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Choice of NHS funded hospital services in England

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Cooperation and Competition Panel – Working Papers

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CCP working paper 4: Choice of NHS-funded hospital services in England

Walter Beckert[1], Mette Christensen[2], Kate Collyer[3]

Executive summary

1. In this discussion paper we examine which factors matter to patients and their GPs when they choose a hospital for treatment. These are the factors that hospitals will focus on to attract patients, so this analysis shows how the incentives created by choice and competition will play out.

2. We use a rich data set that contains information on the choices made by more than 50,000 NHS hip operations patients between 2008 and 2009. We combine this with two other sets of data. First, information on the hospitals' characteristics. This includes various measures of the quality of care that might matter to patients and their GPs such as waiting times, infection rates and overall mortality rates. Second, we have information on the patient such as their age and gender and data on the area where they live. Finally, we map the distance between each patient and the 30 hospitals nearest to them. Standard empirical techniques allow us to compare the characteristics of the hospital chosen by the patient and GP, with those that were available but which were not chosen. This reveals patients' preferences for various hospital characteristics.

3. The comparison shows us which hospital characteristics matter to patients, as well as the relative importance of the characteristics and how the importance differs for different types of patient. We find that many patients have a good choice of hospitals within a reasonable distance of where they live and that nearly four in ten patients choose not to receive treatment at their nearest hospital and instead travel to a hospital further afield. The analysis suggests that patients are more likely to choose a hospital if it provides higher quality care and prefer hospitals with shorter waiting times, lower hospital acquired infection rates and lower overall mortality rates. The findings also highlight the importance of the GP in helping patients to choose the most appropriate hospital for treatment.

4. We can use this information to predict how the number of patients that choose any given hospital would change in response to a change in that hospital's quality. This demand sensitivity is determined by factors such as the location of the hospital relative both to the patient and to competitors, as well as different aspects of quality relative to competitors. The demand sensitivity describes the strength of competitive constraints faced by each hospital, taking all of these factors into account.

5. We use this information to simulate the effect of hypothetical mergers. We can predict how a hospital's demand sensitivity, and therefore its competitive constraints, changes after a merger with a nearby hospital. By comparing the effects of different hypothetical mergers we can identify those mergers that are more likely to increase the merger parties' market power. These mergers

[1] Birkbeck College, University of London
[2] Cooperation and Competition Panel. The views expressed in this paper are those of the authors and not necessarily those of the Cooperation and Competition Panel.
[3] Cooperation and Competition Panel. The views expressed in this paper are those of the authors and not necessarily those of the Cooperation and Competition Panel.

would need to deliver significant efficiency gains and benefits for patients if they are to have a net positive effect on welfare.

6. The paper is structured as follows:
    - First, we briefly explain the policy context, how choices are made and the incentives for acute service providers to compete for patients;
    - Second, we describe the data used in our analysis, present the empirical methodology employed in the paper and discuss the related literature;
    - Third, we present the preliminary results, including a description of the extent of choice for patients using NHS-funded acute services in England;
    - Finally, we show how the results of our empirical model can be used to determine the sensitivity of patient demand with respect to quality. We demonstrate, using a hypothetical example, how this analysis might be used to inform the competitive assessment of a merger of acute service providers.

Policy context

7. Competition has existed in the health service in England in some form since the "internal market" for healthcare was established in 1991. Since that time the nature of competition has changed from one focused on competition for contracts to one of competition for patients. In 2004 some non-emergency (ie elective) patients in England were first able to choose which hospital they wished to attend. Patient choice of hospital was extended in 2006 and a payment system was introduced to create incentives for hospitals to compete for patients.

8. Under the current system, prices for individual services are now regulated and set centrally by the Department of Health. Acute service providers are reimbursed at a fixed price per period of care, per patient for groups of clinically similar treatments that use common levels of healthcare resources.[4] [5]

9. Patient referrals for treatment are made through a centralised booking system, Choose and Book.[6] Information on some quality indicators is published by the Department of Health on the NHS Choices website.[7] [8] On the basis of this information and the GP's local knowledge, patients and their GPs select the hospital that best meets their requirements for treatment.

[4] See Payments by Results Guidance 2010-11 http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/@ps/documents/digitalasset/dh_112970.pdf

[5] There is some evidence that in 2011 some primary care trusts (PCTs) constrain patient choice by influencing GP referral decisions and restricting hospital's incentives and ability to compete for patients. It is not clear how prevalent such behaviour was in 2009, the period of our analysis. See *Review of the operation of "any willing provider" for the provision of routine elective care*, Cooperation and Competition Panel July 2011.

[6] See http://www.chooseandbook.nhs.uk/

[7] See NHS Choices at: http://www.nhs.uk/Pages/HomePage.aspx

[8] The website provides a range of information intended to help patients choose a provider, including the Care Quality Commission overall rating for quality of services, assessment of financial management and inspection reports as well as feedback from patients.

Choosing a hospital – decision making

10. The choice of which hospital to attend for treatment is supposed to be made by the patient with the support and advice of their GP. In practice, hospital choice is more complex and can be made by either by the patient, the GP or by the patient and the GP together. In this work it has not been possible to identify or predict who will actually make the decision and so it has not been possible to identify the patient's preferences separately from those of the GP. In this work we model the choice of hospital as a joint decision of the patient and the GP.

11. The factors that are likely to affect who makes the choice of hospital include:

    - Patient awareness of the right to choose
    - Whether the patient is offered choice by the GP
    - The value the patient places on choice
    - The GP's perception of the value the patient places on choice
    - The way in which the hospital appointment is made (eg patient telephones hospital)

12. The difficulty in predicting which patients are likely to make the decision for themselves, which will have the decision made for them by their GP and which will make the decision jointly comes about because we do not know how each choice is made in practice. Further, a number of the factors that affect choice run contrary to one another so we cannot use patient or GP characteristics to say how hospital choice will be made. In the following paragraphs we consider the evidence for each of these factors in turn.

13. Patients are more likely to take an important role in the decision making if they are already aware of their right to choose a hospital. A Department of Health survey showed that in March 2009 (the period of our study) 50 per cent of patients were aware before they visited their GP that they had a choice of hospitals. According to a study by the King's Fund, awareness of the right to choose has been shown to depend positively on: the degree of education; age; gender (men are more likely to be aware than women); and location (people living in small towns, villages or rural areas were more likely to be aware of their right to choose).

14. Patients are also more likely to influence the choice decision if they are offered choice by their GP. The King's Fund found that overall 47 per cent of patients recalled being offered a choice. This varied considerably according to whether the patient was aware before they visited their GP that they had a choice of hospitals – 62 per cent of patients that were aware of their right to choose recalled being offered choice, compared to just 32 per cent of those who were not aware.

15. Whether the patient or GP makes the hospital choice decision will also be affected by the value placed on choice by the patient. Survey evidence shows that 75 per cent of patients said that being offered choice is either important or very important to them. Choice was important to more of those patients with no qualification, to more women and to more people from mixed or non-white backgrounds. Patients aged 51-80 were significantly more likely than younger patients aged 16-35 to think choice is important.

16. However, the decision making will also depend on the GP's perception of the value placed on choice by the patient. Evidence from the King's Fund suggests that some GPs believe that choice of hospital is more relevant to certain types of patient (younger, more educated and middle class) and to those living in urban areas. According to the King's Fund study, many GPs assumed responsibility for choosing on behalf of a significant proportion of their patients, including older patients and those with language difficulties, low levels of literacy or mental health problems.

