Review Article

Regionalization of esophagectomy: where are we now?

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Abstract: The morbidity and mortality benefits of performing high-risk operations in high-volume centers by high-volume surgeons are evident. Regionalization is a proposed strategy to leverage high-volume centers for esophagectomy to improve quality outcomes. Internationally, regionalization occurs under national mandates. Those mandates do not exist in the United States and spontaneous regionalization of esophagectomy has only modestly occurred in the U.S. Regionalization must strike a careful balance and not limit access to optimal oncologic care to our most vulnerable cancer patient populations in rural and disadvantaged socioeconomic areas. We reviewed the recent literature highlighting: the justification of hospital and surgeon annual esophagectomy volumes for regionalization; how safety performance metrics could influence regionalization; whether regionalization is occurring in the US; what impact regionalization may have on esophagectomy costs; and barriers to patients traveling to receive oncologic treatment at regionalized centers of excellence.

Keywords: Esophagectomy; regionalization of surgeries; regionalization; surgical outcome-volume relationships

Submitted Jun 25, 2019. Accepted for publication Jul 19, 2019.
doi: 10.21037/jtd.2019.07.88
View this article at: http://dx.doi.org/10.21037/jtd.2019.07.88

Introduction

There is an abundance of evidence accumulated over the past few decades that demonstrates increasing hospital and surgeon operative volume improves the perioperative outcomes of patients undergoing high-risk elective operations (1–3), including a variety of cardiovascular and oncologic surgical procedures (4–8). Regionalization is defined as the organization of a system for the delivery of healthcare, in this case the performance of esophagectomy, within a region to ensure availability of essential services, and presumably increased quality of services (9). Regionalization is a proposed strategy to leverage high-volume centers for esophagectomy to improve quality outcomes. It is important to understand the benefits and challenges inherent in regionalization efforts and to learn from the efforts of hospital systems that have already begun the process of regionalization.

Esophagectomy for cancer is a potentially life-saving operation with significant perioperative risks including a 33.1% frequency of major complications and 3.1% incidence of operative mortality (10). Regionalization of esophagectomy has the potential of significantly improving outcomes from treatment of esophageal cancer and complex benign esophageal disease but must be implemented in a manner that does not leave behind patients with limited access to optimal surgical oncologic care. We review the

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recent literature on important influences regionalization efforts for esophagectomy. Specifically, the justification of hospital and surgeon annual esophagectomy volumes affect clinical outcomes for regionalization; how safety performance metrics could influence regionalization; whether spontaneous regionalization is occurring in the United States (US). In addition, we reviewed what impact regionalization may have on esophagectomy costs; and how socioeconomic, geographic, and barriers to regionalization including patient opinions on traveling to receive oncologic treatment at a regionalized center of excellence.

Volume outcomes as a justification for regionalization

One of the first comprehensive demonstrations of the relationship between increasing surgical volume for esophagectomy and patient outcomes was published by Birkmeyer *et al.* in 2002 (11). Though not suggesting any specific volume thresholds to optimize outcomes, the authors enumerated that higher hospital volume decreased the odds of mortality after esophagectomy. Birkmeyer *et al.* subsequently demonstrated a similar volume-outcome relationship with regard to annual surgeon procedure volume for esophagectomy, even after adjusting for hospital volume (12). These two landmark studies fueled the next two decades volume-outcomes research in high-risk operations.

The British National Health System (NHS) began mandated regionalization of esophagectomies in 2003, resulting in a decline from 113 centers performing esophagectomy in 2003 to only 43 in 2014 (13). Median annual surgical volume at these centers rose from 21 to 55 patients, with a subsequent decline in 30-day (7.4% *vs.* 2.5%), 90-day (11.3% *vs.* 4.6%) and 1-year postoperative mortality (29.7% *vs.* 19.8%, P<0.001). However, the authors warned that only a minimal amount of the decrease in mortality over time was explainable by increased hospital volume within the logistic regression modeling. This finding suggests that although esophagectomy outcomes improved in the NHS after regionalization of surgery for esophageal cancer, there may be unmeasured variables contributing to this finding. Advances in diagnostic techniques, neoadjuvant treatment, and perioperative intensive care over the past two decades may be major driving forces in the improving survival rates seen in the surgical treatment of esophageal cancer (14). Accordingly, usage of curative-intent resection from 2004 to 2013 in the US National Cancer Database (NCDB) has increased from 43.4% to 61.8%, from 36.1% to 45.0%, and from 30.8% to 38.6% for stage I, II, and III esophageal cancer, respectively (P<0.001) (15).

