Seminar
Briefing
Issue 27

What NHS Trusts Can Do to Reduce Waiting Times for Cancer Treatment

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CONTENTS

1 Introduction

The NHS Improvement Economics team is part of the Strategy Directorate in NHS Improvement. NHS Improvement aims to implement changes to help improve both quality and efficiency. Recent research by the Economics team intended to support this has included research on A&E performance, NHS staffing, and inpatient falls.

One of the major goals of the recent NHS Long Term Plan is to improve cancer survival rates. A crucial part of that is earlier diagnosis and timely treatment, the focus of the research presented today. A few statistics highlight the importance of this: over 350,000 new cancer cases appear in the UK each year and cancer deaths account for about 28 percent of all deaths in the UK (Cancer Research UK, 2019). The number of newly diagnosed cases each year is somewhat misleading with respect to the burden of cancer on the NHS: around 90-95 percent of patients suspected of having cancer are not diagnosed with cancer. However, all potential cancer patients proceed along the same cancer pathway and undergo the same diagnostic procedures. The total burden, then, is substantial higher than statistics on actual cancer cases imply.

For cancers diagnosed in the UK, five-year survival rates are low in comparison to Europe, as Figure 1 shows. There are likely to be multiple reasons for this, but one important factor may be speed of diagnosis. Some research suggests clinical outcomes are positively affected by earlier treatment, although other studies find a weaker link between the two. What is certain is that patients attach great importance to early diagnosis when cancer is suspected and timely treatment if it is confirmed. Waiting times, of course, affect both diagnosis and treatment.

Source: ABPI (2019)

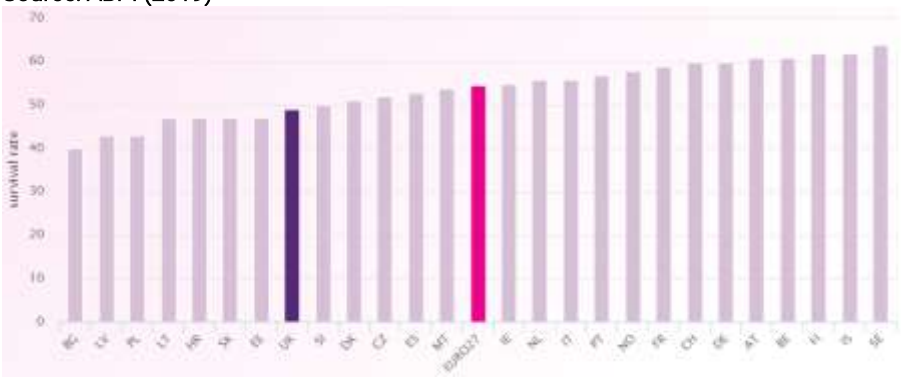

FIGURE 1: FIVE YEAR SURVIVAL RATE ALL CANCERS (EXCLUDING NON-MELANOMA SKIN CANCER) 200-2007 CUMULATIVE (PATIENTS AGES >15)

The NHS Constitution sets out certain patient rights in respect of how quickly they ought to be seen by a cancer specialist, and when treatment should begin if required, following an urgent referral from a GP when cancer is suspected (NHS, 2019). The three areas that our waiting times analysis focussed on, and their operational standards, are:

1. Two-week wait (2WW): 93 percent of patients are to be seen by a specialist within 14 days of urgent GP referral for suspected cancer.

2. 31-day wait: 96 percent of patients are to receive first treatment for cancer within 31 days of diagnosis.

3. 62-day wait: 85 percent of patients should begin first treatment for cancer within 62 days of urgent GP referral for suspected cancer.

Performance against these standards is often measured and monitored at the level of the Trusts, for example by monitoring whether standards are being met and how this is changing over time. For our analysis, we instead took a different perspective: that of the patient. Our analysis is one of the first, if not the only, large-scale nation-wide review of diagnosis and treatment pathways for suspected cancer at the patient level, which focusses on assessing what Trusts can do to improve.

As the schematic in Figure 2 shows, the clock starts on a suspected cancer pathway with a referral from the GP. The patient then moves to a waiting list or a patient-tracking list. The first outpatient appointment should occur within the target of 14 days. A range of other tests and appointments, appropriate to the particular cancer, then should occur and, for those patients diagnosed with cancer, their first treatment should take place within 62 days from the initial GP referral.

