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**EVIDENCE AND IMPACT OF NHS CHOICE AND  
COMPETITION POLICIES ON THE DELIVERY OF  
PROSTATE CANCER SERVICES: A NATIONAL  
POPULATION BASED EVALUATION**

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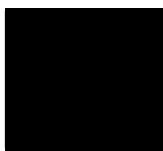
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# ABSTRACT

## **Background**

Policies encouraging patient choice and hospital competition have been introduced across several countries with the aim of improving the efficiency, equity and quality of health care services. The English National Health Service (NHS) is an example of a publicly funded health system in which hospitals are expected to compete on quality and not price to attract patients, who themselves are allowed to choose any hospital that best meets their needs. To date, there is limited evidence about the factors that influence patients' decisions to choose a hospital other than their nearest ("patient mobility") or the implications of these choices on the health system.

## **Methods**

In this thesis, national patient-level datasets and mixed quantitative and qualitative research methods were used to investigate the role of choice and competition policies on the delivery of specialist cancer services, using prostate cancer as a case study. This included an assessment of both the extent and drivers of patient mobility for curative prostate cancer treatment as well as the wider system impact of patient mobility and hospital competition on service capacity, service configuration, technology adoption and patient outcomes. Semi-structured interviews were undertaken with men previously treated for prostate cancer to provide further insight into the factors that inform and influence provider choice.

## **Results**

Patient mobility for cancer treatment far exceeds the 5-10% considered necessary to stimulate improvements in quality. One in three men and one in five men bypassed their nearest centres for prostate cancer surgery and radiotherapy respectively. Travel time was the dominant factor influencing location of care, but its impact was less strong for younger and more affluent socioeconomic groups. Men were attracted to centres offering innovative technologies and

practices of care as well as centres that employed clinicians with a national reputation for prostate cancer. This has resulted in shifts in market share for individual cancer centres resulting in a net gain of patients for some centres - “winners” - and a net loss of patients for others - “losers”. Surgical centres classified as “losers” had a greater likelihood of closing their service. Competition between hospitals has contributed to the rapid adoption of costly technology for prostate cancer surgery. However, there is limited evidence to suggest that hospital competition improves patient outcomes.

### **Conclusions**

The thesis demonstrates unequivocally that patient mobility and hospital competition is occurring within the NHS. Choice and competition policies rather than a coordinated policy towards centralisation have been the most significant drivers in the reconfiguration of prostate cancer surgical services in the NHS. Indicators, which accurately reflect the quality of cancer treatment delivered, are needed to guide patients’ decision-making. In their absence, patient mobility may negatively affect the efficiency and capacity of a regional or national cancer service without improvements in patient outcome, and widen socioeconomic inequalities in access to care.

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## List of Abbreviations

ENT – Ear, Nose and Throat

GP – General Practitioner

GIS – Geographic Information Systems

HES – Hospital Episode Statistics

HHI - Herfindahl-Hirschman Index

HRG – Healthcare Resource Groups

HTA – Health Technology Assessment

IMD – Index of Multiple Deprivation

IMRT – Intensity Modulated Radiotherapy

LSOA – Lower Layer Super Output Area

LSHTM – London School of Hygiene and Tropical Medicine

NCRAS – National Cancer Registration and Analysis Service

NHS – National Health Service

OPCS 4 - UK Office for Population Census and Surveys Classification of Interventions and

Procedures – 4<sup>th</sup> revision

PbR – Payment by Results

PROMs – Patient Reported Outcome Measures

RCS – Royal College of Surgeons

RP – Radical Prostatectomy

RT – Radiotherapy

RTDS – Radiotherapy Dataset

SCI – Spatial Competition Index

SMDT – Specialist Multidisciplinary Team

UK – United Kingdom

US – United States of America

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# 1. INTRODUCTION

## 1.1 Choice and Competition in the NHS in England

In 2002, the then Labour government embarked on a large scale reform of the health system, marking a shift away from targets and transparent public reporting of outcomes, towards the introduction of market-related mechanisms to drive improvements in the quality of NHS services (Secretary of State for Health 2002). This was accompanied by sustained annual increases in NHS funding (Bevan, 2010). Patient empowerment and choice were the core components of “Choice and Competition” policy, with a desire to encourage greater patient consumerism and mobility between providers (Department of Health, 2005).

In 2003, the government started to encourage a diverse range of providers (public and private) to deliver clinical services in order to increase capacity to meet excess demand and drive down waiting lists (Department of Health, 2005). A new reimbursement mechanism was also introduced - “Payment by Results” (“PbR”) - whereby providers were to be paid according to nationally agreed tariffs for hospital services (Department of Health, 2002; Jones & Mays, 2009). Healthcare Resource Groups (HRGs) supported PbR by providing a classification framework of relevant hospital activities representing current practice. With tariffs for services essentially fixed, providers were therefore encouraged to compete for “market share” on measures of quality rather than price and receive financial rewards accordingly as money followed the patients (Le Grand, 2009).

Pilot provider choice schemes were introduced from 2002, including choice for cardiac patients (Le Maistre *et al*, 2003), choice for patients waiting for elective surgery in London (Burge *et al*, 2005; Dawson *et al*, 2004), and choice at the point of referral (Taylor *et al*, 2004). In January 2006, GPs across England were required to offer patients a choice of at



least four local healthcare providers at the point of referral for elective surgery (Department of Health, 2004).

By 2008, patients requiring routine elective treatment (including selected non-surgical treatments) had a “free choice” of any licenced NHS (acute or foundation trust) or independent sector provider which met the standards set by the CQC and were able to provide care at the national tariff rate (Department of Health, 2007b; Dixon *et al*, 2010b).

The NHS Choices website was introduced in 2007 to support patient choice, and provide information on providers and facilitate comparison (Department of Health, 2008). In addition to information sourced from the Care Quality Commission (CQC), the website presented service user ratings as well as intervention-specific quality ratings in the form of patient reported outcome measures and clinical outcome measures (e.g. hip revision rate, emergency readmission rate, and mortality rates) (Department of Health, 2008; Greaves *et al*, 2012; Timmins, 2008). The types of performance indicators reported continue to evolve and more recently include hospital staff recommendations. The Health and Social care Information Centre ([www.hscic.gov.uk](http://www.hscic.gov.uk)) and MyNHS (<https://www.nhs.uk/Service-Search/performance/search>) websites also provide comparative data on providers.

In 2017, the NHS remains committed to choice and competition policy, encouraging health care users to select providers that best meet their health care needs (Department of Health, 2016). At the same time, the NHS continues to embark on a program of regionalisation and centralisation of specialist health care services including cancer care (Independent Cancer Taskforce, 2015).

This mixed policy approach which includes both “top down” coordination of services and competition has evolved in response to the nature of the relationship between the state, the

medical profession and the public, which had historically shaped the NHS (Jones & Mays, 2009). The challenge is for these individual policy instruments to be appropriately balanced (Stevens, 2004). However empirical evidence is lacking to understand how such co-existing policies may interact or what incentives are necessary to balance them (Baicker & Levy 2013). The current evidence suggests that providers and commissioners are preferring to choose coordination or cooperation rather than competition as a means of effecting major service reconfigurations (Allen *et al*, 2017).

The next section appraises the literature relating to the impact of choice and competition policies in the NHS, and provides the context for this thesis, which intends to focus on the role and impact of these policies on the delivery of NHS prostate cancer services.

## **1.2 Impact of Choice and Competition policy in the NHS**

### *1.2.1 Awareness and Implementation*

The 2009 Kings Fund Patient Choice survey of 2,181 patients, who had been referred for a hospital outpatient appointment in the previous 2 weeks, provides the main evidence with respect to the awareness and implementation of choice policies (Dixon *et al*, 2010a). It highlighted two main issues. First, the lack of awareness amongst patients that they had a choice of provider for routine elective treatment (only 45% of those surveyed were aware prior to visiting their GP that they had a choice). Second, there appeared to be variation in the implementation of choice of provider at the point of referral (only half of all patients recall being offered a choice) (Dixon *et al*, 2010a), which has likely resulted from a failure to engage with GPs in the choice process. GPs had initially experienced technical difficulties with the “choose and book” electronic system, which had been implemented to facilitate specialist hospital referrals. In addition, many GPs did not “buy-in” to the patient choice agenda and its

expected benefits (Dixon *et al*, 2010a; Rosen *et al*, 2007; Sanderson *et al*, 2013). Others reported difficulty in advising on providers outside their local area, instead relying on their own knowledge of local providers (Sanderson *et al*, 2013).

### 1.2.2 *Information sources*

It was expected that individuals would use comparative performance data in order to make informed choices about their health care provider. However current evidence suggests that patients rarely search for health quality information, don't trust it, or don't use it in a rational way to make choices (Fung *et al*, 2008; Marshall & McLoughlin, 2010). The Kings Fund survey found that only 4% of patients used the NHS Choices website when making decisions about treatment provider, with the majority of patients reliant on advice from their friends and family network, prior experience, and GP (Dixon *et al*, 2010a).

### 1.2.3 *Patient choice*

In order for choice policies to stimulate improvements in provider quality, it is expected that some patients will select a provider based on quality and be prepared to move beyond their expected provider (usually the nearest) to other providers for a particular service. In theory it is anticipated that even movement of between 5-10% of users will provide the necessary incentives to improve quality (Le Grand, 2009). However, a major critique is that there is still limited evidence that such policies have affected where patients ultimately receive treatment. (Pollock *et al*, 2012).

The London Patient Choice Pilot (LPCP) evaluation based on 19,976 actual visits for selected ophthalmic, orthopaedic, ENT (Ear Nose and Throat), urology and general surgery procedures demonstrated that 65.5% of patients travelled beyond their local providers in order to receive

quicker treatment (Dawson *et al*, 2004). However this was in a controlled environment where transport was free for patients choosing alternative providers and patients had already been waiting longer than 6 months for procedures at their local hospital (Burge *et al*, 2005). In the Kings Fund patient choice study, 31% of individuals surveyed went to a non-local provider for the last secondary care episode (Dixon *et al*, 2010a).

Using Hospital Episode Statistics data, Kelly and Tetlow demonstrated that the percentage of patients receiving elective surgery at their nearest Trust fell year on year from 2003/2004 to 2010/11. In 2003/2004, 68% of hip replacements and 77% of hernia operations were performed at the patient's nearest Trust (Kelly & Tetlow, 2012). By 2010/11, this had fallen to 54% and 61% respectively. However, a notable caveat is that the study did not take into account whether the nearest Trust performed the specific intervention in question.

Whilst there is some evidence that patients in the NHS are prepared to move to alternative centres for secondary care treatment, it is inconsistent and does not include cancer care.

#### 1.2.4 Equity

There is a concern that patient choice may exacerbate socioeconomic inequalities in access to services and the quality of care received (Dixon & Le Grand, 2006; Fotaki, 2010). However, the results to date from studies using data on actual patient visits in the NHS have been equivocal. The London Patient Choice Pilot, demonstrated that patient's age was positively associated with staying at the local hospital to which they were originally referred and that men are more likely than women to move to alternative hospitals (Dawson *et al*, 2004). This is in keeping with another study that found that elderly and more income-deprived patients are more likely to choose their nearest hospital for elective hip surgery (Beckert *et al*, 2012). However, a study focusing on socioeconomic differences in the choice of centre for coronary

artery bypass grafting found that income was a poor predictor of responsiveness to choice policies, and that sicker patients were more responsive to differences in quality (Gaynor *et al*, 2016).

#### 1.2.5 *Efficiency*

At the time of introducing choice and competition policies, the government attempted to encourage a diverse range of providers (public and private) to deliver clinical services in order to increase the capacity of the system to ensure sufficient choice was available to meet excess demand (Department of Health, 2005). However, there was a concern that creating spare capacity would result in inefficiencies if the increased costs of doing so were not off-set by quality and efficiency gains elsewhere (e.g. increased productivity) (Jones & Mays, 2009). However, to date there has been no evidence to suggest that such system-level inefficiencies have occurred (Farrar *et al*, 2009; Fotaki, 2014).

In addition, studies have demonstrated a reduction in elective waiting lists and average length of stay following the introduction of Choice and Competition policy (Cooper *et al*, 2011; Cooper *et al*, 2009; Dawson *et al*, 2007; Gaynor *et al*, 2013; Moscelli *et al*, 2017; Siciliani & Martin, 2007). However, it is thought that these improvements have instead resulted from increased NHS investment on staffing capacity, as well as other target-driven performance management policies introduced during this time rather than market based reforms (Bojke *et al*, 2014; Brereton & Vasoodaven, 2010; Fotaki, 2014).

#### 1.2.6 *Quality*

The impact of hospital competition on the quality of services in the English NHS remains unclear (Fotaki, 2014; Oliver, 2012). Three large econometric analyses reviewing the impact

of post 2006 NHS choice policy reforms on quality, reported that hospitals located in the most competitive market areas, i.e. where patients have high levels of provider choice, had superior clinical quality (in terms of mortality from acute myocardial infarction (AMI)) compared to hospitals facing less competition (Bloom *et al*, 2015; Cooper *et al*, 2011; Gaynor *et al*, 2013).

In the study by Cooper *et al*, the lower 30-day acute myocardial infarction mortality rates were attributed to wider improvements in hospital performance which had been stimulated by the need to compete for elective surgical patients (e.g. cataract surgery) (Cooper *et al*. 2011). A later study by Bloom *et al*, attempted to demonstrate that the observed improvements in clinical quality in hospitals located in the most competitive market areas are due to better management practices, which has likely influenced care across medical and surgical specialities (Bloom *et al*, 2015).

However, these econometric studies have received a lengthy critique. First, they fail to acknowledge that mortality rates across all hospitals were falling during this time-period and that differences in mortality could be attributed to the slowing down of mortality declines in less competitive markets rather than improving performance in more competitive areas (Mays, 2011). Second, there is no explanation as to how competition in the elective surgery market would affect outcomes for acute myocardial infarction (Pollock *et al*, 2012). Third, the studies do not attempt to explicitly link the effect of patient choice and competition between providers for a particular elective procedure (e.g. hip or knee replacement) on individual patient outcomes. (Bevan & Skellern, 2011). Lastly, the study findings are at odds with two previous studies analysing the impact of the 1990s internal market which demonstrated reductions in clinical quality in the most competitive markets (Propper *et al*, 2008; Propper *et al*, 2004).

A more recent NHS study focusing on the relationship between hospital market competition for elective hip replacement surgery and improvements in outcome (measured using the

Oxford Hip Score - a patient reported outcome measure) found that hospital competition had no significant influence on patient outcomes (Feng *et al*, 2015). Conversely, another NHS study found that hospital competition was correlated with a reduction in 30-day mortality after a cardiac valve replacement (Diller *et al*, 2014).

When considered together these studies demonstrate that there is considerable uncertainty regarding the role of hospital competition in stimulating improvements in health care quality. In addition, there has been little or no published data investigating what the impact of patient mobility has been on individual providers; for example, the effect on capacity and practices of care if patients are indeed choosing a hospital other than their nearest. The NHS is effectively a closed box system and assuming the number of patients requiring treatment for any one condition remains stable or increases, the mobility of patients is likely to have an effect on the efficient utilisation of available capacity of individual providers and their subsequent funding (given that this follows the patient). Equally, centres may have to respond in some way to prevent local patients from leaving, or to attract new patients for a particular intervention, but the current NHS literature does not provide any evidence as to how this may occur.

### **1.3 Choice and Competition policy and NHS cancer care services.**

Within cancer care, inequalities in service provision, access and survival have persisted across England and Wales over the last two decades (Berglund *et al*, 2012; Bungay, 2005; Department of Health, 2013; Haward, 2006; Hoskin *et al*, 2013; Jack *et al*, 2003; Palser *et al*, 2009; Rachet *et al*, 2010; Royal College of Surgeons of England, 2014; Williams & Drinkwater, 2009). By allowing patients to select a provider that best meets their needs and by encouraging providers to compete in order to stimulate improvements in quality, it could be argued that choice policies have the potential to minimise these inequalities.

However, to date there has been no research investigating their impact within cancer services. There are also several reasons to question whether choice policies are relevant to cancer patients and whether such policies are able to drive meaningful improvements in quality. Some of the potential issues are outlined below, many of which are also likely to be relevant to other specialist disease areas.

### *1.3.1 Centralisation versus a competitive environment*

There is robust evidence that higher case volume and greater experience in managing cancers both at the provider and individual physician level is associated with improved survival outcomes (Birkmeyer *et al*, 2002; Halm *et al*, 2002; Wouters *et al*, 2009). For prostate cancer, the incidence of post-operative complications, positive surgical margins and late urinary complications are reduced when performed by “high volume” surgeons in “high volume” centres (Van Poppel & Joniau, 2008; Vickers *et al*, 2009). As a result, NHS Trusts have been undergoing reconfiguration of their cancer services since the early 2000s with greater centralisation of surgical services (National Institute for Health and Care Excellence, 2002; NHS England, 2014).

However, such organisational changes limit the potential for patient choice and competition between providers and plans for further reconfiguration of cancer services are continuing. In 2015, the NHS independent cancer task force recommended the creation of “Cancer Alliances” across England to implement its vision for improving the quality of cancer care services across the cancer care continuum (from prevention to survivorship) (Independent Cancer Taskforce, 2015). Alliances are expected to coordinate the efforts of a wide stakeholder set (including Clinical Commissioning Groups (CCGs), patients, and providers) to strengthen regional commissioning of cancer services and achieve effective implementation of its strategic goals at the local level through the 44 newly developed national Sustainability



and Transformation plans (“footprints”) (NHS England, 2016 ). At its core is the expectation that services should meet the needs of the local population, and tie in with existing health service infrastructure and referral patterns within pre-determined geographical boundaries. It remains unknown how such changes could act to mitigate the effect of patient choice and hospital competition.

### *1.3.2 Time-frame for choice*

Many common cancers are time sensitive, requiring the prompt initiation of treatment. This therefore limits the potential for making informed decisions about treatment providers through a review of available performance indicators. In addition, patients may have to choose between different treatment options even prior to considering where they receive their care, which for many may be too much of an additional burden given the difficulties encountered in selecting between cancer treatments (Clark *et al*, 2003; Clark *et al*, 2001; Davison & Goldenberg, 2003).

Some patients may consider moving to alternative providers to receive quicker treatment. However for cancer care, extensive efforts have been made to ensure prompt diagnosis and treatment of suspected cancers through a system of defined targets, (Department of Health, 2000; Department of Health, 2007a; NHS England, 2015) thus reducing this as a driver to move.

There are also significant time and financial constraints that a decision to move can have on an individual seeking treatment. Treatment options are complex and may last for many months when considering chemotherapy or radiotherapy, thus limiting the opportunity to receive treatment out of area if so desired. For example, radiotherapy for prostate cancer or lung cancer can entail between 6-8 weeks of daily treatment.

### 1.3.3 Comparative health information in cancer care

It is expected that patients are able to select the provider that best meets their needs through a comparative review of available options. The NHS Choices website was therefore developed to provide this information. However, in cancer care there is lack of clarity as to the optimum indicators for measuring performance at the provider and individual physician level given the multidisciplinary nature of cancer treatment (Burns *et al*, 2016).

Outcomes from individual surgeons are now starting to be published for bowel and oesophago-gastric cancer (with other cancers to follow) (Royal College of Surgeons of England, 2016a; Royal College of Surgeons of England, 2016b). However, there is no consensus as to how best to measure performance of other surgical procedures such as a radical prostatectomy or cancer treatments such as radiotherapy.

In the absence of clear comparative health information on cancer care providers, it is unclear from the literature what information patients use to make decisions regarding their location of cancer treatment. A concern is that patients will be reliant on informal sources of information (e.g. word of mouth) when making decisions regarding their provider (Victoor *et al*, 2012), which may result in choices that do not ultimately improve their health outcomes.

## **1.4 Rationale for investigating impact of choice policies in prostate cancer**

Given the heterogeneous nature of cancers in terms of their clinical presentation, method of diagnosis, treatment options and prognosis it is necessary to study the impact of provider choice policies within a single cancer site. For the purpose of this research, I have selected prostate cancer.

Prostate cancer is the most common malignancy in men, with approximately 40,000 new cases diagnosed annually in the United Kingdom (34,000 with non-metastatic disease) (Royal College of Surgeons of England, 2016c). Compared to other common cancers such as breast, bowel and lung, the biology of the disease is such that in the non-metastatic setting, outcomes are not necessarily influenced by treatment delay. Due consideration can be made for the preferred strategy, more so than other malignancies where: (1) the optimal evidence based management strategy is often already clearly defined; (2) patients may present acutely with complications associated with localised/locally advanced disease requiring emergency intervention.

There is also evidence of regional variation in availability of prostate cancer services across England. Currently, men with non-metastatic prostate cancer are managed within specialist multidisciplinary teams (composed of one or more hospital) which usually provide all essential treatments. The National Prostate Cancer Audit (NPCA) has highlighted national variation in the treatments offered by specialist multidisciplinary teams (SMDTs) and therefore provider choice may facilitate access to cancer treatments that are not available locally (Aggarwal *et al*, 2016).

Even for providers offering the same modality of treatment e.g. radical prostatectomy (RP) or external beam radiotherapy (EBRT) there is variation in the technology or technique used. For instance, radical prostatectomy may be performed as an open, laparoscopic or robot-assisted procedure (Ficarra *et al*, 2009). Likewise, external beam radiotherapy for prostate cancer, may be delivered with 3D conformal techniques, intensity modulated radiotherapy (IMRT), stereotactic beam radiotherapy (SBRT) or using proton beam therapy (only available outside of the UK currently) (Sheets *et al*, 2012; Tree *et al*, 2014). Patients may therefore choose to move to another hospital either because the perceived quality of that hospital is thought to be

better or because they prefer to be treated using a particular technique that is not available locally.

Finally, as with other cancer and non-cancer specialist sites, policies in the NHS continue to promote the reconfiguration of prostate cancer surgical services with a view to creating higher-volume surgical units (NHS England, 2014). Both choice and competition as well as centralisation attempt to achieve gains in patient outcome, however they require different health system configurations and provider incentives. Finding the right balance between the two is therefore key (given that centralisation may negatively affect choice and competition) but there is currently limited evidence to guide how best to achieve this.

## 2. RESEARCH DESIGN OVERVIEW

### 2.1 Aims and Objectives

The PhD aims to evaluate the impact of NHS choice and competition on prostate cancer services using a mixed methods research design. There are five main research objectives.

1. To evaluate the empirical evidence for patient mobility in elective secondary care services in countries that have introduced patient choice policies.
2. To determine to what extent men diagnosed with prostate cancer in the NHS travel beyond their nearest treatment provider for curative treatment, and the patient and hospital characteristics associated with this mobility.
3. To assess the impact of patient mobility on individual providers with respect to their net gains and losses of patients.
4. To investigate the impact of hospital competition on patient outcomes for men receiving treatment for prostate cancer.
5. To understand what factors inform and influence where patients choose to receive prostate cancer treatment.

The outputs of this research are expected to provide a greater understanding of how NHS cancer patients are responding to provider choice policies and what implications this may have on the future organisation and delivery of cancer services and mechanisms for supporting patient choice and quality improvement.

## 2.2 Empirical approach to investigating patient choice

Previous studies have attempted to identify the extent to which patients actively choose their health care provider and the factors that influence this (Victoor *et al*, 2012). However, these are largely based on data derived from interviews, and surveys, which ask individuals about recent health care episodes or hypothetical scenarios (Albada & Triemstra, 2009; Combier *et al*, 2004; Dixon *et al*, 2010a; Finlayson *et al*, 1999; Schwartz *et al*, 2005).

Patient registration data from actual hospital episodes (revealed preferences) have been used in other studies to assess whether patients are choosing (Gutacker *et al*, 2016; Haynes *et al*, 2003). However, in reality this is limited as it is not possible to ascertain whether the patterns of service utilisation represent an active choice by the patient alone or are a consequence of pre-defined referral pathways, physician preferences or issues with capacity at their local provider. Clinicians in particular play a key role in informing and facilitating the choice process and the decision to receive treatment at a particular provider.

Given the inherent difficulties associated with establishing active choice using data on revealed preferences, one can instead ask a different empirical question: namely, whether there is evidence that patients receive care at hospitals other than their nearest. This question is related to the concept of “**patient mobility**”.

Patients travelling beyond their nearest provider are considered to have moved which is used as a proxy for “choice”. This is based on the assumption that patients’ act to minimize their travel times and would therefore be expected to receive treatment from their nearest provider (Burge *et al*, 2004; Victoor *et al*, 2012).

From a quantitative perspective, patient mobility is derived from knowing where a patient lives and where they move to for a health care intervention or service given the available choice of providers. This defined the empirical approach for the quantitative analyses.

In addition to the quantitative analyses, in-depth qualitative interviews were planned with men previously treated for prostate cancer in order to gain a more nuanced and in-depth understanding of the nature of the choices patient are expected to make. In particular, to what extent and in what way patients want to be given these choices as well as the factors informing and influencing their decisions regarding treatment location.

### **2.3 Study Design**

This section provides an overview of the research design and data sources I used in the thesis. Each study component described below was designed to address a specific research objective. The results of these analyses have been presented in the form of six empirical research papers. Four have been published in the peer reviewed literature and two are currently under review.

The **first component** of the research was a systematic review of the published international literature to assess whether there is any empirical evidence of patient mobility for elective secondary care services in response to provider choice policies. The systematic review was also intended to inform the quantitative component of the study, both in terms of the optimum methodology to use to assess the determinants of patient choice and to guide which hospital characteristics to consider within the multivariate regression analyses. The output of this component of the research produced a published research paper which is presented in the results section:

**“Patient mobility for elective secondary healthcare services in response to patient choice policies: a systematic review”**

*See Chapter 3, Pages 32-58*

The **second component** of my research study was a quantitative analysis of patient mobility and its determinants using data on actual patient visits for curative prostate cancer treatment in the English NHS. Patients receiving radical prostate cancer surgery and radical radiotherapy were considered as two separate populations given the variation in the duration and intensity of these two treatments and the availability of these services in the English NHS. Patients diagnosed with metastatic disease were excluded as treatment options are standardised, and the need for rapid institution of treatment precludes the ability to choose a treatment provider in most instances.

The systematic review was integral in defining the optimum methods to use within this component of the study. For the first part of the analysis I used a hospital bypassing model (Varkevisser & Van Der Geest, 2007) to estimate the proportion of men with prostate cancer who travelled beyond their nearest provider for a particular treatment. The second part of the analysis involved using conditional logit regression, a statistical method widely used in the econometric choice literature, to analyse the determinants of patient choices by modelling the odds that a patient moved to a particular hospital as a function of travel time and hospital and patient characteristics (Beukers *et al*, 2014; McFadden, 1973). The outputs of the research produced two published empirical research papers relating to prostate cancer surgery and prostate cancer radiotherapy, which are presented in the results section:

**“Determinants of patient mobility for prostate cancer surgery: a population-based study of choice and competition”**

*See Chapter 4, Pages 59-73*



**“Hospital quality factors influencing the mobility of patients for radical prostate cancer radiation therapy: a national population based study”**

*See Chapter 5, Pages 74-86*

The **third component** of the research study was designed to address the impact of patterns of patient mobility on individual providers, specifically their net gains and losses of patients. This component of the study was undertaken in light of the results from the previous analyses (Chapters 4 and 5), which had demonstrated that large numbers of patients travelled beyond their nearest provider for surgery and radiotherapy in the English NHS. These gains and losses were analysed in the context of the intensity of spatial competition faced by individual treatment centres. This analysis was integral to our understanding of the impact of these policies on NHS providers given that money follows the patient and therefore decreases in patient numbers could affect the viability of the centre.

The analysis focusing on the impact of patient mobility on individual radical radiotherapy treatment providers, was included as part of the earlier analyses reviewing patient mobility patterns for prostate cancer radiotherapy in Chapter 5 **“Hospital quality factors influencing the mobility of patients for radical prostate cancer radiation therapy: a national population based study”**.

With respect to prostate cancer surgery, it was noted during the time-period of the analysis (2010-2014), detailed in Chapter 4 **“Determinants of patient mobility for prostate cancer surgery: a population-based study of choice and competition”**, that some centres closed their radical prostatectomy service. At the same time, there was an increase in the numbers of centres performing robot-assisted procedures. The subsequent analysis in Chapter 6 therefore investigated whether there was an association between the net gains and losses of patients by individual providers and the intensity of hospital competition, on both the observed closures

of centres and the adoption of robotic surgical equipment. The output of this component of the research was published as a separate empirical research paper:

**“Effect of patient choice and hospital competition on service configuration and technology adoption within cancer surgery: a national population based study”**

*See Chapter 6, Pages 87-98*

The **fourth component** of the study analysed the impact of hospital competition on patient outcomes following prostate cancer surgery using multilevel regression modelling. The creation of a competitive environment to support patient choice and to provide incentives for hospitals to compete with each other is in conflict with policies that seek to centralise services into fewer centres. Centralisation aims to improve quality by eradicating very low volume surgery and to increase the number of procedures performed by remaining centres. To assess the effects of these two policies, the analysis in this chapter compares the relative impact of both hospital procedure volume and hospital competition on patient outcomes following a radical prostatectomy whilst adjusting for relevant case-mix criteria. The results of the analysis have been presented as a research paper, which has been submitted for publication:

**Impact of hospital volume and hospital competition on patient outcomes following prostate cancer surgery: a national population-based study**

*See Chapter 7, Pages 99-128*

The **fifth component** of the study utilised qualitative research methods to understand what factors inform and influence where patients choose to receive prostate cancer treatment. This involved interviews with men previously treated for prostate cancer. Men were recruited through a UK wide prostate cancer support organisation called “Tackle prostate cancer” which is composed of 55 member groups. Semi-structured interviews were undertaken with twenty-

five men and the results of the analysis have been presented as a research paper, which has been submitted for publication:

**“Hospital choice in the context of a cancer diagnosis: a qualitative study”**

*See chapter 8, Pages 129-161*

The quantitative and qualitative components of the research were intended to be complimentary as part of a mixed methods approach to understanding how patient choice was operating within the NHS. Both sets of analyses were undertaken during the same time-period and continually evolved as part of an iterative process. For instance, factors identified within the qualitative component that have influenced choice of prostate cancer provider were assessed within the empirical model using data on actual patient visits. Likewise, the findings of the quantitative component influenced the sampling framework and the topic guide for the semi-structured interviews.

During the course of the study it was also decided to interview prostate cancer specialists (Urologists, Oncologists) working in England to help triangulate and contextualise the findings from the qualitative and quantitative studies. In total, I spoke to twenty specialists across England. The findings provided further depth to the interpretation and policy implications of my empirical findings, but have not been reported as a specific chapter in the thesis.

## **2.4 Data Sources**

Data for the quantitative component of the study was made available through the National Cancer Registration Service in England (NCRS), which provided a linked patient level extract incorporating three data sources – Cancer Registry, Hospital Episode Statistics (HES), and

The National Radiotherapy Dataset (RTDS). At the start of the PhD, linked data was available for men treated between 2010-2014 inclusive.

I had access to the data through my affiliation with the National Prostate Cancer Audit (NPCA) based at the Clinical Effectiveness Unit of the Royal College of Surgeons. The PhD research project was designed and developed by me prior to receiving funding from the National Institute for Health Research. The PhD project fits within the wider service evaluation projects that the NPCA undertakes to provide a better understanding of the determinants of variations in processes and outcomes of prostate cancer care.

Other data sources available through the NPCA include:

1. **NPCA Organisational survey** – a comprehensive review of the configuration of prostate cancer services in England also detailing the availability of essential diagnostics, staging and therapeutic facilities (e.g. robotic surgery)(Royal College of Surgeons of England, 2014).
2. **Performance indicators** – these were developed as part of the NPCA using Hospital Episode Statistics and include length of stay, 30-day emergency re-admission rates and incidence of urinary complications within 2 years of surgery. Data was available for men who underwent a radical prostatectomy between 2008-2011 (Royal College of Surgeons of England, 2016c).

## 2.5 Ethics

### 2.5.1 *Quantitative Component*

Anonymised non-identifiable secondary level patient data from the National Cancer Registration Service (NCRS) was used to undertake the quantitative analysis. The personal details only included age, ethnicity and lower layer super output areas (LSOAs) and no further identifiers. Regulatory approval, data security and governance procedures had already been established as part of the NPCA through which the data was available. Given that the PhD involved the use of anonymised secondary data, NHS REC approval was not sought in accordance with their guidelines. I received approval from the NPCA data controller, The Health Quality Improvement Partnership (HQIP), to use data collected from the audit for the purposes of my research.

### 2.5.2 *Qualitative component*

This study involved in-depth interviews with human subjects regarding personal and potentially sensitive issues related to their health, health care or in the case of health care professionals their place of work. It was therefore essential that the research methodology employed ensured the privacy, confidentiality and respect of all participants.

Participants were not recruited from the NHS and no component of the research took place on NHS premises, therefore NHS ethics was not required. Approval from the LSHTM Observational/Interventions Research Ethics Committee was therefore sought on 29<sup>th</sup> April 2015. Approval was granted on the 11<sup>th</sup> June 2015. **See Appendix A (page 204) for a copy of the ethics approval.**

## 3. RESULTS CHAPTER 1

### 3.1 Systematic Review

The **first component** of the research was a systematic review of the published literature to assess whether there is any empirical evidence of patient mobility for elective secondary care services in response to patient choice policies. The results have been presented in the form of the published article.

### 3.2 Research paper 1

**Patient mobility for elective secondary healthcare services in response to patient choice policies: a systematic review**

The online PDF can be accessed at:

**[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5502904/pdf/10.1177\\_1077558716654631.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5502904/pdf/10.1177_1077558716654631.pdf)**

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## RESEARCH PAPER COVER SHEET

**PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.**

### SECTION A – Student Details

Student	Ajay Aggarwal
Principal Supervisor	Jan van der Meulen
Thesis Title	Evidence and impact of NHS choice and competition policies on the delivery of prostate cancer services: a national population based evaluation

**If the Research Paper has previously been published please complete Section B, if not please move to Section C**

### SECTION B – Paper already published

Where was the work published?	Medical Care Research and Review		
When was the work published?	June 2016		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
Have you retained the copyright for the work?*	YES	Was the work subject to academic peer review?	YES

*\*If yes, please attach evidence of retention. If no, or if the work is being included in its published format, please attach evidence of permission from the copyright holder (publisher or other author) to include this work.*

### SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	
Please list the paper's authors in the intended authorship order:	
Stage of publication	

### SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I designed the study, carried out the review and analysis, and wrote the first draft of the manuscript
--	--

Student Signature: \_\_\_\_\_


Date: 22.09.17

Supervisor Signature: \_\_\_\_\_

Date: 22 Sept 2017

# Patient Mobility for Elective Secondary Health Care Services in Response to Patient Choice Policies: A Systematic Review

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Richard Sullivan<sup>3</sup>, and Jan van der Meulen<sup>1</sup>

## Abstract

Our review establishes the empirical evidence for patient mobility for elective secondary care services in countries that allow patients to choose their health care provider. PubMed and Embase were searched for relevant articles between 1990 and 2015. Of 5,994 titles/abstracts reviewed, 26 studies were included. The studies used three main methodological models to establish mobility. Variation in the extent of patient mobility was observed across the studies. Mobility was positively associated with lower waiting times, indicators of better service quality, and access to advanced technology. It was negatively associated with advanced age or lower socioeconomic backgrounds. From a policy perspective we demonstrate that a significant proportion of patients are prepared to travel beyond their nearest provider for elective services. As a consequence, some providers are likely to be “winners” and others “losers,” which could result in overall decreased provider capacity or inefficient utilization of existing services. Equity also remains a key concern.