Although no comparable mandate for regionalization has occurred in the US, similar volume-outcome results to the NHS appear in recent US analyses. An apparent lean towards regionalization in the state of Florida from 1997 to 2006 showed both an increase in incidence of esophagectomy (P<0.05) and increase in 30-day survival rate [odds ratio (OR) 1.87, 95% confidence interval (CI): 1.16–3.03] in the second half of the decade compared to the first half (16). High-volume centers (≥12 esophagectomies annually) had a dramatically lower mortality risk (OR 0.54, 95% CI: 0.32–0.92) and modest decrease in length of stay compared to low-volume centers (16.3 *vs.* 18.0 days, P=0.05). Similarly, a meta-analysis of sixteen studies from 1990–2013 found that both high-volume hospitals (HR 0.82, 95% CI: 0.75–0.90) and high-volume surgeons (HR 0.87, 95% CI: 0.74–1.02) had decreased pooled adjusted mortality compared to their low-volume counterparts (17). The studies included in the meta-analysis exhibited heterogeneity in their definition of high and low volume centers and surgeons, with high-volume centers for esophagectomy ranging from 9 to 43 cases annually, and high-volume surgeons for esophagectomy ranging from 9 to 20 surgeries annually. US regionalization of esophageal surgery was further studied by Fuchs *et al.* querying the Nationwide Inpatient Sample from 1998 to 2011, demonstrating that mortality risk was significantly reduced when receiving an operation at a high (≥29) volume center compared to low (<6) and intermediate (6 to 19) volume centers (OR 0.54, 95% CI: 0.45–0.65) (18). Furthermore, there was no difference in mortality risk between low- and medium-volume centers. Thus, the authors postulated that there does not appear to be any lower volume threshold below a high-volume cut-off such as 20 esophagectomies per year that significantly improves esophagectomy mortality.

Though they did not expound upon any specific volume thresholds, the Japanese experience of 16,556 esophagectomies from 2011–2013 found that 38 hospitals (3.8%) accounted for one third of all esophagectomies occurring in the country (19). After accounting for surgeon volume, each 10-patient increase in annual hospital volume lead to a 12% decreased risk of 30-day mortality (OR 0.88, 95% CI: 0.79–0.97). Similar to the UK experience (20) as well as the recently published Swedish experience (21), surgeon volume was not a significant predictor of mortality.

This finding leads the authors to posit that structures and processes of care such as the perioperative team including preoperative clinics, intraoperative anesthesia support, and postoperative critical care management may be more important for patient outcomes than individual surgeon experience. Notably, low-volume and high-volume surgeons had comparable mortality rates at high-volume hospitals (1.9% and 1.8%, respectively). High-volume centers likely have structures and processes of care in place to reduce perioperative complication rates, as well as the ability to rescue patients who suffer serious postoperative complications from mortality. Lack of processes of care at lower volume centers may leave these sites prone to higher rates of failure to rescue after high risk operations (22,23).

Evaluation of the Michigan Quality Surgical Collaborative database found that hospitals with low failure to rescue rates were more likely to have closed intensive care units, board-certified intensivists, hospitalists, residents, and rapid responses teams (P<0.01) (24). Ghaferi *et al.* described a 3.2-time greater odds of failure to rescue after esophagectomy in very low-volume hospitals (≤4 per year) compared to very high-volume hospitals (≥15 per year) (23). Analysis of the National Surgical Quality Improvement Program (NSQIP) database from 2010 to 2014 found that increased age (OR 2.68, 95% CI: 1.65–4.36), African American race (OR 2.75, 95% CI: 1.28–5.93), ASA class ≥4 (OR 1.82, 95% CI: 1.08–3.05) and major cardiopulmonary or septic complications (OR 5.29, 95% CI: 2.97–9.44) all increased the risk of failure to rescue after esophagectomy (22).