17. Once a GP has decided to refer a patient for treatment, the hospital appointment can be booked in a number of different ways and the role of the patient and GP in making the choice will also differ between these alternatives. These different mechanisms vary between individual GPs, between different GP practices and between PCT areas. Using Choose and Book, the GP can show the patient the set of hospitals available to them. Evidence suggests that about half of all patients that were offered a choice, were offered a choice of two hospitals and the other half were offered a choice of between 3 and 5 hospitals. If the chosen hospital makes appointments available to book directly, the patient and GP can book online during the patient GP consultation. Alternatively, the patient receives a letter setting out the options and can then book for themselves by telephone or online. The King's Fund found that appointments are most frequently booked by the GP (36 per cent) and by the patient on the telephone (36 per cent). A small proportion of referrals (6 per cent) are booked by the GP receptionist. In some PCT areas referrals are reviewed by Referral Management Centres that determine whether the referral meets the required clinical threshold for treatment.

18. In conclusion, studies by the Department of health and the King's Fund show the difficulty of predicting whether the hospital choice decision will be made by the patient, the GP or by the patient and GP jointly. The role of the patient will tend to be more important where the patient is actually offered choice. Patients are far more likely to recall being offered a choice of hospitals if they are already aware of their right to choose but these patients are also less likely to say that choice is important to them. Finally, the actual mechanisms for making referrals differ significantly from GP to GP and from area to area in a way that cannot be observed.

Provider incentives

19. Patient choice and a system of fixed prices linked to the number of patients treated create incentives for acute service providers to compete for patients on quality dimensions. Quality is multi-dimensional; eg clinical quality, "hotel services". Quality standards are regulated by the Care Quality Commission (CQC), which published quality and financial management rates for all Trusts during the period of our analysis.[9] Quality is difficult to observe. Given information asymmetries, theory shows that price competition has ambiguous effects on quality and welfare (too much or too little quality).

20. Patients (and GPs) choose their preferred hospital, trading off location, quality and other factors that matter to them. Patients have limited willingness to travel, so providers are spatially differentiated and there is scope for market power. There is variation in quality (eg teaching

[9] The CQC rates Trusts from 1 (weak) to 4 (excellent) on a range of quality indicators. For each Trust it also provides an overall quality rate and an overall financial management rate.

hospitals, the number of doctors per bed), so providers are also differentiated along this dimension and there is further scope for market power.

21. Within this system, acute service providers facing competition are expected to respond to patient needs and to improve quality and productivity in order to prevent patients and GPs from choosing an alternative provider.[10] A provider can improve quality in the short to medium term in a number of different ways. For example, by reducing mortality rates by enforcing best practice clinical procedures and appointing highly qualified staff, by reducing waiting times, by enforcing infection control procedure and by improving the overall management of the Trust.

22. Emerging empirical evidence suggests that competition between hospitals is improving quality. Two recent studies both find that the reforms that introduced competition between acute service providers have led to fewer deaths for heart attack patients in hospitals facing more competition.[11] This is consistent with a recent report by the Kings Fund, which indicates that many providers are focusing on the experience of their patients and the interests of GPs and are using this information to drive quality improvement.[12]

Our approach

23. In the following paragraphs we describe our approach to analysing the factors that influence patient and GP choice of hospital. We first describe the patient-level data before presenting the methodology we have employed to identify patient preferences. Finally, we discuss the findings in some of the related literature.

Data

24. The analysis is based on Hospital Episode Statistics (HES) data that is collected by the NHS Information Centre for Payment by Results, the case-based payment system by which hospitals are paid according to the number of patients they treat. The HES data used in our analysis was collected for the period April 2008 to April 2009. Our analysis of travel patterns is based on the population of patients that had inpatient elective hip replacements.[13]

25. We calculated the straight line distance (in km) between each patient and each hospital in the HES data.[14] The hospital site where the patient was treated is provided in the HES data.[15] [16]After we have matched patients and hospitals in the data[17], our sample consists of 51,505 patients, 146

[10] See Liberating the NHS: Regulating Healthcare providers http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_117842.pdf

[11] Does hospital competition save lives? Evidence from the NHS patient choice reforms Cooper, Gibbons, Jones and McGuire, 2010 LSE Health Working Paper 16/2010; Death by market power: Reform, competition and patient outcomes in the National Health Service Gaynor, Moreno-Serra, and Propper, 2010 Working Paper CMPO, University of Bristol

[12] Patient choice: How patients choose and how providers respond Kings Fund 2010

[13] HES data is recorded at the patient-episode level. An episode is defined as a single period of care under one consultant. A spell may consist of several episodes. For example, a patient may be admitted for treatment of a broken leg and while still in hospital, diagnosed and treated for diabetes. In order to exclude patients that were treated for a hip replacement after having been admitted with a different condition, we only include the first episode of the patient spell.

[14] The distance is measured from each hospital to each patient's super lower output area. Output areas are the base unit for Census data releases by the Office of National Statistics. Our data identifies the Super Lower Output Area (SLOA) in which the patient lives. There are 34,378 SLOAs in England and Wales. A super lower output area has an average population of 1,500 households.

[15] The site is not always recorded, particularly if a trust has multiple sites. We used the National Joint Registry to identify as many patients as possible.

[16] Hospital postcodes are taken from Connecting for Health, and grid references from the National Postcode Services Directory.

[17] We were unable to match 4,301 patients with the hospital sites where they were treated. As a result our sample fell from 62,792 inpatients that received elective hip replacements in their first episode, to 58,491.

NHS Trusts and Foundation Trusts and 216 hospital sites.[18] We restrict the set of possible choices of acute service provider to the 30 nearest providers to the patient.[19]

26. The HES data provides information on the age and gender of the patient, as well as the identity of the referring GP. We gathered information on the area where the patient lives, including whether it is rural or urban[20] and the degree of income and health deprivation.[21]

27. We used information on GP referrals from the HES data. For the period 2006 to 2008 we identified which hospitals each GP referred to and the total number of patients the GP referred to each hospital. From this we calculated the probability distribution for the GP and the acute service provider site in the GP's set of choices.[22] That is, for each hospital in the GP's choice set we calculated the probability that each GP would refer a patient there for a hip replacement.

28. Our dataset also contains information on the hospitals that patients chose to attend, including whether the trust is a Foundation Trust (FT)[23], teaching status, the number of beds (size), CQC quality and financial ratings, the number of doctors and the number of nurses. This information was gathered from Dr Foster Intelligence and the NHS Estates Return Information Collection 08/09.

Method

29. We have developed a model that examines the effect of a number of factors, including distance and quality, on the probability that a patient is admitted to a particular hospital.[24] The model starts from the observation that patients can choose to have their hip operation at any hospital in England. We assume that the patient/GP chooses the hospital which best suits their needs, so if patient/GP *i* chooses hospital *j*, we infer that patient/GP *i* prefers hospital *j* to all the other hospitals in the country.

30. In our data we observe each NHS-funded provider that was chosen by 51,505 patients and their GPs between April 2008 and April 2009. The data reveals that many different patients/GPs chose many different hospitals.

31. We also observe much information about the patient, the GP and the hospital. We know the output area where the patient lives, their age and their gender. We observe which hospitals the patient's GP has referred their patients to for hip replacements between 2006 and 2008. Finally, we know the location of the hospital (how far it is from the patient's home), the size of that hospital, the number of nurses and doctors it has, it's CQC quality and financial rating, the

[18] We excluded the 6,986 patients in our matched sample that were treated at independent sector hospitals because it has not yet been possible to collect any further information on these hospitals. This leaves 51,505 patients in our sample. This omission from our model means that it is not possible for us to take into account directly the role of the independent sector providers in the provision of acute services. However, we do take these providers into account indirectly in our model through a count of how many are located near to each hospital. This allows us separately to identify their effect.