FIGURE 2: CANCER TREATMENT PATHWAY

With respect to what improvement Trusts might make, we focus on two aspects of the pathway. The first is what determines the duration of a patient's pathway after referral; this covers all patients with suspected cancer. The second focuses on those patients who are diagnosed with cancer, and explores what factors affect the probability of the patient receiving treatment within 62 days from first referral. These are factors that we believe Trusts can affect positively.

2 Methods

As background, we used PubMed to find the relevant literature on operational factors that affect waiting times for cancer treatment. This produced 612 titles and abstracts. All but four, however, focused primarily on clinical or other issues and were not relevant for our project.

The literature review set important parameters for our project. First, it was clear the analysis would need to be segmented by tumour site, or type of cancer, since factors such as progression times and treatment vary substantially from one cancer to another. Second, the way in which regional and patient characteristics might affect pathways needed to be considered. Finally, operational variables expected to have an impact included the number and timing of diagnostic appointments, whether more than one provider made referrals, and the type of hospital and specialist that provided treatment.

The data for this study came from the Hospital Episode Statistics (HES) database which contains information on each admission, A&E episode and outpatient appointment in the NHS in England, each with a unique patient identifier. HES allows us to identify patients who have suspected cancer as there is a field indicating that the patient is subject to the 2WW target. Recent years of data also include a start and end date for cancer treatment, and we therefore used 2016-17 data for our analysis.

Adjustments to the data included the following:

- Collapsing data into a single pathway for each patient and tumour site
- Omitting patients for whom referral or completion dates were incorrect or missing (some Trusts had no data at all for any patients)
- Including only five prevalent tumour sites: breast, upper gastrointestinal (GI), lower GI, lung and prostate

After filtering and cleaning, the data included 257,379 pathways across 81 NHS Trusts, distributed as described in Figure 3.

Region	Number	Percent of Region's Trusts
London	10	26%
Midlands & E England	25	53%
North of England	28	55%
South of England	18	47%

FIGURE 3: TRUSTS INCLUDED BY REGION

Grouping patients by tumour site was not straightforward because a range of medical terms may be used to describe the same cancer or tumours. We consulted with clinical experts to help develop algorithms based on medical terminology. Some notations about tumour site were obvious, e.g. "lung", but others were far less so, e.g. "bilobectomy". We also benefited from expert advice in creating a cancer treatment variable to identify patients that were diagnosed with cancer. The algorithm used a combination of diagnostic codes, medical specialties, and treatment descriptions. This is important because the 62-day target applies only to patients treated specifically for cancer.

We further divided the sample into two subsets. The first included all patients on a suspected cancer pathway. For these, we wanted to know what affects total waiting time, regardless of whether the patient received treatment for cancer. We used a negative binomial regression for that analysis because the waiting time data were count data and highly skewed. The second subset included only patients who were treated for cancer. Here, we wanted to know how likely patients are to breach the 62-day target. We used a logit regression with a similar set of explanatory variables.

Figure 4 describes the model. Two of the key variables were the number of appointments and the number of days to the first appointment. Other pathway characteristics that had an impact include: visiting a one-stop clinic, where there is more than one appointment on the same day; the hospital cancelling an appointment at the last minute for non-medical reasons; the patient cancelling or not attending an appointment (DNA); having a telephone appointment; and having more than one provider along the pathway.