Other studies have emphasized the importance of individual surgeon volume over hospital volume on perioperative outcomes after esophagectomy. The British National Health System experience of 16,572 esophagectomies from 2000–2010, found that each additional annual esophagectomy case reduced a surgeon's 30-day mortality by 3.4% (25). Interestingly, mortality rate continued to improve as surgeon volume rose with no obvious inflection point to denote a useful minimum surgeon volume threshold. A meta-analysis by Brusselaers *et al.* found that any effect of hospital volume on long-term survival after esophagectomy was removed after adjustment for surgeon volume (OR 1.01, 95% CI: 0.97–1.06); yet high-volume surgeons continued to exert a survival benefit after adjustment for hospital volume (OR 0.91, 95% CI: 0.85–0.98) (17). A study of the effects of surrogate operative experiences for esophagectomy (including excision of esophageal diverticulum, gastrectomy, gastroduodenostomy, and repair of diaphragmatic hernia) found that low-volume esophagectomy surgeons with increasing surrogate operative volume approached operative mortality rates of high-volume surgeons (4.3% *vs.* 3.8%, respectively). Nishigori *et al.* additionally noted that high-volume centers often have formal or informal mentorship from experienced senior surgeons who can supervise and assist "inexperienced surgeons in their surgical technique and postoperative care," thus bolstering the outcomes of low-volume surgeons in high-volume centers (19).

There is presently no federal United States initiative to mandate or encourage regionalization of higher risk elective surgeries to high-volume centers and surgeons through privileging, credentialing or reimbursement policies. However, an advocacy organization, the Leapfrog Group, recommends minimum annual hospital and surgeon volumes of specific high-risk operations for an institution to achieve the coveted Leapfrog Surgical Volume Standard (26). The 2018 update to the Leapfrog Hospital Survey states a minimum annual esophagectomy for cancer hospital volume of 20 and surgeon volume of 7 to meet this standard. To this end, some hospital systems have voluntarily made the "Take the Volume Pledge" in 2015 for high-risk procedures including esophagectomy to inform surgical privileging decisions at these hospitals, mirroring the above mentioned Leapfrog Surgical Volume Standard (27). The research in this area has many limitations including the heterogeneity of studied and proposed volume thresholds for improved esophagectomy outcomes. Despite the evidence for and intuitive appeal of regionalization of high-risk operations, there continues to be no consensus in regards to volume pledges being linked to hospital accreditation to perform certain operations or surgeon privileging within hospitals (28).

Safety performance as a justification for regionalization

In lieu of using a volume-outcome relationship as a justification for regionalization, some groups have looked at specific safety performance measures to recommend regionalization. It is unclear whether all high-volume hospitals are safe or whether all low-volume hospitals are unsafe for surgical patients (29,30). Risk-standardized mortality rate (RSMR) has been employed to evaluate hospital safety in managing acute cardiac and pulmonary conditions (31), and is currently used by the Centers for Medicare and Medicaid Services to award hospitals performance bonuses and Star ratings (32).

Chiu *et al.* recently employed RSMR modeling to

evaluate how realignment of patients undergoing complex oncologic operations in the NCDB would affect patient distribution and postoperative mortality (33). They analyzed 292,040 patients undergoing primary resection for lung, esophageal, gastric, or colon cancer between 2008–2012. RSMRs were calculated for each hospital by operation as a ratio of the hospital's "predicted" 90-day mortality rate (based on patient-level and unique hospital-specific factors) to that of its "expected" 90-day mortality rate (based on patient-level and average hospital-specific factors across the entire cohort), multiplied by the average observed mortality rate for the procedure within the entire cohort. After exclusion of ultra-low volume hospitals, hospitals received safety rankings based on RMSR quintiles: "safest" (lowest quintile), "intermediate safety" (quintile 2–4), and "least safe" (highest quintile). For esophagectomy patients, 90-day mortality was significantly higher for "least safe" (14.6%, OR 5.91, 95% CI: 12.7–16.6) and "intermediate safety" hospitals (6.7%, OR 2.5, 95% CI: 1.9–3.4) as compared to the "safest" hospitals (3.09%, P<0.001). When modeling mortality for each patient who received care at a "least safe" hospital instead choosing to have surgery at a "safest" hospital, 3,592 lives (95% CI: 3,333–3,908) would have been saved in the overall cohort. For esophageal cancer patients, this approach to regionalization could have saved 149 lives (95% CI: 126–182) out of the 7,005 patients, with only 9 patients (95% CI: 7–10) needing to move to a "safest" hospital to save one life. Utilizing hospital safety-ratings designated by volume status (based on Leapfrog Group thresholds), 2,161 lives (95% CI: 1,690–2,844) could have been saved in the overall cohort by shifting patients to a high-volume hospital. Notably, 183 esophageal cancer patient lives (95% CI: 129–310) could have been saved with volume-based safety-ratings, yet the number needed to move to a high-volume hospital to save one life rose 3-fold to 34 (95% CI: 20–49). Furthermore, the number of destination hospitals for optimal mortality after esophagectomy dropped from 45 in the RMSR model to 21 in the volume-based model, while requiring nearly five times as many patients to switch hospitals (6,302 *vs.* 1,292, respectively). The authors posited that although the reported mortality benefits might be diluted by real-world barriers to patient realignment such as travel distances, patient unwillingness to switch providers, and hospital reluctance to transfer referrals away, the otherwise low numbers of patients required to relocate on a national scale for tangible mortality benefits are efficient and obtainable.

