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The causal effect of hospital volume on health gains from hip replacement surgery

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Key Findings

- Hospital volume does not have a causal impact on hip-specific patient-reported health outcomes for planned primary hip replacements in the English NHS.
- The clinically small and positive volume-outcome correlation disappears once we adjust for the confounding effect of hospitals' quality reputation on volume (volume endogeneity).

What Problem Was This Research Addressing?

This research aims to understand whether increasing hospital volumes has a positive effect on health outcomes in the context of planned hip replacement using administrative hospital data in England. Despite evidence of a positive correlation between volumes and outcomes, there is little evidence to date on the causal mechanisms at play. A difficulty in estimating causal effects comes from the fact that volumes may also be determined by hospitals' reputation. High-quality hospitals will also attract more patients, and thus have higher volumes. This study investigates the causal effect of hospital volume on the health gains of patients receiving a planned hip replacement procedure in the English National Health Service (NHS) in 2015/16. Volumes are calculated using hospitals' yearly hip patient population. Patients' health gains are measured with patient-reported measures of hip-related functional status, pain and quality of life, shortly before and 6-month after surgery.

What This Research Adds

This research contributes to the existing literature on volume-outcome relationship in several ways. First, we use patient-reported outcome measures (PROMs) to capture the effect of hospital volume in terms of improvements in patients' health status. Hip-specific patient-reported health measures provide a relevant measure of quality from a patient perspective and capture fine variations in health outcomes. Second, the availability of rich patient-reported data on functional status collected just before the surgery ensures that we thoroughly control for differences in patient case-mix across hospitals, which would otherwise confound our estimates. Third, we obtain causal estimates of the effect of hospital volume on health outcomes, by employing a measure of predicted volumes rather than the observed volumes to account for the confounding effect of hospitals' reputation on volumes. This methodology can be applied to a variety of institutional settings and procedures.

Methods

We investigate the effect of hospital volume on health outcomes by regressing patients' post-surgical health status on hospitals' yearly volumes in an Ordinary Least Squares regression. We use a set of dummy variables corresponding to categories of volumes, to allow for potential decreasing marginal returns to scale on outcomes. The model specification includes controls for patient characteristics (age, gender, comorbidities, pre-surgery health status and socio-economic status) and hospital characteristics (hospital status).

Project Partner:

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Abbott

Low (high) quality hospitals will face a lower (higher) demand, thus inducing a positive correlation in estimates of the effect of volume on outcomes (i.e. volume endogeneity). To address this, we use a patient choice model of hospitals where we predict which hospital would patients choose, mainly based on patient's distance to the hospital. This amounts to constructing the hospital volumes that would be observed if patients were choosing hospitals based on proximity, and abstracting from quality reputations. In our regression, observed hospital volumes are replaced by the predicted volumes, to investigate the causal effect of volume on outcomes. The first set of results using observed volumes suggest a positive association, while results with predicted volumes isolate the causal relationship running from hospital volume to health outcomes.

Research Findings

Results with observed hospital volumes indicate a positive effect of hospital volumes on health outcomes, for patients treated in hospitals of 200 hip replacements cases a year or more, compared to hospitals with lower hip patient volume. The estimated association is however quantitatively small, as it accounts for less than one-fourth of a clinically meaningful change in hip-specific patient-reported outcome measure. The volume coefficients for the predicted hospital volumes are smaller and no longer statistically significant despite precise estimation. This suggests that hospitals with higher quality attract more patients, thus creating a spurious positive relation between health outcomes and volumes. After accounting for reverse causality, hospital volumes are no longer associated with improved health outcomes. Figures 1 and 2 provide a graphical intuition of our results. In a sensitivity analysis, we include surgeon volume and characteristics to ensure that surgeon effects are not driving our results at the hospital level. Results are unchanged, and show that predicted hospital volume has no effect on health gains even after controlling for surgeon volume. Figure 1 shows that the positive correlation between post-surgery health and observed volumes (correlation coefficient r=0.33) reduces when we adjust for pre-surgery health (r=0.10). Using predicted volumes further reduces the positive volume-outcome correlation (Figure 2, r=0.07) and regression results are no longer statistically significant. These figures offer a graphical representation of the importance of adjusting for patient severity and volume endogeneity. In conclusion, we find no causal effect of hospital volume on health gains from planned hip replacement in England, after accounting for the endogeneity of hospital volumes.

Policy Relevance of Research

- Planned hip replacement patients represent 70,000 cases annually in England.
- Concentrating the provision of planned hip replacements in the English NHS would not result in better health outcomes, and may have adverse effects on patient access to care.
- The causal effect of volume on outcomes needs to be isolated from the effect of hospitals' quality reputation on volumes.

Figure 1. Observed volumes and post-surgery health (left), and health gains (right)

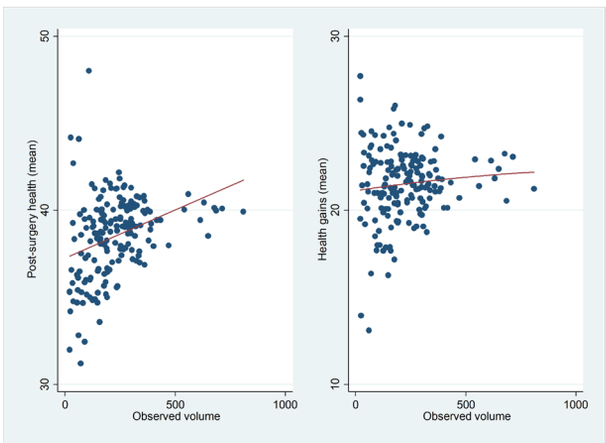
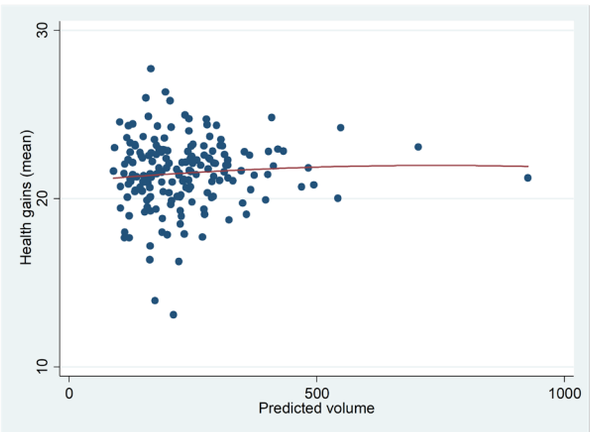


Figure 2. Predicted volumes and health gains



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