[19] Only a negligible proportion of patients chose a hospital that was not in the set of 30 trusts nearest to them, so we are excluding very few choices in restricting the choice set in this way.

[20] We use the Office of National Statistics definition of rural/urban.

[21] We use the English Indices of Deprivation 2004 from the Office of the Deputy Prime Minister.

[22] We take the GP's choice set to be the set of all acute service providers to which it has referred a patient during the period of our analysis.

[23] NHS Foundation Trusts are not-for-profit, public-benefit corporations that have the freedom to decide their own strategy and the way services are run. They can retain their surpluses and borrow to invest in new and improved services. More than half of all NHS providers are currently Foundation Trusts and in the recent White Paper the Government promised that all providers would be Foundation Trusts within three years.

[24] We develop a conditional logit model. See Appendix 1 for technical discussion.

mortality rate for hip replacements, the readmission rate for hip replacements, the length of time patients have to wait for treatment at the hospital and the MRSA infection rate.

32. As each patient, together with their GP, chooses the best hospital for them, their choice reveals their preferences for different hospital characteristics (eg MRSA infection rate, waiting time, distance).[25] For example, suppose there are two hospitals. The first hospital (H1) has excellent clinical quality, but a very long waiting time. If we observe the patient and their GP choosing the second hospital (H2), which has poorer quality, but a shorter waiting time, this reveals that for this patient and their GP waiting time is more important than clinical quality.

33. Based on the information revealed by the choices made by the 51,505 patients in our sample, the model estimates the probability that patient/GP *i* chooses hospital *j*, conditional on the characteristics of patient/GP *i* and those of hospital *j*[26]. In doing so, we identify the patient, GP and hospital characteristics that matter and which explain the choices patients/GP actually made.

Related literature

34. Several other studies have estimated patient choice or analysed the effects of hospital mergers. Universally, all studies find that distance or travel time matters to patients. This finding is the same regardless of whether they use data on patients from the US, England or Europe.[27] One study of Dutch patients choosing hospitals for one of two medical conditions, orthopaedics and neurosurgery, find that the further away the nearest hospital is, the less likely the patient is to bypass it.[28]

35. The results on the role of quality are less clear, partly because measures of hospital quality vary widely between studies. Few studies have much information on the quality of hospitals. One study in the US with information on quality of both inputs (such as the number of nurses per bed, the hospital type and size) and on the output (such as the mortality rate), found, like us, that patients prefer hospitals with lower mortality rates and that older patients are less willing to travel.[29]

36. A number of studies have found that different aspects of hospital quality have different degrees of importance for hospital choice for different medical conditions. For example, a study in the US found that patients with cancer attach greater weight to hospitals with good cancer services and that women in labour place more weight on good maternity services. The study of Dutch patients found that patients needing neurosurgery place greater weight on a low waiting time than patients needing orthopaedic care.

37. Though very few studies have simulated the effects of hospital mergers, a substantial number have looked at the impact of hospital mergers retrospectively. Many of these use US data because the US competition authorities have investigated conduct and mergers in healthcare sector since the mid-1980s. Most recently, the Federal Trade Commission (FTC) announced the

[25] In this model we treat the patient and the GP as a single decision maker. Therefore, the choice of hospital can be thought of as a choice made by the patient or the GP or a choice made by the patient in consultation with their GP.
[26] See Appendix 1 for a technical presentation of the methodology.
[27] See for example, Sivey (2010) for a study of patients in the UK and Ho (2006) for a study of US Medicare patients.
[28] Varkevisser and Geest (2007).
[29] Tay (2003)

Hospital Merger Retrospective Project to study consummated hospital mergers.[30] The studies all found that insurance companies paid higher prices after the mergers, though the magnitude of the price effects varied.[31] Although price is the main strategic variable for hospitals in the US, a number of the studies looked at the impact of hospital mergers on quality of care. One study found little evidence that the merger improved quality of care and in fact suggested a small deterioration relative to other hospitals.[32] The authors of a review of the studies concluded that the papers did not support the hypothesis that the mergers looked at raise quality of care at acquired hospitals.[33]

Results

38. In this section we present the preliminary results of our empirical model of patient and GP choice of acute service providers. This section is structured as follows:
    - In the first part we present some summary statistics of patient travel patterns:
        - average distance travelled by patients admitted to hospital for a hip replacement;
        - average distance between patients in our sample and their nearest acute service provider;
        - the proportion of patients that have a choice of at least one, two, three or four hospital trusts; and
        - the proportion of patients that choose their nearest hospital trust for treatment.
    - The final part of the section sets out the results of our empirical model and explains the factors that influence patients' and GP's choice of acute service provider.

Summary statistics on patient travel patterns

Average distance travelled

39. Patients travelled, on average, just over 12 km for a hip operation in 2008/9. The average distance travelled was different for different groups of patients. Older patients tended to travel shorter distances than younger patients[34], as did those living in more health-deprived and income-deprived areas.[35] Female patients travelled slightly shorter distances than male patients. Patients living in rural areas travelled, on average, 9.3 km further than those living in urban areas.

40. The average distance travelled also varies according to the referral pattern of the referring GP. Patients who attended a hospital that their GP tended to prefer[36] travelled just 9.8 km, while patients who attended a hospital that their GP did not prefer travelled 13.4 km. This suggests that

[30] These studies have been published in a special edition of the International Journal of the Economics of Business, February 2011.
[31] Haas-Wilson and Garmon (2011), Thompson (2011), Tenn (2011), Ramano and Balan (2011)
[32] Ramano and Balan (2011)
33 Haas-Wilson and Vita (2011)

[34] We define older patients as though who were more than 70 years old when admitted to hospital. The median age of patients in our sample is 70 years.
[35] We define areas as more health deprived or more income deprived, if the deprivation score is greater than the median in our sample.
[36] We define a hospital as being preferred by the referring GP if the probability that the practice refers a patient to the hospital is greater than the median in our sample.

GPs tend to refer patients to nearby hospitals and patients that don't go to their GP's preferred hospital travel further than those who do.

41. Distance travelled differs for different types of hospital. Patients that attended NHS trusts travelled 13.1 km, while those attending FTs travelled 11.4 km. Patients that attended smaller hospitals also travelled further than those attending larger hospitals (measured by the number of beds), as did those attending hospitals with more nurses per patient. These patterns may reflect underlying relationships between types of hospital and location (eg smaller hospitals are more likely to be located in rural areas).