Is regionalization occurring in the United States?

Despite the above evidence, comparative analysis of modern esophagectomy outcomes based on hospital volume remain heterogenous. Analysis of the National Inpatient Sample from 2000–2014 demonstrated that low- (<5 operations annually) and intermediate-volume (5–20 operations annually) centers had a 2.17- and 1.62-time greater odds of in-hospital perioperative mortality after performing esophagectomies compared to high-volume (>20 operations annually) centers. Regionalization occurred over the study period with the proportion of esophagectomies performed at high-volume centers increasing from 29.2% to 68.5% (P<0.001) resulting in a subsequent overall esophagectomy mortality rate drop from 10.0% to 3.5% over the study period (P<0.001) (34). Conversely, evaluation of the State Inpatient Databases of California, Florida, and New York from 2009–2011 found that 82.1% of esophagectomies continue to occur at hospitals performing <20 esophagectomies annually in those states (35). Notably, the unadjusted and propensity matched mortality and complication risks were not significantly different based on hospital volume. Additionally, recent review of esophagectomies in the Society of Thoracic Surgeons General Thoracic Surgery Database from 2011–2014 found that only 43% of the 164 participant institutions had an esophagectomy volume of ≥5 annually (36). These institutions comprise an enriched cohort of surgeons with historically exceptional perioperative thoracic surgical outcomes, suggesting that although hospital volume remains low at a majority of participant institutions, morbidity and mortality rates remain excellent.

A recent assessment of the NCDB comparing esophagectomy hospital volumes in the US from 2004–2006 (Era 1) to 2010-2012 (Era 2) found conflicting evidence for spontaneous regionalization on a national scale (37). Overall esophagectomy volume declined by 6.5% from Era 1 to Era 2 (5,968 *vs.* 5,580, P<0.001). Evidence for regionalization from Era 1 to Era 2 included a 12.4% decline in the number of hospitals performing esophagectomies (756 *vs.* 663, P=0.014). In addition, there were fewer patients treated at low-volume (<13 esophagectomies/year) hospitals (4,384 *vs.* 3,910, P<0.001), an increase in the proportion of patients receiving care at academic centers (57% *vs.* 63%, P<0.001), and an increase in the proportion of patients traveling >20 miles for surgery (45% *vs.* 51%, P<0.001). Despite these changes, 97% of the hospitals in the study

were low-volume (which remained unchanged between the eras), and of the hospitals that performed esophagectomies in both eras, 98% maintained the same volume status between eras. Patient outcomes did improve over time, with 90-day mortality decreasing from 10% to 8% (P<0.001), length of stay decreasing by 1 day (11 *vs.* 10, P<0.001), positive margin rate decreasing by 3% (P<0.001) and lymph node harvest increasing by 4 (P<0.001). This study utilized 90-day standardized mortality ratios, defined as the ratio of observed mortality at a hospital compared to the expected mortality of patients treated at a high-volume hospital based on multivariate logistic regression adjustment. However, whereas low-volume hospitals had a significantly higher 90-day standardized mortality ratio compared to high-volume hospitals in Era 1 (1.5 *vs.* 1.0, P<0.001), there was no difference in standardized mortality ratio for low-volume hospitals compared to high-volume hospitals in Era 2 (1.2 *vs.* 0.99, P=0.07). Taken together, these results suggest that although patient mortality improved over time, these improvements were seen across all hospital volumes in Era 2. Notably, such mortality improvements occurred despite a high proportion of the highest mortality risk patients receiving care at low-volume hospitals in Era 1 (77%) and Era 2 (73%). Accordingly, the 90-day mortality in these highest risk patients between low-volume and high-volume hospitals narrowed between Era 1 (19.3 *vs.* 13.0%, P=0.003) and Era 2 (12.3 *vs.* 11.3%, P=0.57). As such, there appears to be some modest shifting of patients towards fewer hospitals resulting in fewer low-volume hospitals overtime. Yet, the vast majority of esophageal cancer surgery continues to occur at low-volume hospitals nationally, which continue to take care of a disproportionate amount of the highest operative risk patients, albeit with improved outcomes compared to the prior decade.

