

Does Busy Make Perfect? Surgeon Major Thoracic Surgery Case Volume Impact on Esophagectomy Outcomes

INTRODUCTION

Esophageal cancer:

- 8th most common incident cancer worldwide
- 5th leading cause of cancer among patients aged 40-59 years in the USA
- Approximately 17,000 new cases and >15,000 deaths in 2015

Esophagectomy: Surgical procedure removing the esophagus and reconnecting the lower gastrointestinal tract to the upper gastrointestinal tract

- Surgical resection is primary treatment and is part of multimodality treatment.
- Remains curative option for early stage and locally advanced disease²
- Despite improvements in postoperative mortality over the past thirty years, esophagectomy continues to have a high mortality rate, in some reports up to 10 percent

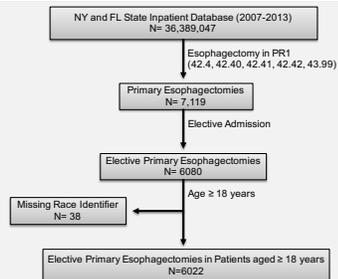
The Leapfrog Group:

- Established standards using volume as a proxy for quality of care (2002)



Do surgeons with low major thoracic surgery case volumes operating at high volume hospitals exhibit patient outcomes comparable to high volume surgeons?

METHODS



- 42.4 Excision of the esophagus
- 42.40 Esophagectomy, otherwise specified
- 42.41 Partial esophagectomy
- 42.42 Total esophagectomy
- 43.99 Other total gastrectomy

FIGURE 1. Inclusion criteria flowchart

High Vol Hosp (≥ 13 esolyr) vs Low Vol Hosp (< 13 esolyr)³

High Vol Surg (≥ 119 esolyr) vs Low Vol Surg (< 119 esolyr)

We used *generalized linear mixed modeling* and adjusted for patient characteristics (sex, race, sum of Elixhauser comorbidities⁶, age), year, and hospital State.

RESULTS

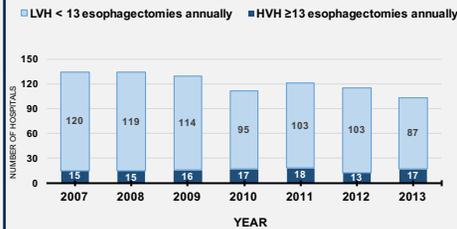
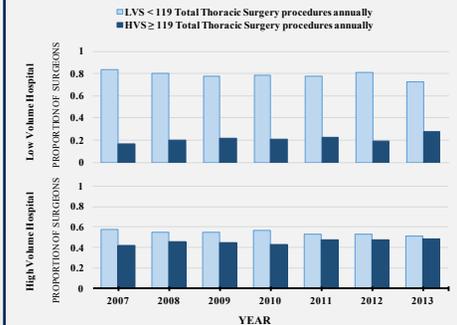


FIGURE 2. Number of high volume hospitals (HVH) and low volume hospitals (LVH) performing esophagectomies. A greater proportion (84%-89%) of hospitals in New York and Florida States (2007-2013) performed <13 esophagectomies/year. Hospital volume was dichotomized based on Leapfrog Group definitions for high volume and low volume hospitals³.



Low volume hospital (< 13 esophagectomy procedures annually)
High volume hospital (≥ 13 esophagectomy procedures annually)
LVS = low volume surgeon
HVS = high volume surgeon

FIGURE 3. Distribution of low volume surgeons (LVS) and high volume surgeons (HVS) at low volume hospitals (LVH) and high volume hospitals (HVH) performing esophagectomies. At LVH, 72-84% of surgeons were LVS. At HVH, 52-58%-31% of surgeons performing esophagectomies were LVS. Surgeon major thoracic surgery volume was dichotomized as surgeons > 20%ile vs surgeons < 20%ile.