## Keywords

patient choice, provider competition, patient mobility, hospital bypassing

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## **Introduction**

A number of high-income countries have introduced policies that enable patients to select a health care provider of their choice with the aim of increasing service capacity, enhancing efficiency, and improving the quality of health care delivered (Dixon, Robertson, & Bal, 2010; France & Taroni, 2005; Magnussen, Vrangbæk, & Saltman, 2009). It is expected that by publicly reporting information on the quality of providers' services, patients will select a provider that best meets their needs. From the provider perspective, it is anticipated that this "competition in the market" offers a stimulus to become more responsive and patient-centered, thus improving performance (Berwick, James, & Coye, 2003).

Given the costs associated with reconfiguring the health care system to support patient choice and to encourage competition between providers, it is essential to understand how patients have responded to the introduction of these policies. A key question is therefore whether "patient choice" policies have encouraged patients to actively choose their provider (Dusheiko, 2014).

Studies attempting to answer this question have predominantly used data derived from surveys, asking individuals about recent health care episodes or their responses to hypothetical scenarios (Dixon, Robertson, Appleby, Burge, & Devlin, 2010; Finlayson, Birkmeyer, Tosteson, & Nease, 1999; Schwartz, Woloshin, & Birkmeyer, 2005; Victoor, Delnoij, Friele, & Rademakers, 2012). Other studies have used actual patient data from hospital or primary care episodes (Haynes, Lovett, & Sunnenberg, 2003). However, the latter studies are limited as they can only ascertain where patients were being treated and not whether they made an active choice. Furthermore, it is not possible to determine to what extent these choices were influenced by primary care physicians.

Given the inherent challenges associated with establishing active choice, one can instead ask a different empirical question: namely, whether there is evidence that patients seek care at hospitals other than their nearest. This question is related to the concept of "patient mobility."

Even accounting for individual characteristics, the extent to which patients are able to move to alternative providers will depend on a number of circumstances, including area characteristics (e.g., urban vs. rural), the health care setting (e.g., primary vs. secondary care), the urgency of the clinical condition requiring medical support (e.g., emergency vs. elective), and the severity of the intervention (e.g., cataract surgery vs. coronary artery bypass grafting). Furthermore, the configuration of the health care market varies significantly between countries, with patient opportunity to choose dependent on organizational structures, systems of financing, and the geographical organization of specialist services.

Therefore, in this systematic review we aim to establish the evidence for patient mobility for elective services in the secondary care setting in countries that have introduced policies that enable patients to choose their health care provider. We also assess the methodological approaches used to describe patient mobility and analyze to what extent patient mobility is associated with patient, provider, and area characteristics.

## Method

### *Search Strategy*

A combined search was performed in Pubmed and Embase for articles published between January 1, 1990 and June 30, 2015 (Appendix A). Search terms were defined and modified iteratively following an initial broad search of the literature and a consultation with the authors of some retrieved studies.

### *Inclusion Criteria*

Published full text empirical studies that investigated patient mobility and its determinants using information on the patients' residence (e.g., zip code, county) and their actual secondary care episodes were considered for inclusion.

Two distinct types of study relating to patient mobility were identified from the preliminary analysis. The first type determines whether or not patients travel beyond their nearest secondary care provider(s) to receive care. The second type assesses the relative impact that distance on one hand and provider characteristics (e.g., quality) on the other hand have on patients' choice of provider. Both study types were considered for inclusion and we describe the different models within these types in our "Results" section.

Only studies investigating patient mobility in European, North American (Canada and the United States) and Australasian countries, (Australia and New Zealand only) were considered. Countries had to have introduced patient choice policies in which providers are expected to compete on the basis of quality, mainly through publicly reporting indicators of provider-level performance (<http://www.nhs.uk/pages/home.aspx>; <http://www.kiesbeter.nl/>; Swedish Association of Local Authorities and Regions, 2013; Vrangbæk, Robertson, Winblad, Van de Bovenkamp, & Dixon, 2012)

Study participants must have been enrolled in a voluntary, tax-based, or social health insurance scheme and received elective (or non-emergency) outpatient/inpatient services in a secondary care setting. Only studies published in English and in peer-reviewed journals were considered for inclusion.

### *Exclusion Criteria*

A key aspect of our study is to understand the patient and provider factors that influence where patients receive care. Therefore, we excluded studies that review patterns of mobility primarily reflecting insurer preferences for particular providers (e.g., through selective contracting and use of explicit financial incentives to channel patients to preferred providers; Boonen, Donkers, & Schut, 2011; Rosenthal, Li, & Milstein, 2009). For the same reason, we also excluded studies focusing on physician referral patterns because they primarily reflect physician preferences (Ringard, 2010).

Studies reviewing cross-border mobility were excluded. Also, studies reviewing patient mobility in the acute care setting (i.e., emergency hospital visits) were excluded

as decisions regarding location of secondary care are constrained by the patients' clinical condition and the necessity for urgent treatment.

Longitudinal studies that looked at the impact of the publication of performance indicators on hospital volumes or the effect of hospital competition on treatment outcomes, were excluded as they provide no explicit information on the impact of patient and provider characteristics on mobility or assessment of where patients are expected to receive their treatment based on their residence (Cooper, Gibbons, Jones, & McGuire, 2011; Cutler, Huckman, & Landrum, 2004; Lavery et al., 2012).

Articles that were published after 1990 but which used pre-1990 patient-level data were also excluded for the following reasons. First, introduction of provider choice policies did not occur before 1990 in most European countries. Second, reconfiguration of specialist services due to centralization after 1990 has influenced the choice of available providers. Third, there has been an increase in the quantity and quality of publicly available information to inform provider choice over the same period.

### *Data Selection*

AA and DL independently selected articles that met the inclusion criteria based on titles and abstracts. When there was uncertainty about whether an article fulfilled the inclusion criteria, it was included for full text review. In the next stage, full text articles were reviewed independently by AA and DL. Final inclusion was based on consensus. Disagreements were resolved following discussion with JvdM. Reference lists from included studies were hand-searched for additional potentially relevant articles.

### *Data Extraction*

AA independently extracted study data and consulted DL and JvdM in case of uncertainty. Data extracted included: location of study; geographical unit of analysis (regional vs. national); secondary care context (intervention/service[s] patients received), source of data (e.g., hospital discharge records); time-frame of analysis; study sample size and exclusion criteria; model for estimating patient mobility; definition of "expected" provider; construction of hospital "choice sets"; proportion of patients travelling beyond their expected provider(s); patient and provider characteristics analyzed; statistical analysis.

For "expected" provider(s) we refer to the nearest provider(s) offering the relevant intervention given the patient's clinical condition. For hospital "choice sets," we refer to the selection of hospitals that offer the relevant intervention as defined by the study authors. For example, this may include all hospitals within a threshold distance or region.

### *Study Assessment*

The studies selected are best described as cross-sectional studies. A review of published checklists and scoring scales for systematic reviews was undertaken to identify the appropriate tool to assess the selected studies (Higgins & Green, 2008; Sanderson,

Tatt, & Higgins, 2007); however, no suitable tool was found. A 10-item checklist was therefore created and validated (Appendix B) with reference to previously published relevant checklists for observational studies (Loney, Chambers, Bennett, Roberts, & Stratford, 1998; Munn, Moola, Riitano, & Lisy, 2014; Vandenbroucke et al., 2007).

One of the methodological challenges faced in using patient mobility as a proxy for patient choice is to separate the impact of patient choice from that of other factors. Patient mobility has been conceptualized as conforming to three distinct categories (Ringard, Rico, & Hagen, 2005; Tessier, Contandriopoulos, & Dionne, 1985). First, mobility due to patient choice; second, mobility due to primary care or secondary care referral preferences induced by physicians; and third, mobility due to insufficient local supply. In reality there are inherent difficulties in separating mobility due to patient choice and physician preferences given that these decisions are rarely mutually exclusive.

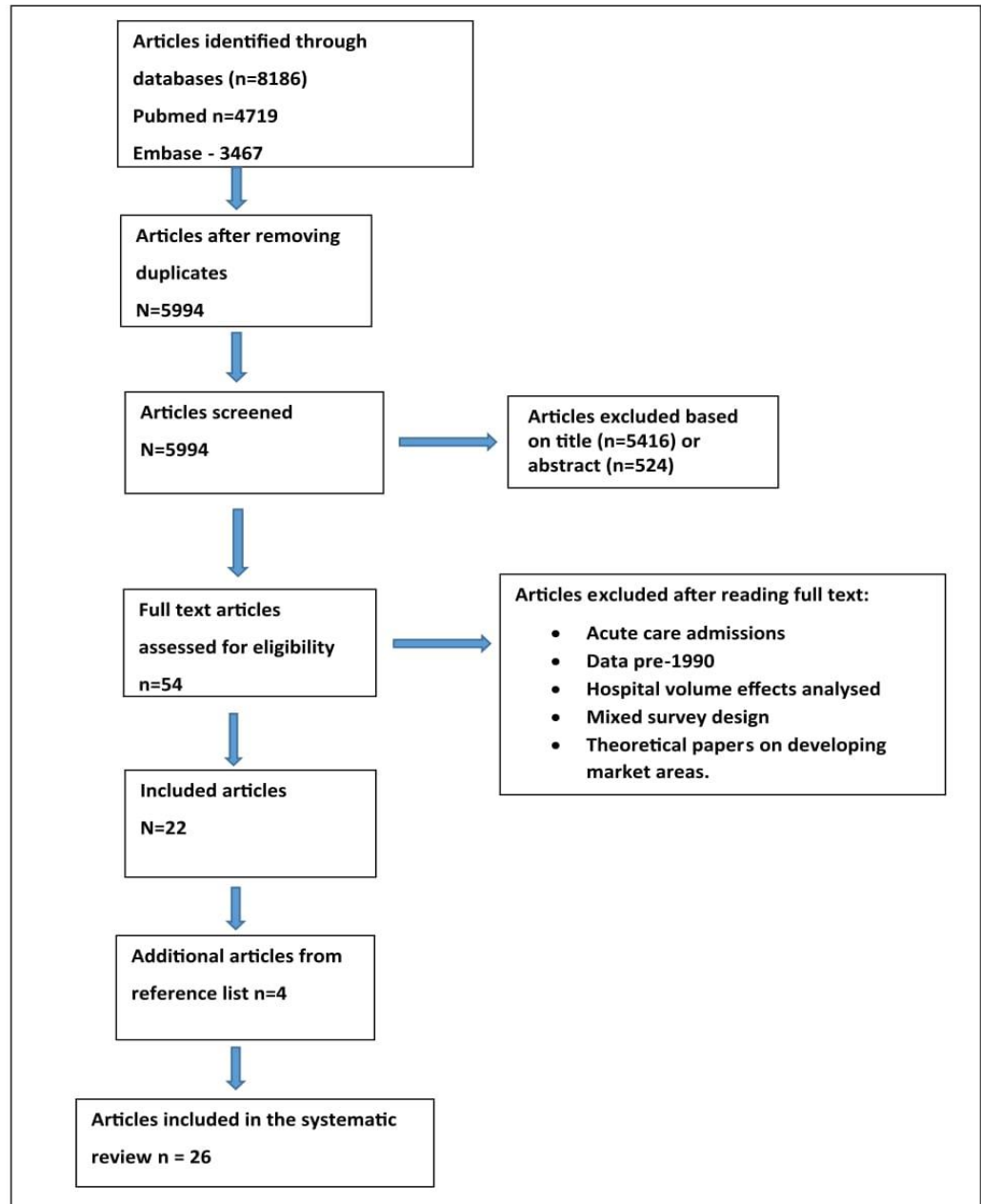
A key component of our checklist was therefore to assess whether the authors had accounted for, and adequately measured, relevant patient and health system factors that influenced patient mobility in order to identify “true movers.” “True movers” are considered to be individuals who travel beyond their nearest provider to an alternative provider without the biasing effect of health system factors (e.g., explicit financial incentives to choose particular providers). AA and DL independently assessed the selected articles according to each item on the checklist. Disagreements were resolved following discussion with JvdM.

## Results

A total of 5,994 titles and abstracts were assessed for eligibility of which 54 were selected for full text review (Figure 1). Twenty-two publications were included in the final analysis (Balía, Brau, & Marrocu, 2014; Basu, 2005; Beukers, Kemp, & Varkevisser, 2014; Chernew, Scanlon, & Hayward, 1998; Cook et al., 2009; Escarce & Kapur, 2009; Fabbri & Robone, 2010; Fattore, Petrarca, & Torbica, 2014; Hanning, Ahs, Winblad, & Lundstrom, 2012; Howard, 2006; Kronebusch, 2009; Losina et al., 2007; Messina, Forni, Collini, Quercioli, & Nante, 2013; Nostedt et al., 2014; Pope, 2009; Radcliff, Brasure, Moscovice, & Stensland, 2003; Roh, Lee, & Fottler, 2008; Roh & Moon, 2005; Saunders, Bellamy, Menachemi, Chukmaitov, & Brooks, 2009; Sivey, 2012; Varkevisser & van der Geest, 2007; Varkevisser, van der Geest, & Schut, 2010, 2012). The reference lists of selected articles were hand-searched and a further four articles (Beckert, Christensen, & Collyer, 2012; Ho, 2006; Moscone, Tosetti, & Vittadini, 2012; Roh & Moon, 2005) met the inclusion criteria. A total of 26 articles were included in the final analysis. All articles were retrospective cross-sectional studies using administrative data on actual patient visits.

### *Models to Assess Patient Mobility*

We found that the studies used three main methodological models to assess mobility. Two of the models fit within the first type of studies (determining whether or not



**Figure 1.** Flowchart of study selection.

patients travel beyond their nearest provider; see the “Method” section). We refer to these as the “hospital bypassing model” (estimating the proportion of patients traveling beyond their expected provider for a particular intervention/service) and as the

“regional model” (estimating the proportion of patients traveling outside a predefined geographical region based on their place of residence).

A third model fits within the second type of studies (assessing the relative impact of distance and provider characteristics on the choice of provider). In this article, this is referred to as the “patient choice model.”

Table 1 outlines the key characteristics of each study according to the three models that we used to assess mobility. The studies were conducted in six countries: United States—12 studies; Italy—5 studies; Netherlands—4 studies; England—3 studies; Sweden—1 study; and Canada—1 study. Of the five studies analyzing regional mobility, four were from Italy. Seven of the 10 studies using the hospital bypassing model were undertaken in the United States.

Coronary artery bypass grafting, percutaneous coronary intervention (Chernew et al., 1998; Moscone et al., 2012), cataract surgery, and joint replacement surgery (Beckert et al., 2012; Beukers et al., 2014; Losina et al., 2007) were the commonest elective interventions analyzed. Other studies looked at a mix of surgical and medical admissions or a variety of admission types related to a particular secondary care discipline (e.g., neurosurgical services, HIV services, cancer; Cook et al., 2009; Varkevisser & van der Geest, 2007).

### *Definition of “Expected Provider” and “Choice Set”*

A number of different definitions for the expected provider were used across the selected studies (Table 1). In the majority of studies using the hospital bypassing model this was the nearest provider. However, other definitions included all providers within a threshold distance or a specific area code (Escarce & Kapur, 2009; Saunders et al., 2009). The expected provider(s) in studies using the regional model were all hospitals within an administrative or governmental region.

The choice set was constrained in some of the studies using the patient choice model to providers within a defined regional area (Moscone et al., 2012; Pope, 2009). However, other definitions were evident. For example, in a Dutch study using the patient choice model for neurosurgical services, only hospitals within an hour of the patient’s residence were included in the choice set. The authors assumed that individuals traveling further were away from home when they needed health care (Varkevisser et al., 2010). Similarly in a U.K. study, the choice set only included the nearest 10 hospitals receiving more than 30 cataract referrals from the patients’ primary care physicians (Sivey, 2012).

### *Extent of Mobility*

All studies showed evidence of patient mobility in response to provider choice policies. For those studies using the hospital bypassing mode, rates ranged from 23% to 76% (Basu, 2005; Cook et al., 2009; Escarce & Kapur, 2009; Losina et al., 2007; Nostedt et al., 2014; Radcliff et al., 2003; Roh et al., 2008; Saunders et al., 2009; Varkevisser & van der Geest, 2007).

**Table 1. Descriptive Analysis of Selected Articles (n = 26) Stratified According to Methodological Model.**

Study and setting	Geographical unit	Time period analyzed	Secondary care discipline	Intervention	Number of patient hospital episodes	Definition of expected provider(s)	Definition of "choice set"	Percentage travelling beyond expected provider (s)	Determinants of mobility
<b>Hospital bypassing model</b>									
Nostedt (2014) Canada	One region	2004-2006	Surgery	Colorectal cancer surgery (Type NS)	2,086	8 nearest rural hospitals performing cancer surgery	Any hospital beyond eight nearest rural cancer surgery providers	(1) 46.5% bypass all rural cancer centers for rectal cancer surgery. (2) 28.8% bypass all rural cancer centers for colon cancer surgery	Provider characteristics— Provider reputation; Patient characteristics—Disease severity
Cook (2009) England	One region	January 2005- June 2006	Medicine	HIV (mixed services)	3,983	Nearest hospital offering HIV care	Any hospital beyond nearest provider offering HIV care	50%	Patient characteristics— Socioeconomic status, age
Escarce (2009) USA	One region	2000	(1) Surgery (2) Medicine (3) Obstetrics (4) Pediatrics	NA	224,990	All hospitals within threshold distance	Any hospital beyond threshold distance	76.30%	Accessibility—Distance; Provider characteristics—Hospital size, advanced technology; Patient characteristics—Health insurance plan
Saunders (2009) USA	One region	1997-2004	(1) Medicine (2) Surgery	(1) Colonoscopy, (2) Endoscopy	3,543,194	Hospitals within patient zip code providing endoscopy services	Any hospital or ambulatory care center beyond patient zip code offering endoscopy services	52.5% for Colonoscopy, 45.4% for Upper GI endoscopy	Accessibility—Distance; Patient characteristics—Health insurance plan, ethnicity
Roh (2008) USA	One region	2000-2003	Obstetrics and Gynecology	NA	10,384	Nearest rural hospital	Any hospital beyond nearest rural provider	36.30%	Accessibility—Distance; Provider characteristics—Degree of market competition; Patient Characteristics—Health insurance plan
Losina (2007) USA	National	2000	Surgery	Knee replacement	113,015	Nearest hospital plus any hospitals within 2 miles of that hospital	Any hospital beyond 2 miles of patient's nearest provider	42.70%	Provider characteristics—Provider quality; Patient characteristics—Ethnicity, socioeconomic status, urban residence

(continued)



**Table I. (continued)**

Study and setting	Geographical unit	Time period analyzed	Secondary care discipline	Intervention	Number of patient hospital episodes	Definition of expected provider(s)	Definition of "choice set"	Percentage travelling beyond expected provider (s)	Determinants of mobility
Varkevisser (2007) Netherlands	National	2003	Surgery	Neurosurgical/orthopedic outpatient visit	58,475	Nearest hospital providing neurosurgical or orthopedic services	Any hospital beyond nearest provider offering orthopedic or neurosurgical services	40% for orthopedic services. 50% for neurosurgical services	Accessibility—Travel time Provider characteristics—Waiting times, provider quality; Patient characteristics—Patient comorbidity, age, socioeconomic status, intervention type
Basu (2005) USA	Four regions	1997	(1) Surgery, (2) Medicine	(1) Hip/joint replacement, (2) Breast reconstruction post mastectomy, (3) Organ transplantation, (4) Bone marrow transplantation, (5) CABG, (6) PCI, (7) Pacemaker insertion	40,665	All hospitals within threshold distance	Any hospital beyond threshold distance	45%	Patient characteristics—Age, ethnicity, disease severity, health insurance plan, residence adjacent to metropolitan center
Roh (2005) USA	One region	1993-2000	Obstetrics	NA	19,618	Nearest rural hospital	Any hospital beyond nearest rural provider	NA	Provider characteristics—Advanced technology, Patient characteristics—Health insurance plan, disease severity, age, ethnicity
Raddliff (2003) USA	Seven regions	1991-1996	(1) Obstetrics, (2) Surgery	NA	1,473,755	1. Nearest rural hospital, 2. Any hospital within threshold distance 15 miles (Bypass 15)	1. Any hospital beyond nearest provider, 2. Any hospital beyond 15 miles of patient residence	Bypass 15 rate—23.3% obstetrics, 50.1% specialty surgery, 31% general surgery.	Patient Characteristics—Region of residence, disease type, health insurance plan
<b>Patient choice model</b> Beukers (2014) Netherlands	National	2008-2010	Surgery	Hip replacement	56,256	Nearest hospital providing orthopedic services	All 92 hospitals providing orthopedic services in Netherlands	NA	Accessibility—Travel time, Provider Characteristics—Waiting time, Provider quality, Patient characteristics—Gender, Age > 60 years



Table 1. (continued)

Study and setting	Geographical unit	Time period analyzed	Secondary care discipline	Intervention	Number of patient hospital episodes	Definition of expected provider(s)	Definition of "choice set"	Percentage travelling beyond expected provider (s)	Determinants of mobility
Beckett (2012) England	National	2008-2009	Surgery	Hip replacement	39,060	Nearest hospital	30 nearest hospitals to the patient providing orthopedic services	40% bypass nearest hospital	Accessibility—Distance; Provider characteristics—Provider quality, waiting times; Patient characteristics—Age, socioeconomic status
Moscone (2012) Italy	National	2004-2007	(1) Surgery, (2) Medicine	(1) CABG, (2) PCI	230,600	Nearest hospital	All hospitals within region (n = 144)	45% bypass hospitals within 15km of residence. 19% bypass hospitals within 50 km of residence	Accessibility—Distance; Provider characteristics—Hospital size, private hospital; Patient Characteristics—Social network effect, prior hospital use
Varkevisser (2012) Netherlands	National	2006	Medicine	PCI	2,670	Nearest hospital providing neurosurgery services	All hospitals within threshold travel time providing neurosurgery services	NA	Provider characteristics—Provider quality, provider reputation (clinical/nonclinical staff assessment)
Sivey (2012) England	National	2001-2004	Surgery	Cataract	87,128	Nearest hospital receiving >30 cataract referrals for each GP practice	Nearest 10 hospitals receiving >30 cataract referrals for each GP practice	NA	Accessibility—Travel time, waiting time; Patient Characteristics—Rural residence
Varkevisser (2010) Netherlands	National	2003	Surgery	Neurosurgical outpatient visit	5,389	Nearest hospital providing PCI	All hospitals within threshold travel time providing PCI	NA	Accessibility—Travel time; Provider characteristics—Provider reputation (clinical/nonclinical staff assessment), waiting time; Patient Characteristics—Gender, retired status, lower socioeconomic status

(continued)

**Table I. (continued)**

Study and setting	Geographical unit	Time period analyzed	Secondary care discipline	Intervention	Number of patient hospital episodes	Definition of expected provider(s)	Definition of "choice set"	Percentage travelling beyond expected provider (%)	Determinants of mobility
Kronebusch (2009) USA	Four regions	1995-1996, 2001-2002	Surgery	(1) CABG, (2) Hip replacement, (3) Knee replacement, (4) Breast cancer surgery, (5) Colorectal cancer surgery, (6) Thoracic cancer surgery, (7) Open prostatectomy, (8) Transurethral prostate (TURP)	1,595,597 (1995-1996), 1,836,078 (2001-2002)	Nearest hospital	All hospitals within threshold distance	NA	Accessibility—Distance; Provider Characteristics—Degree of market competition, provider quality
Pope (2009) USA	One state plus sample of other states	1998-2004	Medicine	Cardiology (Mixed services)	28,647	Nearest hospital	All hospitals within statewide sample (n = 164)	NA	Provider Characteristics—Provider quality
Ho (2006) USA	Five regions	1997-1998	(1) Cancer, (2) Obstetrics, (3) Surgery, (4) Medicine	Kidney transplant	28,866	Nearest hospital	All hospitals within threshold distance	NA	Accessibility—Distance; Provider Characteristics—Advanced technology
Howard (2006) USA	National	2000-2002	Surgery	Kidney transplant	36,991	Nearest kidney transplant center	Individualized for each patient based on threshold distance and location of nearest kidney transplant provider	NA	Accessibility—Distance; Provider Characteristics—Provider quality; Patient Characteristics—Age, ethnicity, socioeconomic status, health insurance plan, disease severity
Chernew (1998) USA	One region	1991	Surgery	CABG	8,000	Nearest hospital providing CABG	All hospitals within threshold distance performing CABG	NA	Accessibility—Distance; Provider Characteristics—Provider quality; Patient Characteristics—Health insurance plan

(continued)

Table I. (continued)

Study and setting	Geographical unit	Time period analyzed	Secondary care discipline	Intervention	Number of patient hospital episodes	Definition of expected provider(s)	Definition of "choice set"	Percentage travelling beyond expected provider (s)	Determinants of mobility
<b>Regional model</b>									
Balia (2014) Italy	National	2008	(1) Surgery, (2) Medicine	NA	863,953	All hospitals within patient's administrative region of residence	All administrative regions within Italy	25.10%	Accessibility—Distance; Region Characteristics—Provider capacity (beds), GDP per capita of region, advanced technology, proportion of population >65 years
Fattore (2014) Italy	National	2009	Surgery	Aortic valve replacement	11,531	All hospitals within patient's administrative region of residence	All administrative regions within Italy	13.60%	Provider Characteristics—Private center; Patient Characteristics—Age; Region Characteristics—Region of residence, region size,
Messina (2013) Italy	One region	2001-2007	Surgery	Cardiac (Type NS)	23,645	All cardiac units within patient's health area	All three health areas within patient's region	27%	Patient Characteristics—Disease severity, Region Characteristics—Local health area
Hanning (2012) Sweden	National	2005-2008	Surgery	Cataract	293,608	All hospitals within patient's administrative region of residence	All administrative regions within Sweden	4%	Patient Characteristics—Age, patient comorbidity; Provider Characteristics—Waiting times
Fabbri (2010) Italy	National	2001	(1) Medicine, (2) Surgery	(1) Cancer (Mixed services), (2) Complex surgery (Type NS)	5,674	All hospitals within patient's local health authority of residence	171 local health authorities within Italy	42% for cancer treatment, 58% for complex surgery.	Region Characteristics—GDP per capita of region, advanced technology, regional contiguity

Note. NA = not applicable; NS = not stated; PCI = percutaneous coronary intervention; CABG = coronary artery bypass grafting. Refer to the "Results" section for description of methodological models. "Expected Provider" defined as the nearest provider(s) offering the relevant intervention given the patient's clinical condition. "Choice Set" defined as the selection of hospitals that offer the relevant intervention as defined by the study authors. Studies by Becker (2012) and Moscone (2012) classified as patient choice model, but also used hospital bypass model as part of an initial analysis to quantify extent of mobility.

### *Distant Admission*

Threshold distances were also used to define local and distant admissions (Basu, 2005; Escarce & Kapur, 2009; Radcliff et al., 2003; Saunders et al., 2009). In most cases, these thresholds were defined arbitrarily; however, one study created a threshold based on average distances travelled to local hospitals by patients living within the same county. Different thresholds were subsequently created according to admission type and county of residence (Basu, 2005).

Two studies used a series of increasing threshold distances to analyze patterns of mobility (Radcliff et al., 2003; Saunders et al., 2009). The results of both studies demonstrated that while patients are prepared to bypass their nearest provider, there is a threshold distance above which patients are rarely prepared to travel to receive care at an alternative center. Furthermore, the Saunders study showed that rates of hospital bypassing increased between 10 and 20 miles to 30 to 50 miles but sharply decreased beyond 30 to 50 miles (Saunders et al., 2009).

Other studies, assessed not only whether rural patients bypassed their nearest provider but whether their destination provider was a rural or urban center (Roh et al., 2008; Roh & Moon, 2005). Urban admissions were considered as a proxy for distant admission and analyzed separately to those admissions at other rural providers.

### *Determinants of Patient Mobility*

As can be expected, all studies, irrespective of the model they used to study patient mobility, showed that accessibility to a provider has an important effect on patient mobility. Patients are more likely to receive treatment from their nearest provider (either measured in terms of distance or travel time) or at a hospital located within their region (Balía et al., 2014; Beckert et al., 2012; Beukers et al., 2014; Chernew et al., 1998; Escarce & Kapur, 2009; Ho, 2006; Howard, 2006; Kronebusch, 2009; Moscone et al., 2012; Roh et al., 2008; Saunders et al., 2009; Sivey, 2012; Varkevisser et al., 2010, 2012; Varkevisser & van der Geest, 2007).

Studies using the hospital bypassing or patient choice models considered the impact of patient and provider characteristics at the patient level on decisions to bypass or choose a particular provider (Tables 1 and 2). In contrast, the studies using the regional model considered measures describing providers at a regional level and their impact on the flow of patients between regions.

For patient characteristics, 10 out of the 17 studies that reported results demonstrated that older patients were more likely to receive treatment from their nearest hospital (Balía et al., 2014; Basu, 2005; Beckert et al., 2012; Beukers et al., 2014; Cook et al., 2009; Fattore et al., 2014; Hanning et al., 2012; Howard, 2006; Roh & Moon, 2005; Varkevisser & van der Geest, 2007). Six out of nine studies demonstrated that patients in lower socioeconomic groups were more likely to receive treatment from their nearest providers (Beckert et al., 2012; Cook et al., 2009; Howard, 2006; Losina et al., 2007; Varkevisser et al., 2010; Varkevisser & van der Geest, 2007).

**Table 2. Study Checklist (Articles Listed by Date of Publication)—See Appendix B for a More Detailed Description of the Items.**

Study	Patient factors										Health system factors										
	Study described in detail?	Study design	Datasource	Inclusion/exclusion criteria specified?	Was the study population representative?	Secondary care context described in detail?	Appropriate hospital choice set?	Appropriate statistical analysis?	Age	Gender	Ethnicity	Socio-economic status	Insurance status	Disease severity	Comorbidities	Provider capacity	Referral patterns	GP	Copy-pasters	Provider characteristics	Regional characteristics
Balia (2014) Italy	Yes	Patient choice model	National administrative database	Yes	Yes	No	No	Yes	x	x	x	N/A	x	x	x	x	x	N/A	✓	x	✓
Beukers (2014) Netherlands	Yes	Patient choice model	National administrative database	No	Yes	Yes	Yes	Yes	✓	x	x	x	x	x	✓	x	x	N/A	✓	✓	x
Fattore (2014) Italy	Yes	Inter-regional model	National administrative database	Yes	Yes	Yes	Yes	Yes	✓	x	x	N/A	x	x	x	x	x	N/A	✓	x	✓
Nostredt (2014) Canada	No	Hospital bypassing model	Disease-specific registry	No	No	Yes	Yes	No	✓	x	x	N/A	✓	x	x	x	x	N/A	x	x	x
Massina (2013) Italy	Yes	Inter-regional model	Regional administrative database	Yes	Yes	Yes	Yes	No	x	x	x	N/A	✓	x	x	x	x	N/A	x	x	x
Beckert (2012) England	Yes	Patient choice model	National administrative database	Yes	Yes	Yes	Yes	Yes	✓	x	x	N/A	x	x	✓	✓	✓	N/A	✓	✓	x
Hanning (2012) Sweden	Yes	Inter-regional model	Disease specific registry	Yes	Yes	Yes	Yes	Yes	✓	x	x	N/A	✓	x	✓	✓	x	N/A	x	x	x
Moscone (2012) Italy	Yes	Patient choice model	Regional administrative database	Yes	Yes	Yes	No	Yes	✓	x	x	N/A	x	x	x	x	✓	N/A	✓	x	x
Varkevisser (2012) Netherlands	Yes	Patient choice model	Health insurer claims database	Yes	Yes	Yes	Yes	Yes	✓	x	x	✓	x	x	x	x	x	N/A	✓	✓	x
Sivey (2011) England	Yes	Patient choice model	National administrative database	Yes	No	Yes	Yes	Yes	✓	x	x	N/A	x	x	✓	✓	✓	N/A	x	x	x
Fabbri (2010) Italy	Yes	Inter-regional model	National administrative database	No	Yes	No	No	Yes	x	x	x	N/A	x	x	x	x	x	N/A	✓	x	✓
Varkevisser (2010) Netherlands	Yes	Patient choice model	Health insurer claims database	Yes	Yes	Yes	Yes	Yes	✓	x	x	✓	x	x	x	x	x	N/A	✓	✓	x
Cook (2009) England	Yes	Hospital bypassing model	Disease-specific registry	Yes	Yes	Yes	No	Yes	✓	x	✓	N/A	x	x	x	x	x	N/A	✓	✓	NA
Escarce (2009) USA	Yes	Hospital bypassing model	Regional administrative database	No	No	No	No	Unclear	x	x	x	✓	x	x	x	x	x	x	✓	✓	x
Kronebusch (2009) USA	Yes	Patient choice model	Regional administrative database	No	Yes	Yes	Yes	Yes	✓	✓	✓	✓	x	✓	✓	✓	✓	✓	✓	✓	x

(continued)

**Table 2. (continued)**

Study	Patient factors										Health system factors											
	Study described in detail?	Study design	Datasource	Inclusion/exclusion criteria specified?	Was the study population representative?	Secondary care context described in detail?	Appropriate hospital choice set?	Appropriate statistical analysis?	Age	Gender	Ethnicity	Socio-economic status	Insurance status	Disease severity	Comorbidities	Provider capacity	Referral patterns	GP	Copy-ments	Provider characteristics	Regional characteristics	
Pope (2009) USA	No	Patient choice model	Regional administrative database	Unclear	No	No	No	Yes	x	x	x	✓	x	x	x	x	x	x	N/A	x	✓	x
Saunders (2009) USA	Yes	Hospital bypassing model	Regional administrative database	Yes	Yes	Yes	Yes	Yes	✓	✓	x	✓	x	✓	x	x	x	x	x	✓	x	x
Roh (2008) USA	Yes	Hospital bypassing model	Regional administrative database	Yes	Unclear	No	No	Yes	✓	✓	x	✓	x	x	x	x	x	x	x	✓	x	x
Losina (2007) USA	No	Patient choice model	Health insurer claims database	Yes	Yes	Yes	Yes	Yes	x	x	✓	✓	x	x	x	x	x	x	N/A	x	✓	✓
Vankeiser (2007) Netherlands	Yes	Hospital bypassing model	Health insurer claims database	Yes	Yes	Yes	Yes	Yes	✓	✓	x	✓	x	x	✓	x	x	x	N/A	✓	x	x
Ho (2006) USA	No	Patient choice model	Other	Unclear	No	No	No	Yes	x	x	x	✓	x	x	x	x	x	x	x	✓	x	x
Howard (2006) USA	Yes	Patient choice model	Disease-specific registry	Yes	Yes	Yes	Yes	Yes	✓	✓	✓	✓	✓	x	x	x	x	x	x	✓	✓	x
Basu (2005) USA	No	Hospital bypassing model	Regional administrative database	No	Unclear	Unclear	No	Yes	✓	✓	✓	✓	✓	x	x	x	x	x	x	x	x	✓
Roh (2005) USA	Yes	Hospital bypassing model	Regional administrative database	Yes	No	No	No	Yes	✓	✓	x	✓	✓	✓	x	x	x	x	x	✓	x	x
Radcliff (2003) USA	Yes	Hospital bypassing model	Regional administrative database	Yes	Yes	No	No	No	x	x	x	✓	x	x	x	x	x	x	x	x	x	x
Cherniew (1998) USA	Yes	Patient choice model	Regional administrative database	Yes	Unclear	Yes	No	Yes	x	x	x	✓	x	x	x	x	x	x	x	✓	✓	N/A

Note. N/A = not applicable; ✓ = factor accounted for in study; x = factor not accounted for in study.