Regionalization and healthcare costs

Few studies have adequately quantified the true cost versus cost savings of regionalization of esophageal surgery. Kennedy *et al.* evaluated this question utilizing the Nationwide Inpatient Sample form 2004–2013, finding that across all hospitals the mean inpatient cost of an esophagectomy was significantly higher in patients with a high preoperative risk index compared to all other patients ($92,017 *vs.* $54,874, P<0.001) (38). Very high-volume hospitals (performing >87 esophagectomies annually) had statistically similar costs of care when compared to low-volume (performing <7 esophagectomies annually) hospitals ($62,758 *vs.* $67,173, P=0.35). The results suggest that the well-described mortality benefits of patients undergoing esophagectomy at high-volume hospitals does not increase cost.

Complications, which often lead to increased length of stay, are a strong driver of cost after esophagectomy (39). Esophagectomies remain costly in the best of circumstances, with a median 90-day cost for Medicare patients from 2002–2009 of $45,471. The median excess cost for any complication after esophagectomy estimates to be $13,659, with mechanical wound (most commonly postoperative fistula formation) and pulmonary complications carrying the highest excess cost. Higher hospital and surgeon annual esophagectomy volume has been shown to reduce anastomotic leak rates (20), as well as other complications. Additionally, postoperative complications drive unplanned readmissions after esophagectomy for cancer, leading to increased costs after esophagectomy (40).

Another potential for cost savings with regionalization resides in the conjecture that high-volume centers are more likely to have enhanced recovery protocols in place for perioperative management of esophagectomy patients. Numerous health systems have now published the results of their esophagectomy enhanced recovery programs, demonstrating decreased intensive care unit stay and hospital length of stay (41–43), as well as cost savings ranging from $2,200 to $7,800 per operation and inpatient event (P<0.01) (43–45). Notably, one center's experience with a comprehensive preoperative, perioperative, and postoperative enhanced recovery protocol decreased 30-day readmission rates (and therefore associated readmission costs) from 24.2% to 2.4% (P<0.05) (46). Another health system utilized lean manufacturing techniques and perioperative cost data collected over 5 years to cut their esophagectomy costs by 43.8% (from $61,703 to $27,025) with a subsequent 65% decrease in length of stay (from 14 to 5 days) (47). Additionally, cost tends to decrease with increasing experience of a center in conducting an enhanced recovery protocol, likely reliant upon improved compliance over time (48).

Barriers to regionalization

Recent studies indicate that most cancer patients continue to receive surgical care at the nearest hospital to their home, regardless of surgical volume or even associated clinical outcomes at that institution. For patients undergoing gastrectomy in California, 67% chose their geographically closest hospital, which was more likely a

low-volume hospital (49). This geographic trend suggests an unwillingness, inability, or some other potential barrier, perhaps socioeconomic, to travel to high-volume centers. Moreover, in the above study a quarter of patients bypassed their geographically nearest hospital to receive care at a hospital that had a lower annual gastrectomy volume, suggesting that objective outcome data may play less of a part in a patient's choice on where to receive care compared to personal factors. Alternatively, a lack of access to accurate hospital-by-hospital outcome data presented in a patient-centered format may prevent informed and shared decision making on where to receive complex oncologic care. Esophageal cancer patients in the NCDB who traveled further (median distance of 107 miles) had significantly increased rates of undergoing an esophagectomy (67.8% *vs.* 42.9%, P<0.001) and improved 5-year survival (39.8% *vs.* 20.6%, P<0.001) compared to those who stayed locally (traveling a median distance of 2.7 miles) (50). Indeed, those traveling furthest for surgery were less likely to be >80 years old, on Medicaid, or African American (51).

It is certainly likely that the economic challenges patients and families face traveling even moderate distances for complex oncologic care are not financially endurable by many. In a survey of healthy adults, 85% stated they would travel one hour for complex care at a "top-ranked" hospital, but around half of respondents felt that safety and outcomes were equivalent between such "top-ranked" hospitals and their smaller local community affiliate hospitals (52). A separate survey similarly found that 94% of respondents expected that cancer care at an small hospital would improve after affiliation with a larger top-ranked cancer hospital, and 77% would choose to have surgery at the smaller hospital after such an affiliation was made (53). In regards to these large-small hospital affiliations, the majority of respondents believed that physicians at the larger hospital would "often" or "always" be involved in their care at the small hospital, with 92% expecting that surgeons from the larger hospital would operate at the smaller hospital. These opinions appear pervasive in the US despite the realities of practices in affiliated hospitals, as well as evidence that the odds of mortality after complex oncologic surgery are 1.4 times higher (95% CI: 1.2–1.6) at an affiliated hospital compared to a partner top-ranked cancer hospital (54). There are many theories for patient reluctance to travel to a regional center, including but not limited to lack of strong preference by a referring care provider, lack of access to second opinions, or inflexible local referral patterns that reduce patient exposure to larger hospitals. Nevertheless, there remain numerous patient-related reasons that a majority of high-risk operations such as esophagectomy continue at relatively low-volume hospital systems.

