Knowledge & Library Services: Search results

Date results sent: 02/02/2016

Search question:

Is there evidence of a volume outcome relationship for thoracic surgery undertaken in high volume centres?

Terms used:

Key

/	Subject heading	**Exp**	Explode – search a subject heading along with all of the narrower subject headings in its tree hierarchy
?	Wildcard (ie Wom*n will	**Adj**	Adjacent will retrieve terms next to each other or within a number of words (eg ADJ5)
*****	retrieve women and woman)		

Patient/Population/Problem	Intervention	Comparison	Outcome
Patients requiring thoracic surgery Primary lung surgery Lung resection Thoracic malignancies Pneumothorax Thoracic sepsis	Thoracic surgery Primary lung surgery Lung resection		Volume outcome Post operative survival High volume centres Medical subject

Medical subject headings: Thoracic surgery/ Lung/ Pneumothorax neoplasms/			headings: Post operative period/ Hospitals, high volume/ Survival rate/ Treatment outcome/ Survival analysis/ Surgical procedures, operative/

The complete search strategy is in the Appendix.

Limits applied:

Age group	Language	Publication type	Time limit
n/a		Any	Last 5 years

Disclaimer

Although every effort has been made to ensure this information is accurate, it is possible it may not be representative of the whole body of evidence available. Both articles and internet resources may contain errors or out of date information. None of the resources have been critically appraised. No responsibility can be accepted for any action taken on the basis of this information.

Summary of resources searched and results:

Source	Results
NICE	0
NHS EVIDENCE	2

COCHRANE LIBRARY	1 {DARE database not a cochrane review}
MEDLINE	46
EMBASE	50
BRITISH THORACIC SOCIETY	0

Obtaining full text: For help with getting the full text of these articles, please contact the PHE Knowledge & Library Services (libraries@phe.gov.uk)

Results:

Guidance

None found

Synopses and summaries

None found

Systematic reviews

Pieper D, Mathes T, Neugebauer E, Eikermann M. **State of evidence on the relationship between high-volume hospitals and outcomes in surgery: A systematic review of systematic reviews**. Journal of the American College of Surgeons. 2013;216(5):1015-25.e18

Von EM, Gooiker GA, Van W, Post PN, Van CJHV, Tollenaar RAEM, et al. **The relationship between volume or surgeon specialty and outcome in the surgical treatment of lung cancer: A systematic review and meta-analysis**. Journal of Thoracic Oncology. 2012;7(7):1170-8.BACKGROUND: Whether improvement of quality of surgical cancer care can be achieved by centralizing care in high-volume specialized centers is a subject of ongoing debate. We have conducted a meta-analysis of the literature on the effect of procedural volume or surgeon specialty on outcome of lung resections for cancer. METHODS: A systematic search of articles published between January 1, 1990 and January 20, 2011 on the effects of surgeon specialty and hospital or surgeon volume of lung resections on mortality and survival was conducted. After strict inclusion, meta-analysis assuming a random-effects model was performed. Meta-regression was used to identify volume cutoff values. Heterogeneity and the risk of publication bias were evaluated. RESULTS: Nineteen relevant studies were found. Studies were heterogeneous, especially in defining volume categories. The pooled estimated effect size was significant in favor of high-volume hospitals regarding postoperative mortality (odds ratio [OR] 0.71; confidence

interval 0.62-0.81), but not for survival (OR 0.93; confidence interval 0.84-1.03). Surgeon volume showed no significant effect on outcome. General surgeons had significantly higher mortality risks than general thoracic (OR 0.78; 0.70-0.88) or cardiothoracic surgeons (OR 0.82; 0.69-0.96). A minimal annual volume of resections for lung cancer could not be identified. CONCLUSIONS: Hospital volume and surgeon specialty are important determinants of outcome in lung cancer resections, but evidence-based minimal-volume standards are lacking. Evaluation of individual institutions in a national audit program might help elucidate the influence of individual quality-of-care parameters, including hospital volume, on outcome. Copyright © 2012 by the International Association for the Study of Lung Cancer.

