline assumptions, due to far fewer unnecessary colonoscopies being carried out. This is discussed further in section 3.1.2 below.

We assume that this extreme lower bound is unlikely, as we would expect that, if colonoscopies were offered as an alternative screening programme, there would be some degree of uptake.[40]

[39] Office of Health Improvement & Disparities (2023), 'Corporate report, NHS screening Programmes in England: 2020 to 2021', https://www.gov.uk/government/publications/nhs-screening-Programmes-annual-report/nhs-screening-Programmes-in-england-2020-to-2021#nhs-bowel-cancer-screening-Programme-bcsp, 16 February, last accessed 12 March 2024.

[40] Evidence suggests that the uptake of colonoscopies has been lower than for other types of screening programmes in areas of the world where it has been offered, such as Norway, Sweden, the Netherlands and Italy. See, for example, Bretthauer et. al. (2022), 'Effect of Colonoscopy Screening on Risks of Colorectal Cancer and Related Death', October, published in *The New England Journal of Medicine*, **387**:17, pp. 1547–1556. doi: 10.1056/NEJMoa2208375. Epub (2022) 9 October, https://pubmed.ncbi.nlm.nih.gov/36214590/, and Segnan N., Senore C., Andreoni B., et al; SCORE3 Working Group—Italy. 'Comparing attendance and detection rate of colonoscopy with sigmoidoscopy and FIT for colorectal cancer screening', *Gastroenterology* (2007) **132**:7 2304–2312. doi:10.1053/j.gastro.2007.03.030.

- Upper bound: the uptake of colonoscopy in screening is equal to the current FIT rates

We consider that a case where all those individuals who currently undergo the FIT instead undergo a colonoscopy procedure to be screened for bowel cancer is the upper bound for this scenario. In this case, we estimate the additional cost per individual in the screening sample to be £270 relative to the factual case, leading to an additional cost of £1.1bn to the NHS. This is driven largely by the higher testing cost of colonoscopies relative to the cost of the FIT.[41]

In this extreme scenario, unlike the efficiency-based outcomes, the health-based outcomes for cancer patients are superior in the counterfactual scenario than in the factual scenario. We estimate the cost per cancer patient to be £3,000 lower than in the factual scenario, and the number of lost life years is estimated to be 800 fewer.

This is because, while the FIT produces a small number of false negatives, our model assumes that colonoscopies have zero error rate, resulting in an even lower proportion of false negatives. This makes colonoscopy a more accurate, albeit less cost-effective, screening tool.

As with the base case, we abstract from the fact that the NHS is unlikely to be able to deliver such large volumes of colonoscopies.

4.1.4 Impact of Biomedical Scientists in the second counterfactual scenario

In the second counterfactual scenario, in the absence of Biomedical Scientists' involvement in the FIT, there is no alternative screening tool. As discussed in section 3.1.4, we assume that patients can confirm their diagnosis only once they have become symptomatic and gone to their GP.

In this scenario the **additional cost per individual relative to the factual situation is £30, and consequently the total cost to the healthcare system is £115m**. This result is driven largely by the small number of patients with cancer who incur additional costs in the absence of Biomedical Scientists. In this scenario, cancer patients are assumed to be diagnosed at a later stage in the absence of screening tools. These patients incur significantly greater costs, both through the higher cost

[41] See Table 3.2.

of treatment if they are diagnosed at a later stage, and through the cost of lost life years (measured in QALYs) resulting from the greater probability of death. As a result, under the this counterfactual we estimate an **additional cost per cancer patient of £21,400**, and **5,600 lost life years for each annual cohort of individuals in the relevant age group**.

4.1.5 Impact of Biomedical Scientists in the third counterfactual scenario

In the third counterfactual scenario we examine the impact of using a different screening tool, the gFOBT, instead of the FIT. This test has a lower testing quality and proxies the impact of improvements in testing quality over time due to Biomedical Scientists' involvement (see section 3.1.5). The gFOBT is less accurate than the FIT;[42] in other words, it results in a higher rate of both false positives and false negatives,[43] both of which incur additional costs. In this scenario, relative to the factual scenario, larger numbers of participants in the screening programme receive false positive outcomes. They have to pay for the cost of undergoing an unnecessary colonoscopy. As larger numbers of participants also receive false negative outcomes, there could be significant health costs.