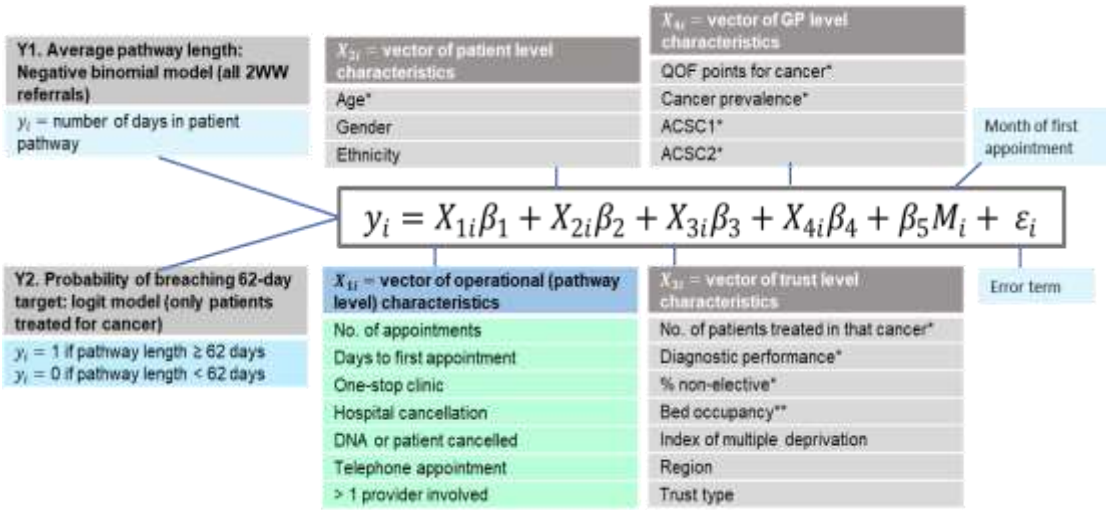

FIGURE 4: ECONOMETRIC MODEL

The three vectors of control variables are (1) patient characteristics, (2) GP characteristics, which include quality considerations, and (3) Trust characteristics, which capture such items as Trust performance and patient demand ("busyness"). Month of first appointment is included to account for

seasonality in the hospital performance, for example delays that might occur in winter when influenza and other respiratory illnesses may significantly increase patient numbers in the Trusts.

3 Results

Not surprisingly, having more appointments correlates with a longer duration of the cancer pathway in days. As Figure 5 shows, the median time to complete the cancer treatment pathway for patients with one appointment is twelve days. Adding one appointment lengthens the pathway by 29 days; having three appointments adds an average of 19 more days and also increases the likelihood of exceeding the 62-day standard by 5 percent; having four appointments adds another 15 days and makes exceeding the standard 23 percent more likely. From an operational perspective, these findings support focusing on streamlining cancer treatment pathways as much as is clinically appropriate. Although it may seem obvious that additional appointments increase the length of the pathway, we were able to quantify the effect and understand the relationship with the 62-day standard.

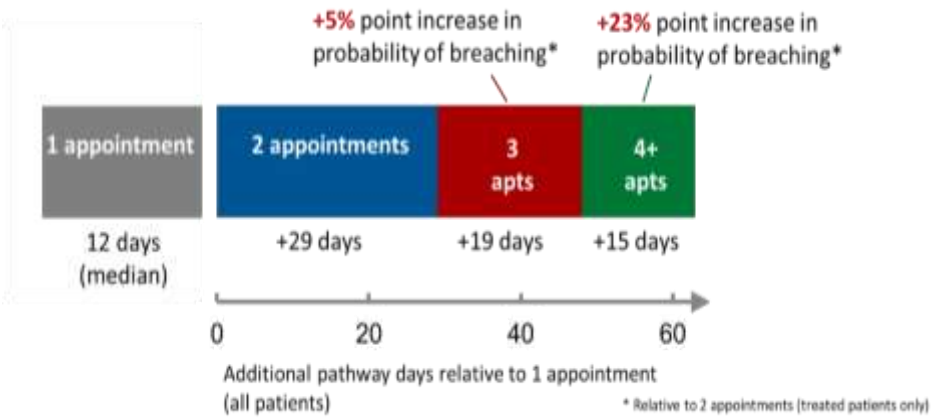

FIGURE 5: EFFECT OF NUMBER OF APPOINTMENTS ON PATHWAY LENGTH AND PROBABILITY OF EXCEEDING 62 DAYS

We were also able to show the differences in cancer treatment pathway times by type of cancer, which can provide important information about resource allocation. We found these differences to be substantial. Figure 6 compares lung cancer and breast cancer. Having only one appointment resulted in nearly identical total times. For second and subsequent appointments, however, the differences are extensive. The explanation for this may be that treatment pathways for breast cancer already are more streamlined than for lung cancer. Alternatively, lung cancer may be inherently different enough from breast cancer in terms of complexity of appropriate treatments to account for at least some of the differences in pathway time.