Six of the eight studies reviewing the impact of ethnicity on patterns of mobility found a statistically significant association (Table 1). Of these, four studies demonstrated that non-White patients were less likely to bypass local rural hospitals than White patients when controlling for all other factors (Basu, 2005; Roh et al., 2008; Roh & Moon, 2005; Saunders et al., 2009). These studies also demonstrated that non-White patients are less likely to travel as far as White patients to receive treatment, especially to providers based in out-of-area urban settings. Two studies found that non-White men and women were less likely to receive care at higher quality hospitals for total hip replacement surgery and kidney transplantation (Howard & Kaplan, 2006; Losina et al., 2004).

In eight of the nine U.S. studies that included patients affiliated with different health insurance plans, the extent of mobility varied depending on health plan type (Basu, 2005; Chernew et al., 1998; Escarce & Kapur, 2009; Howard, 2006; Radcliff et al., 2003; Roh et al., 2008; Roh & Moon, 2005; Saunders et al., 2009). It is not possible to make comprehensive conclusions as to overall trend in patient mobility according to insurance plan type. However, the increased rates of mobility reported for patients with commercial health insurance plans may be due to the potentially greater number of alternative providers that are available to choose from compared with what would be the case with Health Maintenance Organizations, Medicaid, and Medicare plans (Basu, 2005; Roh et al., 2008). Another explanation could be that younger patients and those with employer-sponsored coverage were more responsive to quality-of-care differences between providers and had the means (physical/financial) to access more distant hospitals (Radcliff et al., 2003).

All six studies analyzing the effect of provider capacity (i.e., measured in terms of waiting times for a particular treatment) on patient mobility demonstrated that patients were more likely to move to providers with shorter waiting times (Beckert et al., 2012; Beukers et al., 2014; Hanning et al., 2012; Sivey, 2012; Varkevisser et al., 2010; Varkevisser & van der Geest, 2007).

All eight studies analyzing the effect of proxy measures for provider quality on patient mobility demonstrated that patients are more likely to travel further to receive treatment from providers who deliver a better quality of care according to these measures (Beckert et al., 2012; Beukers et al., 2014; Chernew et al., 1998; Howard, 2006; Kronebusch, 2009; Losina et al., 2007; Moscone et al., 2012; Pope, 2009; Varkevisser et al., 2012; Varkevisser & van der Geest, 2007). Different measures of provider quality were used in each of the studies (e.g., generic mortality rates, hospital infection rates, heart failure readmission rates, transplant failure rates, high volume surgical unit, hospital ranking). Other provider factors that are associated with a willingness to travel further are the availability of advanced technology (although not necessarily for the specialty in question) and a larger hospital (Balía et al., 2014; Escarce & Kapur, 2009; Fabbri & Robone, 2010; Ho, 2006; Roh & Moon, 2005).

In administrative regions with older populations (age >65 years) and high levels of affluence (measured as GDP per capita) patients were less likely to move to providers outside their region. Similarly patients were more likely to seek care within regions that were accessible by public and private transport (Balía et al., 2014; Fabbri & Robone, 2010; Fattore et al., 2014).

### Study Assessment

Articles were assessed according to the checklist described in the “Method” section (Table 2). When reviewing the hospital choice sets, we found that 12 of the 26 studies did not state explicitly whether the alternative hospitals offered the particular service in question (Balía et al., 2014; Basu, 2005; Chernew et al., 1998; Cook et al., 2009; Escarce & Kapur, 2009; Fabbri & Robone, 2010; Ho, 2006; Moscone et al., 2012; Pope, 2009; Radcliff et al., 2003; Roh et al., 2008; Roh & Moon, 2005). Also, it is likely that the fitness of the patients and severity of the disease will have an effect on patient mobility, but only six studies assessed disease severity (Basu, 2005; Hanning et al., 2012; Howard, 2006; Messina et al., 2013; Nostedt et al., 2014; Roh & Moon, 2005) and three comorbidity (Kronebusch, 2009; Roh & Moon, 2005; Saunders et al., 2009).

Another important checklist item was that studies accounted for possible effects of copayments on decisions where to have their care or treatment. While some of the U.S. studies chose particular subpopulations (e.g., Medicare patients for whom copayments are generally fixed between providers; Losina et al., 2007; Pope, 2009), 10 of the 12 studies which looked at patients enrolled in a variety of insurance schemes made no account of the impact of variation in copayments on their destination hospital (Basu, 2005; Chernew et al., 1998; Escarce & Kapur, 2009; Ho, 2006; Howard, 2006; Kronebusch, 2009; Radcliff et al., 2003; Roh et al., 2008; Roh & Moon, 2005; Saunders et al., 2009).

### Discussion

This is the first review to systematically describe and analyze the published empirical literature on patient mobility for elective services in the secondary care setting. Our review demonstrates that patients travel to a hospital other than their nearest provider for a wide variety of health care interventions.

A further major finding of this review is the identification of three main methodological models (hospital bypassing, regional, and patient choice models) used to analyze patient mobility in different health care markets. Our results demonstrate that the model used to define mobility is influenced by the health care context with no single model providing a single policy frame. For instance, the regional model has been used almost exclusively in the Italian studies, with the key variable being whether or not patients receive treatment in the administrative region they reside in. This is because the organization and administration of publicly financed health care in Italy was decentralized to 20 regions following constitutional reform in 2001 (Balía et al., 2014). Rates of inflow and outflow of patients are analyzed to assess the effectiveness of regional health care supply, and look for flow imbalances which may have an impact on regional budgets (France, Taroni, & Donatini, 2005). Sweden adopts a similar system with health care decentralized to county councils (Vrangbæk, Østergren, Birk, & Winblad, 2007).

In contrast, the United Kingdom, Netherlands, and the United States do not exhibit the same level of regional decentralization and therefore the hospital bypassing and



patient choice models were used to study mobility between health care providers. While clear differences in the nature of the health care market and extent of competition exist, the response of patients to perceived differences in provider quality is an essential component of all these three countries.

A number of the U.S. studies in our review used the hospital bypassing model to analyze the extent of “rural hospital bypassing” (i.e., the proportion of rural residents bypassing their nearest rural provider[s] to access an urban center for a particular intervention; Escarce & Kapur, 2009; Roh & Moon, 2005). The extent to which this is occurring is a particular concern in the United States due to long-standing concerns related to the availability and quality of health care resources in rural settings (Bronstein & Morrissey, 1991; Buczko, 1997; Escarce & Kapur, 2009).

The review demonstrated that variation exists in the proportion of patients moving to alternative providers for elective secondary services (23%-77%). However, we found that the extent of mobility depends on a number of factors. These include, apart from the secondary health care intervention in question, the study methods used and the geographical unit of analysis (national vs. regional).

It is unclear from the available evidence whether such mobility is sufficient for effective competition and improvements in quality. However, the results of this review demonstrate that there are actual changes in market share which may represent a major driver given the extent of mobility reported.

We found that patients were more likely to move to providers considered to be of higher quality, or that offered advanced technologies. However, mobility may have a negative effect on competition by providing increased incentives for risk selection of patients by providers in order to improve their apparent performance according to the selected indicators.

Service capacity may also be an emerging issue for high-performing centers that receive a net gain of patients due to mobility. Without adequate planning, an increased flow of patients from outside the provider catchment area may result in lengthening waiting lists. At the same time, it may result in unused capacity and resources within centers that have a net loss of patients, creating health system inefficiencies.

The effect of patient choice policies on equity remains a key concern, given that older patients and lower socioeconomic groups are less likely to travel beyond their nearest health care provider. The impact of disease complexity or comorbidities on the decision to move between providers is unclear. On the other hand, the outflow of patients from hospitals located in socioeconomically deprived settings may provide the necessary stimulus to improve provider performance and in this way benefit the majority of nonmovers.

One of the challenges in reviewing these studies is to ascertain whether they are able to identify true movers (i.e., mobility due to patient choice rather than health system factors). Our checklist sought to assess the extent to which these factors have been accounted for (Table 2). We found, particularly in the U.S. studies, that there was limited information on the choice set of hospitals available to each patient. As a result, it was not always possible to ascertain whether the choice of available hospitals considered in the study actually provided the service or intervention in question.

It was also not possible to assess the extent of selective contracting of providers by different insurers in the U.S. market, and how centralization of services contributed to patterns of mobility. A further issue in the U.S. studies was the paucity of information on the extent of variation in copayments. It was therefore not always possible to disentangle the impact between price and quality on mobility.

Primary care referral patterns and capacity of available providers (e.g., waiting lists) were rarely considered in the selected studies (Table 2), predominantly because of data constraints. Provider capacity as measured through waiting lists is an important health system factor (Dawson, Gravelle, Jacobs, Martin, & Smith, 2007) which can directly affect patient mobility (Beckert et al., 2012; Beukers et al., 2014; Sivey, 2012).

## Conclusion

Provider choice policies have previously been criticized due to the lack of empirical evidence that such policies influence where patients receive treatment (Pollock et al., 2012). Our findings provide substantial evidence that patients are prepared to travel beyond their nearest provider for their care or treatment. It has been hypothesized that the driver for improving provider performance would be the threat of losing market share and that even movement of only 5% to 10% of patients would provide the necessary incentive to improve quality (Berwick et al., 2003; Le Grand, 2009). However, these results suggest that there are likely to be “winners” and “losers” from health care market reforms, which could have an impact on the configuration of existing health care markets if some providers continue to lose market share. There is therefore potentially a trade-off between the effects of mobility on improving provider quality but at the same time decreasing provider capacity.

Equity also remains an issue given that the elderly and low socioeconomic groups are less likely to travel beyond their nearest provider for health care. This in turn may result in hospitals within socioeconomically deprived areas with older demographic profiles having to manage far more complex patient cohorts (both medically and socially), which subsequently affects their quality outcomes.

Further work is required to understand the drivers of patient mobility (e.g., quality, reputation, referral patterns) and its impact on equity in access to services and patient outcomes. In this regard, our checklist for studies of patient mobility provides a framework for developing future research facilitating the comparability of study results.

## Appendix A

### PubMed Search String

Search (((((((((((((((patient choice\*[Title/Abstract]) OR consumer choice\*[Title/Abstract]) OR patient preference\*[MeSH Terms]) OR patient preference\*[Title/Abstract]) OR patient mobility[Title/Abstract]) OR patient travel[Title/Abstract]) OR hospital referral\*[MeSH Terms]) OR hospital referral[Title/Abstract])) OR hospital bypassing)) OR hospital choice[Title/Abstract])) OR hospital market[Title/Abstract]))

AND (((((((health care provider[MeSH Terms]) OR provider\*[Title/Abstract]) OR hospital\*[Title/Abstract]) OR doctor\*[Title/Abstract]) OR Physician\*[Title/Abstract]) OR "specialist care"[Title/Abstract]))

## Appendix B

### Study Checklist

1. Was the study setting described in detail? (Yes/No/unclear/Not applicable)

The study setting should be described in sufficient detail so that others can determine if it is comparable to the population of interest to them. This includes information on the health care environment for a particular country and differences between regions relating to provider choice policy, organization of providers, and system of reimbursement.

2. What study design was used to capture "mobility" (State one of the following):
  - a. Patient choice model
  - b. Hospital bypassing model
  - c. Interregional model
3. What was the main data source? (state one of the following):
  - a. National administrative database
  - b. Regional administrative database
  - c. Disease-specific registry
  - d. Health insurer claims database
  - e. Other
4. Were both inclusion and exclusion criteria specified? (Yes/No/unclear/Not applicable)

This includes information on the sampling frame (e.g., entire population, random sample) and an adequate description of the inclusion and exclusion criteria in order to enable a researcher to determine if it is comparable to the population of interest to them.

5. Was the study population representative of the target population? (Yes/No/unclear/Not applicable)

The study subjects should be described in sufficient detail to ascertain whether those subjects who participated were representative of the entire population from which they were recruited.

6. Was the secondary health care context described in detail? (Yes/No/unclear/Not applicable)

The methods should be described in detail providing information on the clinical discipline being analyzed, whether the health care episodes reviewed are inpatient or outpatient based and whether they are elective or emergency care episodes. In addition, there should be information on the intervention (s) that are being analyzed. If multiple interventions or medical disciplines are included, there should be evidence of detailed subgroup analysis to allow an interpretation of differences between different sets of conditions.

7. Is the “hospital choice set” appropriate given intervention and disease status (i.e., do all hospitals offer the intervention being assessed or account for technical requirement of patient) (Yes/No/unclear/Not applicable)
8. Were the following patient characteristics influencing mobility taken into account? (✓ or ✗ or N/A, i.e., Yes or No or Not applicable)
- Age
  - Gender
  - Disease severity (e.g., cancer stage)
  - Comorbidities
  - Socioeconomic status
  - Ethnicity
  - Health insurance status (e.g., medicare vs. private insurer)

There has to be evidence that relevant patient characteristics have been included in the analysis either as confounding factors, or as exposures of interest.

9. Were the following health system characteristics influencing mobility taken into account? (✓ or ✗ or N/A)
- Forced mobility due to insufficient provider capacity (e.g., Waiting time)
  - Physician-induced mobility (e.g., GP referral patterns)
  - Copayments for health care services
  - Characteristics of the provider (e.g., size, academic status, advanced technology availability)
  - Provider quality metrics (e.g., disease-specific mortality, ranking)
  - Characteristics of region (e.g., urban/rural, region size, GDP per capita)

As above, these factors must be quantified and used in the analysis as confounding factors or exposures of interest.

10. Have the authors used a statistical analysis technique that enables the reader to assess the effect of each patient or system factor (as per the papers’ specific research question[s]) on the likelihood or magnitude of patient mobility (Yes/No/unclear/Not applicable)

### Authors' Note

The views expressed in this publication are those of the authors and not necessarily those of the NHS, the National Institute for Health Research or the Department of Health.

### Declaration of Conflicting Interests

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## 4. RESULTS CHAPTER 2

### 4.1 Patient mobility for radical prostatectomy

The **second component** of my thesis was a quantitative analysis of patient mobility and its determinants using data on actual patient visits for curative prostate cancer treatment in the English NHS. This chapter focuses on patient mobility for radical prostate cancer surgery and the results have presented in the form of the published paper. The supplementary material referred to in the paper is available at the end of this section.

### 4.2 Research paper 2

**“Determinants of patient mobility for prostate cancer surgery: a population-based study of choice and competition”**

The online PDF can be accessed at:

**[http://www.europeanurology.com/article/S0302-2838\(17\)30601-2/pdf](http://www.europeanurology.com/article/S0302-2838(17)30601-2/pdf)**

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### SECTION A – Student Details

Student	Ajay Aggarwal
Principal Supervisor	Jan van der Meulen
Thesis Title	Evidence and impact of NHS choice and competition policies on the delivery of prostate cancer services: a national population based evaluation

**If the Research Paper has previously been published please complete Section B, if not please move to Section C**

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Platinum Priority – Brief Correspondence  
Editorial by XXX on pp. x–y of this issue

## Determinants of Patient Mobility for Prostate Cancer Surgery: A Population-based Study of Choice and Competition

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### Abstract

Many countries have introduced policies that enable patients to select a health care provider of their choice with the aim of improving the quality of care. However, there is little information about the drivers or the impact of patient mobility. Using administrative hospital data ( $n = 19\,256$ ) we analysed the mobility of prostate cancer patients who had radical surgery in England between 2010 and 2014. Our analysis, using geographic information systems and multivariable choice modelling, found that 33.5% ( $n = 6465$ ) of men bypassed their nearest prostate cancer surgical centre. Travel time had a strong impact on where patients moved to but was less of a factor for men who were younger, fitter, and more affluent ( $p$  always  $< 0.001$ ). Men were more likely to move to hospitals that provided robotic prostate cancer surgery (odds ratio: 1.42,  $p < 0.001$ ) and to hospitals that employed surgeons with a strong media reputation (odds ratio: 2.18,  $p < 0.001$ ). Patient mobility occurred in the absence of validated measures of the quality of care, instead influenced by the adoption of robotic surgery and the reputation of individual clinicians. National policy based on patient choice and provider competition may have had a negative impact on equality of access, service capacity, and health system efficiency.

**Patient summary:** In this study, we assessed the reasons why men would choose to have prostate cancer surgery at a centre other than their nearest. We found that in England men were attracted to centres that carried out robotic surgery and employed surgeons with a national reputation.

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Many high-income countries have introduced policies that aim to improve the quality of care by stimulating competition between hospital providers and allowing patients to choose the hospital where they have treatment [1]. In publicly funded health care markets such as the UK,

funding follows the patient, creating quite powerful incentives for hospitals to attract new patients by demonstrating superior quality [2].

To date, our understanding of the extent and determinants of patient mobility across health services remains

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limited, due to a paucity of available research and heterogeneity in the design of empirical studies [3]. The aim of the present study is to undertake the first-ever national analysis assessing the impact of choice and competition policies within cancer care. Our aim was to investigate whether prostate cancer patients, who had a radical prostatectomy in the English National Health Service (NHS), travelled beyond (*bypassed*) their nearest hospital, and the hospital and patient characteristics associated with that mobility.

We obtained individual patient-level data on all men ( $n = 19\,256$ ) who were diagnosed with prostate cancer and underwent radical prostatectomy in the English NHS between January 1, 2010 and December 31, 2014 from the National Cancer Registration and Analysis Service and linked at patient level to Hospital Episode Statistics. Patient characteristics of the study cohort are presented in Supplementary Table 1.

The population-weighted centroids of the patients' Lower Super Output Areas (geographic areas defined by the Office for National Statistics that typically includes 1500 residents or 650 households) and the full postcodes for the hospitals where the surgery was undertaken were inputted into a geographical information system (ESRI ArcGIS 10.3) to calculate travel times according to the fastest route by car (using Ordnance Survey MasterMap Integrated Transport Network). For each patient, the travel time to all prostate cancer surgical centres ( $n = 65$ ) was calculated. The proportion of patients not receiving care at their nearest centre were considered to be "bypassers."

We determined three hospital-level characteristics. These were informed by a systematic review of the literature and qualitative interviews with both men previously treated for prostate cancer and uro-oncology specialists currently practicing in the UK.

We labelled the 12 hospitals that carried out robotic prostatectomies at the start of the study period as "established robotic centres." We identified the 31 "university-teaching hospitals," based on their membership of the Association of UK University Hospitals. We also defined the 12 hospitals with a "strong media reputation," based on whether or not they employed urologists that were listed in 2010 as the *best* prostate cancer surgeons in the UK by the Daily Mail [4], which is the only nationally published source recognising expert prostate cancer surgeons. Further details on the selection of hospital characteristics is available in the Supplementary data.

Conditional logit regression was used to model the odds that a patient moved to a particular hospital as a function of travel time and hospital and patient characteristics [5]. For each patient, we created a data set that included for each patient a row for each hospital providing prostate cancer surgery at the time of treatment (number of hospitals varied between 57 and 65 as 8 hospitals closed during the study period). The dependent variable of the conditional logit model was a dummy variable with a value of 1 for the hospital where a patient had his treatment and a value of 0 otherwise. Patient characteristics were included as interaction terms with travel time in the model and

included age, number of comorbidities, socioeconomic status (based on national quintiles of the Index of Multiple Deprivation) [6], and urban or rural residence [7]. Further detail on patient characteristics and the statistical methods is available in the Supplementary data.

Our analysis demonstrated that 6465 men (33.5%) *bypassed* the nearest centre that carried out prostate cancer surgery. Two thousand, three hundred, and eight-six men (12.4%) *bypassed* at least three hospitals for their treatment and 1258 men (6.5%) at least five hospitals (Supplementary Table 2). There were clear differences in bypass rates between the nine English regions. In London, 50.9% of men had their prostate cancer surgery at the nearest centre whilst corresponding percentages were 86.5% in the North East and 80.6% in Yorkshire and Humberside (Supplementary Table 3).

Travel time had a strong impact on the odds that a patient chose a particular hospital to receive surgery. The odds of a patient choosing a hospital that was up to 10 min further away than the patient's nearest hospital that carried out prostate cancer surgery was found to be on average 78% smaller (odds ratio: 0.22). The odds decreased markedly as the additional travel time increased (Table 1).

The addition of patient characteristics as interaction terms into our model demonstrated that the impact of travel time was smaller for men who were younger, for those who were fitter (no recorded comorbidities), and for those who lived in more affluent or rural areas (odds ratios:  $> 1$ ; Table 1). For example, again compared with having the surgery at the nearest hospital, for men in rural areas, the likelihood of moving to a hospital that was up to 10 min further away was estimated to be 2.5 times smaller ( $= 1/[0.22 \times 1.79]$ ) whereas the corresponding figure for men from urban areas is 4.8 ( $= 1/0.22$ ).

Patients were 1.42 times more likely to move to one of the 12 hospitals that were established robotic centres compared with those that were not and 2.18 times more likely to move to the 12 hospitals that employed surgeons who had a strong media reputation (Table 1). University teaching hospital status had a small but statistically significant impact (odds ratio: 1.09,  $p < 0.001$ ) on attracting patients.

These findings have a number of policy implications that are relevant across a range of elective secondary care services in countries that have introduced patient choice of provider policies [3]. A substantial number of patients, well above the 5–10% thought to be necessary to incentivise improvements in quality [8], were prepared to move to hospitals further away for radical prostatectomy. This occurred in the absence of evidence that these hospitals achieved better outcomes. Instead, they responded to the availability of more advanced surgical technology and the perceived reputation of the hospitals' surgeons.

The provision of robotic surgery has been noted to attract patients to providers in health care markets across Europe and North America [9], resulting in a rapid growth in the number of providers offering this technology. Our own data supports this: men were more likely to choose

**Table 1 – Impact of travel time and hospital and patient characteristics on patient mobility in 19 256 men undergoing radical prostatectomy between 2010 and 2014 in the English National Health Service<sup>a</sup>**

	Adjusted odds ratio	95% CI	p value <sup>b</sup>
Impact of additional travel time (min) <sup>c</sup>	1		<0.001
<10	0.22	0.18–0.27	
11–30	0.03	0.03–0.04	
31–60	0.004	0.003–0.006	
>60	0.0005	0.0003–0.0006	
Difference in impact of additional travel time for selected patient characteristics <sup>d</sup>			
Younger patients (< 65 yr)			<0.001
<10	1.11	1.01–1.23	
11–30	1.14	1.02–1.28	
31–60	1.40	1.20–1.64	
>60	1.37	1.18–1.59	
Patients without comorbidities			<0.001
<10	1.16	0.97–0.98	
11–30	1.12	0.90–1.39	
31–60	1.78	1.23–2.58	
>60	1.32	0.97–1.81	
Patients from more affluent areas (IMD 1 or 2)			<0.001
<10	1.08	0.98–1.23	
11–30	1.36	1.21–1.52	
31–60	1.35	1.15–1.59	
>60	1.12	0.97–1.29	
Patients from rural areas			<0.001
<10	1.79	1.57–2.04	
11–30	2.19	1.93–2.48	
31–60	2.61	2.23–3.05	
>60	2.14	1.84–2.47	
Impact of hospital characteristics			
University hospital	1.09	1.05–1.15	<0.001
Established robotic centre	1.42	1.33–1.52	<0.001
Strong media reputation	2.18	2.05–2.31	<0.001
McFadden's pseudo R <sup>2</sup>		0.70	

CI = confidence interval; IMD = Index of Multiple Deprivation.

<sup>a</sup> Odds ratio represent differences in the odds that a patient moves to a particular hospital as a function of travel time and hospital and patient characteristics.

<sup>b</sup> The p value is based on likelihood ratio test.

<sup>c</sup> Note that the adjusted odds ratios for additional travel time relates to older men ( $\geq 65$  yr), with comorbidity (Charlson  $\geq 1$ ), living in less affluent (IMD 3–5), and urban areas.

<sup>d</sup> Impact of patient characteristics on the odds ratio representing the impact of additional travel time (see results section for interpretation).

one of the 12 established robotic centres in the NHS. It is likely that this competitive advantage has contributed to the large-scale investment in equipment for robotic surgery across the NHS [10]. There has been a more than three-fold increase in the number of centres offering this modality between 2010 and 2016 (from 12 to 42 centres).

Hospital and clinician reputation have also been identified in other studies as important factors influencing decision making for cancer surgery [11]. This suggests that patients, with or without guidance from their primary care physician, social, and medical networks, or clinician who diagnosed the cancer, respond to indicators that in their view reflect differences in treatment quality [12].

The list of prostate cancer surgeons with a national reputation was compiled by the Daily Mail following a survey of urologists working in the UK. Much of the intelligence is therefore likely to be representative of the discussions that are ongoing within particular regions both amongst clinicians as well as patient and carer support groups. It can therefore be considered as a proxy for the wider reputation of hospitals.

The patterns of mobility observed in England has resulted in large and unexpected shifts in market share

for hospitals carrying out prostate cancer surgery. For some hospitals, nearly 80% of patients for whom that hospital was the nearest provider chose to have their treatment elsewhere. Conversely, other hospitals were performing up to 200% more operations than expected because patients from elsewhere travelled to these hospitals for their surgery. Such extremes of mobility are likely to have a negative impact on health system efficiency (due to lengthening waiting lists for some and unused capacity for others) with some surgical units facing the threat of closure given that funding is contingent on the number of procedures performed [2,10]. Equally, surgical unit closures and the greater regionalisation that results may serve to improve efficiency.

Our modelling of patient mobility had a number of limitations. First, we used an administrative dataset and it is likely that we have missed less severe comorbid conditions. Second, the study used centroids of small geographical areas to represent the location of the patients' residence. This will have added "noise" to the determination of travel times.

In conclusion, men are willing to travel for prostate cancer surgery, especially those that are relatively young, fit, and affluent. The study highlights that without appropriate quality information to guide patients'



choices, patients are influenced by the reputation of hospitals and their surgeons and the availability of innovative technologies. National policy based on patient choice and provider competition may have a negative impact on service capacity, equality of access, and health system efficiency.

**Author contributions:** Ajay Aggarwal had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study concept and design:** Aggarwal.

**Acquisition of data:** Aggarwal, Charman, van der Meulen.

**Analysis and interpretation of data:** Aggarwal, Lewis, van der Meulen.

**Drafting of the manuscript:** Aggarwal.

**Critical revision of the manuscript for important intellectual content:** All authors.

**Statistical analysis:** Aggarwal, Charman, van der Meulen.

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**Supervision:** van der Meulen.

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Hospital Episode Statistics were made available by the NHS Health and Social Care Information Centre (2012, re-used with the permission of NHS Digital. All rights reserved.)

The cancer data used for this study are based on information collected and quality assured by Public Health England's National Cancer Registration and Analysis Service. Access to the data was facilitated by the Public Health England's Office for Data Release.

Aggarwal, Charman, Clarke, and van der Meulen are members of the Project Team of the National Prostate Cancer Audit ([www.npca.org.uk](http://www.npca.org.uk))

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.eururo.2017.07.013>.

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## **Supplementary data (in published format)**

### **Material and methods**

#### ***Patient characteristics***

The National Cancer Registration and Analysis Service dataset was used as the data source for cancer stage and the Hospital Episodes Statistics (HES) dataset for age and comorbidities [1,2]. Cancer severity was categorised according to a modified D'Amico classification system that has been developed by the National Prostate Cancer Audit to risk stratify patients using administrative datasets [3,4]. The patients' place of residence was available as the Lower Layer Super Output Area (LSOA), a geographic area defined by the Office for National Statistics that typically includes 1500 residents or 650 households [5].

Four patient level variables were derived from this linked dataset. First, the Royal College of Surgeons Charlson Score, which has been validated for identifying comorbidities in patients undergoing surgical procedures in the English HES data, was used to give patients a score representing the number of identified comorbidities [6]. Second, the Index of Multiple Deprivation, which combines several socioeconomic indicators, to provide a single deprivation score for each LSOA [7]. The Index of Multiple Deprivation was stratified into quintiles such that 1 represents households in the 20% least deprived and 5 in the 20% most deprived LSOAs nationally. Third, the patients' area of residence was classified as urban or rural according to the 2011 Rural-Urban Classification for Small Area Geographies [8]. Fourth, the region of residence was defined according to the nine regions used by the Office for National Statistics for statistical purposes [9].

### ***Hospital characteristics***

At the start of the study period (January 2010), there were 65 NHS hospital trusts providing radical prostatectomy across England. Eight of these stopped this procedure during the study period. HES data was used to identify where each patient had his prostatectomy carried out.

We determined three hospital-level characteristics, which was rigorously informed by a patient involvement approach and systematic review of the literature. The study team undertook 50 in-depth qualitative interviews, both with men previously treated for prostate cancer in England during the analysis period and prostate cancer specialists currently practicing in surgical units across England. This was supplemented by a systematic review of the international literature relating to patient mobility for elective secondary care services [10,11].

We labelled the 12 hospitals that carried out robot-assisted laparoscopic prostatectomies at the start of the study period as “established robotic centres” using information from an organisational survey conducted by the National Prostate Cancer Audit [12].

We identified the 31 “university teaching hospitals”, based on their membership of the Association of UK University Hospitals [13]. Teaching hospitals have been shown to deliver improved outcomes of care relative to non-teaching hospitals due to differences in organisational culture, staffing, technology, and procedure volume [14,15]. For this reason, they may be considered more attractive to patients [16].

We also defined hospitals with a “strong media reputation” based on whether or not they employed urologists that were listed in 2010 as the “best” prostate cancer surgeons in the



UK by the Daily Mail [17]. This newspaper article was identified by patients during the taped qualitative interviews as an important source of information in the triangulation process when considering alternative surgical centres for treatment. It is also readily accessible online and is one of the first articles listed across internet search engines (e.g., Google, Bing, MSN, Yahoo) when the search term “best prostate cancer surgeon” is inputted, and therefore had considerable reach beyond a single print newspaper article.

The Daily Mail list of 12 hospitals was based on an informal survey of 40 urologists practicing in England and Wales. A structured search of the Factiva database (one of the world’s largest archives of print and online newspapers) did not identify any additional articles that provided an assessment of the quality of prostate cancer surgical care across England during the study period.

### ***Statistical analysis***

Conditional logit regression, an accepted standard for choice modelling, was used to model the odds that a patient moves to a particular hospital as a function of travel time and hospital and patient characteristics [18,19]. For each patient, we considered all hospitals that were providing radical prostatectomy at the time of his surgery as alternative options (i.ee, choice set).

Travel time was included in the model as the additional time men had to travel beyond their nearest hospital to an alternative hospital providing prostatectomy. In this way, we accounted for the variation in service configuration across England as, depending on where patients lived, they had to travel between one minute to more than 2 h from their home to

their nearest hospital. Per definition, additional travel time was 0 min if a patient had his prostatectomy in the nearest hospital.

Patient characteristics: age, comorbidity, socioeconomic background, and urban or rural residence were included as interaction terms with travel time. Three sets of analyses were performed. First, we modelled the effect of travel time. Second, we included the three hospital characteristics in addition to travel time. Finally, we included the interactions of patient characteristics with travel time in order to estimate the variation in the trade-off between travel time and hospital quality based on patient characteristics. We present the results from our third model in Table 1. STATA version 14 was used to undertake the statistical analyses.

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**Supplementary Table 1. Characteristics of 19 256 men undergoing radical prostatectomy between 2010 and 2014 in the English National Health Service**

	No.	%
Age (yr)		
<50	702	3.7
50–59	5114	26.6
60–64	5305	27.6
65–69	5973	31.0
≥70	2162	11.0
Cancer severity		
Advanced	50	0.3
Locally advanced	6373	43.9
Intermediate localised	7613	52.4
low risk localised	488	3.4
Insufficient staging information ( <i>n</i> = 4732)		
No. of comorbidities		
0	17 821	92.6
≥1	1435	7.4
Index of Multiple Deprivation (national quintiles)		
1 (least deprived)	5312	28.0
2	4744	24.6
3	3975	20.4
4	2980	15.0
5 (most deprived)	2245	11.7
Urban-rural classification <sup>a</sup>		
Urban	14 685	76.3
Rural	4571	23.7

<sup>a</sup> See methods section in supplementary content for definition.

**Supplementary Table 2. Patient mobility of 19 256 men undergoing radical prostatectomy between 2010 and 2014 in the English National Health Service according to the number of hospitals “bypassed”<sup>a</sup>**

No. of hospitals “bypassed”	No. of patients (%)	Travel time (min) median (interquartile range)
0	12 791 (66.4)	17.8 (10.6–29.5)
1	2667 (13.9)	27.1 (17.5–43.3)
2	1412 (7.3)	33.2 (19.9–57.7)
3	747 (3.9)	48.0 (27.7–89.7)
4	381 (2.0)	52.7 (33.8–75.9)
≥5	1258 (6.5)	81.9 (49.1–118.8)

<sup>a</sup> Hospitals are considered to be “bypassed” if a man has a prostatectomy in a hospital that is further away from his place of residence in terms of travel time by car.

**Supplementary Table 3. Patient mobility of 19 256 men undergoing radical prostatectomy between 2010 and 2014 in the English National Health Service according to region of residence.**

Region	Area (km <sup>2</sup> )	No. of RP centres	No. of men treated	No. of hospitals “bypassed” <sup>a</sup>					
				0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	≥5 (%)
East Midlands	15 627	5	1306	71.80	10.20	4.10	3.10	3.10	7.80
East of England	19 120	5	1992	62.30	9.30	13.20	3.20	1.80	10.30
London	1572	10	2657	50.90	24.10	13.50	5.30	2.50	3.70
North East	8592	3	739	86.50	9.20	2.30	0.40	0	1.60
North West	14 165	9	2247	62.10	15.10	7.70	4.40	2.10	8.50
South East	19 095	12	3737	69.50	9.90	4.90	2.90	2.70	10.10
South West	23 829	8	2394	67.10	11.60	5.30	8.00	2.80	5.20
West Midlands	13 000	7	2278	65.20	17.50	7.50	3.70	0.90	5.30
Yorkshire and Humberside	15 420	5	1906	80.60	13.40	3.50	0.90	0.10	1.40

RP = radical prostatectomy.

<sup>a</sup> Hospitals are considered to be “bypassed” if a man has a prostatectomy in a hospital that is further away from his place of residence in terms of travel time by car.

## 5. RESULTS CHAPTER 3

### 5.1 Patient mobility for radical radiotherapy

After analysing the determinants of patient mobility for radical prostate cancer surgery, this chapter focused on patient mobility for radical radiotherapy. The chapter also addressed the **third component** of the thesis, which was an evaluation of the impact of patient mobility on individual providers in terms of their net gains and losses of patients and how this relates to the level of competition faced by each hospital. The results have been presented in the form of the published paper. The supplementary material referred to in the paper is available at the end of this section.

### 5.2 Research paper 3

**“Hospital quality factors influencing the mobility of patients for radical prostate cancer radiation therapy: a national population based study”**

The online PDF can be accessed at:

**[http://www.redjournal.org/article/S0360-3016\(17\)33774-4/pdf](http://www.redjournal.org/article/S0360-3016(17)33774-4/pdf)**





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## RESEARCH PAPER COVER SHEET

**PLEASE NOTE THAT A COVER SHEET MUST BE COMPLETED FOR EACH RESEARCH PAPER INCLUDED IN A THESIS.**

### SECTION A – Student Details

Student	Ajay Aggarwal
Principal Supervisor	Jan van der Meulen
Thesis Title	Evidence and impact of NHS choice and competition policies on the delivery of prostate cancer services: a national population based evaluation

**If the Research Paper has previously been published please complete Section B, if not please move to Section C**

### SECTION B – Paper already published

Where was the work published?	International Journal of Radiation Oncology Biology Physics		
When was the work published?	August 2017		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
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### SECTION C – Prepared for publication, but not yet published

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Stage of publication	

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Student Signature: \_\_\_\_\_

Date: 22.09.17

Supervisor Signature: \_\_\_\_\_

Date: 22 Sept 2017

Clinical Investigation

# Hospital Quality Factors Influencing the Mobility of Patients for Radical Prostate Cancer Radiation Therapy: A National Population-Based Study

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## Summary

Using geographic information systems and econometric modeling, we present the first national study evaluating the hospital quality factors that attract patients

**Purpose:** To investigate whether patients requiring radiation treatment are prepared to travel to alternative more distant centers in response to hospital choice policies, and the factors that influence this mobility.