RESULTS

| | Low Volume Hospital N=2126 | | p | High Volume Hospital N=3896 | | p |
|---|-------------------------------|-----------------|--------|--------------------------------|-----------------|--------|
| | LVS (79.2%) | HVS (20.8%) | | LVS (54.4%) | HVS (45.6%) | |
| Age (years)* | 64.1 \pm 11.5 | 63.1 \pm 10.8 | 0.10 | 62.8 \pm 11.7 | 63.2 \pm 11.2 | 0.35 |
| Male sex [†] | 1193 (70.9%) | 337 (76.1%) | 0.03 | 1546 (72.9%) | 1384 (78.0%) | <0.01 |
| Race | | | 0.002 | | | <0.001 |
| White | 66.3% | 73.4% | | 77.7% | 86.0% | |
| Black | 10.7% | 5.6% | | 4.8% | 1.8% | |
| Other | 23.0% | 21.0% | | 17.5% | 12.2% | |
| Elixhauser comorbidity measure [‡] | 3 (2-4) | 3 (1-4) | 0.27 | 2 (1-3) | 2 (1-3) | 0.12 |
| Cancer as principal diagnosis | 92.2% | 86.9% | <0.001 | 94.0% | 91.9% | 0.01 |

* values represent mean \pm SD
[†] values represent n (%)
[‡] values represent median (interquartile range)

TABLE 1. Clinical characteristics of patients undergoing esophagectomy at low and high volume hospitals. Patients were predominantly male and white with cancer as a principal diagnosis. Low volume surgeons at high volume and low volume hospitals performed a greater proportion of esophagectomy procedures than high volume surgeons (63% and 37% respectively).

| | HVH vs LVH | | HVS vs LVS | |
|------------------------------------|------------|--------------|------------|--------------|
| | OR | 95% CI | OR | 95% CI |
| In-hospital mortality | 0.47 | [0.33, 0.68] | 0.90 | [0.59, 1.38] |
| PLOS | 0.68 | [0.58, 0.80] | 1.18 | [0.98, 1.43] |
| Pulmonary Complications | 0.87 | [0.73, 1.03] | 1.26 | [1.04, 1.53] |
| Cardiac Complications | 0.96 | [0.80, 1.15] | 1.56 | [1.29, 1.88] |
| Gastrointestinal Complications | 0.81 | [0.62, 1.07] | 1.21 | [0.90, 1.64] |
| Hematologic Complications | 0.62 | [0.50, 0.76] | 1.04 | [0.83, 1.32] |
| Infectious Complications | 0.83 | [0.67, 1.03] | 1.08 | [0.84, 1.37] |
| Neurologic and Other Complications | 0.89 | [0.66, 1.20] | 0.98 | [0.70, 1.39] |

PLOS = prolonged length of stay (≥ 14 days)

TABLE 2. Postoperative outcomes in patients undergoing esophagectomy. High volume hospitals (HVH) were associated with greater than 50% decrease in the odds of mortality and 32% reduced odds of incident prolonged length of stay (PLOS) compared to low volume hospitals (LVH). Surgeon volume had no effect on mortality or incidence of PLOS and postoperative complications.

CONCLUSIONS

Surgeons with low major thoracic surgery case volumes operating at high volume hospitals exhibit patient outcomes comparable to high volume surgeons.

High hospital volume is associated with reduced odds of in-hospital mortality, incidence of PLOS and hematologic complications.

There were no difference in postoperative outcomes after esophagectomy between high volume and low volume surgeons.

In contrast to frequently performed procedures, hospital surgical quality for esophagectomy (and other less commonly performed, high risk surgeries) is most reliably illustrated via quantification of hospital procedure volume, rather than direct measurement of patient mortality.

- Hospital volume allows for selective referral of patients to high-performing hospitals.

REFERENCES

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2015. *CA Cancer J Clin.* 2015;65(1):5-29.
2. Finks JF, Osborne NH, Birkmeyer JD. Trends in hospital volume and operative mortality for high-risk surgery. *The New England journal of medicine.* 2011;364(22):2128-2137.
3. The Leapfrog Group. Factsheet: Evidence Based Hospital Referral. 2004; http://www.leapfroggroup.org/media/file/Leapfrog-Evidence-based_Hospital_Referral_Fact_Sheet.pdf. Accessed 09/27/2015, 2015.
4. AHRQ QI Research Version 5.0. Technical Specifications, Esophageal Resection Mortality Rate. *Inpatient Quality Indicators #8.* 2015.
5. Birkmeyer JD, Stukel TA, Siewers AE, Goodney PP, Wennberg DE, Lucas FL. Surgeon volume and operative mortality in the United States. *New England Journal of Medicine.* 2003;349(22):2117-2127.
6. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. *Medical care.* 1998;36(1):8-27.

ACKNOWLEDGEMENTS

The authors would like to thank Dr. Stina Andersen for assistance with statistical analysis.

This project was funded by the University of California Davis School of Medicine Medical Student Research Fellowship.