In this scenario the **additional cost per individual relative to the factual situation is £45, and consequently the total cost to the healthcare system is £172m**. We assume that the FIT and the gFOBT cost the same.[44] Moreover, in this scenario colonoscopies are not used as a screening tool (they are used only at the confirmation and diagnosis stage). This additional cost is therefore driven solely by health outcomes, which affect cancer patients only.

This scenario also has health-based costs: **cancer patients incur an additional cost of £9,100** and **2,400 more lost QALYs** for each annual cohort relative to the factual. This is driven by the fact that, even if the same number of patients are screened, the gFOBT has a lower sensitivity

[42] There have been 13 population-based screening studies comparing performance characteristics of gFOBT and FIT. Although the studies used different tests and slightly different protocols, the results of all studies consistently showed that FIT has significantly higher sensitivity for advanced adenomas and cancer than the gFOBT, according to the following reference. Mackie, A. (2015), 'Moving from guaiac faecal occult blood test (gFOBT) to a faecal immunochemical test for haemoglobin (FIT) in the bowel screening programme: A consultation', https://legacyscreening.phe.org.uk/policydb_download.php?doc=802, pp. 3–4, last accessed 15 March 2024.
[43] See Table 3.3.

[44] We assume that both the FIT and the gFOBT cost £5. See Table 3.2.

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than the FIT: around 50%, compared with over 90% for the FIT.[45] The result is that patients who have cancer have a relatively high probability that this will be missed by the test, leading to a higher proportion of patients being diagnosed at a later stage, with a subsequent higher cost of treatment and increased probability of death.

4.1.6 Comparison of the counterfactual scenarios

These results illustrate that Biomedical Scientists contribute in a combination of health-based and efficiency-based outcomes, which vary depending on which counterfactual scenario is chosen.

The highest cost per cancer patient and greatest number of lost life years can be seen in the second counterfactual scenario, in which no alternative screening programme is offered. In this scenario, cancer patients cannot have their cancer identified when they are asymptomatic, and can be diagnosed only after presenting their symptoms to a GP. At this point, they are likely to be at a later stage, and therefore more likely to receive a worse health outcome. Our results therefore suggest that, in the absence of Biomedical Scientists, a policy that offers no alternative screening programme would have the highest cost per cancer patient, which would be driven largely by health-based costs.

The highest overall cost per individual, by contrast, is found in the first counterfactual scenario, in which colonoscopy is offered as an alternative screening programme. The higher additional cost per individual relative to the other models is driven by the cost of providing colonoscopies to every individual in the population. Colonoscopies are much more expensive than FIT testing (see section 3.1.2). This has a higher cost per individual than the other scenarios, which have worse health outcomes, because the vast majority of people in each cohort tested do not have bowel cancer. Therefore, even though offering colonoscopies leads to a better expected outcome for cancer patients than no screening, it has a greater cost per individual, which is driven by efficiency-based costs.

The results introduced in this section show that Biomedical Scientists play an important and valuable role at the initial testing stage of the bowel cancer patient pathway by facilitating the testing procedure and improving the quality of testing. In this way, Biomedical Scientists help to improve the efficiency of screening processes and ensure the timely

[45] D'Souza, N., Brzezicki, A. and Abulafi, M. (2019), 'Faecal immunochemical testing in general practice', February, in *British Journal of General Practise*, February, **69**:679, pp. 60–61.

identification of potential bowel cancer cases. Moreover, Biomedical Scientists' contributions to enhancing the quality of testing leads to more accurate diagnoses, enabling healthcare providers to offer timely and appropriate interventions.