**Methods and Materials:** We present the results of a national cohort study using administrative hospital data for all 44,363 men who were diagnosed with prostate cancer and underwent radical radiation therapy in the English National Health Service between 2010 and 2014. Using geographic information systems, we investigated the extent to which men choose to travel beyond (“bypass”) their nearest radiation therapy

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the authors and not necessarily those of the NHS, the National Institute for Health Research, or the Department of Health.

Hospital Episode Statistics were made available by the NHS Health and Social Care Information Centre (©2012, reused with the permission of NHS Digital. All rights reserved.)

Data for this study are based on patient-level information collected by the NHS, as part of the care and support of cancer patients. The data are collated, maintained, and quality assured by the National Cancer Registration and Analysis Service, which is part of Public Health England. Access to the data was facilitated by Public Health England's Office for Data Release.

Conflict of interest: H.P. has worked as a consultant and has been paid for lectures and received hospitality to travel to meetings from Janssen, Astellas, Ferring, Sanofi Aventis, and Novartis.

Supplementary material for this article can be found at [www.redjournal.org](http://www.redjournal.org).

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for radiation therapy treatment in health care markets. We found that 1 in 5 men bypassed their nearest radiation therapy center for treatment, especially those who were younger and more affluent. In the absence of indicators reflecting treatment quality, centers that were early adopters of intensity modulated radiation therapy or that offered shorter hypofractionated treatment schedules were more attractive to patients.

center, and we used conditional logistic regression to estimate the effect of hospital and patient characteristics on this mobility.

**Results:** In all, 20.7% of men ( $n=9161$ ) bypassed their nearest radiation therapy center. Travel time had a very strong impact on where patients moved to for their treatment, but its effect was smaller for men who were younger, more affluent, and from rural areas ( $P$  for interaction always  $<.001$ ). Men were prepared to travel further to hospitals that offered hypofractionated prostate radiation therapy as their standard schedule (odds ratio 3.19,  $P<.001$ ), to large-scale radiation therapy units (odds ratio 1.56,  $P<.001$ ), and to hospitals that were early adopters of intensity modulated radiation therapy (odds ratio 1.37,  $P<.001$ ).

**Conclusions:** Men with prostate cancer are prepared to bypass their nearest radiation therapy centers. They are more likely to travel to larger established centers and those that offer innovative technology and more convenient radiation therapy schedules. Indicators that accurately reflect the quality of radiation therapy delivered are needed to guide patients' choices for radiation therapy treatment. In their absence, patient mobility may negatively affect the efficiency and capacity of a regional or national radiation therapy service and offer perverse incentives for technology adoption. © 2017 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Many countries have introduced policies that allow patients to choose the hospital where they have their treatment (1, 2). Patients are expected to choose a hospital that delivers better-quality care, and the resultant competition between providers as they attempt to attract new patients is expected to stimulate improvements in quality. However, for complex treatments such as radiation therapy we have no data to support whether patients are prepared to travel to alternative, more-distant centers, or the quality factors that influence this.

It is also debatable whether such policies are relevant in cancer care, given the increasing centralization of cancer services, which by its nature will reduce the choices available to patients (3, 4). Treatment decisions are complex, and the therapy itself may last for months, resulting in significant physical and financial burden for those considering treatment at a more-distant hospital. Furthermore, there is a lack of valid performance indicators that accurately reflect the quality of cancer treatment, especially radiation therapy.

However, radiation therapy has seen a relentless diffusion of new technologies over the last decade, which has shaped clinical practice in both the targeting and delivery of treatment. It has been suggested that in certain health care markets, clinicians and hospital providers are encouraged to diversify practice through the integration and marketing of new high-cost technologies (eg, proton beam therapy), to attract new patients. However, this has been largely anecdotal, with little or no evidence in publicly funded health systems (5, 6).

Using linked patient-level national datasets, geographic information systems, and applied econometric modeling,

we investigated whether prostate cancer patients who had radical radiation therapy in the English National Health Service (NHS) “bypassed” their nearest radiation therapy provider for treatment, as well as the provider and patient characteristics associated with that mobility.

The NHS provides an ideal system for understanding the impact of patient choice policies. It is a national, single-payer, tax-based system in which care is free and not based on ability to pay for insurance or treatment. The costs of services are fixed under a national tariff, and providers are therefore expected to compete on quality and not price (7). Patients have access to all available NHS providers in England, with no explicit restrictions on the choices available.

## Methods and Materials

We obtained individual patient-level data on all patients diagnosed with prostate cancer between January 1, 2010, and March 31, 2014 who subsequently underwent radiation therapy in the English NHS. Data were retrieved from the National Cancer Registration and Analysis Service and linked at patient level to the National Radiotherapy Dataset and Hospital Episode Statistics (8, 9). Patients who underwent radiation therapy in the private sector were not included in the analysis ( $<10\%$  of eligible patients).

The National Radiotherapy Dataset provided information on each patient's radiation therapy treatment: start and finish dates, treatment site (primary with or without regional nodes), total dose, number of fractions, and radiation therapy technique (intensity modulated radiation therapy vs 3-dimensional conformal radiation therapy). The National Cancer Registration and Analysis Service dataset



provided information on cancer stage and the Hospital Episode Statistics dataset on age and comorbidities. Cancer severity was categorized according to a modified D'Amico classification system (10-12). The patients' place of residence was available as the Lower Layer Super Output Area (LSOA), a geographic area that typically includes 1500 residents or 650 households (13, 14).

### Travel times

The population-weighted centroids of the patients' LSOAs (used to define patient residence) and the full postal codes for the hospitals where the radiation therapy was undertaken were inputted into a geographic information system (ESRI ArcGIS 10.3) to calculate travel times according to the fastest route by car (using Ordnance Survey MasterMap Integrated Transport Network).

### Assessment of mobility

All radiation therapy treatment providers (n=57) were ranked according to the distance in terms of drive time by car from the patient's residence. The proportion of patients not receiving care at their nearest provider (ranked >1) were considered to be "by-passers" (15).

We identified for each radiation therapy center the number of patients for whom that center was nearest but who had their treatment elsewhere—"leavers"—and also those patients for whom another radiation therapy center was nearest but who had their radiation therapy at that center—"arrivers." A center was identified as being a "winner" or "loser" of patients if the difference between arrivers and leavers was statistically significant (16). Patients receiving radiation therapy at their nearest center were defined as "core users."

### Competition indices

For each center we also calculated a spatial competition index (SCI) as a measure of "external competition" (17, 18). The SCI provides a uniform metric that can be used across all centers in England to factor in the demand for services and the availability of alternative hospitals for patients to choose. In this analysis the SCI for a radiation therapy center was calculated according to both the number of eligible patients within a 60-minute drive and the number of alternative radiation therapy centers within a 60-minute drive for each eligible patient:

$$SCI_i = 1 - \frac{1}{n_i} \sum_{j=1}^{n_i} \frac{1}{k_{ji}}$$

where radiation therapy center *i* has *n* eligible patients within a 60-minute drive and patient *j* in center *i* has *k* alternative radiation therapy centers within a 60-minute drive. The SCI ranges theoretically from 0 for centers in a monopoly environment to a value close to 1 for centers in the most competitive environment.

### Patient characteristics

Four patient-level variables were derived from the linked dataset. First, patient age at the time of prostate cancer diagnosis. Second, the Royal College of Surgeons Charlson Score was used to identify the number of comorbidities (19). Third, the Index of Multiple Deprivation (IMD) was used as a measure of the patients' socioeconomic deprivation (20). The IMD was stratified into quintiles according to the national distribution, such that 1 represents households in the 20% least deprived and 5 in the 20% most deprived LSOAs. Fourth, the patients' area of residence was classified as urban or rural (21).

### Hospital characteristics

At the start of the study there were 52 radiation therapy centers across England. A further 5 centers opened during the study period. In the absence of publicly reported performance indicators for prostate cancer radiation therapy, we created 4 hospital-level variables as proxies for quality, which may make a hospital more attractive to patients when considering where to have radiation therapy treatment. These variables were informed by the peer-reviewed literature, in-depth qualitative interviews undertaken by the study team with men previously treated for prostate cancer in the United Kingdom, and The National Prostate Cancer Audit organizational survey (22).

We identified the 28 "university teaching hospitals," on the basis of their membership of the Association of UK University Hospitals (23). Studies have demonstrated that teaching hospital status is associated with higher quality for certain interventions compared with non-teaching hospitals and therefore may be preferentially chosen by patients (24-28).

Second, we labeled the 3 hospitals that were delivering intensity modulated radiation therapy (IMRT) as a standard of care at the start of the study period (2010) as "early IMRT adopters." There was emerging evidence at the time that this technique delivered improved outcomes (reduced pelvic toxicity) relative to standard 3-dimensional conformal techniques (29, 30). In addition, IMRT was already a standard of care in countries such as the United States in 2010, which may have prompted patients to seek treatment at centers that offer this technique in the NHS (29, 30).

Third, we identified 8 centers that we classified as "large-scale radiation therapy units" on the basis of the number of linear accelerators on site. The median number of linear accelerators across the 57 English NHS radiation therapy centers was 4 (range, 2-12) (31). Centers with ≥8 linear accelerators on site (ie, in the top quintile based on the distribution of linear accelerators) were considered to meet this criteria. These centers may have been considered preferentially by patients owing to their large capital and staff infrastructure investment toward radiation therapy facilities or wider reputation effects from being regional centers.

Fourth, we identified 4 centers that were delivering hypofractionated radiation therapy (ie, higher dose per treatment delivered over fewer total number of attendances) as their standard dose-fractionation regimen for prostate cancer at the start of the study period in 2010. Although a dose of 74 Gy delivered over 37 treatments remains the standard of care, hypofractionated regimens halve the duration of treatment, from 8 weeks to 4 weeks (32, 33).

### Statistical analysis

We used conditional logit regression to model the odds that a patient moved to a particular hospital as a function of travel time and hospital and patient characteristics (34, 35). We created a data set that included for each patient a row for each hospital providing prostate cancer radiation therapy at the time of treatment (number of hospitals varied between 52 and 57 because 5 hospitals opened during the study period). The dependent variable of the conditional logit model was a dummy variable with a value of 1 for the hospital where a patient had his treatment and a value of 0 otherwise.

Travel time was included in the model as the additional time men had to travel beyond their nearest hospital to an alternative hospital providing radiation therapy. In this way we accounted for the variation in service configuration across England. Per definition, additional travel time was 0 minutes if a patient had his radiation therapy in the nearest radiation therapy center.

First, we modeled the effect of travel time and individual hospital characteristics on the odds of moving to a particular hospital as part of a univariate analysis. In the second model, we included both hospital characteristics and travel time as part of a multivariate conditional regression model. In the third model, we included travel time, hospital characteristics, and the interactions of patient characteristics with travel time. Patient characteristics included age, comorbidity, socioeconomic background, and urban or rural residence. (We present the results of both models in Tables 3 and 4.) Stata version 14 was used to undertake the statistical analyses (StataCorp, College Station, TX).

## Results

### Patient population

We identified 46,654 men diagnosed with prostate cancer between January 1, 2010, and March 31, 2014 who subsequently received radiation therapy (Supplementary Material Appendix 1; available online at [www.redjournal.org](http://www.redjournal.org)). Of these men, 44,860 received radical radiation therapy. A total of 497 men were excluded because they lived outside England or could not be assigned to an NHS radiation therapy provider. The final study cohort comprised 44,363 men, and patient characteristics are presented in Table 1.

**Table 1** Characteristics of 44,363 men undergoing radical radiation therapy between 2010 and 2014 in the English National Health Service

Characteristic	n	%
Age (y)		
<65	12,951	29.2
65-69	9453	21.3
70-74	12,373	27.9
≥75	9586	21.6
Cancer severity		
Advanced	620	1.8
Locally advanced	19,037	55.6
Intermediate localized	13,292	38.8
Low-risk localized	1276	3.7
Insufficient staging information (n=10,138)		
No. of comorbidities		
0	34,368	77.5
≥1	9995	22.5
Index of multiple deprivation (national quintiles)		
1 (least deprived)	10,832	24.4
2	10,780	24.3
3	9651	21.8
4	7336	16.5
5 (most deprived)	5764	13.0
Urban rural classification*		
Urban	33,332	75.1
Rural	11,031	24.9

\* See text for definition.

### Patient mobility

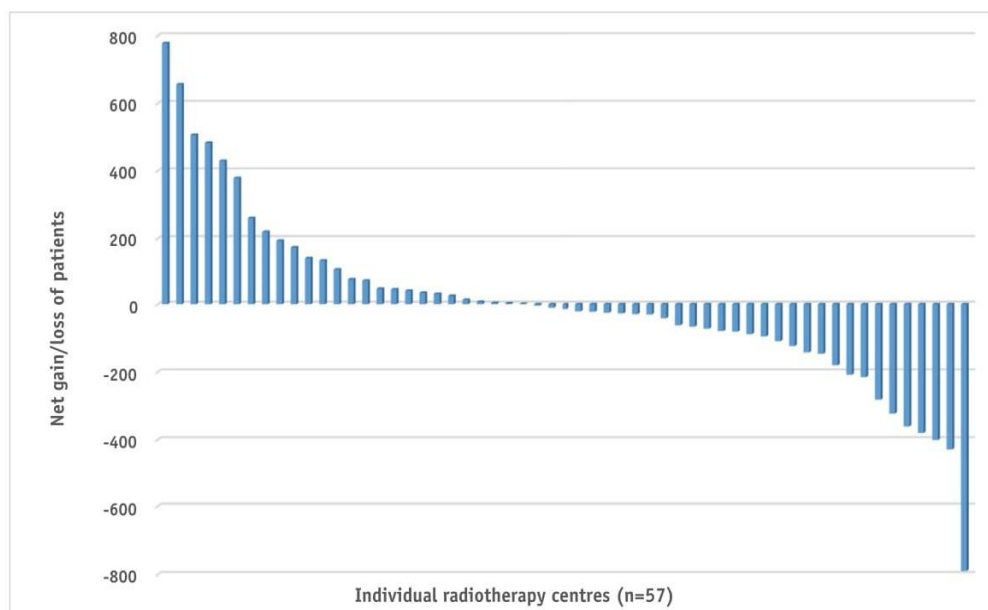
In all, 9161 men (20.7%) “bypassed” or traveled beyond their nearest radiation therapy center to an alternative, more-distant center (Table 2); 5142 men (12.6%) bypassed only 1 center, and 1125 men (2.5%) bypassed 5 or more centers for treatment (Table 2). Figure 1 demonstrates the net gains and losses of patients by individual prostate cancer radiation therapy centers (n=57) due to patient mobility during the study period. Of the 57 centers, 19 (33.3%) were classified as “winners” and 25 (43.9%) as “losers”; 13 centers had no statistically significant net gain

**Table 2** Patient mobility of 44,363 men undergoing radical radiation therapy between 2010 and 2014 in the English National Health Service: Number of hospitals “bypassed” and median travel time

No. of hospitals bypassed*	No. of patients (%)	Travel time (min), median (interquartile range)
0	35,202 (79.4)	20.7 (12.1-32.7)
1	5142 (12.6)	38.3 (23.4-53.6)
2	1764 (4.0)	44.0 (22.9-59.6)
3	822 (1.9)	46.7 (34.7-60.6)
4	308 (0.7)	55.6 (43.3-67.3)
≥5	1125 (2.5)	52.9 (36.8-89.8)

\* Hospitals are considered to be “bypassed” if a man has radiation therapy in a hospital that is further away from his place of residence in terms of travel time by car.





**Fig. 1.** Net gains and losses of patients by each radiation therapy center (blue bars) due to patient mobility between 2010 and 2014. (A color version of this figure is available at [www.redjournal.org](http://www.redjournal.org).)

or loss of patients. Some of the “winners” were treating 500 or more patients than expected if they had been operating solely on men for whom they were the nearest center. Conversely, some of the “losers” were treating nearly 400 fewer procedures than expected. When considering the degree of external competition faced by each center, centers experiencing the largest net gains or losses were predominantly located in the most competitive areas (SCI between 0.70 and 1) (Fig. 2).

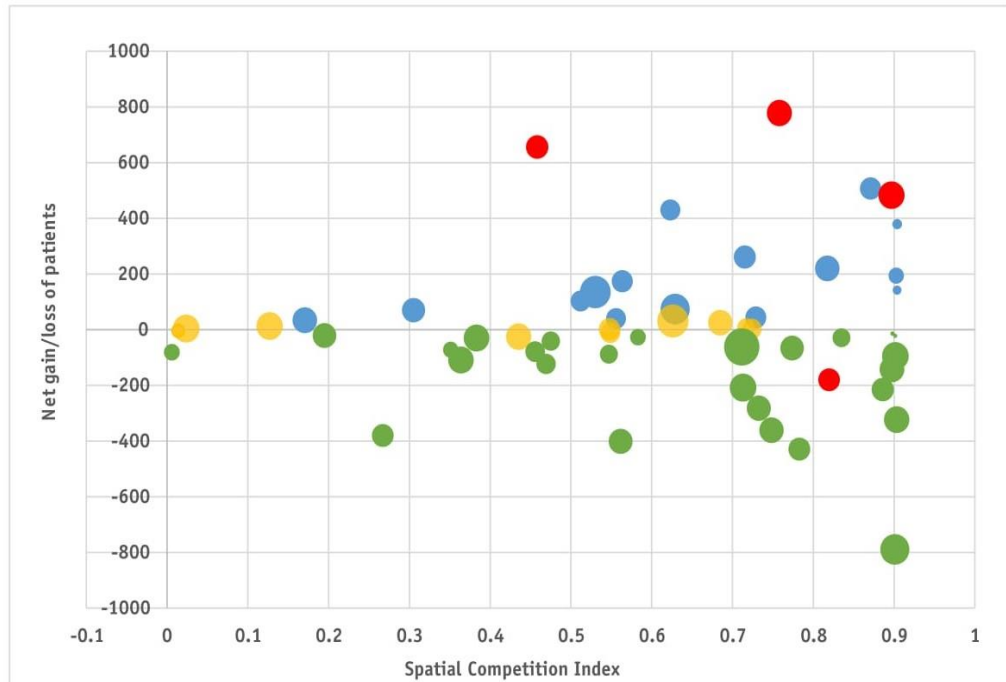
### Impact of travel time and patient and hospital characteristics on patient mobility

Travel time had a very strong impact on the odds that a patient traveled to a particular hospital to receive radiation therapy in the univariate and multivariate conditional regression models (Tables 3 and 4). The odds of a patient traveling to a hospital that was up to 10 minutes further away than the patient’s nearest radiation therapy provider was found to be on average 72% smaller (odds ratio [OR] of 0.28) according to a conditional logit model that only included additional travel time (Table 3, model 1). The odds of a patient traveling to a particular hospital decreased markedly as the additional travel time increased.

The results of the univariate analysis assessing the impact of hospital characteristics on the odds of traveling further to a particular hospital are presented in Table 3 (model 1). When considering the impact of hospital characteristics on mobility patterns of patients as part of a multivariate regression model including travel time and patient characteristics, men were 3.19 times more likely to travel to a particular radiation therapy center if it offered hypofractionated radiation therapy as standard (Table 4,

model 3). In addition, patients were 1.56 times more likely to travel to a center classified as a large-scale radiation therapy unit, and 1.37 times more likely to travel to a center if it was an established IMRT center. There was a small but significant increase in the likelihood that patients traveled to a specific center if it had university hospital status (OR 1.19).

The addition of patient characteristics as interaction terms into our model showed that the impact of travel time was smaller for men who were younger and for those who lived in more affluent or rural areas, because the ORs expressing the interaction terms are greater than 1 (Table 4, model 3). The greater the size of the interaction term value, the larger its attenuating effect on the impact of travel time. For example, compared with having the radiation therapy at the nearest provider, for men classified as living in urban and less affluent areas, who are aged  $\geq 65$  years, and who have comorbidities, the odds of traveling to a hospital that was up to 10 minutes further away was estimated to be 82% smaller (OR 0.18). The corresponding figure for men from rural areas (keeping all other patient characteristics the same as described) was 60% smaller (OR 0.40 =  $0.18 \times 2.23$ , based on multiplying the OR of the main effect of additional travel time with the OR of the interaction term). This implies that men from rural areas have a greater odds of traveling to an alternative hospital up to 10 minutes further away compared with men from urban areas. Different patient characteristics attenuate the effect further. For example, men from both rural and affluent areas (positive interaction terms) have an even greater odds of traveling to an alternative hospital up to 10 minutes further away (keeping all other patient characteristics the same, OR 0.51 =  $0.16 \times 2.23 \times 1.26$ ) compared with men from urban and less affluent areas.



**Fig. 2.** Graph demonstrating the impact of competition (measured by the spatial competition index [SCI]) on the net gain or loss of patients for radiation therapy centers between 2010 and 2014. SCI score = 0: Hospital facing weakest competition; SCI score = 1: Hospital facing strongest competition; size of circle = number of men expected to have radiation therapy at center; blue = centers classified as “winners”; green = centers classified as “losers”; orange = centers with no statistically significant gain or loss of patients; red = centers offering hypofractionated radiation therapy as standard.

## Discussion

There is limited evidence about what factors inform and influence cancer patients’ choice of treatment provider (1). In this study we demonstrate that in the United Kingdom NHS, 1 in 5 patients who have radiation therapy treatment

“bypass” their nearest radiation therapy center. Travel time had a very strong impact on where patients received their treatment, but this effect was smaller for men who were younger, more affluent, or living in rural areas. Men were more likely to travel to centers that offered shorter hypofractionated radiation therapy regimens as standard for

**Table 3** Impact of travel time and hospital characteristics on patient mobility in 44,363 men undergoing radical radiation therapy between 2010 and 2014 in the English National Health Services

Parameter	Unadjusted OR (model 1)*	95% CI	P <sup>†</sup>	Adjusted OR (model 2) <sup>‡</sup>	95% CI	P <sup>†</sup>
Impact of additional travel time (min)	1		<.001	1		<.001
<10	0.28	0.27-0.29		0.27	0.26-0.28	
11-30	0.07	0.06-0.07		0.06	0.05-0.06	
31-60	0.006	0.005-0.06		0.005	0.004-0.005	
>60	0.0002	0.0001-0.0002		0.0002	0.0001-0.0002	
Impact of hospital characteristics						
University hospital	1.28	1.26-1.31	<.001	1.18	1.14-1.23	<.001
Large-scale RT unit	1.95	1.91-1.99	<.001	1.55	1.48-1.62	<.001
Early adopter of IMRT	1.15	1.11-1.20	<.001	1.37	1.30-1.46	<.001
Hypofractionated treatment (standard)	1.73	1.68-1.78	<.001	3.10	2.92-3.28	<.001

Abbreviations: CI = confidence interval; IMRT = intensity modulated radiation therapy; OR = odds ratio; RT = radiation therapy.

\* Model 1 presents unadjusted ORs from the univariate analysis assessing the impact of additional travel time and hospital characteristics on the odds that a patient travels to a particular hospital.

<sup>†</sup> P value based on likelihood ratio test.

<sup>‡</sup> Model 2 presents adjusted ORs from the multivariate conditional logit analysis assessing the impact of both additional travel time and hospital characteristics on the odds that a patient travels to a particular hospital.

**Table 4** Impact of travel time and hospital and patient characteristics on patient mobility in 44,363 men undergoing radical radiation therapy between 2010 and 2014 in the English National Health Service

Parameter	Adjusted OR (model 3)*	95% CI	P <sup>†</sup>
Impact of additional travel time (min) <sup>‡</sup>	1		<.001
<10	0.18	0.16-0.20	
11-30	0.04	0.04-0.05	
31-60	0.002	0.002-0.003	
>60	0.00006	0.00004-0.00009	
Impact of hospital characteristics			
University hospital	1.19	1.14-1.23	<.001
Large-scale RT unit	1.56	1.49-1.63	<.001
Early adopter of IMRT	1.37	1.30-1.45	<.001
Hypofractionated treatment (standard)	3.19	3.01-3.37	<.001
Difference in impact of additional travel time for selected patient characteristics <sup>§</sup>	Interaction terms		
Younger patients (<65 y)			<.001
<10	1.17	1.07-1.28	
11-30	1.10	1.00-1.21	
31-60	1.42	1.15-1.76	
>60	2.01	1.46-2.77	
Patients without comorbidities			NS
<10	0.95	0.87-1.03	
11-30	0.93	0.85-1.02	
31-60	0.96	0.79-1.17	
>60	1.24	0.94-1.63	
Patients from more affluent areas (IMD 1 or 2)			<.001
<10	1.26	1.17-1.36	
11-30	1.20	1.10-1.29	
31-60	1.08	0.92-1.29	
>60	1.31	1.05-1.62	
Patients from rural areas			<.001
<10	2.23	2.04-2.44	
11-30	2.21	2.03-2.42	
31-60	3.21	2.72-3.79	
>60	1.87	1.51-2.33	
McFadden's pseudo R <sup>2</sup>	0.82		

Abbreviations: IMD = Index of Multiple Deprivation; NS = nonsignificant. Other abbreviations as in Table 3.

\* Model 3 presents adjusted odds ratios from the multivariate conditional logit analysis assessing the impact of additional travel time, hospital characteristics, and patient characteristics on the odds that a patient travels to a particular hospital.

<sup>†</sup> P value based on likelihood ratio test.

<sup>‡</sup> Note that the adjusted ORs for the impact of additional travel time in model 3 relates to a particular patient group: older men (≥65 years), with comorbidity (Charlson ≥1), from less affluent (IMD 3-5) and urban areas.

<sup>§</sup> The impact of selected patient characteristics on additional travel time is presented as interaction terms. These should be multiplied with the corresponding adjusted OR for additional travel time to formulate a new OR. Interaction terms can be used in any combination to assess the effect of different patient characteristics on the odds that a patient travels to a particular hospital. For example, the adjusted ORs presented (‡) relate to older men (≥65 years), with comorbidity (Charlson ≥1), from less affluent (IMD 3-5) and urban areas. To calculate the new OR for younger and more affluent men traveling 11-30 minutes, but who still have comorbidity and live in urban areas, multiply 0.04 (travel time adjusted OR for 11-30 minutes) by the corresponding interaction term for men who are affluent (1.20) and men living in rural areas (2.21). The new odds ratio is  $0.04 \times 1.20 \times 2.21 = 0.11$ . That is, men with these patient characteristics have a greater odds of traveling up to 30 minutes to a particular hospital.

prostate cancer, larger established radiation therapy units, and those centers that utilized IMRT earlier. Mobility between providers resulted in winners and losers, with some centers treating hundreds more patients each year than expected if they only treated local patients.

These findings are relevant across a range of elective secondary care cancer services in countries that have introduced patient choice of provider policies (1). A substantial number of patients were prepared to bypass their

nearest radiation therapy center despite the absence of comparative provider-level performance information relating to the quality of radiation therapy treatment and the prolonged duration of treatment.

The routine availability of hypofractionated radiation therapy for prostate cancer was the strongest hospital-level driver of patient mobility. It is not possible to say whether patients were prepared to travel further to these centers because hypofractionated radiation therapy is more



convenient or because patients considered these centers to be innovative and therefore potentially better (36). However, the potential desire for treatment of shorter duration correlates with our study findings that travel time has a very strong impact on the choices that patients make. In addition, previous research has shown that patients are reluctant to undergo radiation therapy compared with other prostate cancer treatment modalities, owing to its prolonged duration (37).

Patients in our cohort were more likely to travel to the 3 centers labeled as early adopters of IMRT, despite rapid expansion in the availability of IMRT across centers in England during the study period (38, 39). This suggests that there is a wider reputation effect associated with being an early adopter of innovation and that patients may have considered these centers to be at the forefront of technology (40, 41). To illustrate this point, all 3 established IMRT centers were also amongst the first adopters of stereotactic body irradiation in England (12). Similarly, patients were more likely to travel to larger-scale radiation therapy units, which may have had a wider reputation as being a regional center of excellence for radiation therapy or cancer care more generally.

The patterns of mobility observed has resulted in large and unexpected shifts in market share. Radiation therapy centers located in the most competitive areas had significant gains and losses of patients (Fig. 2). In the NHS, funding follows the patient (7), and therefore centers losing patients may have to cease providing that service owing to lost income. Such an eventuality has already transpired for surgical centers providing radical prostatectomy, several of which have closed in the last 5 years (42). This pattern of winners and losers also highlights the inefficiency and wasted capacity within the current radiation therapy service, which may further increase as a result of the current drive toward opening new radiation therapy centers across England (5 opened during the study period) to improve access to treatment. Equally, the impact on service capacity (eg, waiting times) needs to be considered for those centers treating significant numbers of out-of-area patients.

### Appropriate implementation of advanced radiation technologies

In the absence of performance indicators, centers that diversify their clinical practice (eg, through the integration of new technology) are potentially more attractive to patients. In the United States, competition has been a key driver in the rapid expansion of innovative radiation therapies, such as IMRT, proton beam therapy, and Cyberknife, for the management of prostate cancer to maintain market share and attract new patients. This has occurred at significant additional cost without any clear evidence for benefits to patients over existing standards of care (6,30,43-46).

To avoid similar patterns of technology adoption for radiation therapy across different health systems, we recommend the use of formal health technology assessment

processes to support decision making regarding the integration of new technologies in publicly funded systems (5, 47). In contrast to new cancer drugs, radiation therapy has remained beyond the remit of health technology assessment (5). The Health Economics in Radiation Oncology project, which is being carried out under the auspices of the European Society for Radiotherapy and Oncology, is attempting to define economic frameworks for assessing the clinical and economic benefit of new radiation therapy technologies and is still in its infancy (48).

There is also a necessity to develop valid performance indicators for radiation therapy to guide patient decision making and potentially stimulate improvements in treatment outcomes through “quality competition” as patients are responsive to perceived differences in quality (49). This is important, given the increasing reliance on unsubstantiated web- and media-based cancer information, especially for new technologies (50-52). A series of process indicators have been proposed by professional bodies, but these are hard for patients to interpret (53, 54). Although outcome measures are preferable, an important caveat is that these can only be published following a lag period (toxicity measures at 1 and 5 years) (55).

### Methodologic limitations

Our modelling of patient mobility used centroids of the LSOAs, small geographic regions typically made up of approximately 650 households, to represent the location of the patients’ residence. This approach has been used in previous studies of patient mobility in England (56). However, it is likely that the “noise” added to the travel times will have attenuated rather than enhanced the observed relationships. Our model uses average drive times, which is the standardized methodology for these analyses and considered superior to straight-line distance. However, we do acknowledge that drive times are variable depending on the time of day, which may affect patients’ decision making. In addition, public transport times were not available for this analysis.

We have not included waiting times as a factor influencing provider choice, because these were not publicly available for individual centers. Some patients may have considered moving to alternative providers to receive quicker treatment; however, extensive efforts have been made in the English NHS to ensure prompt diagnosis and treatment of suspected cancer patients through a system of defined targets (57, 58). In 2014/2015 95.3% of people treated for urologic cancers in the NHS began their first definitive treatment within the 31-day target (59). Other potential determinants of mobility, such as care giver/work location, were not available in our dataset, and we were unable to assess the effect of disease severity owing to incomplete staging data. However, the overall impact on our observed patterns of mobility is likely to be small in the context of up to 20% of patients bypassing their



nearest provider. The overall predictive probability of our model, despite these exclusions, is very high, 82% (note models with values above 60% for goodness of fit estimation are considered to have a high degree of explanatory power) (60).

## Conclusions

Men with prostate cancer are prepared to bypass their nearest provider for radical radiation therapy, particularly those who are younger and more affluent. They are more likely to travel to larger established centers and those that offer innovative technology and shorter radiation therapy schedules. Patient mobility varies significantly across regions and between centers and is mainly evident in areas where competition between providers is strongest. This in itself implies that competition as a mechanism to stimulate improvements in the quality of care can only work in specific parts of the country. Indicators that accurately reflect the quality of radiation therapy delivered are essential to guide patients' choices for radiation therapy treatment. In their absence, patient mobility may negatively affect the efficiency and capacity of regional or national radiation therapy services and offer perverse incentives for technology adoption even in publicly funded health systems.

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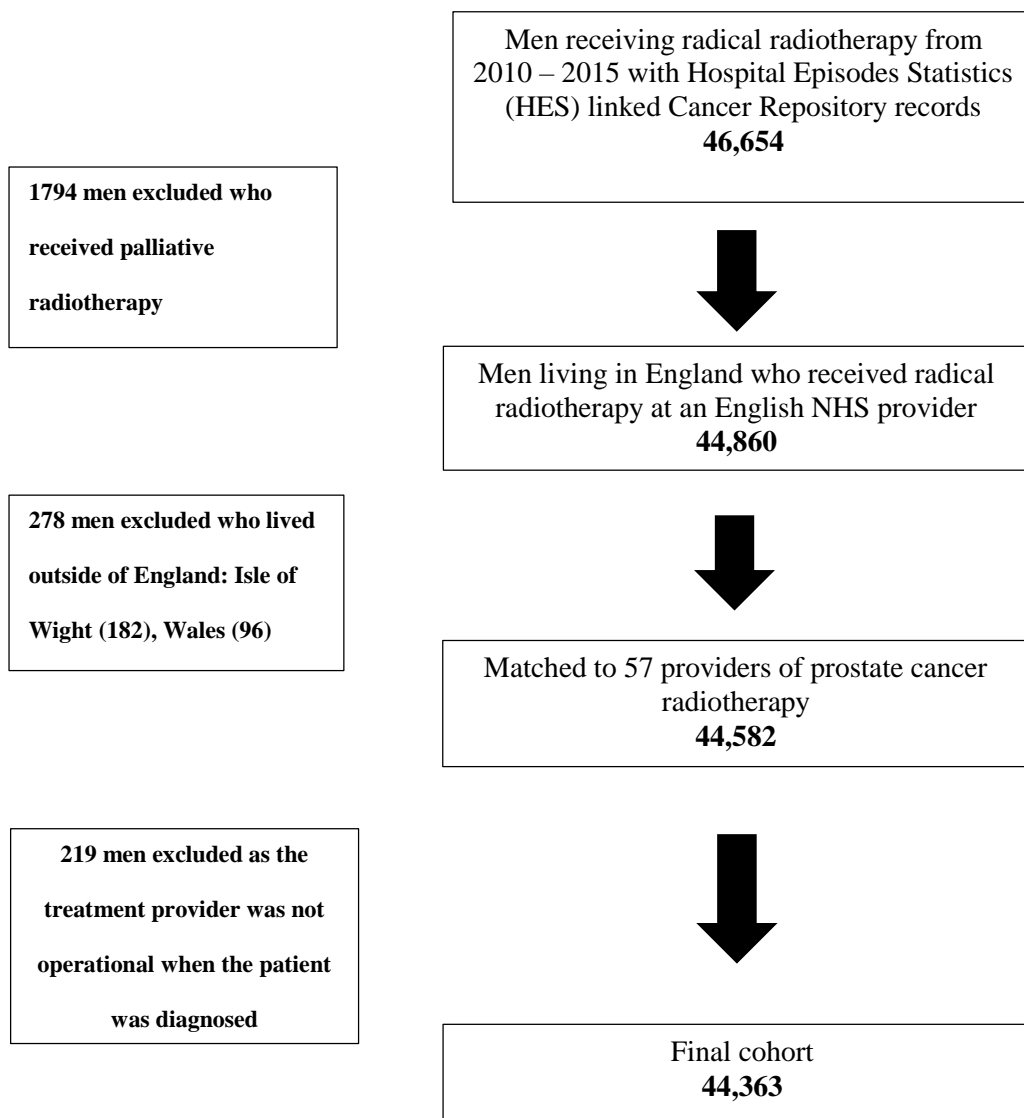
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## Supplementary Material

### Appendix 1. Flow chart of men included in the study



## **6. RESULTS CHAPTER 4**

### **6.1 Impact of choice and competition on cancer service delivery**

The previous results paper evaluated the impact of patient mobility on individual radiotherapy providers in terms of their net gains and losses of patients. With respect to prostate cancer surgery, it was noted during the time-period of analysis (2010-2014) that some centres closed their radical prostatectomy service. At the same time, there was an increase in the numbers of centres performing robot-assisted techniques. Chapter 6 analysed whether there was an association between the net gains and losses of patients by individual providers and the intensity of hospital competition on both the observed closures of centres and the adoption of robotic surgical equipment. The results have been presented in the form of the published paper. The supplementary material referred to in the paper is available at the end of this section.

