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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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### Article info

#### Article history:

Accepted July 11, 2017

#### Associate Editor:

Christian Gratzke

#### Keywords:

Patient mobility  
Patient choice  
Provider competition  
Equity  
Cancer  
Robotic surgery  
Reputation

### 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

<http://dx.doi.org/10.1016/j.eururo.2017.07.013>

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Please cite this article in press as: Aggarwal A, et al. Determinants of Patient Mobility for Prostate Cancer Surgery: A Population-based Study of Choice and Competition. Eur Urol (2017), <http://dx.doi.org/10.1016/j.eururo.2017.07.013>

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

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