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

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Supplementary information about Material and Methods

Patient characteristics

The National Cancer Registration and Analysis Service (NCRAS) 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 1,500 residents or 650 households[5]

Four patient level variables were derived from this linked dataset. First, the RCS Charlson Score, which has been validated for identifying co-morbidities in patients undergoing surgical procedures in the English HES data, was used to give patients a score representing the number of identified co-morbidities.[6] Second, the Index of Multiple Deprivation (IMD), which combines several socioeconomic indicators, provided a single deprivation score for each LSOA.[7] The IMD 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 (RALPs) 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.e. 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 two hours from their home to their nearest hospital. Per definition, additional travel time was 0 minutes 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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