### **6.2 Research paper 4**

**“Effect of patient choice and hospital competition on service configuration and technology adoption within cancer surgery: a national population based study”**

**The online PDF can be accessed at:**

**[http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045\(17\)30572-7/fulltext?elsca1=tlpr](http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(17)30572-7/fulltext?elsca1=tlpr)**

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Student	Ajay Aggarwal
Principal Supervisor	Jan van der Meulen
Thesis Title	Evidence and impact of NHS choice and competition policies on the delivery of prostate cancer services: a national population based evaluation

**If the Research Paper has previously been published please complete Section B, if not please move to Section C**

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Where was the work published?	Lancet Oncology		
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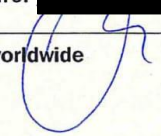
For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I designed the study, undertook the analysis and wrote the first draft of the manuscript
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Student Signature: \_\_\_\_\_

Date: 22.09.17

Supervisor Signature: \_\_\_\_\_

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# Effect of patient choice and hospital competition on service configuration and technology adoption within cancer surgery: a national, population-based study



Ajay Aggarwal, Daniel Lewis, Malcolm Mason, Arnie Purushotham, Richard Sullivan, Jan van der Meulen



## Summary

**Background** There is a scarcity of evidence about the role of patient choice and hospital competition policies on surgical cancer services. Previous evidence has shown that patients are prepared to bypass their nearest cancer centre to receive surgery at more distant centres that better meet their needs. In this national, population-based study we investigated the effect of patient mobility and hospital competition on service configuration and technology adoption in the National Health Service (NHS) in England, using prostate cancer surgery as a model.

**Methods** We mapped all patients in England who underwent radical prostatectomy between Jan 1, 2010, and Dec 31, 2014, according to place of residence and treatment location. For each radical prostatectomy centre we analysed the effect of hospital competition (measured by use of a spatial competition index [SCI], with a score of 0 indicating weakest competition and 1 indicating strongest competition) and the effect of being an established robotic radical prostatectomy centre at the start of 2010 on net gains or losses of patients (difference between number of patients treated in a centre and number expected based on their residence), and the likelihood of closing their radical prostatectomy service.

**Findings** Between Jan 1, 2010, and Dec 31, 2014, 19 256 patients underwent radical prostatectomy at an NHS provider in England. Of the 65 radical prostatectomy centres open at the start of the study period, 23 (35%) had a statistically significant net gain of patients during 2010–14. Ten (40%) of these 23 were established robotic centres. 37 (57%) of the 65 centres had a significant net loss of patients, of which two (5%) were established robotic centres and ten (27%) closed their radical prostatectomy service during the study period. Radical prostatectomy centres that closed were more likely to be located in areas with stronger competition (highest SCI quartile [0·87–0·92];  $p=0\cdot0081$ ) than in areas with weaker competition. No robotic surgery centre closed irrespective of the size of net losses of patients. The number of centres performing robotic surgery increased from 12 (18%) of the 65 centres at the beginning of 2010 to 39 (71%) of 55 centres open at the end of 2014.

**Interpretation** Competitive factors, in addition to policies advocating centralisation and the requirement to do minimum numbers of surgical procedures, have contributed to large-scale investment in equipment for robotic surgery without evidence of superior outcomes and contributed to the closure of cancer surgery units. If quality performance and outcome indicators are not available to guide patient choice, these policies could threaten health services' ability to deliver equitable and affordable cancer care.

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## Introduction

The centralisation of complex cancer surgery into fewer, high-volume units is occurring across Europe, the USA, and Canada, guided by evidence that centres that carry out a high volume of surgical procedures have better outcomes of care for patients than do centres that carry out a low volume of surgical procedures.<sup>1–3</sup> At the same time, patient choice and hospital competition policies have been introduced in several countries<sup>4–7</sup>—and are under consideration in others<sup>8</sup>—with the aim of improving the responsiveness and efficiency of health services delivered. In health-care systems where hospitals compete on quality and not on price, competition is also

expected to incentivise improvements in the quality of hospital services to attract patients.<sup>9</sup>

Choice and competition, as well as centralisation, attempt to achieve improvements in patient outcomes, but they require different health-system configurations and provider incentives to operate effectively. Finding the right balance between choice and competition on the one hand and centralisation on the other is therefore key, but there is little evidence to guide how best to achieve this.<sup>10</sup>

The UK National Health Service (NHS) is an example of a health system that remains committed to choice and competition as a health-care reform model since the inception of this model in 2006.<sup>11</sup> The cost of providing

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## Research in context

### Evidence before this study

Several countries have introduced policies that allow patients to choose a specific health-care provider, with the aim of improving the quality of care. We did a systematic review to assess the evidence that patients with cancer are willing to travel beyond (bypass) their nearest hospital for cancer surgery, and to assess the effect of competition on outcomes of surgery. We searched PubMed and Embase for relevant articles published between Jan 1, 1990 and Dec 31, 2015. Search criteria are in the appendix. 5994 titles and abstracts were reviewed. Five studies had empirically assessed the mobility of patients for cancer surgery. Patients were attracted to hospitals that had shorter waiting lists, that offered advanced technology, and that had indicators of better service quality than other hospitals. There was significant heterogeneity in the design of empirical studies, including differences in data quality, the geographical unit of analysis, and limited control for the influence of price competition. No studies had looked at the effect of competition on outcomes of cancer.

### Added value of this study

To our knowledge, this is the first national evaluation of the effect of choice and competition policies on the patterns of service configuration and technology adoption for cancer surgery. We studied travel patterns of more than

19 000 patients who had a radical prostatectomy between 2010 and 2014 in the National Health Service (NHS) in England. The mobility of men to alternative, more distant centres resulted in substantial changes in market share for individual surgical centres, which were most marked in areas of highest competition. Centres that lost local patients to other centres were at risk of closure. Patients were attracted to centres offering robotic surgery, and other centres adopted this technology to preserve their market share. We found that, between 2010 and 2017, there has been large-scale adoption of robot-assisted radical prostatectomy, increasing by three times, from 12 centres at the start of 2010 to 42 by 2017. During the same time period, 16 of the 65 NHS radical prostatectomy centres in England closed their prostate cancer surgery unit.

### Implications of all the available evidence

Patients with cancer respond to policies that enable them to choose a surgical provider of their choice. In the absence of appropriate information about quality of care, policies based on patient choice and hospital competition could create incentives for adoption of new technologies without evidence of superior outcomes as hospitals look to retain and attract new patients. The resulting changes in market share for individual hospitals could threaten the viability of their surgical services.

services is fixed under a national rate tariff scheme<sup>12</sup> and hospitals are expected to compete for patients on the basis of quality. Receiving care incurs no additional user charges at the point of access and patients have the right to choose and travel to any hospital that best meets their needs.

Additionally, national policy in the UK continues to advocate centralisation of specialist cancer services such as prostate and oesophagogastric surgery.<sup>13–16</sup> Not only does this serve to reduce the number of hospitals that patients with cancer can choose from, but it is also expected that patients will receive care at their nearest (local) centre on the basis of established secondary care referral pathways for specialist cancer surgery.<sup>17</sup>

However, our 2017 analysis<sup>18</sup> found that not all patients are following the expected referral patterns for specialised cancer surgery. One in three men who had a radical prostatectomy for prostate cancer between 2010 and 2014 in the NHS travelled beyond or bypassed their nearest prostate cancer surgery centre, in many cases across regional boundaries. This observation especially applied to younger, fitter, and more affluent men than to older, less fit, and less affluent counterparts. In the absence of indicators that accurately reflect the quality of prostate cancer surgery, men were attracted to centres offering robot-assisted radical prostatectomy or centres that employed surgeons with a national reputation for prostate cancer surgery.

There is little evidence about what effect patient mobility and hospital competition have had on the

configuration of specialist cancer services and the introduction of new surgical technologies into clinical practice. We used patient-level data and geographical information system modelling to analyse the effect of patient mobility for cancer surgery and hospital competition on service configuration and technology adoption within the NHS, using prostate cancer as a model. In light of our findings, we appraised the international evidence exploring the role of choice and competition policies on the delivery of cancer surgery services and considered opportunities for developing the empirical research base in this area.

## Methods

### Patient population

For this national, population-based study we obtained individual patient-level data from the National Cancer Registration and Analysis Service (NCRAS) for all men who were diagnosed with prostate cancer and underwent a radical prostatectomy in the NHS in England between Jan 1, 2010, and Dec 31, 2014. These data were linked at the individual patient level to Hospital Episode Statistics (HES), the administrative database of all hospital episodes in NHS hospitals in England.<sup>19</sup>

The study was exempt from NHS Research Ethics Committee approval because it involved analysis of an existing dataset of anonymised data for service evaluation.



### Study design

To define each individual patient's residence, we used the population-weighted centroids of small geographical areas termed lower super output areas (LSOAs). These weightings provide location coordinates for the greatest population density in the LSOA. There are 34753 of these small geographical areas (ie, LSOAs) in England, with an average population of about 1600.<sup>20</sup> Both the LSOAs and full postcodes for the hospitals where the surgery was done were inputted into a geographical information system (Esri ArcGIS 10.3) to calculate travel times according to the fastest route by car to all surgical centres in England (calculated by use of the Ordnance Survey MasterMap Integrated Transport Network). Patients receiving surgery at their nearest centre were defined as core users. Those who did not receive care at their nearest surgical centre were classified as bypassers.

For each surgical centre, we identified the number of leavers—patients for whom that centre was nearest but who had their treatment at an NHS centre further away. We also identified the number of arrivers—patients for whom another centre was nearest but who had their surgery at that centre. A centre was identified as being a winner (ie, having a net gain of patients) or loser (ie, having a net loss of patients) if the difference between leavers and arrivers was statistically significant based on the conditional method for testing a difference between two Poisson means.<sup>21</sup>

For each surgical centre we calculated a spatial competition index (SCI) as a measure of external competition.<sup>22,23</sup> The SCI provides a uniform metric that can be used across all surgical centres and that represents the demand for services and the availability of alternative hospitals. Across England, there is variation in the concentration of available hospitals depending on the degree of urbanisation or rurality. For example, the northeast (one of nine English regions) is a predominantly rural area that is 8592 km<sup>2</sup> in size and had three surgical centres at the start of the study period. Conversely, London is 1572 km<sup>2</sup> in size (and the largest urbanised region in Europe) and had ten surgical centres at the start of the study period.<sup>24</sup>

### Data analysis

In this analysis, the SCI for a surgical centre was calculated on the basis of both the number of eligible patients within a 60-min drive and the number of surgical centres within a 60-min drive for each eligible patient; in the equation shown, the surgical centre *i* has *n* eligible patients within a 60-min drive, and patient *j* in centre *i* has *k* surgical centres within a 60-min drive:

$$SCI_i = 1 - \frac{1}{n_i} \sum_{j=1}^{n_i} \frac{1}{k_{ji}}$$

The SCI ranges theoretically from 0 for centres in a monopoly environment to a value close to 1 for centres in the most competitive environment.

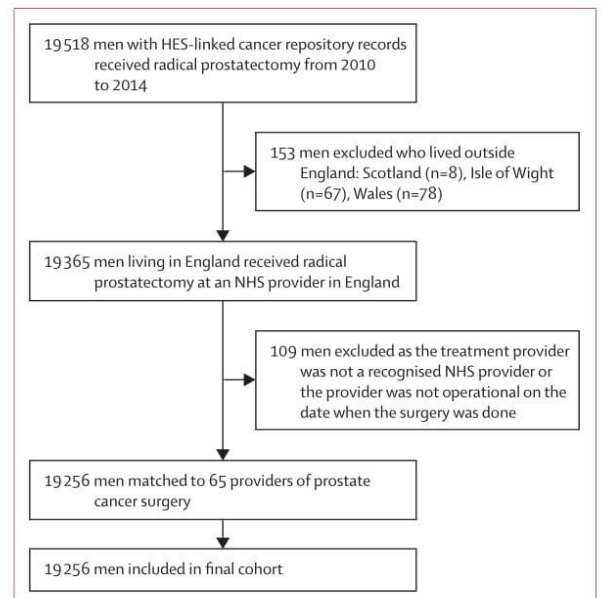
At the start of the study period (January, 2010) there were 65 prostate cancer surgical centres in England, of which 12 centres routinely performed robot-assisted radical prostatectomy procedures. These centres were labelled as established robotic centres. An analysis of HES data, in addition to an organisational survey produced as part of the National Prostate Cancer Audit,<sup>17</sup> was used to evaluate the change in configuration of prostate cancer surgical units across England and the availability of robotic surgery from 2010 onwards. The  $\chi^2$  test was used to compare proportions. All analyses were done with Stata, version 14, to assess the effect of competition, as measured by the SCI, on changes in service configuration (expressed as net gains or losses of patients as defined above) and adoption of robotic surgery in the NHS.

### Role of the funding source

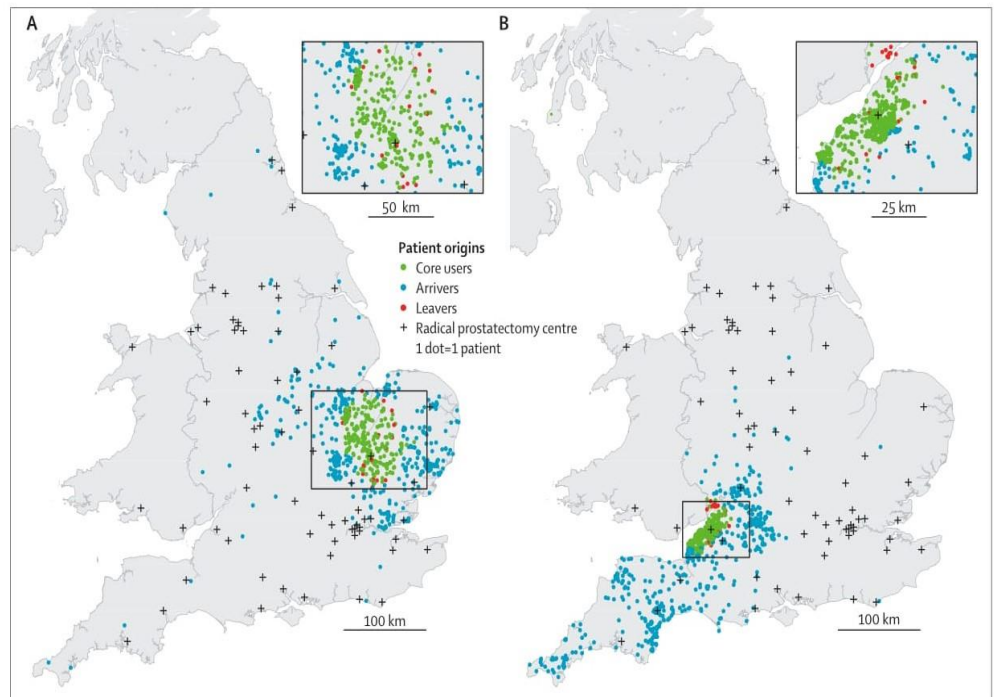
The funder of the study, National Institute for Health Research, had no role in study design, data collection, data analysis, data interpretation, writing of the report, or the decision to submit for publication. AA and JvdM had full access to all the data in the study, take responsibility for the integrity of the data and the accuracy of the data analysis, and had final responsibility for the decision to submit for publication.

### Results

We identified 19 518 men who were diagnosed with prostate cancer and underwent radical prostatectomy in

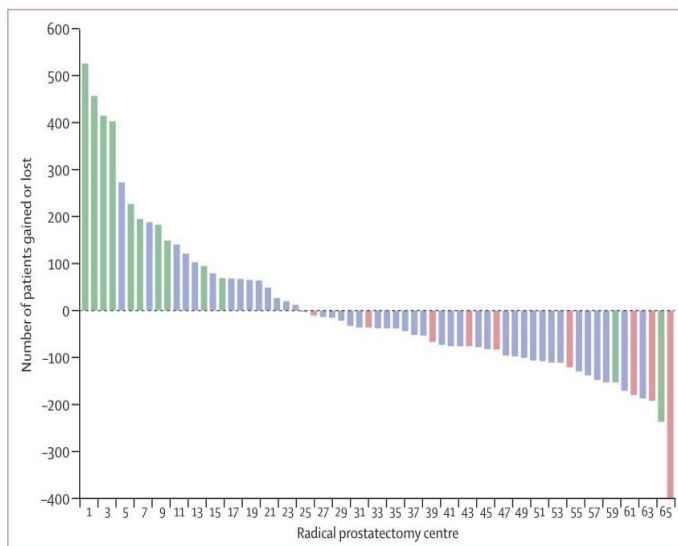


**Figure 1: Flowchart of men included in the study**  
HES=Hospital Episode Statistics. NHS=UK National Health Service.



**Figure 2: Mobility patterns of patients receiving radical prostate cancer surgery at two selected NHS cancer centres**

Maps of the UK, illustrating the mobility pattern of patients who received radical prostate cancer surgery at two selected National Health Service (NHS) cancer centres (indicated with a + symbol in the area of core users) located in the east of England (A) and southwest England (B) that had a net gain of patients from outside their local area (ie, more arrivers than leavers). Both centres were established robotic centres. The maps include a scaled magnification of the region inset. Contains National Statistics data, © Crown copyright and database right 2017; NHS Research Scotland (NRS) data, © Crown copyright and database right 2017; Ordnance Survey data © Crown copyright and database right 2017; and Northern Ireland Statistics and Research Agency data.



**Figure 3: Net gains and losses of patients for each radical prostatectomy centre (n=65) during the study period**

Established robotic radical prostatectomy centres (n=12) shown in green and centres that closed during the 2010–14 study period (n=10) shown in red. Centres in blue are centres that were neither robotic radical prostatectomy centres nor centres that closed during the study period.

the NHS in England between Jan 1, 2010, and Dec 31, 2014. Of these 19 518 men, 262 (1.3%) were excluded because they either lived outside England or could not be assigned to a particular hospital; 19 256 were eligible for inclusion in the study (figure 1).

Figure 2 shows the places of residence for patients who had their prostate cancer surgery at two selected surgical centres located in the east of England (figure 2A) and southwest England (figure 2B), both of which were classified as winners. Figure 3 shows the net gains and losses of patients for each radical prostatectomy centre identified during the study period. 23 (35%) of the 65 centres were classified as winners and 37 (57%) of 65 as losers. Five centres did not have a statistically significant net gain or loss of patients. Some of the winners were doing 400 to 500 more procedures than expected if they had only been operating on local men for whom this was the nearest centre. Conversely, some of the losers were doing approximately 200 fewer procedures than expected (and 400 fewer in the case of one centre).

Figure 3 also shows the relationship between, on the one hand, radical prostatectomy centres having a net gain or net loss of patients and, on the other hand, being an established robotic centre or a centre that closed during the study period. Centres with a net gain were



more likely to be established robotic centres (ten [43%] of the 23 winners were robotic centres, compared with two [5%] of the 37 centres with a net loss;  $p=0.0043$ ). Conversely, ten (27%) of the 37 centres with a net loss of patients closed down during the study period.

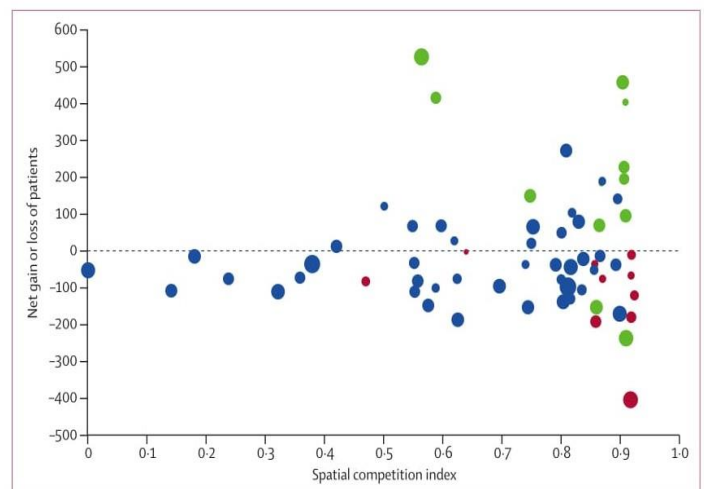
Centres with the largest net gains or losses were predominantly located in the most competitive areas (figure 4). Established robotic centres were most likely to be located in the highest quartile (SCI 0.87–0.92) for hospital competition. Seven (41%) of the 17 centres in the highest SCI quartile were established robotic centres compared with five (10%) of the 48 other centres in the three other quartiles ( $p=0.0050$ ). Similarly, for centre closures, six (35%) of the 17 centres in the highest SCI quartile closed compared with four (8%) of the 48 other centres ( $p=0.0081$ ).

Both the analysis of HES and the results of the national organisational survey showed profound changes in the organisation and practices of prostate cancer surgical care that continued beyond the end of the study period (figure 5). Between 2010 and 2017, there has been large-scale adoption of robotic surgery, increasing by three times, from 12 (18%) of 65 centres open at the start of 2010 to 39 (71%) of 55 centres open in 2014 to 42 (86%) of 49 in 2017. In the same time period, 16 (25%) of the 65 NHS radical prostatectomy centres in England closed. Both the closures and the rapid and widespread adoption of robotic surgery have been unforeseen, effectively rendering commissioning guidelines—published only in 2015 and recommending phased introduction of robotics for prostate cancer surgery within the NHS—obsolete.<sup>25</sup>

## Discussion

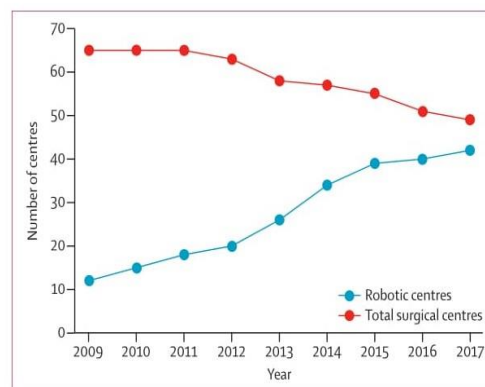
Our results suggest that, during the study period analysed, patient choice and hospital competition, rather than a coordinated policy towards centralisation, have been drivers in the changing configuration of surgical cancer services. The proportion of patients who bypassed their nearest hospital to have prostate cancer surgery elsewhere has been far larger than the 5–10% considered to be necessary in the health economics literature to incentivise improvements in hospital quality.<sup>26</sup>

In the absence of data on outcomes, the mobility of patients has been driven by factors such as availability of advanced surgical technology and the reputation of individual hospitals and clinicians.<sup>18</sup> The resulting competition between hospitals has contributed to the closure of radical prostatectomy centres in the NHS in England and widespread adoption of robot-assisted radical prostatectomy as centres have had to respond to potential changes in their market share, which threatened both their income and their ability to meet minimum procedure volume requirements. This finding indicates that patient choice and hospital competition, although rarely considered in redesign of cancer services, are potentially powerful drivers of service change, even



**Figure 4: Effect of competition on the net gain or loss of patients for each radical prostatectomy centre during the study period**

The size of the circles corresponds to the number of men expected to have surgery at the centre. Red circles correspond to centres that closed during the study period (2010–14). Green circles correspond to established robotic centres. Blue circles correspond to centres that were neither robotic radical prostatectomy centres nor centres that closed during the study period. Spatial competition index (SCI) score 0=hospital facing weakest competition. SCI score 1=hospital facing strongest competition.



**Figure 5: Changes in the number of robotic centres and total number of centres in the NHS in England (2009–17)**

within publicly funded systems. It is unlikely that these findings are limited to the NHS in England or to prostate cancer surgery alone.

From a wider system perspective, the geographical layout of cancer services means that not all centres face the same competitive pressures and, in turn, will respond differently to choice and competition policies as mechanisms for quality improvement. For example, ten of the 12 established robotic centres or early adopters of robotics were located in the most competitive areas. However, we found that patients were prepared to travel substantial distances for treatment, in some cases bypassing several surgical units, which means that even centres within less competitive areas face some level of external competition for patients and subsequently become late adopters of technology to retain local patients.<sup>27</sup>

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Attempts to coordinate cancer care services through centralisation and regionalisation have largely ignored the fact that patients are prepared to bypass their local services for treatment. This occurrence is partly due to the paucity of empirical evidence about the extent of patient mobility.<sup>28–30</sup> Additionally, cancer care plans have exerted limited control of the available services and technology at the individual hospital level (eg, introduction of new devices and practices of care), which can serve as proxy measures of quality in the absence of quality indicators.<sup>31</sup>

Substantial levels of patient mobility mean that centres need to compete with other providers to meet minimum procedure volume thresholds as set down by national policy.<sup>16</sup> In England, each prostate cancer surgery centre is expected to do a specified number of operations per year or face the threat of closure.<sup>15,32</sup> Competition policies have therefore stimulated a form of centralisation through natural selection, as centres act to protect their status as a cancer surgery centre, rather than through a coordinated process based on valid indicators of quality. Similar effects have been observed in the US health-care market, where both acute and non-acute care services have closed in response to competition.<sup>33,34</sup> It is unclear whether these effects have improved the quality of care.

None of the centres that closed during the study period did so because of explicit evidence of poor quality. Instead, the closures appear to have been influenced by the decisions of individual patients in selecting their health-care provider. Further research is required to establish what effect the observed pattern of closures has had on travel times, outcomes, and equity in access to surgical services for the most vulnerable groups, given their decreased ability to travel.<sup>28,35</sup>

The patterns of patient mobility observed occurred at a time when comparative outcome measures for prostate cancer surgery were not available. This observation highlights that providers of cancer services, just like any other industry, will consider the use of alternative incentives to attract or retain patients.<sup>36–38</sup> Patients will gravitate to places that make themselves attractive and by doing so they will create centres that treat large numbers of patients, which itself will attract further patients.<sup>39</sup>

Patients with prostate cancer were more likely to travel to centres that were early adopters of robot-assisted radical prostatectomy, showing the powerful effect of advanced technology on perceptions of quality. The result of this travel pattern has been that other centres have invested in costly robotic surgery to avoid losing their patients to other centres and to maintain their market share to preserve their cancer centre status, despite a scarcity of evidence for the superiority of this surgical procedure with respect to functional and oncological outcomes.<sup>40,41</sup> Notably, none of the centres that adopted robotic surgery closed down. Similar patterns have been observed in other health-care markets across the USA and Europe, with cancer centres adopting robotic surgery to increase their market share.<sup>36,42–44</sup>

Our previous systematic review of the literature on patient choice and competition<sup>28</sup> identified five empirical studies in high-income settings showing that patients with several tumour types, including breast, bladder, gastric, colorectal, and thoracic cancers, were prepared to bypass their nearest surgical centre.<sup>45–50</sup> The availability of advanced surgical techniques, procedure volume, and both surgeon and hospital reputation were identified as key drivers for patient mobility. Patients of advanced age and from low socioeconomic backgrounds were less likely to consider alternatives than those who were younger and more affluent.

Hospital competition, rather than the pursuit of better quality care by itself, is also cited as a major factor influencing the adoption of new technologies and diversifying individual practices of care for both cancer surgery and radiotherapy.<sup>51</sup> There is growing evidence of rapid adoption of technology for cancer surgery across a range of cancer types, beyond prostate cancer, such as renal, colorectal, and gynaecological cancer surgery.<sup>36,52–55</sup> For radiotherapy, where one would expect potentially less patient mobility than is normally observed for services because of the protracted duration of radiotherapy regimens, the past decade has also seen a substantial increase in the use of an array of high-cost technologies.<sup>41</sup> These technologies have included intensity-modulated radiotherapy, stereotactic-beam radiotherapy, and proton-beam therapy, with providers trying to gain a competitive advantage over others.<sup>51</sup>

The question as to whether competition can stimulate improvements in outcomes of cancer surgery remains unanswered. Two studies have analysed the effect of hospital competition on the pricing of pancreatic cancer<sup>56</sup> and colon cancer<sup>57</sup> surgery, and one study assessed the effect of such competition on the efficiency of cancer care delivery across tumour types in the US cancer health-care market.<sup>58</sup> Studies across other specialties have shown mixed results for the effect of fixed-price markets on improvements in health-care quality.<sup>8,23,59–66</sup>

The dearth of studies on patient mobility in both high-income and emerging economies is a major limitation for evidenced-based policy making to decide how best to balance patient choice and top-down policy approaches to service coordination in cancer care. We have highlighted potential approaches for management of this health system challenge.

For patients, having choice over their treatment or how a specific treatment is given might be more important than having a choice over the actual service provider.<sup>67</sup> Therefore, differences in availability of technology at the local level, even within a system that publishes validated outcome measures, can contribute to shifts in market share.<sup>28</sup> Investment in medical devices for cancer care<sup>51</sup> seems to be driven predominantly by individual clinicians and clinical departments, possibly because the regulatory hurdles for adoption of new devices are relatively low compared with those of medicines.<sup>31,68</sup>



The use of health technology assessment processes or value frameworks for all new technologies across the cancer care spectrum (ie, medicines, radiotherapy, and surgery) would act as a meaningful first step towards providing stronger guidance on which interventions are likely to deliver the greatest value to patients and society.<sup>69,70</sup> Other options for coordination of technology adoption include coverage with evidence development schemes or establishment of nationally designated research centres to trial new technologies before considering reimbursement.<sup>71</sup> However, a significant time lag remains before functional and oncological outcomes will be available to inform national implementation, especially for conditions with a lengthy disease course—such as prostate cancer.

Competition between hospitals will continue irrespective of attempts to centralise cancer services. Whether public reporting of performance indicators could help to achieve improvements in care quality through competition is debatable.<sup>72</sup> It might never be feasible to develop meaningful indicators for some tumour types. For example, the appropriateness of many available indicators is problematic because they can only be published after a long lag period (eg, side-effects and survival rates at 1 and 5 years), during which clinical practice can change substantially.<sup>73</sup> Additionally, there is little evidence to suggest that individuals are more likely to use published performance indicators than proxies for quality, such as a hospital's or clinician's reputation.<sup>74,75</sup>

However, in the absence of any indicator, hospitals will try to differentiate themselves to attract new users, and patients will continue to be reliant on lay sources of information, including industry marketing.<sup>76</sup> This observation strengthens the need to develop and provide access to performance indicators across different tumour types to inform patients' decision making. Performance indicators are publicly available for oesophageal and bowel cancer surgery in the NHS.<sup>77,78</sup> Additionally, the National Prostate Cancer Audit has completed a national Patient Reported Outcome Measures (PROMs) collection exercise for men following radical surgery or radiotherapy, with the aim of reporting risk-adjusted outcomes at the individual hospital level.<sup>79</sup> Public reporting of outcomes would mean that quality improvement could be stimulated through hospitals competing for market share or aiming to avoid reputational losses.<sup>80,81</sup>

Finally, the configuration of cancer services needs to account for existing patterns of patient mobility, hospital capacity, catchment areas, and clinical quality. To this end, location-allocation modelling provides a rigorous empirical approach to optimising the configuration of health-care services (including decisions about service centralisation).<sup>82,83</sup> For example, it can guide which centres should close to maximise outcomes, or minimise travel distances for those individuals who face difficulties in accessing services because of financial and physical constraints.<sup>82,84</sup>

A limitation of our study is that we used centroids of the LSOAs as the representation of the patients' residence. This will have added noise to the determination of centres' net gain and net loss of patients. It is likely that this noise has attenuated rather than enhanced the observed relationships between spatial competition and technology adoption on the one hand and patient mobility on the other.

In conclusion, we show that patient choice and hospital competition can have a major influence on the configuration of cancer services. The challenge for health systems is to balance choice and competition with service centralisation, but there is a paucity of empirical evidence to inform this decision making. Our study highlights the need to have robust quality performance and outcome measures available to patients and referring health centres, to avoid reliance on often misleading surrogate indicators. Otherwise, choice and competition policies could seriously limit rather than facilitate health services' ability to deliver equitable and affordable improvements in cancer outcomes.

#### Contributors

AA conceived the study. AA, JvdM, and DL were involved in the design, analysis, and interpretation. AA wrote the paper, with support from JvdM. All authors were involved in revising the work critically and approved the final version.

#### Declaration of interests

JvdM reports grants from Healthcare Quality Improvement Partnership during the conduct of the study. All other authors declare no competing interests.

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## Supplementary Appendix

### Research in context – Evidence before this study

Search criteria included: ((patient choice\*[Ti/Abs]) OR consumer choice\*[Ti/Abs]) OR patient preference\*[MeSH Terms]) OR patient preference\*[Ti/Abs]) OR patient mobility[Ti/Abs]) OR patient travel[Ti/Abs]) OR hospital referral\*[MeSH Terms]) OR hospital referral[Ti/Abs])) OR hospital bypassing)) OR hospital choice[Ti/Abs])) OR hospital market[Ti/Abs])) OR hospital competition [Ti/Abs])) AND ((((((health care provider[MeSH Terms]) OR provider\*[Ti/Abs]) OR hospital\*[Ti/Abs]) OR doctor\*[Ti/Abs]) OR Physician\*[Ti/Abs]) OR "specialist care"[Ti/Abs])) AND cancer [Ti/Abs]))



## 7. RESULTS CHAPTER 5

### 7.1 Impact of hospital competition on patient outcomes

The **fourth component** of my thesis was an analysis of the impact of hospital competition on patient outcomes following prostate cancer surgery. The creation of a competitive environment to support patient choice and provide incentives for hospitals to compete with each other is in conflict with policies that seek to centralise services into fewer centres. Centralisation aims to improve quality by eradicating very low volume surgery, and to increase the number of procedures performed by remaining centres.

This chapter compares the relative impact of both hospital volume and hospital competition on outcomes following a radical prostatectomy whilst adjusting for relevant case-mix criteria. The results have been presented in the form of the submitted research paper.