Though these barriers are real, strategies must be created to overcome them as there is an abundance of evidence demonstrating the highest risk patients have improved outcomes at high volume centers. A major risk of ongoing spontaneous regionalization as well as potential mandated regionalization of cancer care is loss of access to appropriate care by rural or socioeconomically disadvantaged patient populations. Geographic distance from urban high-volume care centers negatively impacts cancer survival with associated decreases in appropriate screening rates, later stages at diagnosis, and worse overall survival after definitive therapy (55–57). Moreover, low-volume hospitals more frequently take care of racial and ethnic minorities, uninsured patients, and lower education patients (58). Review of the NCDB from 2010–2013 found that patients treated at low-volume hospitals with esophagectomy were more likely to travel shorter distances, live in rural areas, not receive neoadjuvant therapy, and have worse 90-day mortality (OR 1.67, 95% CI: 1.41–1.99) compared to those treated at high-volume hospitals. In New York state, three quarters of African American patients with esophageal cancer live within 9 miles of a high-volume hospital, yet they still have a significantly decreased likelihood of receiving surgical care at such a center compared to white patients (OR 0.18, 95% CI: 0.14–0.24). Even after propensity matching for care in a high-volume hospital, African American patients had higher postoperative mortality risk (OR 2.45, 95% CI: 1.5–4.03) (59). Analysis of the Surveillance Epidemiology and End Results database in 2008 indicated that African American patients with esophagogastric cancer have worse adjusted 1-year mortality, were more likely to be diagnosed at a more advanced stage, and were less likely to undergo surgical treatment (60). An update to this analysis a decade later found similar results, with African American patients with esophagogastric cancer undergoing surgical resection still having worse mortality than white patients (61).

The vast majority of esophagectomies are still performed at low-volume hospitals (62,63), and within the NSQIP database from 2006–2013, 70.3% of all esophagectomies were performed by non-fellowship trained general surgeons (64). Notably, there was no difference in mortality (3.01% *vs.* 3.21%, P=0.705) or overall morbidity (49.54% *vs.* 50.95%, P=0.357) between patients undergoing esophagectomy by a general surgeon or cardiothoracic surgeon. Evaluation of the Nationwide Inpatient Sample

from 2000–2014 found that as overall in-hospital mortality after esophagectomy has improved from 10.0% to 3.5% (P=0.006), a similar mortality benefit over time has been seen for low-income patients from 30.0% to 2.3% (P=0.02) and non-white patients from 21.1% to 2.5% (P value not available) (34). In contrast, a longitudinal examination of patients undergoing cancer operations at Commission on Cancer accredited hospitals found that African American patients were no more likely to undergo esophagectomy at a high-volume hospital in 2012 as compared to in 2003 (65). Whether this lack of improvement in access to care represents the effects of regionalization of esophageal cancer care is unclear, but the trend is disturbing nonetheless. There is much work to be done to improve the outcomes of esophageal cancer treatment in our most vulnerable populations, either through facilitation of access for patients and families to high-volume referral centers or through outreach and translation of best practices in surgical technique and perioperative care from our centralized high-volume centers to our peripheral lower volume centers where such vulnerable patients continue to receive their care (66).

Conclusions

The benefits of regionalization of esophagectomy into high-volume hospitals or centers with optimal operative safety profiles apparent. Internationally, this regionalization has begun under national mandates, but spontaneous regionalization of esophagectomies has only modestly occurred in the US. Regionalization must not reduce access to optimal oncologic care to our most vulnerable cancer patient populations, such as those in rural and disadvantaged socioeconomic areas. Additionally, there are opportunities for improving patient education and patient referral patterns in the community to optimize surgical outcomes for all patients who would benefit from esophagectomy.

Acknowledgments

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Cite this article as: Clark JM, Boffa DJ, Meguid RA, Brown LM, Cooke DT. Regionalization of esophagectomy: where are we now? J Thorac Dis 2019;11(Suppl 12):S1633-S1642. doi: 10.21037/jtd.2019.07.88