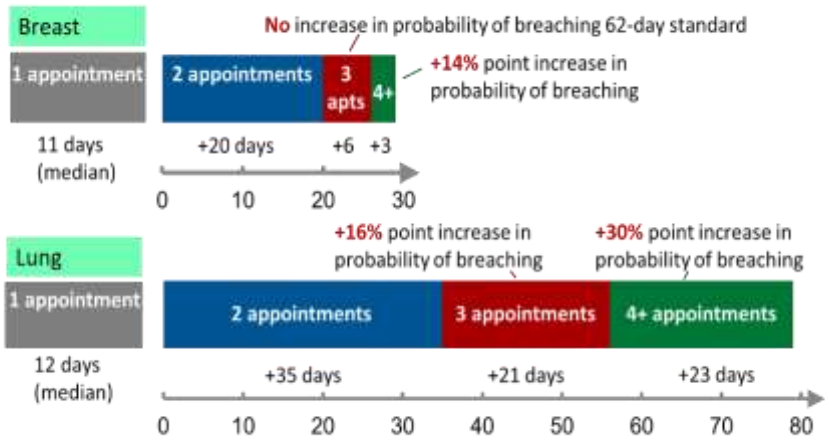

FIGURE 6: EFFECT OF NUMBER OF APPOINTMENTS ON PATHWAY LENGTH: BREAST AND LUNG CANCER

Wait time for the first appointment was a second important determinant of the total length of the pathway. In Figure 7, the sample is split into quintiles based on the number of days the patient waits for the first appointment. The first quintile is the baseline, 1-5 days; 15+ days obviously amounts to exceeding the 2WW target. The blue bars represent additional pathway days for each quintile, relative to the baseline. The red line is the additional probability of breaching the 62-day target for each quintile. What is crucial here is lack of evidence for a "catch-up" effect; for example, if a patient waits 10-12 days for the first appointment, this adds roughly that many days to the total pathway. However, a patient who waits longer than two weeks (i.e. exceed the 2WW target) is much more likely to exceed the 62-day target as well. Reducing time to first appointment, then, has a greater, more persistent impact than might have been expected.

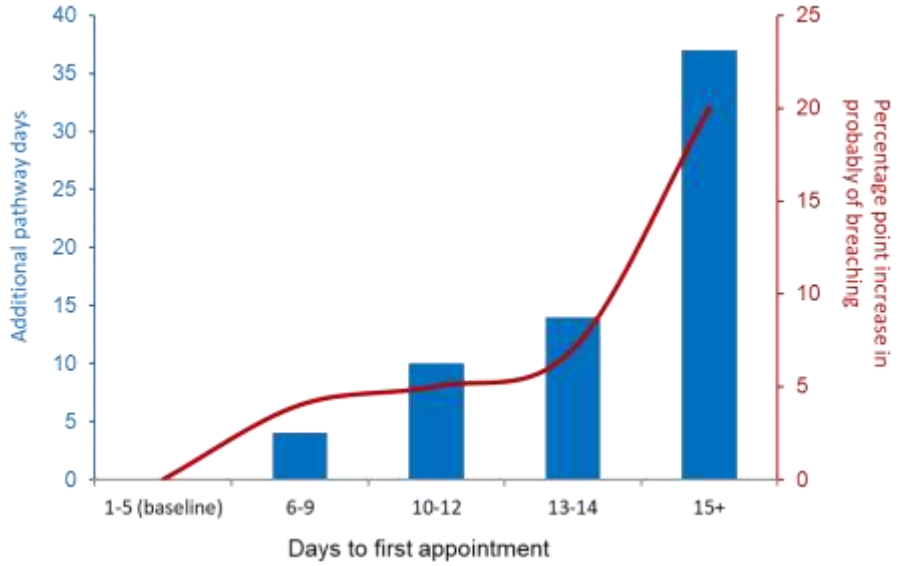

FIGURE 7: EFFECT OF TIME TO FIRST APPOINTNMENT ON TOTAL PATHWAY AND BREACHING 62-DAY STANDARD

Once again, differences are evident by type of cancer, and treatment for breast cancer appears to be more streamlined than, say, treatment for lower gastro-intestinal cancer. It is not clear how much of the difference may be accounted for by the characteristics of each type of cancer.