### 7.2 Research paper 5

**“Impact of hospital competition and service centralisation on patient outcomes following prostate cancer surgery: a national population-based study”**

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### SECTION A – Student Details

Student	Ajay Aggarwal
Principal Supervisor	Jan van der Meulen
Thesis Title	Evidence and impact of NHS choice and competition policies on the delivery of prostate cancer services: a national population based evaluation

**If the Research Paper has previously been published please complete Section B, if not please move to Section C**

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Where was the work published?	
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Where is the work intended to be published?	British Medical Journal
Please list the paper's authors in the intended authorship order:	Aggarwal A, Sujenthiran A, Lewis D, Walker K, Cathcart P, Sullivan R, Clarke N, van der Meulen J.
Stage of publication	Submitted for publication

### SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I designed the study, undertook all the analysis and wrote the first draft of the manuscript
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Student Signature: \_\_\_\_\_

Date: 22.09.17

Supervisor Signature: \_\_\_\_\_

Date: 22 Sept 2017

## **Impact of hospital competition and service centralisation on patient outcomes following cancer surgery: a national population-based study**

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## **ABSTRACT**

### Introduction

Policies that encourage patient choice and competition between hospitals are being implemented in parallel with those that seek to centralise specialist services into fewer high-volume units. However, both policies require different health system reconfigurations and provider incentives to operate effectively. This study explores the effects of the hospitals' competitive environment and procedure volume on patient outcomes following cancer surgery using prostate cancer as a case study.

### Design

National cohort study using linked administrative datasets on actual patient episodes, comparing patient outcomes according to the hospitals' competitive environment (higher versus lower than median value of the spatial competition index) and annual procedure volume (higher versus lower than 50 procedures).

### Setting

NHS secondary cancer care services.

### Participants

All men who were diagnosed and underwent prostate cancer surgery in England between 2008-2011 ( $n=12,925$ ).

### Main outcome measures

Multi-level logistic regression modelling was used to assess separately the effects of competition and procedure volume as hospital-level effects on three patient-level outcome

indicators: Urinary complications, 30-day emergency readmission rates, and Post-operative length of stay.

### Results

Our study found that patients treated in surgical centres located in a more competitive environment were statistically less likely to be readmitted as an emergency within 30 days of discharge (adjusted OR 0.46 (95% CI 0.36-0.60, p=0.005)). However, the level of competition had no effect on the likelihood of a patient developing severe urinary complications or their length of stay following surgery. Conversely, we find that men who underwent prostate cancer in surgery centres with higher procedure volumes had a statistically significant reduction in their length of stay (adjusted OR 0.53 (95% CI 0.30-0.97, p=0.0421) compared to lower volume centres. However, higher volume centres did not have a lower likelihood of developing severe urinary complications, or of being readmitted as an emergency within 30 days of discharge.

### Conclusions

The results highlight the complexity of designing health systems to achieve improvements in patient outcome. In the absence of robust evidence, it is uncertain whether policies based on enhancing the competitive environment or further centralising specialist cancer surgery will result in improvements in the quality, efficiency and equity of healthcare delivered.

### **KEY WORDS:**

Hospital competition, Centralisation, Hospital Volume, Reconfiguration, Patient outcomes, Cancer

## ARTICLE SUMMARY

### What is already know on this subject

- The current organisation of specialist cancer services is based on international evidence that the creation of high-volume surgical units through centralisation will deliver improvements in outcome.
- At the same time, policies encouraging greater patient choice as well as competition between providers are operating in parallel to improve the quality of care.
- There has been no published study to date investigating the impact of hospitals' competitive environment on outcomes of cancer treatment.

### What this study adds

- Patients treated in hospital centres located in a more competitive environment had a lower chance of being re-admitted as an emergency within 30 days of prostate cancer surgery.
- There was no association between the strength of competition and either length of stay or the incidence of severe urinary complications.
- Patients treated in high-volume centres (>50 procedures a year) had no improvements in outcome compared to those treated in low volume centres.
- The lack of an association between volume and outcome is likely to be influenced by the ongoing centralisation of NHS specialist services which has eradicated very low volume surgical units over the last decade.
- Policy makers need to proceed with caution when considering the optimum reconfiguration of health services in the absence of hospital level data on outcomes.

## INTRODUCTION

Policies encouraging patient choice and hospital competition have been introduced across several countries with the aim of improving the efficiency and quality of health care services.<sup>1-</sup>

<sup>4</sup> The English National Health Service (NHS) is an example of a publicly funded health system in which hospitals are expected to compete on quality and not price to attract patients, who themselves are allowed to choose any hospital that best meets their needs.

These NHS policies are operating in parallel with those that seek to centralise specialist services into fewer high volume units. Service centralisation is a response to studies demonstrating improved outcomes of care for patients treated by specialised and experienced teams at centres carrying out a high volume of surgical procedures.<sup>5 6</sup>

In contrast to the impact of hospital volume, there has been no published study to date that has investigated the impact of hospital competition on outcomes of cancer treatment. With respect to the wider literature, studies in cardiac surgery have identified an association between hospital competition and quality improvement.<sup>7-9</sup> It therefore remains unknown whether drives to centralise services and reduce the number of providers could affect the potential benefits of competition, which requires a plurality of available providers from which patients can choose.

Using patient-level data on all men undergoing a radical prostatectomy in England between 2008 and 2011, we analysed the impact of the hospitals' competitive environment and procedure volume on three patient-level outcomes: urinary complications, 30-day emergency readmission rates and post-operative length of stay.

Prostate cancer is a relevant tumour type for a study aiming to understand how volume and competition affect patient outcomes for several reasons. First, the quality of the surgery has an impact on the chance of complete removal of the tumour whilst minimising the risk of side-

effects, such as urinary incontinence and erectile dysfunction.<sup>10</sup> Furthermore, surgical techniques continue to evolve for prostate cancer (e.g. transition from open to robot-assisted surgical techniques) with the aim of improving outcomes further.<sup>11</sup> Second, policies in the NHS continue to promote the reconfiguration of prostate cancer surgical services with a view to creating higher-volume surgical units.<sup>12 13</sup> Third, we have recently demonstrated that English NHS hospitals providing surgical prostate cancer services are responsive to the effects of competition from other centres which has likely contributed to the large-scale investment in robotic surgical equipment in the NHS.<sup>14</sup>

## **PATIENTS AND METHODS**

### Patient population

We obtained hospital-level data on all patients diagnosed with prostate cancer in the English NHS who underwent a radical prostatectomy between 1<sup>st</sup> Jan 2008 and 31<sup>st</sup> December 2011 from the Hospital Episode statistics (HES) database linked at the patient-level to English cancer registry data.

The HES dataset was used to determine age, Royal College of Surgeons (RCS) Charlson comorbidity score,<sup>15</sup> socioeconomic deprivation status,<sup>16</sup> treating hospital, date of procedure, and radical prostatectomy type (e.g. robot-assisted, laparoscopic or open). Radical prostatectomy type was coded using the UK Office for Population Census and Surveys Classification of Interventions and Procedures – 4<sup>th</sup> revision (OPCS4).<sup>17</sup> Reason for emergency re-admission following a radical prostatectomy was coded using the International Classification of Diseases, 10<sup>th</sup> revision (ICD-10). National cancer registry data was used as the data source for cancer stage, which was categorised according to a modified D’Amico classification system.<sup>18 19</sup>



## Hospital characteristics

### *Competition*

For each surgical centre, we calculated a spatial competition index (SCI)<sup>20 21</sup> based on both the number of eligible patients within a 60-minute drive and the number of alternative surgical centres within 60-minute drive for each eligible patient:

$$SCI_i = 1 - \frac{1}{n_i} \sum_{j=1}^{n_i} \frac{1}{k_{j_i}}$$

where surgical centre  $i$  has  $n$  eligible patients within a 60-minute drive and patient  $j$  in centre  $i$  has  $k$  alternative surgical centres within a 60-minute drive. The SCI ranges theoretically from 0 for centres in a monopoly environment to a value close to 1 for centres in the most competitive environment. Centres were stratified into two more or less equally-sized groups in areas with “high” and “low” levels of environmental competition on the basis of the distribution of SCI values across the 65 centres using the median as a cut off, because there are no established cut offs in the literature.

### *Volume*

We were able to determine the average annual procedure volume for each prostate cancer surgical centre ( $n=65$  centres) during the 4-year study period. This ranged from 13 to 154 procedures per centre per year. Hospitals were stratified into two groups and those performing greater than 50 procedures a year were defined as “high volume”.

## Patient outcomes

### *Length of Stay*

HES records were analysed to identify the duration of inpatient stay following a radical prostatectomy. We identified each man who was in hospital more than 3 days from the date

of surgery. This outcome indicator is being used as a performance measure in the UK National Prostate Cancer Audit<sup>22</sup> to assess the quality and efficiency of surgical care.

#### *30-day emergency readmissions*

HES records were analysed to identify men readmitted as an emergency at any hospital within 30 days of the date of discharge following a radical prostatectomy. Readmission rates have been used extensively as an outcome indicator for acute and elective surgical admissions.<sup>23-26</sup> In this analysis, we also used the ICD-10 codes available within HES, to identify the primary reason for emergency hospital admission, and to what extent they related to the surgical procedure undertaken.

#### *Severe urinary complications*

We have previously developed and validated a morbidity tool using OPCS-4 procedure codes within HES readmission records, to identify urinary complications (e.g. stricture, bleeding and incontinence) severe enough to require an intervention, within 2 years of a radical prostatectomy.<sup>27</sup> All men included in the study were assessed for the occurrence of urinary complications using this outcome indicator.

#### Statistical analysis

Multi-level logistic regression modelling was used to assess the effect of hospital competition and procedure volume as hospital-level effects separately on our three patient outcome indicators, adjusting for the patient-level variables (age, comorbidity status, socioeconomic status, and year of treatment). A random intercept for centre was included to deal with the potential clustering of each outcome by centre. Further exploratory analyses were also undertaken to determine the effect of procedure type (e.g. robot-assisted prostatectomy, laparoscopic or open) on the association between competition and volume on patient outcomes. All statistical analyses were undertaken in Stata version 14.

### Patient Involvement

A patient consultation exercise undertaken in March 2017 with patients who previously underwent cancer treatment in the NHS informed the research question and design of the study.

## **RESULTS**

### *Patient population*

We identified 14,044 men who underwent radical prostatectomy between 1<sup>st</sup> Jan 2008 and 31<sup>st</sup> December 2011 (four years) in the English NHS (Figure 1). 840 men were excluded because they had an additional diagnosis of bladder cancer or because they had received radiotherapy in the post-operative setting. Both of these factors would affect our assessment of the occurrence of urinary complications following a radical prostatectomy. A further 279 patients were excluded as they could not be assigned to an NHS hospital. The final study cohort comprised 12,925 men and patient characteristics are presented in Table 1. 60.3% of men were younger than 65 and 16.1% had at least one recorded comorbidity. Of the 7159 men with sufficient staging information, 43.9% had locally advanced cancer and 49.0% intermediate-risk localised cancer. Open surgery was the commonest surgical modality received by patients (42.7%) followed by laparoscopic (31.9%) and robot-assisted (25.4%).

### *Length of stay >3 days*

35.4% of all patients in the study were admitted for longer than three days from the date of surgery. The proportion varied considerably between centres, ranging from 3.2% to 86.4% and was highly correlated with procedure type. For example, the range for open, laparoscopic and robot-assisted radical prostatectomy were 6.3% to 94.9%, 2.2% to 81.9%, and 0% to 40.9% respectively. Note should also be made that during the time-period of the analysis centres were transitioning from open surgery to laparoscopic or robot-assisted techniques.

### *30-day emergency readmissions*

5.4% of all patients in the study were re-admitted as an emergency within 30 days of the discharge date. The proportion of 30-day emergency readmissions varied considerably between providers ranging from 0% to 18.3%. Table 2 lists the 20 most frequent causes of emergency readmission based on ICD-10 diagnostic codes, which accounted for approximately 75% of all emergency admissions. Nearly all are directly related to a complication following a radical prostatectomy.

### *Severe urinary complications*

16.0% of all patients in the study developed at least one severe urinary complication within two years of a radical prostatectomy. The proportion of patients experiencing a urinary complication varied considerably between providers, ranging from 3.3% to 45.1%.

### *Impact of hospital competition*

Table 3 presents the results of the multi-level regression model, as both unadjusted and adjusted odds ratios for the impact of hospital competition on each of our outcome indicators. In the adjusted model, men who received a radical prostatectomy in centres located in areas with the strongest competition were less likely to be readmitted within 30 days of surgery when compared to men receiving care at centres in areas of weaker competition (odds ratio 0.46 (95% CI 0.36-0.60,  $p=0.005$ )). The strength of competition did not have a significant impact on the likelihood of developing a severe urinary complication or of having a length of stay greater than three days following a radical prostatectomy in the unadjusted and adjusted models.

### *Impact of hospital volume*

Table 4 presents the results of the multi-level regression model, as both unadjusted and adjusted odds ratios for the impact of hospital procedure volume on each of our outcome

indicators. Prostate cancer surgical centres were stratified into two groups based on the number of procedures performed per year as described in the methods. In the adjusted model which included the effect of patient characteristics, men treated at high volume centres (>50 procedures per annum), were less likely to have a prolonged length of stay compared to lower volume centres (odds ratio 0.53 (95% CI 0.30-0.97, p=0.0421)). With respect to our other two outcome indicators, there was no statistically significant association between receiving treatment at a high volume centre and the likelihood of developing a severe urinary complication or of being readmitted within 30-days of discharge.

#### *Further exploratory analyses*

Additional multivariate regression analyses were performed to assess whether further adjustment for radical prostatectomy type affected the results. Procedure type was coded using OPCS4 codes available in HES (see Methods).<sup>17</sup> We found that the inclusion of procedure type changed the association between hospital volume and length of stay, which was no longer statistically significant (odds ratio 0.75 (95% CI 0.47-1.19, p= 0.22)). The addition of procedure type had no appreciable impact on any of the other previously observed associations. Of note, a sensitivity analysis including non-linear associations between hospital volume and hospital competition on the one hand and patient outcomes on the other did not change our findings. We also analysed the effect of including both competition and volume in the regression analyses together, however this did not change any of the observed associations.

## **DISCUSSION**

Patients treated in centres located in a more competitive environment were less likely to be readmitted within 30 days of discharge. However, the strength of hospital competition had no effect on the likelihood of a patient developing severe urinary complication or on their length of stay following surgery. Conversely, our study finds that men who underwent prostate cancer

surgery at centres performing greater than 50 procedures a year had a statistically significant reduction in length of stay those in lower-volume centres. However, this effect was not maintained when adjusting for the type of radical prostatectomy procedure that was performed. Higher-volume centres did not have a lower likelihood of developing severe urinary complications, or of being readmitted as an emergency within 30 days of discharge.

### Competition

There has been no previous study investigating the impact of hospital competition on cancer outcomes. Our analysis demonstrates that men treated in regions, which have a high concentration of hospitals are less likely to be re-admitted within 30 days following a radical prostatectomy. Given that approximately 75% of re-admissions were due to complications directly related to a radical prostatectomy, this may reflect better quality surgery including peri-operative care at these centres, or enhanced systems of clinical outreach following discharge.

It is not clear what the driver for improved quality could be for centres located in the most competitive areas. From other studies which have shown similar associations,<sup>7 9 28</sup> it is perceived to be in response to the actual movement or threat of movement of patients from their local referring area to alternative centres.<sup>29</sup> This is considered to stimulate improvements in quality as hospitals seek to retain and attract new patients to prevent the loss of income and preserve their reputation.<sup>7 8 30</sup>

With respect to prostate cancer surgery, we have recently demonstrated that men seem to be responsive to perceived differences in the quality of prostate cancer surgery and are prepared to “bypass” their nearest surgical centre.<sup>21</sup> This movement of patients is marked in more competitive areas,<sup>14</sup> and therefore competition for local patients may have acted as a driver for improving surgical quality.

A further hypothesis from a study by Bloom et al 2015, is that hospitals located in more competitive environments have enhanced system and management practices, which have an impact on improving quality across disease domains.<sup>31</sup> As a result, our findings may not be limited to prostate cancer surgery alone and further evaluation is required to see the impact of hospital competition in other tumour types, especially in those where performance indicators for cancer surgery are publicly reported in the English NHS such as oesophageal and bowel cancer.<sup>32 33</sup>

### Volume

Our findings confirm that procedure volume is positively associated with a reduced length of stay following a radical prostatectomy.<sup>34 35</sup> However, this association was not maintained when taking into account the effect of robot-assisted radical prostatectomy which has been shown to reduce length of stay relative to open radical prostatectomy.<sup>36</sup> High-volume centres were more likely to have adopted robot-assisted radical prostatectomy during the time-period of analysis, which has likely contributed to the observed reductions in length of stay.

Our analysis did not demonstrate an association between hospital volume and the likelihood of developing a severe urinary complication or of being readmitted within 30 days of a radical prostatectomy. This is contrary to earlier international studies which have demonstrated a positive impact of hospital volume on urinary outcomes.<sup>37 38</sup> On further exploration of the data, the differences in outcomes observed in these studies tended to be at the extremes of low and high volume.

In the NHS, the continued reconfiguration of prostate cancer services over the past decade has led to the eradication of very low-volume surgical units (less than 10 procedures per year). As a result, the majority of NHS centres would not be classified as low-volume units according to the categories used in many of the studies in which inferior outcomes were observed.<sup>12</sup> It is

also acknowledged that individual surgeon volume or experience rather than overall hospital volume may be the more significant factor in determining the likelihood of developing medium-term urinary complications following a radical prostatectomy.<sup>39 40</sup>

### Policy Implications

To date, much of the policy focus regarding the organisation of services has been based on the extrapolation of findings from the international literature, namely that eradication of low-volume surgical units through centralisation will deliver improvements in outcome as patients are re-directed towards higher-volume centres.<sup>41</sup> Currently, in the NHS, it is expected that designated pelvic cancer centres perform up to 50 or more prostatectomies and/or cystectomies a year.<sup>13</sup> Centres that fail to meet these volume thresholds are at risk of closure, irrespective of the outcomes that they deliver. The results from our national level study, suggests that the further centralisation of prostate cancer surgical services based on the attainment of procedure volume targets may not necessarily deliver the intended improvements in patient outcome.

The study also highlights the complexity of designing an optimum system given the fact that our study found some evidence that enhancing competition between centres and allowing patients a choice of where they can receive their cancer treatment may in fact stimulate improvements in quality. The evidence to date in the wider NHS has been both limited and mixed with respect to understanding the direction of these associations between competition and patient outcomes.<sup>42</sup> It could therefore be argued that such conflicting policy initiatives (competition versus centralisation) are being implemented, to some extent, based on ideologies rather than robust empirical evidence.

To add further complexity, one needs to consider how competition or centralisation will impact on equity in access to surgery and the efficiency of delivering health care services. Competition, in the absence of publically available information on the quality of surgery, can



create perverse incentives for hospitals to attract patients and to prevent closures.<sup>14</sup> In addition, competition may create inefficiencies as worse performing competitors will lose patients to other centres and not utilise their available surgical capacity.<sup>14</sup>

On the other hand, closures of surgical units as part of the continued centralisation of services may act to optimise the use of available specialist service capacity. However, patients may need to travel further to receive care, and therefore any gains in efficiency need to be balanced with the potential detrimental effect it may have on access to cancer surgery for patients that are less able to travel for treatment, for example due to physical or financial constraints.<sup>21 43</sup> Centres which remain open must also have sufficient capacity to accommodate the expected increase in the number of patients requiring treatment otherwise centralisation may serve to lengthen treatment waiting times.

Going forward, current policy directives designed to reconfigure services need to be subject to timely evaluation (e.g. national audits) to ensure they are delivering their expected improvements with respect to quality, equity and efficiency. We also need to broaden this type of analysis, which is the first of its kind, to consider a wider range of tumour types and intervention specific outcome measures. Any such evaluation also needs to consider the potential impact that the continued implementation of new technologies may have on established relationships between the organisation of health care services and outcomes. For example, we have seen that the earlier implementation of robot-assisted prostatectomy in high volume centres has likely resulted in the observed improvements in post-operative length of stay.

### Limitations

Our findings are likely to be underpowered statistically due to the use of a hierarchical model, which provided an analysis effectively comparing 65 hospitals. Furthermore, our analysis only

considers three outcome measures related to radical prostatectomy, and the effect of hospital characteristics on a number of key outcomes, such as sexual function remain unknown. In addition, we were not able to adjust for cancer stage due to incomplete staging data. Finally, our results need to be considered in the context of a health care system, which has already attempted to centralise specialist surgical services, resulting in the closure of very low volume units.

## **CONCLUSIONS**

This is the first national level study to assess the impact of both hospital competition and hospital volume on the outcomes of cancer surgery. Using prostate cancer surgery as a case study, we observed that patients treated in hospitals located in a more competitive environment were less likely to be readmitted as an emergency within 30 days of discharge, but there was no association between competition and either length of stay or urinary complications. Conversely, the study did not demonstrate any significant improvements in outcomes apart from a reduction in post-operative length of stay, for patients treated in high volume centres. The results highlight that the coordination of cancer services is complex, and that policy makers need to proceed with caution when considering the optimum reconfiguration of health services, in particular further centralisation, in the absence of hospital level data on outcomes. Further research is required to understand the role competition has in stimulating improvements in quality across other tumour types given the paucity of evidence in the empirical literature.

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## **COMPETING INTERESTS**

All authors have completed the ICMJE uniform disclosure form at [www.icmje.org/coi\\_disclosure.pdf](http://www.icmje.org/coi_disclosure.pdf) and declare that they have no conflict of interest that could appear to have influenced the submitted work.

## **AUTHORS' CONTRIBUTIONS**

AA conceived the study. AA, and JvdM have been involved in the design, analysis, interpretation and drafting of the work. AS and KW supported the analysis. All authors have been involved in revising the work critically and approved the final version. AA is the guarantor of the study.

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## **TRANSPARENCY STATEMENT**

The views expressed in this publication are those of the authors and not necessarily those of the NHS, the National Institute for Health Research, or the Department of Health.

AA and JvdM had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

AA as guarantor affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained

#### **DATA SHARING AGREEMENT**

No additional data available.

#### **DETAILS OF ETHICS APPROVAL**

The study is exempt from UK NREC approval because it involved the analysis of an existing dataset of anonymous data for service evaluation.

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## TABLES

**Table 1. Characteristics of 12,925 men undergoing radical prostatectomy between 2008 and 2011 in the English National Health Service.**

	Number	%
<b>Year</b>		
2008	1902	14.7
2009	3427	26.5
2010	3637	28.1
2011	3959	30.6
<b>Age (years)</b>		
<50	489	3.8
50-59	3478	26.9
60-64	3826	29.6
65-69	3772	29.2
≥70	1360	10.5
<b>Cancer severity</b>		
Advanced	64	0.9
Locally advanced	3149	43.9
Intermediate localised	3514	49.0
low risk localised	445	6.2
Insufficient staging information (n=5753)		
<b>Number of comorbidities</b>		
0	10,838	83.9
≥1	2087	16.1
<b>Index of Multiple Deprivation (national quintiles)</b>		
1 (least deprived)	3273	25.3
2	3159	24.4
3	2674	20.7
4	2189	16.9
5 (most deprived)	1630	12.6
<b>Procedure Type</b>		
Open	5510	42.6
Laparoscopic	4138	32.0
Robotic	3277	25.4

**Table 2. Twenty most frequent causes for 30-day emergency readmissions after a radical prostatectomy using ICD-10 codes.**

<b>Reason for Admission</b>	<b>Frequency</b>	<b>(%) of all readmissions</b>	<b>Cumulative frequency (%)</b>
Fitting and adjustment of urinary device	102	14.6	14.6
Mechanical complication of urinary (indwelling) catheter	94	13.5	28.1
Urinary tract infection, site not specified	54	7.8	35.9
Infection following a procedure, not elsewhere classified	40	5.7	41.6
Urinary retention	39	5.6	47.2
Unspecified haematuria	31	4.5	51.7
Haemorrhage and haematoma complicating a procedure	22	3.2	54.8
Constipation	16	2.3	57.1
Disruption of operation wound, not elsewhere classified	15	2.2	59.3
Other complications of procedures, not elsewhere classified	13	1.9	61.1
Other genitourinary complications prosthetic devices, implants & grafts	12	1.7	62.8
Other specified soft tissue disorders	11	1.6	64.4
Pain localized to other parts of lower abdomen	11	1.6	66
Other and unspecified abdominal pain	10	1.4	67.4
Pulmonary embolism without mention of acute cor pulmonale	9	1.3	68.7
Other specified disorders of bladder	9	1.3	70.0
Orchitis epididymitis and epididymo-orchitis without abscess	9	1.3	71.3
Other specified disorders of male genital organs	9	1.3	72.6
Other postprocedural disorders of the genitourinary system	8	1.2	73.7
Pelvic and perineal pain	6	0.9	74.6

**Table 3. Results of a multilevel model exploring the impact of hospital competition (measured with the spatial competition index) on urinary complications, 30-day emergency readmissions and length of stay following a radical prostatectomy**

Outcome	COMPETITION		Unadjusted OR (95% Cis)	Adjusted OR (95% Cis)	P value
	Weakest Competition (6439 men, 33 centres)	Strongest Competition (6486 men, 32 centres)			
Severe Urinary Complication	1114 (17.3%)	959 (14.8%)	0.86 (0.67-1.12)	0.85 (0.66-1.10)	0.21
30-day readmissions	475 (7.4%)	220 (3.4%)	<b>0.44** (0.29-0.67)</b>	<b>0.44** (0.29-0.67)</b>	<b>0.0002</b>
Length of Stay >3 days	2449 (38.0%)	2132 (32.9%)	0.77 (0.43-1.37)	0.75 (0.42-1.33)	0.32

Notes:

1. Adjusted odds ratio for the impact of competition on each outcome measure includes the effect of age, comorbidity, socioeconomic status and year of treatment in the multivariate regression analysis.
2. Odds ratio in bold\*\* are significant at the 5% level



**Table 4. Results of a multilevel model exploring the impact of hospital volume (per year) on urinary complications, 30-day emergency readmissions and length of stay following a radical prostatectomy**

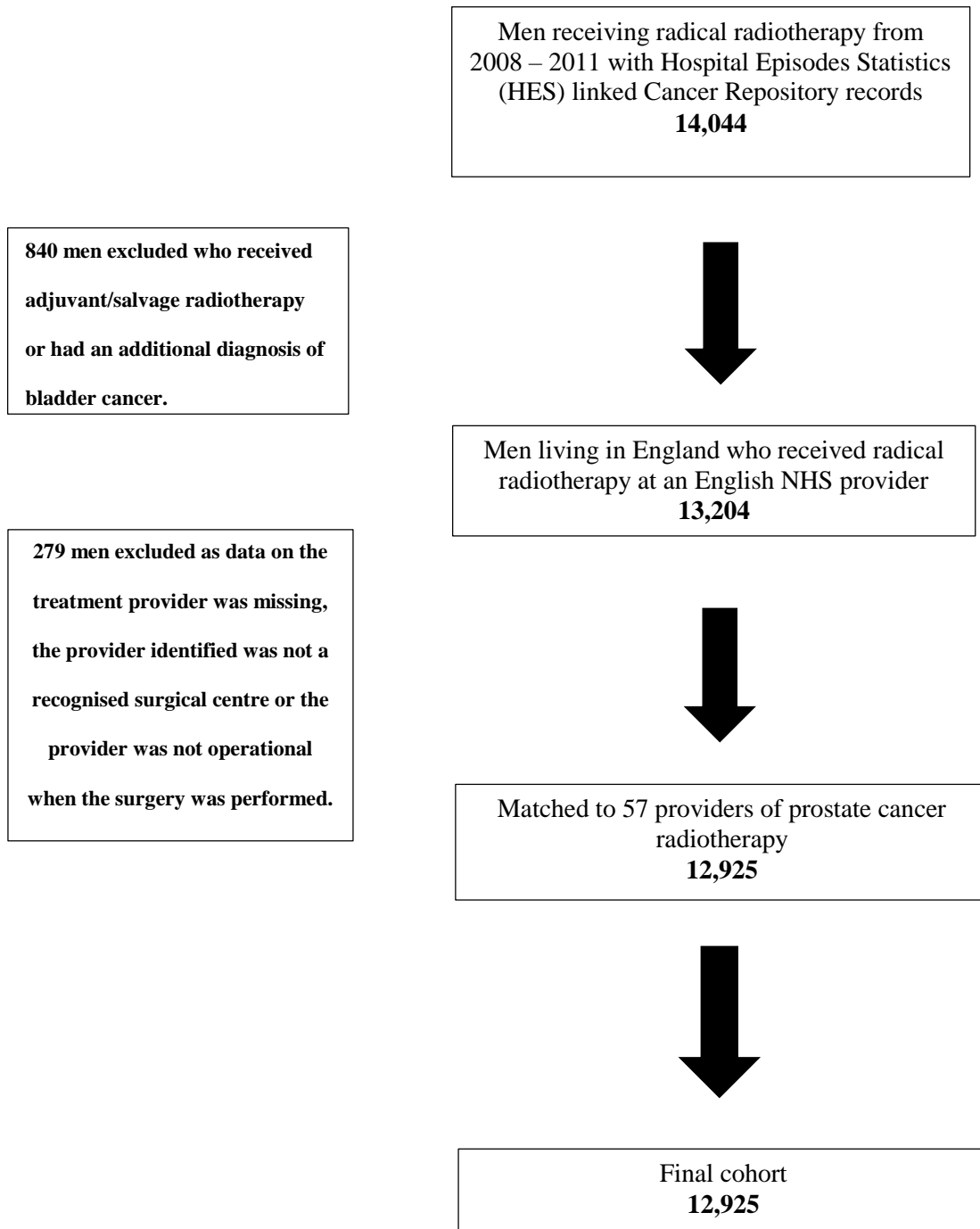
Outcome	VOLUME		Unadjusted OR (95% CIs)	Adjusted OR (95% CIs)	P value
	Low Volume (5863 men, 43 centres)	High Volume (7062 men, 22 centres)			
Severe Urinary Complication	1028 (17.5 %)	1045 (14.8%)	0.92 (0.70-1.20)	0.90 (0.69-1.17)	0.43
30-day readmissions	335 (5.7%)	360 (5.1%)	0.81 (0.51-1.37)	0.92 (0.57-1.48)	0.73
Length of Stay >3 days	2518 (43.0%)	2063 (29.2%)	<b>0.53**</b> (0.29-0.96)	<b>0.53**</b> (0.30-0.97)	<b>0.04</b>

Notes:

1. High volume centres defined as centres performing greater than 50 radical prostatectomies a year.
2. Adjusted odds ratio for the impact of volume on each outcome measure includes the effect of age, comorbidity, socioeconomic status and year of treatment in the multivariate regression analysis.
3. Odds ratios in bold\*\* are significant at the 5% level

## FIGURES

**Fig 1. Flow chart of men included in the study**



## 8. RESULTS CHAPTER 6

### 8.1 Hospital choice – a qualitative study

The **fifth component** of the study utilised qualitative research methods to understand what factors inform and influence where patients choose to receive prostate cancer treatment. This involved interviews with men previously treated for non-metastatic prostate cancer in England between 2010-2015. The results have been presented in the form of the submitted research paper.

### 8.2 Research paper 6

**“Hospital choice in the context of a cancer diagnosis: a qualitative study”**

### 8.3 Additional information

Appendix A – Ethics approval (Page 204)

Appendix B – Participant information sheet (Page 205)

Appendix C – Consent form (Page 208)

Appendix D – Interview topic guide (Page 209)

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## RESEARCH PAPER COVER SHEET

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### SECTION A – Student Details

Student	Ajay Aggarwal
Principal Supervisor	Courtney Davis
Thesis Title	Evidence and impact of NHS choice and competition policies on the delivery of prostate cancer services: a national population based evaluation

*If the Research Paper has previously been published please complete Section B, if not please move to Section C*

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Where was the work published?	
When was the work published?	
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### SECTION C – Prepared for publication, but not yet published

Where is the work intended to be published?	Health Expectations
Please list the paper's authors in the intended authorship order:	Aggarwal A, Bernays S, Payne H, van der Meulen J, Davis C.
Stage of publication	Submitted for publication

### SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I designed the study, undertook all the interviews and analysis and wrote the first draft of the manuscript
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Student Signature: \_\_\_\_\_

Date: 10/10/17

Supervisor Signature: \_\_\_\_\_

Date: 10/10/2007

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## **Hospital choice in the context of a cancer diagnosis: a qualitative study**

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### **Conflict of Interest**

No conflict of interest has been declared

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## **ABSTRACT**

### **Background**

There remains limited international evidence regarding the response of patients to hospital choice policies, the factors that inform and influence patient choices, or the relevance of these policies in the context of severe illnesses such as cancer.

### **Aim**

To evaluate hospital choice policies from the perspective of men who received treatment for prostate cancer in the UK

### **Methods**

Semi-structured interviews were undertaken with a purposive sample of 25 men across England. 14 men had chosen to receive treatment at a cancer centre other than their nearest. Interviews were recorded and analysed concurrently with data collection.

### **Findings**

The geographic configuration of specialist services, the perceived urgency of the condition and protocolled treatment pathways all limit choice. Diseases such as cancer appear not well suited to the patient choice model given the lack of treatment specific hospital-level outcome data to inform decisions. Men instead used proxy measures to differentiate quality, leaving them vulnerable to the influence of marketing and media reporting on innovations within cancer care. The necessity for men to independently collect and appraise complex treatment related information has potentially created socioeconomic inequities in access to the best available treatments. A key positive of the choice agenda is that it enables patients to “exit care” not meeting their expectations.



**Discussion**

Policy makers have failed to consider the organisational, disease specific and socio-cognitive factors that influence patients' ability to choose their treatment providers. Urgent evaluation of these policies across diseases are required to identify opportunities to improve their effectiveness.

**Key Words:** Patient choice, Hospital choice, Cancer, Equity, Innovation

## INTRODUCTION

Hospital choice policies have been introduced across several high-income countries on the assumption they will improve the quality, equity and efficiency of healthcare delivered whilst empowering patients to personalise their care and create a more responsive health care system.<sup>1,2</sup>

In the English National Health Service (NHS), it is expected that patients will select and travel to the health care provider that best meets their needs using comparative performance information about individual hospitals. As care is free at the point of use, NHS hospitals are expected to compete for patients through improvements in quality.<sup>3</sup> The reforms are also expected to enhance equitable access to healthcare by enabling choice of any available NHS hospital irrespective of an individual's ability to pay.<sup>4</sup>

Despite these policies being introduced over a decade ago, there is very little evidence internationally about how they are experienced by patients.<sup>5-16</sup> Concerns have been raised about the extent to which all patients are able to conform to the model of the healthcare user underpinning choice policies, since the extent to which patients can be active and sophisticated in their choice decisions depends on them having access to relevant information, and being able and willing to appraise that information.<sup>3,17</sup>

The study takes a qualitative approach to examine whether choice policies are working as they were intended in the English NHS, using prostate cancer as a case study. Prostate cancer is the most common malignancy in men with approximately 40,000 new cases diagnosed annually in the United Kingdom. There are a wide range of radical treatments that aim to "cure" the cancer, including surgery, radiotherapy, and brachytherapy.<sup>18</sup> As a result patients are required

to choose between different treatment options at the time of diagnosis, depending on their disease characteristics. At the same time, patients are also expected in the current policy environment to choose in which hospital they want to be treated.<sup>18</sup>

There are several reasons to question whether hospital choice policies are relevant to cancer patients. For example, the current commitment to “centralising” cancer services to fewer hospitals reduces the availability of hospitals and on average will increase travel times to alternative hospitals.<sup>19</sup> Also, comparative performance information for individual hospitals – a pre-requisite for hospital choice to function<sup>20</sup> – is not available for most cancer types including prostate cancer. Nevertheless, results from a recent quantitative study have demonstrated that men with prostate cancer are responsive to these policies and prepared to ‘bypass’ their nearest specialist centres for their treatment.<sup>21</sup>

We sought to investigate this further by analysing and comparing in-depth personal accounts from both men who decided to seek treatment at a more distant hospital as well as from men who received their treatment locally. Areas of enquiry included men’s interaction with, and experience of the health service prior to receiving treatment; their perception of the provision of hospital choice; an evaluation of the factors that informed and influenced their eventual treatment location; and the impact of a cancer diagnosis on their decision-making.

