

Does Adoption of New Technology Increase Surgical Volume? The Robotic Inguinal Hernia Repair Model

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Introduction: Robotic Inguinal Hernia repair has been associated with higher costs but shorter length of stay. Robotic surgery is an appealing option for patients undergoing elective hernia surgery however given the high startup, maintenance and operating costs, the adoption of robotic technology may not guarantee increased profitability. Our hypothesis is that the introduction of robotic technology increases the overall surgical volume of inguinal hernia repairs within a hospital as compared to non-robotic hospitals.

Methods: The 2010-2018 Florida Agency for Health Care Administration Ambulatory Patient data was queried for Open, Laparoscopic and Robotic inguinal hernia repairs. To retain the maximum number of procedures, ICD9, ICD10 and CPT codes were used to capture the three procedure types. Hospital and patient demographic data were evaluated, and chi square test were used to determine statistical significance, $p < 0.05$ was considered significant. For each hospital in every year, the total volume of inguinal hernia repairs was calculated. Using a difference in difference technique, we verified the hypothesis by analyzing the difference of the total hernia volume of robotic hospital pre and post adoption of robotic technology versus the difference of total hernia volume of non-robotic hospitals. Difference in difference method is based on poisson regression, which was used to evaluate the relationship between the total inguinal hernia volume of robotic and non-robotic hospitals, before and after adopting the robotic technology. To further augment the analysis, we selected a few robotic hospitals which were early adopters of robotic technology and performed difference in difference analysis with their surrounding non robotic competitor hospitals. Incident Rate Ratios- IRR, from the difference in difference analysis determined the significance of robotic technology.

Results: There were a total of 258,785 inguinal hernia repairs (5,774 Robotic, 88,265 Laparoscopic and 164,746 Open) performed at 398 hospitals, 94 of which had robotic capabilities. Of all the procedure types, around 90% were primary inguinal hernia repairs. Majority of patients in this cohort were white non-Hispanic or Latino males (85%, 84%, 92%), age group 51-70(46%), holding commercial health insurance (43%) and belonged to lowest Charlson comorbidity level (82%). Facility types designation for almost all robotic hospitals was hospital (99%), whereas 65% of non-robotic hospitals were ambulatory surgery centers and all other hospitals. Robotic hospitals experienced a 9.5% increase in total volume of inguinal hernia repairs after introduction of robotic technology (Incident Rate Ratios- IRR 1.095, p value < 0.0001). A significant increase in total hernia volume was observed for the early adopter hospitals with the IRR(s) ranging 1.20-2.51(all p values < 0.0001), implying that adoption of robotic technology can in fact lead to very significant increase in total hernia volume for a hospital.

Conclusion: The introduction of robotic technology leads to an increase in the overall volume of inguinal hernia repairs performed at a given hospital. To further evaluate the impact of robotic technology and significance of this methodology, additional work is underway by adding more procedures and data from other states.