Average distance to nearest hospital trust

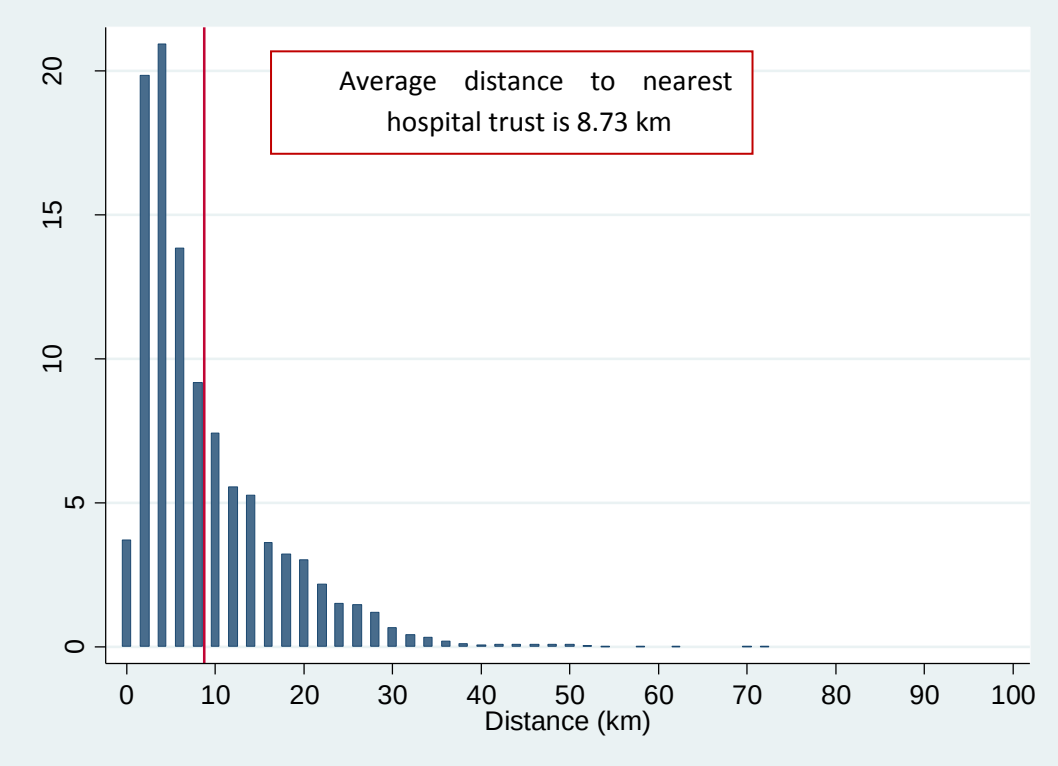
42. On average, patients in our sample need to travel just under 9 km to reach their nearest hospital trust.[37] Half of patients have a hospital trust within 6 km of where they live and 90 per cent of patients have a hospital trust located within 20 km of where they live. Figure 1 shows how far, on average, patients have to travel to their nearest hospital trust. The average distance to the nearest hospital (8.7 km) is marked in red. The chart shows that the majority of patients would travel less than the average distance to their nearest hospital, if they were to choose that provider. However, it also shows that some patients have to travel quite long distances to reach their nearest hospital trust.

43. Most patients in our sample live in urban areas (86 per cent). These patients travel shorter distances to their nearest hospital trust than the average across all of England. On average patients living in urban areas need to travel less than 8 km to reach their nearest hospital trust. 50 per cent of patients in urban areas travel less than 6 km to their nearest hospital and 90 percent have a hospital within 18 km.

44. There are fewer patients in our sample live in rural areas and these patients have to travel further to reach their nearest hospital. On average rural patients travel more than 15 km to reach their nearest hospital trust. However, 50 per cent of patients living in rural areas have a hospital trust within 14 km and 90 per cent are within 27 km of a hospital trust.

[37] This analysis is based on our sample of 51,505 elective hip replacement patients, 146 NHS and Foundation Trusts and 216 hospital sites.

Figure 1: Distance to nearest hospital trust



Source: analysis of HES data

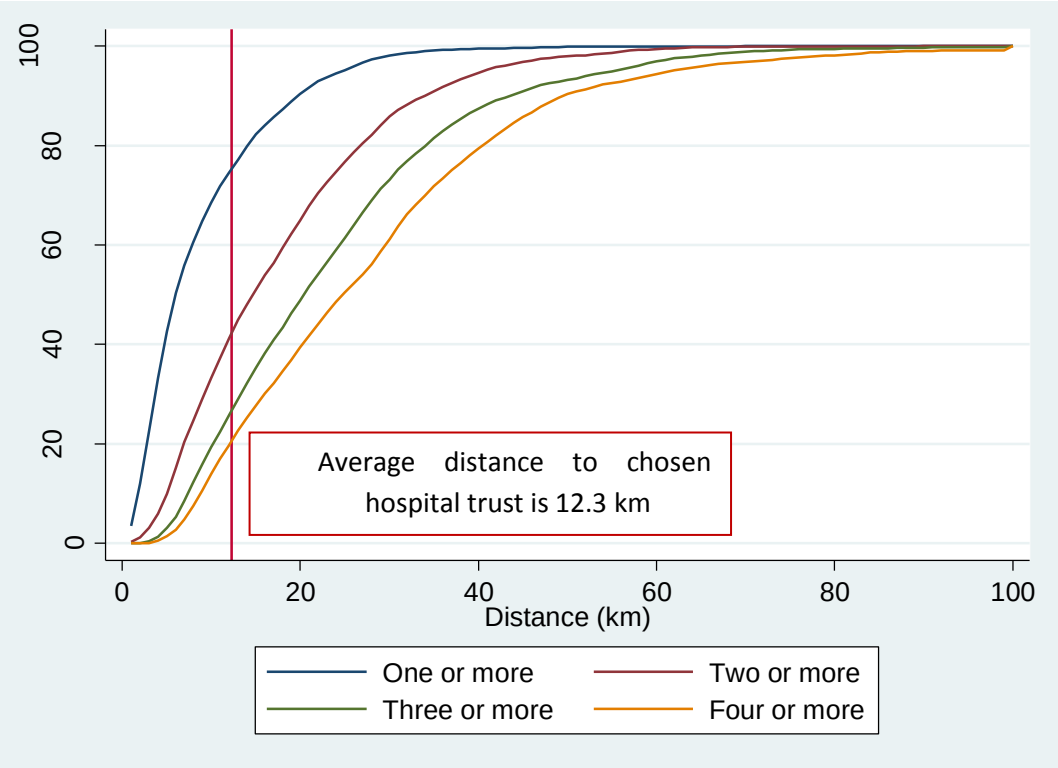
Patient choices

45. The previous analysis suggests that many patients live within reasonable distance of at least one hospital trust. To understand how much choice of hospital trusts patients have, we looked at the proportion of hip operation patients in our sample with a choice of at least one, two, three or four hospital trusts.

46. The results of our analysis are set out in Figure 2, which shows that 40 per cent of patients in our sample have access to at least two hospitals within 20 km and 100 per cent have access to at least one within 60 km. Almost 80 per cent of patients have access to at least three hospital trusts within 40 km and 60 per cent have access to at least four within that distance.

47. Patients travel on average 12.3 km to their chosen hospital for treatment (marked with a vertical red line on Figure 2). 20 per cent of patients can choose between at least four hospital trusts within that distance and 40 per cent can choose between at least two.

Figure 2: Proportion of patients with choice of at least one, two, three or four hospital trusts