## **METHODS**

Our qualitative study forms part of a larger mixed-methods research program designed to evaluate the role of hospital choice policies for patients diagnosed with cancer. Both the qualitative and quantitative components of the research are intended to be complimentary. For example, findings from the quantitative analyses have influenced the sampling framework and

the topic guide for the semi-structured interviews. Similarly, the quantitative analyses have provided the relevant context to enable us to interpret the results of this study at both the individual and health system level.<sup>21-24</sup>

### Recruitment

Participants were selected from a UK-based prostate cancer support group that is the focal point for 55 local support groups in England. Members were approached through the eight regional leads of these support groups. These leads sent out the information sheets and consent forms and requested that interested members forward their contact details to the study team.

The study adopted a non-probabilistic, purposive sampling approach to generate a sample that was ‘theoretically informed’, with the key sampling dimension comprising the NHS region of residence and whether or not men had decided to bypass their nearest hospital for their prostate cancer treatment. This sampling framework was chosen for two reasons.

First, work to date has demonstrated inequity in the availability of some prostate cancer services nationally, and variation in the geographical configuration of cancer centres within these regions (particularly when London is compared to the other three regions).<sup>25</sup> Therefore the aim was to recruit a minimum of five men from each NHS commissioning region (1) North of England, (2) Midlands and East of England, (3) London, and (4) South of England.

Second, our quantitative study has demonstrated that for men diagnosed between January 2010 and December 2014, one in three bypassed their nearest provider for cancer surgery and one in five for radiotherapy.<sup>23,26</sup> It was therefore intended that approximately half of the study sample would include men who had chosen an alternative cancer treatment provider.

### Data collection

Twenty-five semi-structured interviews were undertaken between March 2016 and August 2016 by AA, a medically qualified researcher. A topic guide was informed by an in-depth appraisal of the patient choice literature and the specialist knowledge of the study team.

### Data analysis

Analysis was undertaken by AA, with support from CD. Transcripts were uploaded to Nvivo 11, which was used for data management, and a thematic content analysis of the interviews undertaken. The first five interviews were analysed inductively and coded systematically. Using a constant comparison method,<sup>27</sup> codes continued to be modified iteratively during the analysis of interviews. A coding framework was developed, applied, and refined as necessary, to the dataset. In line with our iterative data collection and analysis approach, the emergence of significant themes prompted further sampling to ensure that individuals from groups whose views may enhance or disprove emerging theory were included.<sup>28</sup> This iterative process continued until data saturation was achieved.

### Ethics

The study received approval by the London School of Hygiene and Tropical Medicine Research Ethics Committee. All participants reviewed and signed a written consent form prior to the interview. Each interview was recorded and anonymised using coded patient identifiers to protect participant confidentiality.

## RESULTS

### Participants

Twenty-five men agreed to participate. They had all received treatment for non-metastatic prostate cancer in the previous five years. Their characteristics are outlined in Table 1. At least five men from each of the four NHS commissioning regions were interviewed with more or less equal proportions of hospital ‘bypassers’ and ‘non-bypassers’ as well as patients receiving surgical and non-surgical therapies. In terms of socioeconomic status, all participants were classified according to their occupation as being from social classes I (professional), II (managerial and technical), III (skilled non-manual/manual).

### Themes

Five broad themes emerged from the data, which collectively inform and influence a patient’s decision to consider and travel to alternative hospitals or to stay with their local providers. These themes also allow an exploration of the nature of the choices patients were being expected to make, and to what extent and in what way patients want to be given these choices.

The first theme highlights how men’s choices are largely shaped by organisational and disease specific factors at the time of diagnosis i.e. the context of diagnosis. The second theme explores the different ways men resist or engage with the choice process in order to manage their fears and anxieties after receiving a cancer diagnosis.

### Theme 1

#### **Context of diagnosis: urgency and trust**

Nearly all men in our sample presented with either urinary symptoms or an abnormal blood test. At the time of the initial GP referral, their sole concerns were timeliness and convenience

in getting to appointments and so men universally accepted referral to their local hospital. From the time of referral, participants likened the process to a “conveyor belt”, often requiring three or four different investigations over several weeks before a diagnosis was achieved.

At this juncture, urgency and trust were recurring themes that limited both the opportunity and desire to consider alternative hospitals. Crucially given the time taken to achieve a diagnosis and the life-threatening nature of their diagnosis, men felt under “pressure” to make a decision quickly so they could start treatment.

Participant 1 - *As soon as someone says ‘you have got cancer’, and as soon as someone says ‘and you can have surgery’; I would guarantee that a lot of people – and I would probably do the same again - but a lot of people would say ‘take it out, get rid of it’.*

This perceived lack of time (exacerbated by short appointment times) meant that men did not necessarily have the opportunity to acquire and process all the relevant information, creating a desire to trust their clinician’s recommendations. In addition, the necessity for repeated investigations to reach a diagnosis for some participants also meant that they had already developed a loyalty towards their local hospital and were reluctant to move.

Participant 2 – *A few months earlier I would have jumped at the chance to get out of that hospital if it could have been done quickly, but what I vividly remember thinking is that having found these people, this surgeon, this nurse and I think at that point the oncologist, they were three people who I liked, I trusted, they took me seriously and they seemed to be caring.*

While such decision-making processes are framed as being driven by patient ‘choice’, in reality participants’ capacity to make decisions about their care as ‘active consumers’ was



commonly constrained by additional difficulties in accessing relevant information, protocolled hospital treatment pathways and referral networks, and pragmatic geographical opportunities. Few men recounted situations where they were informed that they could choose a centre outside of their local network, either to receive the same treatment or to receive treatment options not offered by their local hospital. Some participants felt it took significant effort on their part to push for consideration of treatments or alternative management strategies that had not been mentioned. Conversely, others wished to avoid potential conflict with their treating team and were more reticent in asking about alternative options.

The geographical organisation of NHS services also acted to limit the ability to change provider. Whilst some men had a choice of three or four hospitals within thirty minutes travel time from their house, others had to travel up to ninety minutes just to get to their nearest diagnosing hospital. There were also differences in desire to travel depending on the treatment modality. For example, surgery is a one-off event requiring up to a three or four-day inpatient stay whereas radiotherapy requires daily treatment for up to 8 weeks. Travel time therefore became a key factor in decision-making.

## Theme 2

### **Choice resistance and choice engagement**

In exploring how decisions are made, it is important to understand their context. Participants recounted the anguish and personal stress of having to make treatment decisions in the context of a cancer diagnosis. Men spoke of how they agonised over the treatment decision, and indicated they were not clear on whether the outcome would have been any better if they had chosen an alternative treatment. It was highlighted by some of the participants that they did not have the requisite background or confidence in medical terminology to truly make a rational and informed decision about what the optimal treatment was.

Participant 3 - *I think you're better off choosing a hospital near where you live so that if something goes wrong you can go back to them fairly easily. I think you're probably given too much choice quite frankly. I mean, four [treatment options] was bad enough. And I feel that we are given this menu of options which most men and women who are not medically trained are unable really to make a rational decision.*

Reflective of this lack of confidence and faced with the prospect of a condition that may end life prematurely, men developed diverse strategies to manage their fears and seek reassurance. These behaviours have been broadly categorised into two groups. Some men initially navigated this uncertainty by relinquishing control and relying on their clinician to take charge of decision-making about the best course of treatment. We refer to this as 'choice resistance'.

These men often co-opted family members to research options and to advise them so that they could share some of the weight of responsibility for decision-making. This included having to choose which hospital to attend. Many found that without the expertise to correctly interpret the information, especially given the fine lines between treatment options, that they did not feel competent or comfortable making their own 'informed' decisions. As a result, these men often preferred or felt compelled to trust in the judgement and expertise of clinicians who they believed were in a better position to advise on the best course of treatment given their clinical experience.

Participant 4 - *I might have found out that I might only have a 50% chance of surviving. Well, if that's the case, I can't do anything about it, can I? So knowing more information is a disadvantage, to some extent, if you're dealing with specialists.*

Conversely, some men wished to be much more active throughout the choice process. Following the initial shock of the diagnosis, they experienced a strong desire to try and identify a therapy, clinician or hospital that would maximise their chances of curing the disease. We refer to this process as “choice engagement”. The belief that they had considered all possible options provided some degree of reassurance as they considered that the choice that they ultimately made (be it moving to an alternative provider or staying locally), offered them the best chance of a successful outcome.

*Participant 5 - But I think the thing is, Ajay, when you're told that you've got cancer you think 'I'm about to die, I don't want to die', and when you've got over that and when you get back into the land of the living, as it were, then you want perfection again.*

### Theme 3

#### **‘Push’ and ‘pull’ factors driving hospital choice**

Decisions to seek care at alternative hospitals were driven by both ‘push’ and ‘pull’ factors. Push factors in particular were of relevance to both men who actively engaged with the choice process as well as those men who initially felt inclined to resist choice.

For example, some men described using hospital choice as a means of extricating themselves from care which had failed to meet their, or their families’ expectations. Participants gave detailed accounts of circumstances in which they felt that not ‘enough was being done’. This may have been because they perceived that the management offered was not addressing their specific needs, was outdated, or did not maximise the potential for ‘cure’.

An additional push factor was when participants had encountered difficulties in their relationship with the treating clinician. They may have felt that their concerns were not being

acknowledged, or that they were unable to get the information that they required to make an informed decision. This was particularly acute among participants that considered themselves 'well-informed' about prostate cancer through their own in-depth research. Some described situations where the clinician refused to be challenged about the management plan.

Participant 6 – *Well, the thing is he treated me as if I had a couple of brain cells..... He wouldn't answer my questions. It was just nothing, it was just an ultimatum: 'You do what I say or go away', 'I'm the expert, who are you going to ask?' And he was very, very aggressive so you weren't going to get the information from him, he was just a dictator.*

Other men framed their decisions to move to an alternative hospital in terms of 'pull' factors, based on the desire to achieve the best outcome and the attraction of centres that offered innovative technologies such as robotic surgery or high intensity focussed ultrasound. It was the desire to access a particular treatment that was not available at their local centre which was the main driver (and consequently perceived to be better) rather than the knowledge that the alternative hospital delivered better quality treatment.

Some men found specific hospitals by searching for the availability of particular treatments in the NHS, rather than an in-depth evaluation of the quality of different hospitals according to publicly available performance indicators. Whilst some men chose to move hospitals in order to access particular treatments, it also gave others reassurance to know that innovative treatments were already available locally.

It is also important to note that even for some of the men who chose to move hospitals, experiential factors with respect to hospital and clinician quality influenced their decision making. For example, these men stressed the importance of being cared for in a friendly,

supportive, kind and understanding environment, by individuals who were knowledgeable and professional. Such experiences reassured men that they were receiving care from people who were going to do the best for them, and engendered trust and loyalty towards their team.

#### Theme 4

##### **Informed choice: making sense of information anarchy**

While the premise of the policy is to encourage patients to make informed choices, participants described being struck by the lack of an independent voice to assist in their decision-making, highlighting natural biases amongst urologists and oncologists with these clinicians tending to favour the treatments that they themselves deliver. Whilst acknowledging that lots of information was out there, men would have appreciated an independent person who was able to navigate a way through all the information and summarise the evidence whilst taking into account new and emerging treatments and their own personal situation.

*Participant 7 - I do, however, think that there should at least be a situation where there must be specialists in the country that could give you all the pros and cons of everything and then direct you to where you can get each of those, you know, the best of each. I don't know whether such a situation exists.*

In the absence of an independent source of information, men and/or their families/partners were forced to undertake their own research. They recounted using an array of different sources to support their decision-making. Different values or weights were applied to the sources of information based on their own perception of its quality. Where specific information was not available, proxy measures or heuristics were used based on their personal interpretations of what represented good quality. In our sample, the internet and the social network of individual participants were the most commonly used external sources of

information, although a few deliberately relied on paper booklets as a means to avoid being overloaded with information.

The challenges in filtering and interpreting the quality of the available 'evidence' meant that all participants invested considerable trust in recommendations by members of their medical network, particularly specialist cancer nurses either working within their treating hospital or independent cancer charities. This was despite simultaneously acknowledging and accepting that there may be professional agendas driving the advice they received. Participants' peer support networks played a triangulating role in decision-making, while GPs were considered to be more peripheral to the process. Men highlighted that they did not trust in the GP's opinion as it was not their area of speciality and after their own research, they were in fact 'better informed about the best treatments and operatives'.

*Participant 8- the urologist nurse..., I rang her, and I asked her, 'Who is the best guy to see in the area with the view of having it removed?' and she told me to contact this urologist at Coventry, or there was another guy who she told me about in Birmingham...*

As part of the choice reform agenda, patients should at the least have access to comparative information about the quality of treatments at individual centres. However, for several diseases including prostate cancer, robust measures assessing the quality of treatment are not publicly available. In our sample, comparative hospital quality information from NHS Choices and other websites such as Dr Foster were rarely if ever used, as they were considered not to report the necessary information required to make informed choices about where the best place was for treatment.

In the absence of this information, men used a number of different proxy measures to define the quality of hospitals and individual clinicians, which allowed them to trust a particular individual, institution or technique. This included the individual surgeon's internet profile, particularly their years of experience, research interests, and number of publications.

*Participant 9 - I saw Professor A and looked him up on the internet... and I thought 'mmm, this is an impressive man, oh boy, you know, he's written so many papers'*

Additional criteria that men applied to assess the quality of a clinician, technique or institution included whether a centre was described as a "centre of excellence", despite there being no strict definition about how this label might applied, and the frequency and volume of treatment procedures performed.

*Participant 10 - It's just that when you go to a surgeon, he's got to learn to do the procedure, hasn't he, and you want somebody who's really skilled, just like, in the same way in my opinion, you want somebody grey-haired as the pilot of an aeroplane when you fly.*

In addition to the proxy measures which men used to interpret and identify 'quality care', they were also considerably influenced by industry marketing and by the media's portrayal of treatments and clinicians. For example, two men referred to a Daily Mail article published in 2010, which reported the 'best prostate cancer surgeons in the NHS' as information that they used when requesting a second opinion. The link to this newspaper article was readily accessible online through a google search, appearing as one of the first links, and is the only 'ranking' of UK based prostate cancer surgeons that exists online. One of the surgeons named in the article had also appeared on a television documentary, which reinforced their reputation



as men sought to triangulate the different components of their research to determine the best ‘operatives’.

## Theme 5

### **Expert health-care consumers**

The study identified a distinct subset of men who not only engaged with the process of choice, but also appeared to be satisfied with their decisions. These men viewed their relationship with clinicians very much as a two-way partnership of equals, in which decision-making was effectively shared. This relationship was forged from their own position in society, either as professionals in their own right, or men in charge of teams. These men saw the medical team as conduits to accessing the best care and would challenge the system in order to ensure that the care they received in the NHS met their own expectations.

For some men this was driven by a desire to control the process as much as possible, or to know they have done everything within their own power to ensure they received the best or most novel therapy. They were willing to travel to whomever they considered as the best practitioner or centre for delivering a particular therapy (even if this meant paying out of pocket to do so), often described their behaviour as that of a consumer.

*Participant 11 - I've got a kind of medical background and I've got the ability to seek information and filter it and make sense of it, and I'm fairly assertive, I ask for things you know, I'm not frightened by their authority figure aura you know, 'I'm the doctor and I'm the authority figure, you listen to me and de-de-de-de'*

Their approach to gathering information about prostate cancer was highly nuanced and almost forensic in its attention to detail. They described collating several different sources of

information on multiple aspects of quality, over and above that routinely available from simple google searches. This included peer-reviewed journal articles, information from hospital secretaries about waiting lists, and clinical specialty websites.

It should be highlighted that this sub-group was the exception and not the norm, even amongst those actively engaged in the choice process. For the majority, the pressure to choose and bear the responsibility for trying to understand the best option for them, potentially exacerbated what was already a very anxious time for them. It therefore appears that choice benefits a specific population group. Far from democratising the process it leaves many feeling overwhelmed, burdened by responsibility and in many cases hesitant and doubtful about the choice that they essentially were forced to make somewhere along the line.

## **DISCUSSION**

Hospital choice policies were introduced in the NHS on the assumption that they would drive up quality, enhance equity in access, and afford patients greater control of their health care. However, our study suggests that choice policies have been implemented without proper understanding or consideration of the organisational, disease-specific and socio-cognitive factors that shape patients' experience of the current healthcare system. The interviews highlight, the varying ability and desire of individuals to act as health care consumers, the impact that being diagnosed with a severe medical condition has on decision-making, as well as the difficulties men faced in accessing relevant evidence-based information to make informed decisions.

The first theme highlights how men's choices are largely shaped by organisational and disease specific factors at the time of diagnosis. Organisational barriers include a perceived lack of

time for decision-making, the availability of alternative centres within a reasonable travel distance, and the hierarchies of power and knowledge that exist between patients and clinicians (findings which are consistent with several other studies<sup>7,13,14,29,30</sup>).

We also find that policymakers have failed to understand the emotional and cognitive burden associated with severe medical illnesses such as cancer. Most patients felt a natural “urgency” to receive treatment as quickly as possible, and ideally locally, given the threat posed by having a life-threatening illness. However, some men in retrospect regretted not considering alternative hospital or treatment options especially in circumstances where they were not satisfied with their eventual treatment outcome. The hospital choice agenda can itself be seen to create greater anxiety amongst individuals as it reinforces the fact that variations in the quality of care exist across the NHS.<sup>31</sup>

The current system also does not account for the diverse treatment pathways associated with different disease conditions. It implicitly assumes that at the time of diagnosis there is a single, easily identifiable treatment option, at which point health care users simply have to choose the best available hospital to deliver that treatment. However, in the context of a prostate cancer diagnosis, some men described how they struggled to select the most appropriate treatments. The pressure to choose and bear responsibility for trying to understand the best option left many feeling burdened and doubtful about their choices. As a result, provider choice became an afterthought or irrelevance for many, who preferred instead to trust in the status quo or the recommendations of their clinicians to reduce the complexity of decision-making as much as possible.<sup>32,33</sup>

Furthermore, treatments for prostate cancer do not just entail one-off surgical procedures but may include prolonged courses of treatment such as radiotherapy, which again impacts on the

ability to choose alternative treatment providers. This would suggest that choice policies might be better suited to specific disease interventions (e.g. elective hip replacement) rather than being applied uncritically across all disease areas.

Our study provides important insights into how choice policies may act to widen inequities in access to care. As described in theme 2, men strongly differed in how they handled the choices they were expected to make. Whilst choice felt like a burden for some men, for others it presented an opportunity to reassure themselves that they had done everything possible to secure the best outcome. Theme 5 goes one step further, specifically describing a subset of ‘choice embracers’ who appear to have inherent advantages in accessing and benefiting from what they perceive to be the ‘best’ health care. These advantages appear to be based on their socioeconomic status<sup>34</sup> - for example, their educational background, financial resources and their confidence in negotiating care with the medical professionals – factors which have previously been identified as potential drivers of inequality in other studies.<sup>13,15,26,35-38</sup>

From a national perspective, if particular socioeconomic groups are more able to take advantage of the best available care this could widen inequities in health care outcomes. This was a concern initially highlighted at the time of implementation of these policies<sup>34,39</sup> and is a consequence of placing primary responsibility for fact-finding on patients.

In light of this, policy makers need to consider the introduction of supported choice packages to provide greater transparency, clarity and equity to the hospital choice process.<sup>40,41</sup> This was a feature of the original NHS patient choice pilot schemes and is likely to have contributed to the equitable uptake of “choice” across socioeconomic groups.<sup>42</sup> As well as providing clearer information for patients about the available hospital options locally, the pilot study ensured that costs associated with transport were reimbursed.

A major challenge to the implementation of choice policies in the NHS is the absence of robust indicators of treatment quality at the hospital or clinician level for several different disease interventions including prostate cancer. Theme 4 describes the difficulties that men faced in finding independent and trust-worthy information about their disease and available treatments, which undermined their ability to make an informed choice. Instead, proxy measures were used by individuals to differentiate the quality of alternative treatments and techniques.<sup>43</sup> In reality, some men would have valued more relevant information about the quality of their treatment, for example, the likelihood of achieving a cure, or what their quality of life with respect to their sexual and urinary function was likely to be a few years after surgery.

Participants described how they tried to make up for these information deficits by independently gathering information from several lay sources including the internet and their wider peer support network. Whilst some referred to their specialist nursing team for 'trusted' advice, GPs, who are considered a key source of information about treatments and hospitals in other studies<sup>44</sup> were rarely called upon. Men cited GPs' lack of specialist and up-to-date knowledge as an issue, with some considering themselves better informed.

This lack of relevant and independent information meant that men were vulnerable to 'word of mouth' recommendations and the freely available media and marketing material, which has been shown to not always provide balanced views regarding the pros and cons of treatment.<sup>45,46</sup> It is therefore unsurprising that the availability of a new or advanced technology was a key 'pull' factor in determining where patients received treatment for their cancer. This also reflects the findings from our quantitative study, which demonstrated that men receiving radical prostate cancer treatment were more likely to travel to early adopters of new robotic surgery and radiotherapy techniques, despite lack of evidence that this technique truly delivers improved outcomes of care.<sup>21,23,45</sup>

Our study provides some insight into why technology may act as a strong determinant in patient decision-making. First, new technologies are marketed in a way that gives them a high degree of visibility. For example, one man was able to see a Da Vinci robotic (used for prostate cancer surgery) at his local mall, as part of a marketing drive by the manufacturers. There were also videos of the surgical procedure on YouTube and a number of testimonies from men who had previously received this treatment online and in newspaper articles. It also seemed to offer a source of reassurance for men to know that they were receiving the “latest” and ‘newest’ treatment. Beyond this, there also appears to be a prevailing culture or faith around the perceived benefits of innovation, influenced by the key messages and language used to describe new advances in medical care.<sup>47-49</sup>

Whilst we have focused on the negative consequences of these policies, our study also suggests there have been benefits. Specifically, choice policies have provided a means for patients to ‘exit’ healthcare that did not meet their expectations.<sup>35,50</sup> This was based on participants’ perceived adequacy of the care they were receiving, which largely centred on their relationship with the clinical team and the quality of ongoing management.<sup>10</sup> This also highlights the importance that men placed in being cared for in a supportive, knowledgeable and professional environment which are the foundations of the trust that they ultimately had to place in their treating team.<sup>51,52</sup>

We also find in the context of this study, that choice policies enabled individuals to receive particular treatments that were not available at their local hospital. This allowed them to bridge the significant inequities in the availability of evidence-based treatments that exist across the English NHS.<sup>25</sup> However, this also created new inequities as this was possible only for those patients who were better informed and “active” in their choices, suggesting that many are still not aware of, or able to access these therapies.

There are a number of study limitations. This is a national study of 25 men regarding their experience of receiving treatment for prostate cancer in the English NHS. The sample is small in the context of the number of people treated per year with prostate cancer and therefore not generalisable. However, qualitative interviews allow the generation of rich data about the complexity of patients' experiences, which can be unpicked and contextualised with respect to the quantitative research evidence. In this regard, it has been informative for highlighting the challenges of integrating hospital choice initiatives into the health system.

It is possible that the professional background of the lead researcher as an oncologist could have influenced the reporting of the results, however safe guards included triangulation, multiple coding and discussion of the data interpretation within the wider multidisciplinary study team has sought to limit this as a source of bias.

A further limitation relates to the fact that patients were recruited through a patient support group, which resulted in a skewed sample with respect to participants' socioeconomic characteristics. This social group may be considered to have the educational and financial resource to realise patient choice, however our study demonstrates the inherent difficulties that exist in doing so within the current system and in the context of a severe illness.

## **CONCLUSION**

This study has attempted to enhance our understanding of how hospital choice policies are being experienced by health care users and whether they are working as intended. Through the accounts of men who received treatment for prostate cancer in the NHS, we find that implementation of these policies has been incoherent and that policymakers have failed to understand the organisational, disease-specific and socioeconomic and cognitive factors that



influence patients' desire and ability to choose their treatment provider. The absence of relevant hospital level information on treatment quality has resulted in a spectrum of different choice behaviours with an array of factors informing and influencing treatment location. "Push" factors often from negative experiences of local care were just as relevant as "pull" factors that attracted patient to specific centres, such as the availability of new innovative practices of care. The necessity for men to collect and appraise complex treatment related information has potentially created, socioeconomic inequities, in access to the best available treatments.

Given the NHS' continued commitment to hospital choice, we advocate the need for greater evaluation of the impact of such policies using the experiences of health care users across different diseases and interventions to identify potential opportunities to improve their effectiveness. In the short term, it is essential that independently validated performance measures are developed and made publicly available to limit the impact of the media, industry marketing and the use of non-validated proxies of quality on decision-making. Greater efforts are also needed to address many of the entrenched organisational and attitudinal barriers that exist within the health system that limit the opportunity for choice, in particular what appears to be a lack of buy-in or disincentives amongst clinicians and health care providers. In this regard, independent patient care advisors and a package of supported choice for low socioeconomic groups may help to provide greater transparency, clarity and equity to the hospital choice process.

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**Table 1. Demographic characteristics of study participants (n=25)**

<b>Age</b>	<b>Numbers (%)</b>
50-65	10 (40)
65-75	12 (48)
>75	3 (12)
<b>Region of residence</b>	
North	5 (25)
Midlands and East of England	7 (28)
London	5 (25)
South of England	8 (32)
<b>Social Class</b>	
Professional	8 (32)
Managerial and Technical	9 (36)
Skilled non-manual	6 (24)
Skilled manual	2 (8)
Partly-skilled	None
Unskilled	None
<b>Treatment received</b>	
Surgery	14 (56)
Radiotherapy	9 (36)
Other	2 (8)
<b>Bypassed local hospital</b>	
Yes	14 (56)
No	11 (44)

## 9. DISCUSSION

This program of research has sought to address a number of questions that have persisted since the introduction of patient choice policies in the NHS. In the next section, I summarise the main findings from my PhD. Following this, I discuss how the findings of my thesis have furthered our understanding of the role and impact of choice and competition policies in the NHS before considering future opportunities for research.

### 9.1 Summary of main findings

The thesis demonstrates unequivocally that Choice and Competition are occurring within the English NHS. With respect to patient mobility for prostate cancer treatment, I find that one in three men and one in five men bypassed their nearest centres for prostate cancer surgery and radiotherapy respectively. Patient mobility varied significantly across English regions, with one in two patients bypassing their nearest surgical centre in London compared to one in seven patients in the North East Region. This pattern was related to the number of available providers from which patients could choose in their region, although mobility across regional boundaries was also evident, particularly for those men seeking prostate cancer surgery.

Travel time was the dominant factor influencing location of care, however younger, more affluent men and those living in rural areas were more likely to travel further for radical prostate cancer radiotherapy. For prostate cancer surgery, the same pattern of patient characteristics was observed, however it was also found that fitter men with no comorbidities were also likely to travel further for treatment. Men are prepared to travel to centres where they think they will get the best care and outcomes. When considering the characteristics of each hospital within a conditional logit model, I find that for prostate cancer surgery, men

were attracted to centres that were early adopters of robot-assisted radical prostatectomy and to centres that employed surgeons with a national media reputation for prostate cancer surgery. For radiotherapy, men were attracted to centres that offered hypofractionated prostate radiotherapy as their standard schedule, to large-scale regional radiotherapy units, and to centres that were early adopters of intensity-modulated radiotherapy (IMRT) in the NHS.

The mobility of patients has resulted in shifts in market share for individual cancer centres (both surgical and radiotherapy) resulting in a net gain of patients for some centres - “winners” - and a net loss of patients for others - “losers”. These patterns were more marked in areas of stronger competition as measured by a spatial competition index and resulted in some centres performing up to 400 more surgical or radiotherapy procedures than expected if they had only been treating local men for whom this was their nearest centre. Conversely, some centres were performing significantly fewer procedures (over 500 fewer in the case of one radiotherapy centre) than expected due to patients seeking care elsewhere. From an efficiency perspective, patient mobility is likely to have resulted in lengthening of waiting lists for some centres and/or wasted NHS capacity for others.

The observed shifts in market share for individual surgical providers has also had an effect on service configuration and technology adoption as outlined in Chapter 6 (pages 87-98). 25% (n=10) of the 37 radical prostatectomy centres classified as “losers” closed during the study period with no evidence that their outcomes were any worse compared to those centres which remained open. Centres that gained patients were more likely to offer robotic surgery, compared to centres that lost patients (10/23 [43.5%], compared to 2/37 [5.4%]). Of the 10 surgical centres that closed, none offered robotic surgery. It therefore appears that the co-existence of policies that requires centres to perform a minimum number of procedures with policies that allow patients to select a provider of their choice has stimulated a form of natural

selection, where hospitals compete to preserve their cancer centre status. These competitive factors have likely contributed to the large-scale investment in robotic equipment in the NHS. Between 2010 and 2017, the number of robotic centres has more than tripled – increasing from 1 in 5 (12/65) centres providing the technology in in 2010 to over three quarters (42/49) in 2017.

I also attempted to analyse the complex relationship between a competitive environment and patient outcomes following prostate cancer surgery. My findings demonstrate that patients treated in centres located in the most competitive areas (as measured with a spatial competition index) had a lower chance of a 30-day emergency readmission following surgery. However, there was no association between the strength of competition and other patient outcomes such as post-operative length stay and rates of severe urinary complications. The lack of a statistically significant association between hospital procedure volume and patient outcome after controlling for procedure type is likely to be influenced by the ongoing centralisation of NHS specialist services, which has served to eradicate surgical units that were performing a very low volume of procedures. Whilst one must be cautious in the interpretation of these results, my findings suggest that an association potentially exists between a competitive environment and clinical outcomes and that plans for further centralisation of surgical services may not necessarily deliver the expected improvements in outcome.

Finally, the results of my qualitative work involving interviews with men previously treated for prostate cancer in the UK have been informative in understanding the factors that inform and influence patient choice. The findings demonstrate how the geographic configuration of specialist services, the perceived urgency of a cancer diagnosis and pre-established referral and treatment pathways all limit the opportunity to choose an alternative hospital. Patients were required to collect additional information independently and were mainly reliant on the

internet, the specialist nursing team and their individual social networks. This in itself creates socioeconomic inequities, enabling those with the relevant educational background, financial resources and confidence in negotiating care to potentially benefit from the best available treatment. However, in the absence of relevant up-to-date and interpretable information, patients were required to use a series of proxy measures and heuristics to differentiate quality and were particularly attracted to new technologies and “centres of excellence” (findings that are consistent with my quantitative results). A key advantage of the choice agenda is that it has enabled patients to “exit” care that does not meet their expectations or to bridge variations in the availability of specialist cancer treatments across the NHS.

## **9.2 Policy implications**

The next section discusses how this program of research has enhanced our understanding of the way in which choice and competition policies are operating in the NHS, focusing on five key themes: Patient mobility, Determinants of patient mobility, Equity, Efficiency and Hospital competition.

### *9.2.1 Patient mobility*

The first major finding from the thesis is that the proportion of patients prepared to travel beyond their nearest provider for cancer treatment has been far greater than was originally considered necessary (5-10%) to stimulate improvements in quality within a fixed-price health care market (Le Grand, 2009).

Whilst studies to date have predominantly focused on patient mobility for surgical procedures, my findings within the context of radiotherapy are particularly informative. It suggests that

patients requiring complex daily treatments for up to 8 weeks are prepared to travel to alternative centres, despite the likely physical and financial burden associated with this.

The extent of patient mobility observed is also unexpected given the current organisation of NHS specialist services and lack of clinician “buy-in” to these policies. In the current system patients are rarely, if ever, given a choice of treating hospital by their clinician, (Dixon *et al*, 2010a) in part because clinicians are dis-incentivised from offering alternative hospitals for the same treatment given the loss of hospital income if the patient moved elsewhere for their treatment. This may result in patients not receiving treatment in line with their preferences (Bryan *et al*, 2006), or in patients failing to be informed about other relevant evidence-based treatments, which although not available at their local centre, could have been offered elsewhere.

The overall rates of bypass are higher than expected given the substantial variation in the configuration of specialist services across English regions (i.e. concentration of available providers). For example, for prostate cancer surgery, the movement of patients between centres varied from one in two patients bypassing the nearest provider in London (in which there were 10 centres in 2010 covering an area of 1,572km<sup>2</sup>), to one in seven in the North East (in which there were 3 centres in 2010 covering an area of 8,592km<sup>2</sup>).

This highlights that despite these geographic barriers, health care users are responsive to perceived differences in quality between centres and are prepared to exercise their right to “choose”. One could therefore argue that the rates of bypass observed could potentially be even higher if the current system was better aligned to support hospital choice.

It is unclear from the study findings, whether cancer patients are more sensitive to choice policies than non-cancer patients. The qualitative component of the study suggests that men diagnosed with prostate cancer attempted to balance the perceived urgency of their condition with a desire to do everything possible to secure the best outcome possible. It is not possible to extrapolate these results in the context of prostate cancer to other tumour types without further investigation, given differences in their mode of presentation, disease biology, treatment (type and intensity) and availability of services nationally. However, the systematic review I undertook (Chapter 3, pages 32-58), has been informative in identifying five international studies, which demonstrated that patients with different tumour types including breast, gastric, colorectal, and thoracic cancers are prepared to travel to alternative more distant centres for surgical treatment.

#### *9.2.2. Determinants of patient mobility*

By using a mixed methods approach, my thesis has provided an in-depth insight into the sources of information and the factors that influence patients' choice of provider. It has highlighted that a fundamental issue within the current system, which undermines the choice agenda, is the failure by policymakers to provide relevant measures of quality across different disease interventions. In the case of prostate cancer, there is little or no information at the provider level regarding the outcomes of different treatments in terms of tumour control and quality of life.

Men instead were found to rely on a series of proxy measures to identify and differentiate quality between treatments and hospitals using information largely gleaned from the internet, their specialist cancer nursing teams and their individual social networks. Whilst one may point to the generic markers of quality that are currently presented on websites such as NHS choices (e.g. infection rates), evidence from my qualitative study and the wider literature

suggests that patients rarely use these metrics, as they are difficult to interpret and personalise in the context of their own disease (Dixon *et al*, 2010a; Fung *et al*, 2008; Hildon *et al*, 2012; Marshall & McLoughlin, 2010; Raven *et al*, 2012). In diseases such as prostate cancer, patients also have the added burden of having to assess the merits of competing treatment options as well as differences in the availability of treatment services nationally.

The quantitative analyses found that men with prostate cancer were more likely to travel to centres that were early adopters of innovation such as robot-assisted radical prostatectomy or that had integrated new processes of care (e.g. hypofractionated radiotherapy). With respect to the former, this demonstrates the impact that the availability of innovative technologies has on perceptions of quality. This is likely to be partly influenced by current marketing literature available through websites and mainstream newspapers, which has a tendency to exaggerate the benefits of these innovations with respect to delivering improvements in outcome (Basto *et al*, 2015; Dixon *et al*, 2015).

Similarly, the term “centre of excellence” was applied to specific providers by men interviewed in the study based on the perceived size of the centre, the volume of procedures performed, its research activity and the profile of individual clinicians. Whilst clinician and hospital reputation has previously been highlighted as a key determinant of patient mobility in survey based studies (Schwartz *et al*, 2005) the quantitative component of my thesis provides a better understanding about the impact of reputation on the behaviour of patients and the choices they ultimately make.