The analysis provides important information about other factors that affect total pathway length and the probability of staying within the 62-day window. In Figure 8, the variable 'Effect on pathway length' includes all patients regardless of whether they are actually treated for cancer; the variable 'Effect on probability of exceeding the 62-day window (% points)' only includes cancer patients, the subset to which the 62-day standard applies.

Factor	Effect on pathway length	Effect on probability of exceeding 62-day window (% points)
One-stop clinic	**Minus 13 days**	**Minus 9%**
DNA/patient cancellation	**Plus 33 days**	**Plus 11%**
Hospital cancellation	**Plus 20 days**	**Plus 9%**
Multiple providers	**Plus 4 days**	**Plus 20%**
Referring GP achieving full QOF points for cancer	**No statistically significant effect**	**Minus 2%**

FIGURE 8: OTHER IMPORTANT DETERMINANTS OF PATHWAY LENGTH

Attending a one-stop clinic reduced the pathway by around 13 days on average, all else equal, and lowered the probability of breaching the 62-day standard by about 9 percentage points. It is important to note that in this research, we define attending a one-stop clinic as having more than one HES appointment recorded on the same day. This measure is likely to underestimate the number of one-stop clinics as hospitals may be recording these types of clinic as one appointment. However, based on this data, one-stop clinics appear to have a substantial beneficial impact on cancer treatment waiting times.

On the other hand, the number of days increases substantially when a patient does not appear for an appointment, or when an appointment is cancelled by either the patient or hospital. If a patient attends multiple providers between the point of referral and first treatment, this adds four days on average to the pathway. In addition, the likelihood of exceeding the 62-day window increases by around 20 percentage points.

We were also able to trace patients back to their referring GP and determine GP quality as measured by QOF points awarded for the cancer domains. We found that patients being referred by GPs with higher QOF ratings had a small, but significant, effect on treatment occurring within the 62-day window.

Possible operational lessons include increasing the number of one-stop clinics and expanding them to cover more types of cancer where possible. For some cancers, the one-stop approach already is standard, although this varies across Trusts. Initiatives that reduce "did not attends" and cancellations could shorten the pathway considerably, as would approaches that can streamline and speed up transfers between multiple providers.

3.1 ROBUSTNESS AND DATA ISSUES

We encountered several issues with the data. For example, no data were available on the stage or severity of cancer at the time of diagnosis, which raises potential omitted variable bias. It is possible

severity might affect the pathway directly through waiting times and indirectly through number of appointments or time to first appointment. A literature review did not reveal a clear relationship between severity and waiting times. When we removed potential endogenous variables (the number of appointments, time to first appointment), however, our results remained quite similar for other variables of interest (one-stop clinics, cancellations, etc.).

As noted earlier, we used algorithms to identify patients with suspected cancer, who were ultimately not diagnosed with cancer and therefor not treated. Our sample's ratio of suspected to diagnosed cancers by type of cancer was broadly in line with national statistics, suggesting our algorithms were appropriate.

The amount of missing data for the start or end date of the pathway was quite extensive. We were concerned that this might have led to our sample not being sufficiently representative of the population. To address this, we compared the characteristics of included and excluded patients. We did not find Trust-level differences in terms of performance against waiting times targets. We did, however, find that included patients were somewhat more likely to be female, which probably reflects the large proportion of breast cancer patients in the sample. This did not adversely affect the analysis because the regressions were run separately by cancer type. We also found that included patients were less likely have cancellations or "did not attends". There are several possible explanations for this, but none stood out in this study.

We addressed the robustness of the model in our research, particularly the inclusion of the number of appointments and the time to first appointment. Both variables clearly have a mathematical, mostly linear relationship to the outcome variable, defined as the total length of the treatment pathway. These variables are important in the model because (1) the number of appointments in the pathway likely has an effect and (2) they allow controlling for bias in the results for other variables. With this in mind, we transformed these variables into split variables, i.e. the number of appointments in intervals and the time to first appointment in quintiles. This disrupts the linearity and makes the non-linear effects clearer. This approach also allows more meaningful interpretation for Trusts.