Source: analysis of HES data

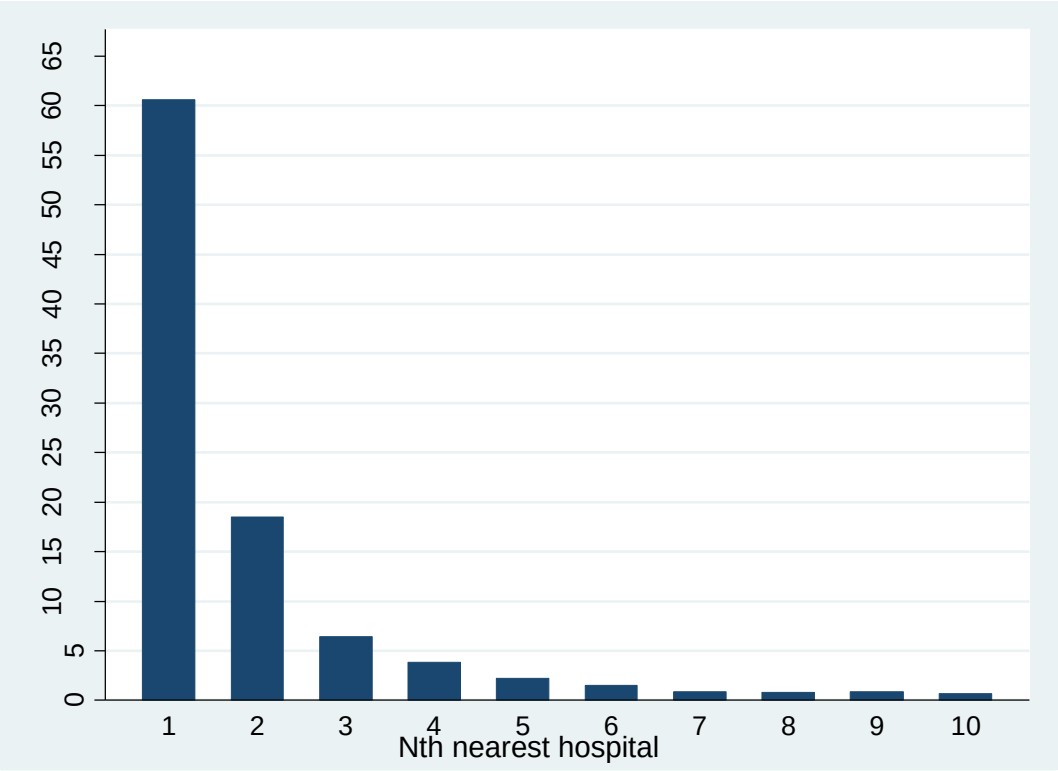
48. Patients living in urban areas have a greater choice of hospital trusts. Our analysis shows that more than 70 per cent of patients in urban areas have access to at least two hospital trusts within 20 km and 40 per cent have access to at least four. Patients living in urban areas travelled less than 12 km on average for their elective hip replacement. Within that distance, 20 per cent of these patients had a choice of at least four hospital trusts and 40 per cent had a choice of at least two.

49. Patients living in rural areas travel on average more than 20 km to their chosen hospital, which is much further than patients living in urban areas. Within that distance, about 10 per cent have a choice of at least four hospital trusts, slightly fewer than 20 per cent have a choice of at least three and about 35 per cent have a choice of at least two hospital trusts.

Proportion of patients who went to their nearest hospital

50. Figure 3 shows the proportion of patients that went to the nth nearest hospital. It shows that slightly more than 60 per cent of patients went to their nearest hospital. This shows that nearly 40 per cent of patients chose a hospital that was not the nearest one possible, which suggests that patients and their GPs are looking at hospital characteristics other than just location when they choose the best hospital to attend.

Figure 3: Proportion of patients who went to their nth nearest hospital



Source: analysis of HES data

Catchment areas

51. A hospital's catchment area is the area within which most of its patients live. We found that 75% of patients lived just under 17km from the hospital they attended and 90% lived within 27km (see Table 1). This suggests that, at least for hip operations, hospitals in England have relatively small catchment areas. Catchment areas differ for hospitals located in rural and urban areas. Hospitals in urban areas take 75% of their patients from less than 15km away and 90% from less than 25 km. Hospitals in rural areas take 75% of their patients from 26km away and 90% from 37km away.

Table 1: Hospital catchment areas for hip operations

Distance travelled by x% of patients	10%	25%	50%	75%	90%
All hospitals	2.2	4.1	8.6	16.7	27.0
Hospitals in rural areas	6.6	10.6	17.4	26.0	36.6
Hospitals in urban areas	2.0	3.7	7.5	14.6	24.6

Source: CCP analysis of HES data

Results of our model of patient and GP choice of provider

52. The data on patient choice suggests that many patients can and do choose a provider of acute services. As a result, there is scope within the system for providers of acute services to compete

on different quality dimensions in order to attract patients. This section presents the results of our model of the factors that determine which provider patients, and their GPs, choose for treatment.

Table 2: Average marginal effects, in percent

Characteristic	Change	All hospitals
Distance	+ 6 km	-44
Mortality rate	+ 5 ppt	-7
CQC rate	+ 1	+15
CQC financial rate	+ 1	-21
Size (number of beds)	+215	-9
Doctors per bed	+10	-4
Nurses per bed	+20	-12
Waiting time (weeks)	+2	-7
Proportion of GP referrals	+ 4 ppt	+9

Source: *calculation of the authors*

53. Table 2 reports the marginal effects of the hospital characteristics. It shows the percentage change in hospital demand as a result of changing one of the hospital characteristics, holding all other characteristics unchanged and taking account of all interactive effects.[38] The results are averaged across all hospitals in our sample. For example, an increase in the CQC rate by one point from "weak" to "fair" would result in an increase in demand by 15 per cent, on average.

54. The results of our empirical model indicate that patients and GPs take account of both location (distance to travel) and quality when choosing a hospital. Our results show that the further away the hospital is, the less likely the patient is to go there. This effect declines with distance. This is consistent with the results of other studies of the determinants of patient choice.[39] We find that willingness to travel depends on the characteristics of the patient. Patients are less willing to travel if they are old, live in an urban area, or live in an income-deprived area. Patients living in areas of high health deprivation are willing to travel even further than those patients living elsewhere.

55. Our results also suggest that patients and their GPs are willing to trade off some hospital characteristics with location. Patients are willing to travel even further for hospitals that communicate clearly with them or their GP, those that have more staff per bed and larger hospitals. However, they are not willing to trade off travel cost with any other measures of quality including the CQC rate.

56. We find that, consistently across a number of measures, patients are less likely to choose a hospital with lower quality. We find that a patient is less likely to choose a hospital if it has: a high mortality rate; a low CQC rate; a low CQC financial rate; a long waiting time; or, above median MRSA infection rates. A low CQC financial rate may be related to poor management of the

[38] Continuous variables are changed by half the standard deviation and discrete variables by one unit. The marginal effects are averaged across all hospitals in our sample. The full coefficient estimates of the model and their standard errors are reported in Appendix 2.
[39] Tay (2003), Sivey (2008a, 2008b), Propper (2010)

hospital, which could impact on patient experience through, for example, cancelled appointments or lost patient notes. Whilst not directly observable to the individual patient, the results of poor management may affect provider reputation and could be observed by GPs.

57. We find that patients are more likely to choose a hospital the fewer staff per bed it has, and also the smaller (fewer beds) it is. As there is a strong negative relationship between the number of staff per bed and the mortality rate (that is, hospitals with a higher number of staff per bed tend also to have a lower mortality rate) we would expect that the number of staff per bed would be indicative of hospital quality and that patients would be more likely to attend a hospital with more staff. However, this unexpected relationship might be explained by the positive relationship between hospital size and number of staff per bed. Our results suggest that patients prefer smaller hospitals (a result consistent with other research), which tend to have more staff per bed. Even though a hospital with more staff per beds will have a lower mortality rate, if patients and their GPs cannot easily observe the number of staff per beds their preference for smaller hospitals may lead them to choose hospitals with fewer staff per beds.

58. Empirically it is difficult to distinguish between the contribution of the patient and GP preferences when choosing an acute service provider for treatment. One way to control for the role of the GP is to add the GP's referral history to a given provider as a characteristic of that provider. For each pair of acute service provider and GP, this is essentially the probability that the GP will refer a patient to that provider. Using this approach our results suggest that the past referral history of the patient's GP is an extremely important factor determining choice of hospital. Patients in our sample were far more likely to choose a hospital if their GP had referred patients to the hospital for a hip operation in the previous 2 years. The greater the proportion of patients that the GP had sent to a hospital, the more likely the patient and their GP were to choose that hospital. This suggests that there is scope for acute service providers to compete directly for GP referrals and there is some evidence that some providers are keen to understand what GPs want and their views as referrers.[40]

59. Our results do not show any statistically significant differences between male and female patients, for any of the variables.