Original research

Wakeam E, Hyder JA, Lipsitz SR, Darling GE, Finlayson SR. **Outcomes and Costs for Major Lung Resection in the United States: Which Patients Benefit Most From High-Volume Referral?** The Annals of thoracic surgery. 2015;100(3):939-46.BACKGROUND: Accountable care organizations are designed to improve value by decreasing costs and maintaining quality. Strategies to maximize value are needed for high-risk surgery. We wanted to understand whether certain patient groups were differentially associated with better outcomes at high-volume hospitals in terms of quality and cost.METHODS: In all, 37,746 patients underwent elective major lung resection in 1,273 hospitals in the Nationwide Inpatient Sample from 2007 to 2011. Patients were stratified by hospital volume quartile and substratified by preoperative mortality risk, age, and chronic obstructive pulmonary disease status. Mortality was evaluated using clustered multivariable hierarchical logistic regression controlling for patient comorbidity, demographics, and procedure. Adjusted cost was evaluated using generalized linear models fit to a gamma distribution.RESULTS: Patients were grouped into volume quartiles based on cases per year (less than 21, 21 to 40, 40 to 78, and more than 78). Patient characteristics and procedure mix differed across quartiles. Overall, mortality decreased across volume quartiles

(lowest 1.9% versus highest 1.1%, p < 0.0001). Patients aged more than 80 years were associated with greater absolute and relative mortality rates than patients less than 60 years old in highest volume versus lowest volume hospitals (age more than 80 years, 4.2% versus 1.3%, p < 0.0001, odds ratio 3.31, 95% confidence interval: 1.89 to 5.80; age less than 60 years, 1.0% versus 0.8%, p = 0.19, odds ratio 1.38, 95% confidence interval: 0.74 to 2.56). Patients with high preoperative risk (more than 75th percentile) were also associated with lower absolute mortality in high-volume hospitals. Adjusted costs were not significantly different across quartiles or patient strata.CONCLUSIONS: Older patients show a significantly stronger volume-outcome relationship than patients less than 60 years of age. Costs were equivalent across volume quartile and patient strata. Selective patient referral may be a strategy to improve outcomes for elderly patients undergoing lung resection.

Tracey E, McCaughan B, Badgery-Parker T, Young J, Armstrong B. **Survival of Australian lung cancer patients and the impact of distance from and attendance at a thoracic specialist centre: a data linkage study**. Thorax. 2015;70(2):152.Lung cancer patients have better survival when treated in thoracic surgical (specialist) centres. To determine whether outcome of non-small cell lung cancer (NSCLC) patients is poorer with increasing distance to the nearest accessible specialist hospital (NASH). We linked cancer registry, hospital and death records of 23,871 NSCLC patients; 3240 localised, 2435 regional and 3540 distant stage patients hospitalised within 12 months of diagnosis were analysed. Distance from patients' residences to the NASH was measured using geographical coordinates. Cox proportional hazards models examined predictors of NSCLC death. Having a resection of the cancer, which admission to a specialist hospital made more likely, substantially reduced hazard of NSCLC death. Distance influenced hazard of death through both these variables; a patient was less likely to be admitted to a specialist hospital than a general hospital and less likely to have a resection the further they lived from the NASH. However, patients who lived distant from the NASH and were admitted to a specialist hospital were more likely to have a resection and less likely to die from NSCLC than patients admitted to a specialist hospital and living closer to

the NASH. These patterns varied little with lung cancer stage. NSCLC outcome is best when patients are treated in a specialist hospital. Greater distance to the NASH can affect its outcome by reducing the likelihood of being treated in a specialist hospital. Research is needed into patient and health service barriers to referral of NSCLC patients for specialist care. Published by the BMJ Publishing Group Limited. For permission to use (where not already granted under a licence) please go to http://group.bmj.com/group/rights-licensing/permissions.

Smith CB, Wolf AS, Mhango G, Wisnivesky JP. **Impact of surgeon volume on outcomes of older stage I lung cancer patients treated via video-assisted thoracoscopic surgery**. Journal of Clinical Oncology. 2015;33(15 SUPPL. 1).Background: Surgeon procedure volume has been shown to influence patient outcomes for several types of cancer operations. Limited data is available however, for the volume-outcome relationship for video-assisted thoracic surgery (VATS) for the treatment of non-small cell lung cancer (NSCLC). In this study, we used population-based data to evaluate the extent to which surgeon volume is associated with post-operative and long-term oncologic outcomes following VATS resection for older patients with early stage NSCLC. Methods: We identified 2,295 patients with stage I NSCLC patients > 65 years treated with VATS lobectomy, segmentectomy or wedge resection from the Surveillance, Epidemiology, and End Results registry linked to Medicare claims. Surgeon volume was ascertained based on the number of Medicare cases resected within each year and grouped into tertiles (low, intermediate, and high). Overall and lung cancer-specific survival of patients treated with VATS vs. open segmentectomy was compared after adjusting patients based on their propensity score. We performed secondary analyses evaluating perioperative complications, need for intensive care unit (ICU) admission, extended length of stay, and perioperative mortality. We then repeated these comparisons adjusting for physician characteristics. Results: Overall (hazard ratio [HR]: 0.73, 95% CI: 0.62-0.87) and lung cancer-specific (HR: 0.76, 95% CI: 0.58-0.99) survival was significantly better among those treated by high volume surgeons after adjusting for propensity scores. Patients treated by high volume surgeons had lower rates of ICU