4.2 Impact of Biomedical Scientists at the confirmation and diagnosis stage

Our assessment of the impact of Biomedical Scientists at the confirmation and diagnosis stage focuses on understanding the time required by medical professionals to fulfil the demand for analysing biopsy samples obtained during colonoscopy and sigmoidoscopy procedures.

As detailed in section 3.2.1, we have estimated the number of additional FTE pathologists required to undertake the tasks currently managed by Biomedical Scientists in sample analysis. Our assessment suggests that an **additional 34 FTE pathologists would be needed** across NHS England to fulfil these responsibilities for the biopsy stage of the bowel cancer patient pathway alone.

To meet the demands of additional FTE pathologists it would be necessary to introduce more pathologists into the system, which would incur additional expenses relating to their educational training and onboarding. While these factors may result in further implications for costs and patient outcomes, we abstracted them out for the purpose of this analysis in order to focus solely on the direct cost implications of reallocating responsibilities from Biomedical Scientists to pathologists.

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5 Conclusion

We have estimated the impact value provided by Biomedical Scientists in the context of the bowel cancer patient pathway. To do so, we have adopted a decision-tree approach aimed at understanding the cost implications of, and value generated by, the presence of Biomedical Scientists within the healthcare system.

We have assessed the value that Biomedical Scientists generate under a range of assumptions about what would happen in the counterfactual. Our analysis focuses on the impact of Biomedical Scientists at two stages of the bowel cancer patient pathway—specifically, the initial testing stage and the confirmation and diagnosis stage. This captures just a fraction of the value that Biomedical Scientists provide across the whole bowel cancer patient pathway.

At the initial testing stage, Biomedical Scientists generate value primarily by facilitating and contributing to the development of FITs, the main screening method that is used to test for bowel cancer when individuals are asymptomatic, which enables earlier diagnosis of bowel cancer and drives positive health outcomes. Our results indicate that, if Biomedical Scientists were absent from the initial testing stage, there would be:

- an additional cost of between £30 and £150 for the average individual who is invited to the screening process (regardless of whether they have bowel cancer);
- between 2,400 and 5,600 lost life years in each annual cohort of individuals who are currently invited to bowel cancer screening;
- an additional cost of between £9,100 and £21,400 for the average cancer patient;
- an overall additional cost to the healthcare system of between £115m and £571m.

At the confirmation and diagnosis stage, Biomedical Scientists play a key role in the analysis of biopsies, which are extracted during the colonoscopy and biopsy process. Our results indicate that, if Biomedical Scientists were absent from this stage of the patient pathway, the NHS would require an additional 34 FTE pathologists to carry out this task. This would be likely to have wider implications for the healthcare system. Our analysis highlights that Biomedical Scientists add significant value within the bowel cancer patient pathway, both by improving patient outcomes and by driving efficiency and cost savings

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relative to a case where Biomedical Scientists are not involved in the pathway.

We note that, because our models are a simplified representation of reality, their results should be interpreted at an orders-of-magnitude level rather than as precise point estimates. Furthermore, it is crucial to acknowledge the contribution of several other contributors in the bowel cancer patient pathway, such as medical laboratory assistants and associate practitioners.

While our models show that Biomedical Scientists have a substantial impact, it is important to note that this analysis focuses on just a part of the bowel cancer patient pathway. Further, the bowel cancer patient pathway is just a small part of the overall work carried out by Biomedical Scientists.

It is estimated that around 95% of clinical pathways rely on access to pathology services.[46] The impact of Biomedical Scientists that we estimate therefore captures just a fraction of the overall impact of Biomedical Scientists on the bowel cancer patient pathway, and on the healthcare system overall. Instead, our results give an indicative example of the value that Biomedical Scientists create within this pathway. Our models also provide a framework for quantifying the impact of Biomedical Scientists more generally.

[46] National Institute of Health and Social Care (2021), 'NICE impact of diagnostic pathology', https://www.nice.org.uk/about/what-we-do/into-practice/measuring-the-use-of-nice-guidance/impact-of-our-guidance/nice-impact-diagnostic-pathology, May, last accessed on 7 May 2024.

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