The final modelling challenge concerned Trust characteristics. The potential issue was that the results were driven by Trust or population characteristics, rather than operational factors. When regressions were rerun using Trust-level fixed effects, however, we did not find significant differences.

4 Conclusion and Next Steps

The key findings of our research are as follows. Length of the pathway and likelihood of treatment within 62 days were affected by the number of appointments in the pathway, and the time to first appointment. The importance of this early stage of the pathway is a critical finding in suggesting how pathways might be improved. A relatively short delay of 5 to 7 days to first appointment might not seem like much, but our analysis shows such delays significantly increase the chances that patients will not receive treatment within 62 days. Moreover, the results highlight the importance of meeting the 2WW goal; the difference in pathway time is stark for patients whose first appointment was more than two weeks after GP referral. Cancellations and "did not attends" have a major impact on lengthening the pathway, and one-stop clinics appear to shorten it. These findings suggest areas of potential improvement through operational and policy changes within Trusts.

Econometric research, as presented in this paper, has most value if it produces positive change. Indeed, one of the important aspects of NHS Improvement is its close relationship between the research, clinical and operational teams. Working with NHS Improvement's Elective Care Intensive Support Team, we developed a Rapid Improvement Guide, which uses the findings of the research and case studies as a basis for suggesting best practice (NHS Improvement, 2018). We also have presented our research in person at least twenty times across the country and have held joint NHS

Improvement – NHS England webinars for each region. Our objective is to reach those who might not otherwise be interested in an econometric paper and explain the importance of our findings to decision-making in cancer services. We have received feedback that this work is now supporting some Trusts in identifying where to focus on in pathways with the intent of speeding up the early stages of the pathway to improve cancer treatment waiting times.

Outside the NHS, we have promoted the research at several conferences, reaching thought leaders in cancer treatment within and outside the UK. The importance of the research is being recognized further - we were awarded the Government Economics' Service Award and the prestigious John Hoy award 2018.

Cancer is a major part of the NHS Long Term Plan and our research will continue. We have two specific projects in mind. The first will use Public Health England's National Cancer Registry data to extend the analysis. As noted above, HES data is an important data source, as it is timely and covers the pathways of patients who are not diagnosed with cancer. It has important limitations too, such as coding errors, missing information, and the absence of information on stage of cancer. The PHE Cancer Registry data provides a richer and more complete picture of the pathways of patients diagnosed with cancer, including information on cancer staging.

Our intention is to extend our analyses using this data, adding new variables on:

- Route to diagnosis
- Stage at time of diagnosis
- Patients who go directly to testing
- Details about one-stop clinics
- Characteristics of multidisciplinary team meetings
- Patients attending multidisciplinary diagnostic centres

Additional data, from the Cancer Patient Experience Survey can also help understand how the patient's experience at the primary care level affects stage at diagnosis and various aspects of the patient pathway in secondary care.

The second project focuses on exploring the drivers of cost in the cancer pathway. In particular, the effect on costs of the operational improvements that we have identified. For this research, we will be utilising the new Patient Level Information and Costing System (PLICS) data. This a fairly new approach to data collection that will become mandatory for acute activity by designated acute care providers for 2018/19 (NHS Improvement, 2018). Data are currently available for around 80 Trusts across England.

PLICS takes costings down to the patient level; costs are specific for the individual patient, not based on averages. Obviously, this will produce particularly rich data by patient and by episode. As for any research using a new dataset, the findings produced will be subject to addressing data quality challenges. However, we should be able to determine what type of care was delivered, in what setting and at what cost and split those according to fixed costs, variable costs, staff costs, drugs costs, etc. PLICS even contains data on time in theatre, based on theatre check-in and check-out times. These data should allow us to greatly enhance information on costings, linking that back to our previous findings on, for example, one-stop clinics. This will provide useful information on the costs of different types of cancer diagnostic pathways.

Combined with research we have already done; these new analyses will help answer questions that are vital to meeting the important goal of improving cancer survival rates in the UK.

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