60. We also interacted patient and hospital characteristics, which shows whether different types of patients have different preferences for different hospital characteristics. We found that older patients are more likely to attend a hospital if it has a longer waiting time. There is some evidence that waiting lists prioritise more urgent cases.[41] There is also a tendency for severely ill patients to be treated at high quality hospitals.[42] Our hypothesis is that as older patients are more likely to be prioritised, waiting time is of less importance to this group. Further, as waiting time is a mechanism for managing within fixed budgets, a long waiting list may be taken as a sign of a high-quality hospital.[43] We found that older patients are less likely to choose a hospital the more staff per bed it has and the better the CQC financial rate. It is unclear what these effects indicate.

[40] See Patient Choice: How patients choose and how providers respond, Kings Fund 03 June 2010
[41] Death on the waiting list for cardiac surgery Bridgewater, 1999 Heart (Editorial)
[42] The effect of hospital quality on choice of hospital for elective heart operations in England, Sivey 2008
[43] See Review of the operation of "any willing provider" for the provision of routine elective care, Cooperation and Competition Panel July 2011

61. We found that, like older patients, patients living in income-deprived areas are more likely to choose a hospital the longer it's waiting time. Again, longer waiting times could be an indication of better quality for these patients. We also found that these patients are less likely to choose a hospital if it has above average (median) MRSA infection rates. Different from other patient groups, these patients are more likely to choose a teaching hospital and less likely to choose a hospital with a good CQC financial rate. It is unclear what these effects indicate.

62. Our results suggest that patients living in areas of high health deprivation, which are closely related to areas of high income deprivation, were more likely to choose a hospital if it has a high CQC financial rate and if it is an FT. These patients were less likely to choose a hospital if it had a long waiting list. Unlike other patient groups we found that they are more likely to attend a hospital if it has above average MRSA infection rates. Patients from health-deprived areas were less likely to choose a hospital if it had a long waiting list, a high CQC rate and if it is a teaching hospital. In general, our results suggest that patients in health-deprived areas are less responsive to quality than other patient groups. One possible explanation is that these patients cannot afford to look at quality as accounted for in our model, but must choose a hospital according to some other unobserved (to us) characteristics. Alternatively, these patients may be less able to identify hospitals with better quality.

63. Finally, we note that our results vary between PCTs. This likely reflects the role PCTs have in shaping the way hospitals provide services in a local area and their influence on referral patterns.

Competitive assessment

64. In this section of the paper we illustrate how the results of a model of patient and GP choice might be used to assess the competitive impact of a merger between providers of hospital services in England. This preliminary analysis draws on the results of the demand model developed in the first part of the paper. It applies the techniques first developed in Capps et al (2001).

65. Merger simulation models were first developed in the 1990's (Hausman et al, 1994 and Werden and Froeb, 1996) and are now used by competition authorities in the US, Europe and the UK to supplement traditional structural analysis. Standard merger simulation models forecast the prices and quantities before and after a merger and allow for the identification of price effects of a merger, given a set of assumptions.[44]

66. We analyse the effect on the number of patients that choose a particular hospital (ie demand) of changes in the quality of hospitals, relative to all other hospitals. To estimate this demand sensitivity, we use the hospital standardised mortality rate as a proxy for quality. Each hospital has its own unique demand sensitivity because no two hospitals are the same; they differ in many ways including their location, the characteristics of their local population and the availability of alternatives for their patients. As prices are fixed, this demand sensitivity is a measure of market power and by comparing it before and after a merger we can assess the competitive effect of the merger. In the following paragraphs we explain the methodology for this analysis and illustrate it using two hypothetical mergers.

[44] Analysts typically assume that the firms compete in a Bertrand differentiated product market.

Method

67. Merger simulation techniques estimate a set of parameters in a "before" and "after" scenario with respect to relative price (in this case, quality) and compare the results to identify the effects of a merger.

68. Following Capps et al, the first step in our analysis is to calculate the market share for each hospital in the pre-merger, or "before", scenario.[45]

69. The next step is to estimate the pre-merger quality elasticity of demand for each individual hospital. This is done by decreasing the quality to hospital j by 10 percent, holding all else constant. That is, we increase the standardised hospital mortality rate by 10 percent. We recalculate the market share and calculate the estimated quality elasticity of demand, which is the percentage change in demand divided by the percentage change in quality. If the hospital has multiple sites, we decrease the quality to all sites simultaneously. This step is repeated for hospital 2.

70. Next we estimate the "after" or joint/post-merger quality elasticities of demand. We increase the quality to both hospital j and hospital k by 10 percent, holding all else constant. We then recalculate the market share of each hospital and recalculate the estimated quality elasticity of demand for each hospital.

71. Finally, we compare the pre- and post-merger elasticities of demand for each hospital. If the two merging hospitals in our simulation are close substitutes for patients, and face few other competitors, then compared to the pre-merger situation, after the merger the pair will face significantly less elastic demand.

Results

72. The quality elasticities based on the preliminary results of our model suggest range from less than 0 to around -2.5, with a mean of -1.1. It is useful to assess the magnitude of these elasticities relative to the standard deviations of the corresponding variables. The average index of mortality rates across all hospitals in our sample is 100 and the standard deviation is 10, so a 10 percent increase in mortality rate is equal to the standard deviation and relatively large.

73. To illustrate the possible application of this merger simulation, we have used this approach to simulate the effect of two hypothetical mergers.

74. The first hypothetical merger takes place in a densely populated metropolitan area. H1 has two sites providing hip operations. Both sites have a much smaller catchment area than the average in our sample (bottom 25th percentile). The trust is much smaller than average, with far fewer beds than most in our sample (bottom 10th percentile). H1 has a good CQC rating and its financial

[45] To do this we average over the empirical distribution of patient characteristics. That is, we take the coefficients from the demand estimation and calculate the predicted probabilities for each patient and hospital pair. We sum the weighted predicted probabilities by hospital, using a weight which is the ratio of the number of patients that have hospital j in their choice set (the number of times hospital j appears in any patient's choice set) to the total number of patients. The estimated market share for hospital *j* is:

$$s_j = \sum_{i=1}^{n} \frac{N_j}{N} \hat{P}_{ij}, \quad j = 1,2,...., J$$

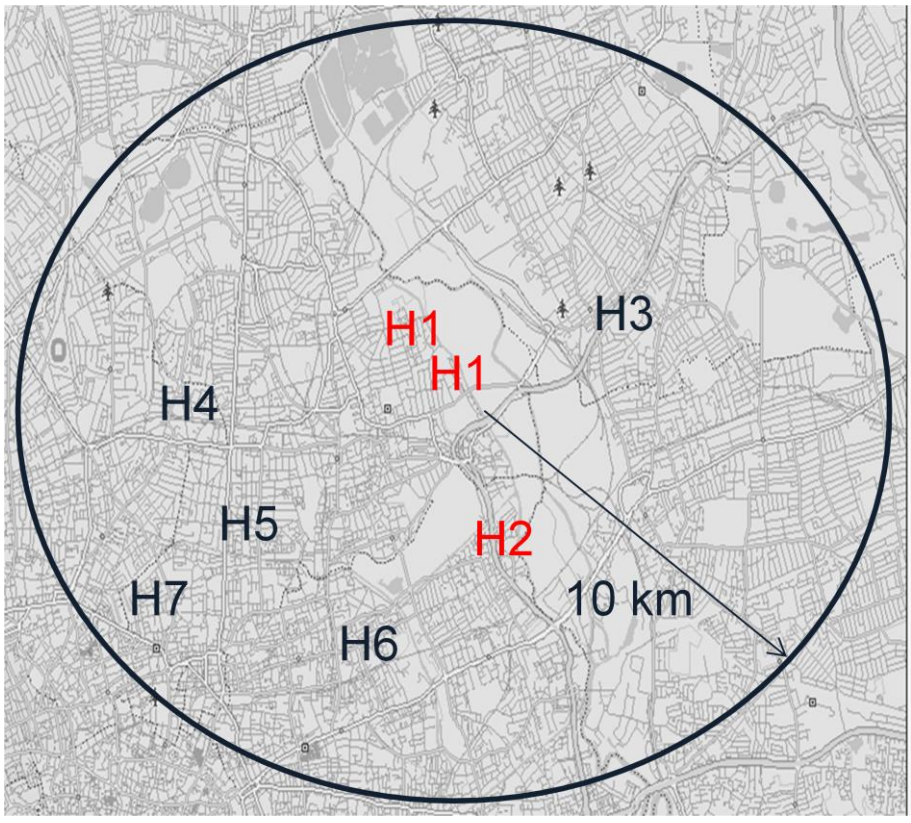
where $\hat{P}_{ij}$ is the predicted choice probability of patient *i* with respect to hospital *j*, and N_j is the number of patients in the sample whose choice sets contain *j*.

rating is fair. It has significantly more doctors and nurses per 100 beds than the average (top 90th percentile). It treats more trauma and orthopaedics patients within 18 weeks than the average. The overall mortality rate for the Trust is significantly above average (top 90th percentile), but the unplanned readmission rate is slightly below average. It is not an FT.

75. H2 has one site. It has a very small catchment area compared to the average in our sample. It is also significantly smaller than average (bottom 10th percentile). It has an excellent CQC rate and financial rate. It has significantly more doctors and nurses per 100 beds than the average (top 90th percentile). The Trust treats more patients within 18 weeks than the average in our sample. Both the overall mortality rate and the unplanned readmission rates for a broken hip are below average.

76. H1 and H2 are located very close to one another (less than 10km). There are five other hospital Trusts within 10km of H1 (see Figure 4).

Figure 4: Geographic distribution of hospitals in hypothetical merger 1



Source: *analysis of HES data*

77. Table 3 shows the results of our analysis for the first hypothetical merger. The analysis of quality elasticities suggests that these hospitals face relatively elastic demand before and after the merger meaning that patients are reasonably able to switch away to a different hospital if quality

falls. For example, before the merger a 10 percent decrease in quality at H2 would result in 11 percent fewer patients choosing this site (10% x -1.12 = -11.2%) and after the merger this only falls to 10 percent.

Table 3: Pre- and post-merger elasticities for hypothetical merger 1

Hospital	Pre-merger elasticity	Post-merger elasticity	Percentage change
H1	-2.29	-2.18	5%
H1	-2.32	-2.21	5%
H2	-1.12	-1.02	9%

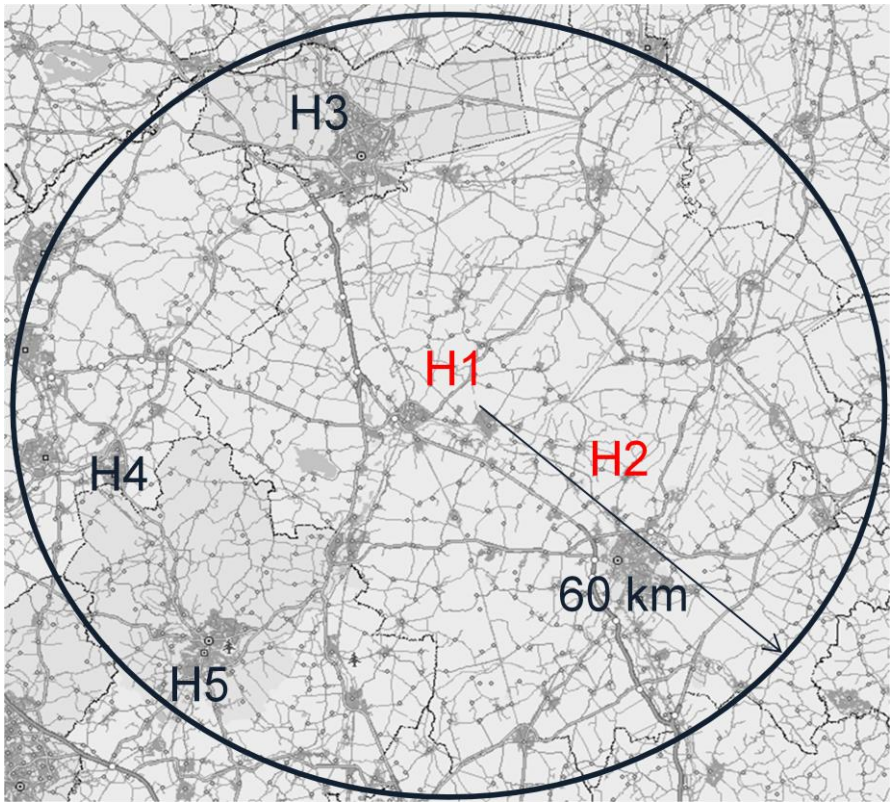
Source: *calculations based on analysis HES data*

78. The second hypothetical example is a merger between H1 (hospital 1) and H2 (hospital 2) in a relatively rural area in England. H1's catchment area is wider than the average across England and the hospital is much smaller than average (bottom 10th percentile). H1 is not an FT. It has a good CQC rating, and its financial rating is fair. H1 has fewer doctors per bed than average in our sample, and more nurses per bed. It treats more patients for trauma and orthopaedics within 18 weeks than the average in our sample. The overall mortality rate is slightly higher than average and the unplanned readmission rates for a broken hip are quite a bit higher than average.

79. H2 also has a wider catchment area than average and the hospital is significantly larger than average (top 25th percentile). H2 is an FT. It has a good CQC rating and financial rating. It has a very high number of both doctors and nurses per bed compared to average (more than 90th percentile). It has a very short waiting list for trauma and orthopaedics. The overall hospital mortality rate is much lower than average (bottom 10 percentile) and the unplanned readmission rate is slightly lower than average.

80. H1 and H2 are about 20km apart. There are three other providers in the local area, all about 60km from H1 (see Figure 5).

Figure 5: Geographic distribution of hospitals in hypothetical merger 2



Source: *analysis of HES data*

81. Table 4 shows the pre- and post-merger estimated elasticities for this hypothetical merger. According to the analysis, before the merger both hospitals have relatively inelastic demand, meaning that few patients switch away to a different hospital if quality falls. H2 has less elastic demand than H1 and our analysis indicates that pre-merger these hospitals enjoy a degree of market power as a result of their geographic differentiation and in the case of H2, likely also due to some quality differentiation. Before the merger a 10 percent decrease in quality of care at H1 would result in just 8 percent fewer patients choosing the hospital. The effect of the merger is particularly significant for H2. Before the merger, a 10 percent decrease in quality of care would mean 3 percent fewer patients choosing it, but this is just 1.4 percent after the merger, a change of more than 50 percent. This means that the merger parties are important competitors to one another and that after the merger they will face less competition, have more market power and their patients will have fewer opportunities to choose an alternative hospital.