One can therefore observe how choice and competition policies have the potential to favour particular providers irrespective of the outcomes they deliver, or indeed how providers including those delivering cancer services will adopt a competitive strategy to establish a



strong position in the market by differentiating their practices of care (Baker & Phibbs, 2002; De Kuijper, 2009; Lutz, 1991). New patients will gravitate to these places and by doing so create specialist centres that treat a large number of patients, which in itself will attract further patients.

Another key determinant of mobility identified in the qualitative interviews was the desire for some patients to exit care that did not meet their needs or which they considered inadequate (Hirschman, 1970). It is arguable that this represents a success of the choice agenda and has allowed patients to access care that meets their own expectations, as previously this would not have been possible. However, a concern which arises is that some patients are moving to alternative cancer centres because the management plan at their local hospital is limited or does not take into account current advances in care. Whilst some individuals are clearly able to bridge these gaps, it remains unknown what the impact on outcomes are for those who are not able to evaluate differences in care or who do not have the financial resources to travel elsewhere.

### 9.2.3 *Equity*

Patient choice policies were expected to improve equity in access to the best available health care services for NHS patients, irrespective of their ability to pay (Le Grand, 2009). Prior to the introduction of these policies, patients could only choose an alternative hospital if they opted out of the NHS, and received care privately. However, the quantitative analyses demonstrate unequivocally a clear socioeconomic gradient in a patients' willingness or ability to travel.

Younger, fitter and more affluent men were more likely to bypass their nearest provider for prostate cancer surgery, and younger and more affluent men for radiotherapy. The qualitative component of my thesis also supported these findings. It identified a subset of men who appeared to have inherent advantages based on socioeconomic status in accessing information, maximising their choice options, and benefiting from what they perceive to be the “best” health care.

From a wider NHS perspective, there is a real concern that offering patients a choice of their treatment provider may widen socioeconomic inequalities in access to services and the quality of care received, especially where men from lower socioeconomic backgrounds are unable to move to higher performing centres due to economic constraints (Dixon & Le Grand, 2006; Fotaki, 2010). In addition, current patterns of mobility, may result in hospitals within socioeconomically deprived areas with older demographic profiles having to manage far more complex patient cohorts (both medically and socially), which will likely impact on their quality outcomes and ability to retain local patients.

#### *9.2.4 Efficiency*

My thesis demonstrates that patient choice policies have created “winners” and “losers” in the health system due to patients considering treatment in hospitals other than their nearest. I assessed this empirically by considering the difference between the number of patients treated in a centre and the number expected to be treated based on each patient’s residence. For some surgical centres, nearly 80% of patients for whom that centre was the nearest provider chose to have their treatment elsewhere. Conversely, other centres were performing up to 200% more operations than expected because patients from elsewhere travelled to these centres for their surgery. Similar findings were observed for radiotherapy providers in the NHS. From an

efficiency perspective, patient mobility is likely to have resulted in lengthening of waiting lists for some centres and/or wasted NHS capacity for others.

#### 9.2.5 *Hospital Competition*

In the NHS, policies promoting choice and competition are operating alongside those that aim to centralise specialist health care services. The likely effect of these policies working in parallel on the equity, efficiency and quality of health care services was unknown at the time that choice and competition was introduced (Jones & Mays, 2009). Nor was there any guidance/evidence as to how these policies could be appropriately balanced. In this regard, the results from my thesis have been informative by highlighting from a conceptual point of view, two different ways in which competition is operating in the NHS and the implications on the wider health system of having a mixed-policy environment.

##### The competitive environment

The first way in which competition is influencing the delivery of health care is through the creation of a health care environment in which patients can select and travel to a health care provider of their choice. We know, from this program of research (and others), that patients are prepared to select and travel to a health care provider of their choice and that patient mobility is largely concentrated in the most competitive areas where there is a plurality of available providers (Damiani *et al*, 2005; Gaynor *et al*, 2013). This environment is thought to stimulate improvements in quality for individual hospitals as they seek to retain and attract new patients to prevent the loss of income and to also preserve their reputation (Le Grand, 2009). This has been demonstrated in published studies which sought to analyse the impact of hospital competition on outcomes of medical and surgical care (Chou *et al*, 2014; Cooper *et al*, 2011; Diller *et al*, 2014; Hibbard *et al*, 2005).

In Chapter 6 (pages 87-98), we can see how a highly competitive environment influenced practices of care for prostate cancer surgery at the individual hospital level. I found that seven (41.2%) of 17 centres in the highest quartile for hospital competition were established robotic centres compared with five (10.4%) of the 48 other centres in the three other quartiles ( $p=0.0050$ ).

Given these observations from my own study and the wider literature, I attempted to analyse the relationship between a competitive environment and patient outcomes following prostate cancer surgery (Chapter 7, pages 99-128). I found that patients treated in centres located in the most competitive areas (as measured with a spatial competition index) had a lower chance of a 30-day emergency readmission following surgery. However, there was no association between the strength of competition and other patient outcomes such as post-operative length stay and rates of severe urinary complications.

The results need to be considered cautiously given the limitations of the study, namely the paucity of patient outcome measures I had available, the lack of information about individual surgeon volume (which may be more relevant), and the underpowered nature of the study given it was an analysis of 65 centres. In addition, the international literature to date has largely supported an association between increasing procedure volume and outcomes. However, the findings from my analysis suggest that an association potentially exists between a competitive environment and clinical outcomes for prostate cancer surgery, and that further centralisation may not deliver the expected improvements in outcome by increasing the volume of procedures performed.

Further research using additional patient outcome measures and across different tumour types and interventions is required before any definitive recommendations can be made regarding

the relative merits of competition and centralisation as a mechanism to improve cancer outcome. This includes a better understanding of the impact of reconfiguring the health system to support either one of the two policies on the equity and efficiency of health care delivery, and the trade-offs that need to be considered if seeking to improve quality.

#### Competition as a mechanism for centralisation - “survival of the fittest”

A major finding from this research program is that patient choice and hospital competition, rather than a coordinated policy towards centralisation, have been the most significant drivers in the configuration of prostate cancer surgical services in the NHS. The incentive for NHS centres to compete has been two-fold. First, payment follows the patient, and therefore the loss of patients from their catchment areas affects hospital income and the viability of the service (Department of Health, 2012). Second, centralisation is largely driven by the need of a surgical service to meet procedure volume targets each year. Those centres not able to meet these targets are at risk of closure.

This link between choice and competition and centralisation has not previously been observed in the NHS and highlights that whilst attempts have been made by policymakers to “control” the healthcare system centrally, it is in fact patients and clinicians that have had a substantial impact on the design of the health service. For example, centres classified as “losers” were more likely to close their service. In addition, the rapid and widespread adoption of robotic surgery in the NHS has been unforeseen, effectively rendering commissioning guidelines, published only in 2015 recommending a phased introduction of robotics for prostate cancer surgery within the NHS, obsolete. By 2015, 39 (71%) of the 55 centres open already offered robot-assisted radical prostatectomy.

Although the creation of a “survival of the fittest” environment was never explicitly intended within the original policy framework (Jones & Mays, 2009), some observers noted at the advent of such policies that it was an inevitability, and framed the potential consequences in both negative and positive lights.

From a negative perspective, it was thought that the reconfiguration of services in response to patient demand rather than the health care needs of the population within a region, may lead to inequities in access to services for the most vulnerable groups given their decreased ability to travel (Paton, 2010). This has potentially been borne out in my study as patient mobility (and the subsequent shifts in market share for individual providers) was largely observed amongst younger, fitter, more affluent men. We also do not know whether the process of “natural selection” resulted in the closure of the worst performing centres (with respect to quality) or whether patients bypassing their nearest providers had better cancer outcomes.

Observers also highlighted the potential inefficiencies that could result from such policies as providers seek to make themselves more attractive to patients, advising the government to heed lessons from the US health system, which had a well-established health care market at the time (Fotaki, 2014; Fotaki *et al*, 2008; Kuttner 2008; Pauly, 2005). The thesis demonstrates the case in point, as surgical centres investing in costly robotic equipment fared better than those who did not in attracting patients and reducing the threat of closure. However, there is little evidence that such investment and changes in practices of care have ultimately improved quality.

From the perspective of the wider NHS, this should serve as a warning as to the potential inefficiencies that result from a lack of appropriate indicators regarding the quality of care to direct patient choice (Arrow, 2001). In their absence, my thesis suggests that such policies

could lead to a technological “arms race” which may inflate the cost of delivering health care without any tangible improvement in outcomes.

Whilst these have been the main concerns of the choice and competition agenda, many of which have been realised, others would argue that the current patient choice/hospital competition model is achieving exactly what has always been desired in the NHS. Simon Stevens (current Chief Executive of the NHS) wrote the following in support of competition in the BMJ in 2011(Stevens, 2011).

*“competition might diminish tiresome but repeated top-down NHS reorganisations and pointless bureaucratic restructuring, which history suggests are the inevitable result of day to day central government control. Imagine instead a world where clinicians controlled more of their own destiny, where those with creative ideas and innovative approaches were free to form new organisations or partnerships, and which would succeed based on the extent to which they met patients’ needs and preferences. This is a conception of the NHS not as a giant hierarchically organised healthcare factory—as now—but as an evolving, plural, distributed, and self directed health ecosystem. Many European healthcare systems operate more like that—why not the NHS?”*

My case study in prostate cancer surgery demonstrates that this vision of a dynamic evolution of services in response to patient preferences has become a reality. If working as intended this will serve to reduce inefficiencies in the current system by weeding out centres, which have the greatest net loss of patients. However, paradoxically, this is moving us away from the competitive environment on which these policies are predicated.

### **9.3 Balancing competition and centralisation**

The next section discusses how best to optimise the health care system if a mixed-policy approach is the preferred strategy within the NHS. i.e. a health care system, which seeks to maintain a competitive environment, continues top down reconfiguration of specialist services, and at the same time wishes to encourage dynamic changes in the delivery of services in response to patient demand.

#### *9.3.1 Designing a health system to support patient mobility and competition*

If the creation of a competitive environment is to be the dominant mechanism by which the health system delivers improvements in healthcare quality, the availability of alternative providers and the travel time between them are important factors (Balía *et al*, 2014; Damiani *et al*, 2005; Gaynor *et al*, 2010). The analysis of patients undergoing surgery and radiotherapy highlights how the spatial configuration of alternative providers (as measured with a spatial competition index) greatly influences the patterns of patient mobility and explains the regional variation we demonstrate. As a result, the geographical layout of cancer services means that not all centres face the same competitive pressures and in turn they will respond differently to choice and competition policies as a mechanism for quality improvement.

To increase the level of competition across England, new specialist cancer providers would be required, especially in regions such as the North East of England, Yorkshire and Humberside, and the East of England. In designing the optimum geographic location of new specialist centres, location allocation modelling, provides a robust empirical approach by accounting for existing patterns of mobility, clinical quality and hospital capacity within the health service (Santibáñez *et al*; Wang & Onega, 2015).



### 9.3.2 *Top down reconfiguration of cancer services*

In the current policy environment it is unclear how strategic plans for the reconfiguration of specialist cancer services are being formulated (e.g. NHS cancer alliances or cancer vanguards) (Independent Cancer Taskforce, 2015). It is imperative that such decisions are based on substantive evidence that centres provide either the best care, improved access or have the capacity to expand their services in the context of increasing demand, rather than be based on the perceived profile or reputation of a centre.

Two empirical approaches to the reconfiguration of services using econometric and geographic methods could be considered to assist in this complex process. Econometric analyses can be used to predict the impact of the closure of cancer treatment units on travel times, equality in access and outcomes using data on an individual's willingness to travel and quality preferences derived from the conditional logit analyses undertaken in this study (Kobayashi *et al*, 2015; Poeran *et al*, 2014). Pilot closures may be based on several relevant factors, for example closing the: (1) worst performers (if outcome data is available), (2) low volume centres, (3) centres that are frequently bypassed and therefore potentially represent wasted NHS capacity, (4) or those centres which do not have all cancer treatment modalities available onsite (e.g. radiotherapy and surgery). In this way, one can simulate multiple options for service reconfiguration, and assess their likely health system effect.

Similarly, using willingness to travel coefficients, geographical techniques such as location allocation modelling as described before, can identify which treatment centres to close in order to minimise disparities in access to cancer care (Wang & Onega, 2015). This involves a step-wise approach that considers the impact of closures of each centre in the choice set before assigning which closure is likely to have the least impact on access expressed in terms of travel

time or distance. This is important as inequities in access have been observed for older, and lower socioeconomic groups with comorbidity, which can subsequently affect outcomes.

### 9.3.3 *Development of indicators for quality improvement*

If a bottom-up approach (led by patients and clinicians) to service configuration and quality improvement is the preferred strategy within the NHS, efforts need to be made to fill the current gaps with respect to information about the quality of cancer treatment (both surgery and radiotherapy) delivered by individual providers. This information needs to be provided in a format that is interpretable for patients and will assist in their decision making (Department of Health, 2016). The qualitative component of my research demonstrated the current information anarchy that exists in prostate cancer with little if any independent information about aspects of care that patient's value, for example, their likely functional and oncological outcomes from treatment.

Instead, patients remain reliant on a variety of different types and sources of information (e.g. word of mouth, the internet, personal knowledge) as well as the media interpretation of technological developments (Abrishami *et al*, 2014; Dixon *et al*, 2010a; Victoor *et al*, 2012). In addition, specialist centres continue to differentiate their practices of care which adds further complexity for patients when considering what are the best treatments and who are the best practitioners.

It is a recommendation of this thesis that the development and reporting of patient-level outcomes for interventions should be undertaken as part of a public engagement strategy, which seeks to better understand what the public wish to see reported with regards to the quality of care delivered by individual cancer providers and clinicians. Whilst most attention

has been devoted to the development of outcome measures which reflect the quality of treatment, in reality there are many other aspects of quality that patients are likely to value and would wish to see reported. A public engagement approach can also assist in the development of an online platform, which allows individuals with cancer and their carers/relatives to better assess differences in the quality of care and provide guidance on the value of new innovations that are increasingly marketed and publicised in the media (Aggarwal *et al*, 2014).

With respect to outcome indicators, it is important to acknowledge that it may be difficult (or not ever be possible) to develop meaningful indicators for some tumour types. For example, the appropriateness of many indicators that are currently available is problematic because they can only be published or measured after a long lag period (e.g. side-effects/survival rates at 1 and 5 years) during which time clinical practice can change considerably (Walker *et al*, 2013). Neither is it helpful to merely publish a series of process indicators, which may be difficult for patients to interpret and do not necessarily help to differentiate the quality of care between providers (Danielson *et al*, 2011). It is also not clear as to the level at which these outcomes should be reported, for example at the individual hospital or clinician level. There is an ongoing debate within the surgical arena as to whether individual surgeon volume is a stronger predictor of outcome than hospital level procedure volume. However, moves towards clinician based outcome reporting are controversial (Jenkins & Cooper; Trinh *et al*, 2013), and may prove particularly challenging for radiotherapy given the multidisciplinary nature of treatment delivery.

Despite these limitations, the current Secretary of State for Health - Jeremy Hunt - remains firmly committed to the transparent reporting of outcomes on sites such as MyNHS (Jeremy Hunt, 2017). In addition, progress continues to be made in the development of clinically relevant quality measures. For example, indicators reflecting aspects of the quality of prostate

cancer surgery and radiotherapy have been recently developed using administrative datasets by the National Prostate Cancer Audit (Royal College of Surgeons of England, 2016c; Sujenthiran *et al*, 2017a). They have helped to define differences in the outcomes between alternative treatment techniques (e.g. Intensity modulated radiotherapy versus 3D conformal radiotherapy) (Sujenthiran *et al*, 2017a; Sujenthiran *et al*, 2017b) and are now being used to differentiate the quality of treatment at the level of individual providers. These indicators await formal inclusion in the Clinical Outcomes Program which is an initiative that since 2013 aims to publish quality measures at the level of the individual consultant, team or unit (Health Quality Improvement Partnership, 2016).

## **9.4 Strengths and Limitations**

The strengths and limitations of specific methods and analytical approaches have been discussed in the preceding chapters, and this section will focus on more overarching themes.

### *9.4.1 Methodological approach*

A key strength of the thesis has been the use of quantitative and qualitative research methods, which has meant that the findings are nuanced and more attentive to the effect of such on policies on individuals as well as the overall patient group. Throughout the thesis, I have attempted to keep the patient as the main focus, understanding how individual characteristics (e.g. socioeconomic status) impact on their ability to travel to alternative hospitals and in turn to understand the factors which potentially influence where they ultimately decide to receive treatment. Much of the discussion around the impact of “choice” would have been lost if a singular approach had been undertaken.

In addition, the design of the study has enabled each method to inform the other. In particular, the systematic review of the literature informed the quantitative approach to investigating patient choice and in conjunction with the qualitative interviews identified factors influencing patient mobility, which could subsequently be assessed within the quantitative model. Both quantitative and qualitative analyses were undertaken during the same time-period and ensured that the methods and specific areas of investigation continually evolved as part of an iterative process.

#### 9.4.1 Data

A major strength of my thesis was that it used linked national level patient datasets. Only a small proportion of total number of NHS patients (1-2%) receiving either surgery or radiotherapy during the time-period of analysis were excluded. Exclusions predominantly related to men either residing outside of England or because they received treatment at an unrecognised surgical or radiotherapy provider.

The NHS itself is an ideal forum for understanding the impact of patient choice policies. It is a national single-payer, tax-based system, in which care is free at the point of access and not based on ability to pay for insurance or treatment. Since 2008, patients have access to all available NHS providers in England with no explicit restrictions on the choices available. I was careful to ensure the choice-set of available centres was accurate and included closures or openings of centres during the time-period of analysis.

Previous analyses focusing on patterns of patient mobility have used regional, or insurer-based patient databases or limited national samples of patients (Ho, 2006; Messina *et al*, 2013; Pope, 2009). There has been a lack of clarity regarding whether the “choice set” of hospitals from

which patients are expected to choose actually perform the procedure in question (Chernew *et al*, 1998). In addition, many studies perform an aggregated analysis that attempts to look at mobility patterns for multiple elective interventions or mixed acute/elective patients (Kronebusch, 2009). This fails to understand the nuances affecting particular treatment decisions for specific diseases and interventions. Many also do not account for pre-existing specialist referral patterns based on insurance status (e.g. preferred providers) or the influence of co-payments on patient choice (Escarce & Kapur, 2009; Ho, 2006). My analysis of the radiotherapy dataset (RTDS) was particularly unique, as there are few databases internationally that provide such detail with respect to total doses and fractionation schedules and allowed me to analyse the impact of variations in radiotherapy practice on patient mobility.

The main issue with respect to the data was the high proportion of patients with missing cancer staging information (approximately 25-30%). I was therefore not able to assess the impact of cancer stage on the patterns of patient mobility observed. However, given that disease stage is unlikely to preclude treatment at any one location (surgical and radiotherapy centres are able to readily treat patients with intermediate and locally advanced disease (Royal College of Surgeons of England, 2016c)) the impact on patient mobility is likely to be small.

Comorbidity scores (presented as the RCS Charlson Score (Armitage *et al*, 2010)) were available using the HES dataset and the inclusion of this information for each individual patient as a co-variate, offered insight into the impact of a patients' fitness on their propensity to travel beyond their nearest hospital.

Ideally, the analysis would have used patient postcodes to identify their residence, however these were not available due to data restrictions. Lower layer super output areas (LSOAs) were

used instead. These encompass approximately 650 households (1500 residents) and the geographic point coordinates used in the analysis were centred on the most population dense areas within the LSOAs to improve accuracy (population-weighted centroids). Other studies have used Middle Layer Super output areas, which cover a population of 5000 residents, or GP post-codes which are not as precise. The use of LSOAs will have added “noise” in the evaluation of travel times which will have attenuated rather than enhanced the observed relationships.

#### *9.4.2 Patient choice*

As discussed in the introduction, it is not possible to ascertain empirically from administrative data whether patients have made an active choice to receive care at a particular centre. The thesis therefore used patient mobility as a proxy measure as it can be quantified. This is a strength of the study as it appreciates the complexity of investigating choice and what can be inferred using quantitative data. In the wider literature, quantitative studies using similar methods that claim to have quantified patient choice (predominantly in the health economics literature) are in fact only describing patterns of mobility. It is for this reason I used a mixed methods approach to understand the complexity of patient choices in the context of a cancer diagnosis

The thesis was unable to assess the impact of the patient’s GP on a decision to move. Given that the GP has no incentive to refer to any one provider in the NHS, it is accepted that many such decisions are made in partnership and to separate the relative impacts on decision-making is empirically very challenging.

#### 9.4.3 *Travel time estimation.*

My model uses average drive times, which is the standardised methodology for these analyses and considered superior to straight-line distance. However, I do acknowledge that drive times are variable depending on the time of day, which may affect patient's decision-making. In addition, public transport times were not available for this analysis. The use of public transport times would be recommended for future work and could act as a sensitivity analysis.

Our estimation of hospital bypassing may be affected in circumstances where men reside at the boundaries of two different specialist multidisciplinary (SMDT) networks for prostate cancer (Aggarwal *et al*, 2016). For example, whilst the diagnostic centre they initially present to may be their closest hospital, the surgical or radiotherapy centre associated with this diagnostic centre as part of the SMDT network may be located further away from the patient's residence than the surgical centre of a different SMDT network. This may affect the estimations of the proportion of bypassers in both directions. For example, patients initially offered treatment at a more distant radiotherapy centre, may request to receive care at their nearest radiotherapy centre instead, which would mean they are technically "non-bypassers" according to the definitions used, despite choosing to change their treatment location.

#### 9.4.5 *Determinants of mobility*

A major limitation of the study is that performance measures that accurately reflect the quality of prostate cancer treatment are currently not available. As a result, the study uses a series of proxy measures to define quality as well as other hospital factors, which could influence a decision to move. The hospital characteristics considered were informed by the peer-reviewed literature, in depth qualitative interviews, and the National Prostate Cancer Audit Organisational survey (Royal College of Surgeons of England, 2014).



A notable exclusion was waiting times for procedures as some patients may have considered moving to alternative providers to receive quicker treatment. However, extensive efforts have been made in the English National Health Service to ensure prompt diagnosis and treatment of suspected cancer patients through a system of defined targets. In 2014/2015 95.3% of people treated for urological cancers in the NHS began their first definitive treatment within the 31 day target (NHS England, 2015).

Other potential determinants of mobility such as care giver/work location were not available in our dataset. Procedure volume was considered as a covariate, however this information was not publicly available during the time of the analysis to inform patient decision-making and therefore not included.

#### 9.4.6 *Competition*

The study used a spatial competition index as a proxy measure for competition. A number of measures are proposed in the literature, of which the most commonly used metric is the Herfindahl-Hirschman Index (HHI), which is a measure of market concentration (Wong *et al*, 2005). It is calculated by squaring the market shares of individual providers (number of patient predicted to be treated or actually treated by each centre) in a particular market area. If there is an equal split of patients between centres then it is considered a market with low concentration. Equally, if there is one dominant centre in the market area, this is considered a concentrated market. My empirical analysis did not use HHI as there was no established definition for market structure with several alternatives used in the literature depending on the availability of data (Cooper *et al*, 2011; Gaynor *et al*, 2013; Gravelle *et al*, 2012). In addition, a hospital which has lots of nearby competitors but attracts the majority of patients due to perceived quality in their market area would be considered to be in a monopoly environment.

Instead, I decided to use a spatial competition index, as a measure of the external competition faced by each individual treating centre. This metric accounts for the demand for services (number of eligible patients) and the availability of alternative hospitals within 60 minutes drive time. This was adapted from other studies (Gravelle *et al*, 2012) which have previously used this measure of competition, and was preferred for this analysis, as it took into account regional variation in the availability of alternative providers and provided an ideal measure of a hospital's competitive environment.

#### 9.4.7 *Patient outcomes*

A major limitation of the thesis is the lack of more recent data on patient outcomes of surgical treatment quality including rates of incontinence, sexual dysfunction and tumour margin status. In addition, it was not possible to factor in individual surgeon volume. However, one could argue that this sums up the current policy context in which decisions regarding the costly reconfiguration of services are being undertaken without national level evidence that they will ultimately improve outcomes.

The recent PROMS exercise undertaken by the National Prostate Cancer Audit would mean that further evaluation using more sensitive measures of treatment quality could be undertaken in the future. Equally, since the study period of analysis in the paper (2008-2011) the number of prostate cancer surgical centres has decreased from 65 to 49. The analysis could therefore be repeated in the future to assess the relative impacts of “centralisation” and “competition” on quality as part of a difference in differences approach.

## 10. CONCLUSION

Choice and competition policies were introduced in the NHS on the supposition that they would drive up quality, enhance equity in access, and afford patients greater choice and control of their health care. The thesis demonstrates that patients with cancer are prepared to travel in significant numbers, to alternative more distant centres for treatment, based on where they think they will get the best care and outcomes. Health care providers in turn appear to be adopting a competitive strategy aiming to attract new patients using specific branding or special ingredients (e.g. new practices or processes of care) whilst not necessarily improving the quality of care delivered. The patterns of mobility observed are inequitable and are largely manifest by younger more affluent patients. There is also evidence that such policies create inefficiencies in the delivery of specialist prostate cancer services by increasing costs and having a negative impact on capacity. Finally, the overall impact of hospital competition on improving patient outcomes remains unclear and policy makers need to proceed with caution when considering the optimum reconfiguration of health services in the absence of hospital level data on outcomes.

## 11. TRAINING

As part of my Doctoral Research Fellowship funded by the NIHR I have undertaken training in research methods relevant to my PhD study as outlined below.

### **Quantitative**

- Introduction to STATA – Imperial College London
- Analysing patient level data using Hospital Episode Statistics – University of York
- Introduction to Arc GIS – University of Southampton
- Advanced Arc GIS – University of Southampton
- Statistical Methods in Epidemiology – LSHTM
- Choice modelling and stated choice survey design – University of Leeds

### **Qualitative**

- Qualitative Research Methods – Oxford University
- Qualitative Methodologies – LSHTM
- Nvivo – University of Surrey

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## 13. APPENDICES

### Appendix A – Ethics approval

#### London School of Hygiene & Tropical Medicine

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LONDON  
SCHOOL of  
HYGIENE  
& TROPICAL  
MEDICINE



Observational / Interventions Research Ethics Committee

LSHTM

11 June 2015

Dear

**Study Title:** Choice and Competition: Does provider choice improve quality outcomes for cancer patients?

**LSHTM Ethics Ref:** 9737

Thank you for responding to the Observational Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

#### Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

#### Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

#### Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Covering Letter	Covering letter ethics committee response - 9737	09/06/2015	V1

#### After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: <http://leo.lshtm.ac.uk>

Additional information is available at: [www.lshtm.ac.uk/ethics](http://www.lshtm.ac.uk/ethics)



**Professor John DH Porter**  
Chair

[ethics@lshtm.ac.uk](mailto:ethics@lshtm.ac.uk)  
<http://www.lshtm.ac.uk/ethics/>

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## **Appendix B – Participant information sheet**

### **Experience and management of prostate cancer**

We would like to invite you to take part in our research study. Before you decide whether you would like to, please read this information so you know what the study is about and what taking part means for you.

#### **What is the study about?**

We would like to better understand how men with prostate cancer are being treated. We are especially interested in how patients' choose their treatment and where they are treated. We intend to do this by talking to men who have been diagnosed with non-metastatic prostate cancer in the last three years. We want to understand the patient journey and the process men go through when making decisions regarding their care. This will help guide what information is needed to help people with their choices and how best to organise cancer services in England to improve the quality of care.

#### **Who is carrying out this study?**

The study is led by a researcher from the London School of Hygiene and Tropical Medicine (LSHTM) (see [www.lshtm.ac.uk](http://www.lshtm.ac.uk)) who works within cancer services in the NHS. He will be supported by a team of researchers who specialise in cancer services and health care quality improvement. The study is funded by the National Institute for Health Research (NIHR) (see [www.nihr.ac.uk](http://www.nihr.ac.uk)).

#### **Why have I been asked?**

The regional leads of "Tackle Prostate Cancer" have agreed for the research team to approach its members within the local prostate cancer support groups in England. You have been asked as we want to understand the experiences of men with prostate cancer. We are interested in the choices people make about going to healthcare services and the support they receive when making important decisions regarding their care.

**What does taking part involve?**

We would like you take part in a one-to-one interview with the lead researcher. This would be at a time convenient for you. We anticipate that the interview will last between half an hour and an hour and it will take place by telephone or Skype. The interview will involve discussing your views, opinions and experiences in greater detail. If you would prefer the interview to be done face to face, arrangements can be made to make this possible.

**Do I have to take part?**

Your contribution is very important to us but it is entirely up to you. If you do take part, you don't have to answer all the questions and you can end the interview at any time.

**What will happen to the information I give?**

This study will help health professionals to improve the care we can provide to men with prostate cancer and potentially other cancers. Everything you tell us will be **strictly confidential**. No one will be able to trace anything said in the interview back to you as an individual. Data and results from this study will not include any names or identifying information and will be stored securely in line with the research team's policies.

**What's in it for me?**

We have found that people find being interviewed a positive experience. It's an opportunity to talk about your life to an attentive listener. At the same time you will be contributing to research of national importance which may have an impact on the care that other men in a similar situation receive.

**What do I do if I am interested in taking part?**

If you are interested in taking part we would be grateful if you could reply to the introductory email/letter sent by the "Tackle Prostate Cancer" regional lead indicating you would be happy to be contacted about the study. Following this one of the research team will phone you to talk to you about whether you would like to take part in an interview and answer any questions you may have about the study.

If you have any questions or would like to know more, please contact:

Dr Ajay Aggarwal

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London WC1H 9SH

phone: 07714750203

e-mail: [ajay.aggarwal@lshtm.ac.uk](mailto:ajay.aggarwal@lshtm.ac.uk)



## Appendix C – Consent form

### Experience and management of prostate cancer

#### Consent form

Please read the following statements, initial those you agree with in the box on the right, and then sign your name at the end:

1.	I confirm that I have read the information sheet for the above study and have had the opportunity to ask questions.	
2.	I agree to take part in an interview.	
3.	I agree to the interview being audio recorded.	
4.	I understand that all information I give during the interview will be strictly confidential.	
5.	I understand that the results of the study will be anonymised. This means that no one will be able to trace anything I say during the interview back to me.	
6.	I understand that anonymised, unidentifiable quotes of mine may be used in reports of the study.	
7.	I understand that my participation is voluntary and that I can stop the interview at any time without giving any reason.	
8.	I am willing for members of the project research team to have access to my anonymised responses.	
9.	I understand that anonymised information I give may be reviewed by the authorities responsible for regulating the study (the London School of Hygiene & Tropical Medicine).	
10.	I am willing for the anonymised information that I give to be stored in a secure data repository if required.	

Name of participant	Signature	Date

If you would like more information, please contact: Dr Ajay Aggarwal email: [ajay.aggarwal@lshtm.ac.uk](mailto:ajay.aggarwal@lshtm.ac.uk)



## **Appendix D –Interview topic guide**

### **Initial narrative**

- **When did you first get a sense that things weren't right?**
  - What were you thinking at that time?
  - Did you search for any information or speak to anyone at this stage?
- **Who did you go to for advice?**

### **Initial GP consultation**

- **What was recommended?**
  - If referral for diagnosis recommended – were you given a choice of where you could be referred?
  - If no – would you have liked to be offered a choice? Was it important to you at this time? (see next section – place of diagnosis)
  - Did you request an alternative referral? If yes why?
- **How did you decide where to go? (If yes to latter question or first question)**
  - What options were you considering?
  - What information sources did you use?
  - Did you speak to anyone?
  - What factors were most important in your decision?

### **Place of diagnosis**

- **What hospital were you referred to?**
  - How did you feel about being referred there?
  - Had you or anyone you knew had any experience of the hospital that you were being referred to?
  - Did you know anything about the consultant or department?

### **What happened after the referral? – (e.g. tests etc)**

- Did you search for any information or speak to anyone regarding your referral?  
(Note this is a trigger for information seeking and interpretation)
- What investigations did you have and where?

## Diagnosis

- **At what stage were you given the diagnosis?** (if not discussed in relation to previous question)
  - Who did you see? Was this at the same hospital you were initially referred?
  - Did you have any expectations or preferences before the consultation?
- **How did you feel when you were given the diagnosis?**
  - What was explained to you about the processes you were going to go through?
- **If diagnosis and treatment discussion not at the same stage refer to information seeking section first?**
- **Overall - how did you feel about the consultation (and the physician) and the information you were given?** (Reassured/trust/sufficient info? )

## Treatment options

- **At what point did the discussion regarding treatment take place and with whom?**
  - Did you feel in a position to have a discussion about treatment at that stage?
  - Did you have any other treatment options in mind at the time of the meeting?
- **What options were you given with regards to treatment and where you might have it?**
  - Was the planned location of treatment where you expected it?
  - Had you heard anything/had experience of these hospitals before?
- **Did you ask about any other treatments/hospitals?**
  - Did you request a referral elsewhere?
  - If yes - Did you feel comfortable doing this? How did the clinician respond?
  - If no would you liked to have been given a choice of other options?
- **What factors were most important to you when considering the options?**
  - (If not discussed in above question) Was the location of the treatment important to you? – Would you have considered any other locations for your treatment?
- **What information were you given?** – leaflets/experiential

- **Did you have an opportunity to talk to anyone else at this stage?**
- **How were things left at the end of the consultation?**
  - Did a decision have to be made at this time?
  - Time frame for decision making? Await further appointments?
- **Did you feel in a position to make a choice at this stage?** ( if requirement to choose at this stage)
- **Overall - how did you feel about the consultation (and the physician) and the information you were given?** (Reassured/trust/sufficient info? )

### **Information seeking and interpretation**

- **What happened when you got home?**
  - Had you had any experience of cancer – personally or someone else?
  - Who did you speak to? (GP, friends, family, specialist nurse)
- **Did you search for any information yourself?**
  - If no did anyone search for any information on your behalf?
  - If yes - What motivated this decision? What were you looking for and why?
- **Were you considering any other treatments or locations?**
- **What type of information did you find?**
  - Was the information you found helpful?
  - Were you able to understand the information? Did you Trust it?
  - How did you process the information/what weight did you attach to the info sources?
  - Did you look at any NHS choices or Doctor Foster websites?
- **What information would you like to have been given?**
- **How did the conversations you had or the information you found affect your decision making or choices?**

### **Follow up consultation**

- **What happened at the follow up consultation? Who did you see?**

- Did you enquire about any other options or ask for a referral elsewhere?
  - How did the clinician respond? How did you feel about doing this?
- **Were you able to go to the hospital or receive the treatment that you wanted?**
  - **Overall - how did you feel about the consultation (and the physician) and the information you were given? (Reassured/trust/sufficient info? )**

### **Location of Treatment**

- **Where did you have your treatment in the end?**
- **How did you get there?**
- **Was there anything particularly good or bad about the hospital?**  
(probe – something particular bad about the hospital you were receiving treatment in or something that would have attracted you to a different hospital?)

### **Decision making/choice**

- **Looking back on it now, do you feel like you made the decision or would you describe it differently?**
- **Do you feel comfortable with how decisions were made about your treatment?**  
(probe – explore at the time? And now?)
- **Do you feel you had much choice in the decision making process?**  
(probe – would you have preferred things to be different, in what way?)

### **Closing Questions**

- **Is there anything else you would like to tell me about?**