Table 4: Pre- and post-merger quality elasticities for hypothetical merger 2

Hospital	Pre-merger elasticity	Post-merger elasticity	Percentage change
H1	-0.77	-0.65	15%
H2	-0.31	-0.14	54%

Source: *calculations based on analysis HES data*

82. Compared to the first hypothetical example, our analysis indicates that both of these hospitals would face substantially less sensitive demand as a result of the merger. This might suggest that this merger would lessen competition and have adverse effects on patients and taxpayers unless there are significant efficiencies or other benefits associated with the merger.

Discussion

83. This analysis of patient data shows that many patients in England have a good choice of hospital within a reasonable distance. Around 20 percent of patients in our sample can choose between at least four hospitals within 12 km, the average distance patients travel for a hip operation, and 40 percent can choose between at least. We found that nearly 40 percent of patients chose a hospital that was not the nearest one possible, which suggests that patients and their GPs are looking at hospital characteristics other than just location when they choose the best hospital for treatment.

84. Our analysis of the choices made by the patients in our data reveals that quality of care, measured by mortality rate, CQC rate, waiting time and MRSA infection rates, are all important factors in choice of hospital. In common with other studies, we find that location is also very important. The preferences of the GP are clearly very important determinants of choice of hospital.

85. We have estimated quality elasticities of demand for hospitals in England. As far as we are aware, this is the first time this has been estimated. The analysis in this paper uses these quality measures directly to assess the competitive effects of mergers on quality. The results of our analysis suggest that merger simulation techniques may be usefully applied to the health sector.

Appendix 1: The demand model

86. Let $i = 1,2,....,n$ denote individuals (patients) and let $j = 1,2,...,J$ denote hospitals. We want to estimate the probability that patient i chooses hospital j, conditional on characteristics of patient i and characteristics of the hospitals in patient j choice set. Let individual $i's$ choice set be given by $1,2,...,J_i$, i.e. different individuals potentially have different choice sets (we will return to the specification of choice sets in the first section of this paper). The econometric model is motivated by a random utility model where the underlying assumption is that individual i will choose hospital j if individual i prefers j over all other hospitals in his/her choice set. Let individual $i's$ utility of going to hospital j be given by:

$$u_{ij} = \beta dist_{ij} + \mathbf{x}_j'\alpha + dist_{ij}\mathbf{x}_j'\gamma + \mathbf{v}_i\mathbf{x}_j'\delta + \varepsilon_{ij}, \qquad j = 1,2,...., J_i$$

where $dist_{ij}$ denotes the distance from patient i to hospital j, $\mathbf{x}_j$ denotes hospital-specific characteristics of hospital j (such as CQC rating, waiting times, mortality rates and number of doctors and beds), $\mathbf{v}_i$ denotes patient-specific characteristics (such as age, gender and income deprivation measures of $i's$ residential area) and $dist_{ij}\mathbf{x}_j$ and $\mathbf{v}_i\mathbf{x}_j$ denote interactions of hospital-characteristics with distances and with patient-characteristics, respectively. The assumption is then that individual i chooses hospital j if $u_{ij} > u_{ik}$ for all other hospitals in $i's$ choice set $k \neq j, \ k = 1,..,J_i$.

87. Let y_i denote the choice of patient i, i.e. $y_i = j$ means that patient i chose hospital j, then the probability of i going to hospital j is given by (McFadden (1974))

$$p_{ij} \equiv P(y_i = j \mid dist, \mathbf{x}, \mathbf{v}) = \frac{\exp(\beta dist_{ij} + \mathbf{x}_j'\alpha + dist_{ij}\mathbf{x}_j'\gamma + \mathbf{v}_i\mathbf{x}_j'\delta)}{\sum_{k=1}^{J}\exp(\beta dist_{ik} + \mathbf{x}_k'\alpha + dist_{ik}\mathbf{x}_k'\gamma + \mathbf{v}_i\mathbf{x}_k'\delta)}, \qquad j = 1,2,...., J_i$$

88. We can then calculate the market share of hospital j as

$$s_j = \sum_{i=1}^{n}\frac{N_j}{N}\hat{P}_{ij}, \qquad j = 1,2,...., J$$

where N_j is the frequency with which hospital j appears in any of the n choice sets, and N is the total number of observations.

Appendix 2: Results of the demand model

Conditional (fixed-effects) logistic regression: Number of observations =979,242
LR chi2(137) = 179458.71
Prob chi2 = 0.0000
Log likelihood = -35978.273
Pseudo R2 = 0.7138

choice	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
Distance	-0.814	0.02	-32.58	0.00	-0.86	-0.77
Distance^2	0.000	0.00	42.39	0.00	0.00	0.00
Size (number of beds)	-0.002	0.00	-13.66	0.00	0.00	0.00
CQC rate	0.432	0.05	8.43	0.00	0.33	0.53
CQC financial rate	0.275	0.06	4.35	0.00	0.15	0.40
Number of doctors per 100 beds	0.010	0.01	1.88	0.06	0.00	0.02
Number of nurses per 100 beds	-0.017	0.00	-8.95	0.00	-0.02	-0.01
Waiting time (weeks)	-0.076	0.01	-11.73	0.00	-0.09	-0.06
Mortality rate	-0.025	0.00	-8.40	0.00	-0.03	-0.02
Teaching (d=1)	-0.75	0.11	-6.85	0.00	-0.96	-0.53
MRSA (d=1 if above median)	-0.306	0.07	-4.37	0.00	-0.44	-0.17
Patient age*distance	-0.022	0.00	-14.59	0.00	-0.03	-0.02
Patient in rural area*distance	0.014	0.00	6.78	0.00	0.01	0.02

Patient in income-deprived area*distance	-0.187	0.01	-12.78	0.00	-0.22	-0.16
Patient in health-deprived area*distance	0.016	0.00	9.30	0.00	0.01	0.02
CQC rate*distance	-0.010	0.00	-11.27	0.00	-0.01	-0.01
CQC financial rate*distance	-0.025	0.00	-22.77	0.00	-0.03	-0.02
Size*distance	0.000	0.00	16.49	0.00	0.00	0.00
Number of staff per bed*distance	0.001	0.00	1.19	0.24	0.00	0.00
Good communication*distance	0.009	0.00	29.21	0.00	0.01	0.01
Teaching*distance	-0.025	0.00	-8.26	0.00	-0.03	-0.02
Patient age*CQC financial rate	-0.055	0.02	-2.22	0.03	-0.10	-0.01
Patient age*number of staff per bed	-0.090	0.02	-3.62	0.00	-0.14	-0.04
Patient age*waiting time	0.007	0.00	1.93	0.05	0.00	0.01
Patient in income-deprived area*CQC financial rate	-2.097	0.22	-9.40	0.00	-2.53	-1.66
Patient in income-deprived area*waiting time	0.086	0.03	2.55	0.01	0.02	0.15
Patient in income-deprived area*MRSA	-1.657	0.35	-4.79	0.00	-2.336	-0.98
Patient in income-deprived area*teaching	2.234	0.47	4.73	0.00	1.31	3.16
Patient in health-deprived area*CQC rate	-0.082	0.02	-4.61	0.00	-0.12	-0.05

Patient in health-deprived area*CQC financial rate	0.252	0.03	7.57	0.00	0.19	0.32
Patient in health-deprived area*waiting time	-0.034	0.00	-8.16	0.00	-0.04	-0.03
Patient in health-deprived area*MRSA	0.523	0.05	10.75	0.00	0.43	0.62
Patient in health-deprived area*FT	0.161	0.04	4.39	0.00	0.09	0.23
Patient in health-deprived area*teaching	-0.562	0.07	-8.27	0.00	-0.70	-0.43
Probability of GP referral to hospital j	4.088	0.06	68.05	0.00	3.97	4.21

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