admission (p = 0.02), thromboembolic complications (p = 0.03) and respiratory complications (p = 0.002). The distribution of all post-operative complications, requirement for ICU admission, extended length of stay, and perioperative mortality was not significantly different across groups after adjusting for surgeon characteristics. Conclusions: Elderly stage I NSCLC patients undergoing VATS by high-volume surgeons have better survival outcomes compared to those undergoing surgery by lower volume surgeons.

Shahian M, Grover L, Prager L, Edwards H, Filardo G, O'Brien M, et al. **The Society of Thoracic Surgeons voluntary public reporting initiative: the first 4 years**. Annals of surgery. 2015;262(3):526.To evaluate participant characteristics and outcomes during the first 4 years of the Society of Thoracic Surgeons (STS) public reporting program. This is the first detailed analysis of a national, voluntary, cardiac surgery public reporting program using STS clinical registry data and National Quality Forum-endorsed performance measures. The distributions of risk-adjusted mortality rates, multidimensional composite performance scores, star ratings, and volumes for public reporting versus nonreporting sites were studied during 9 consecutive semiannual reporting periods (2010-2014). Among 8929 unique observations (~1000 STS participant centers, 9 reporting periods), 916 sites (10.3%) were classified low performing, 6801 (76.2%) were average, and 1212 (13.6%) were high performing. STS public reporting participation varied from 22.2% to 46.3% over the 9 reporting periods. Risk-adjusted, patient-level mortality rates for isolated coronary artery bypass grafting were consistently lower in public reporting versus nonreporting sites (P value range: <0.001-0.0077). Reporting centers had higher composite performance scores and star ratings (23.2% high performing and 4.5% low performing vs 7.6% high performing and 13.8% low performing for nonreporting sites). STS public reporting sites had higher mean annualized coronary artery bypass grafting volumes than nonreporting sites (169 vs 145, P < 0.0001); high-performing programs had higher mean coronary artery bypass grafting volumes (n = 241) than average (n = 139) or low-performing (n = 153) sites. Risk factor prevalence (except reoperation) and expected mortality rates were generally stable during the

study period. STS programs that voluntarily participate in public reporting have significantly higher volumes and performance. No evidence of risk aversion was found.

Samson P, Patel A, Crabtree TD, Morgensztern D, Robinson CG, Colditz GA, et al. **Multidisciplinary treatment for stage IIIA non-small cell lung cancer: Does institution type matter?** Annals of Thoracic Surgery. 2015;100(5):1773-9.Background Improved survival of patients with early-stage non-small cell lung cancer (NSCLC) undergoing resection at high-volume centers has been reported. However, the effect of institution is unclear in stage IIIA NSCLC, where a variety of neoadjuvant and adjuvant therapies are used. Methods Treatment and outcomes data of clinical stage IIIA NSCLC patients undergoing resection as part of multimodality therapy was obtained from the National Cancer Database. Multivariable regression models were fitted to evaluate variables influencing 30-day mortality and overall survival. Results From 1998 to 2010, 11,492 clinical stage IIIA patients underwent resection at community centers, and 7,743 patients received resection at academic centers. Academic center patients were more likely to be younger, female, non-Caucasian, have a lower Charlson-Deyo comorbidity score, and to receive neoadjuvant chemotherapy (49.6% vs 40.6%; all $p < 0.001$). Higher 30-day mortality was associated with increasing age, male gender, preoperative radiotherapy, and pneumonectomy. Patients undergoing operations at academic centers experienced lower 30-day mortality (3.3% vs 4.5%; odds ratio, 0.75; 95% confidence interval [CI], 0.60 to 0.93; $p < 0.001$). Decreased long-term survival was associated with increasing age, male gender, higher Charlson-Deyo comorbidity score, and larger tumors. Neoadjuvant chemotherapy (hazard ratio, 0.66; 95% CI, 0.62 to 0.70), surgical intervention at an academic center (hazard ratio, 0.92; 95% CI, 0.88 to 0.97), and lobectomy (hazard ratio, 0.72; 95% CI, 0.67 to 0.77) were associated with improved overall survival. Conclusions Stage IIIA NSCLC patients undergoing resection at academic centers had lower 30-day mortality and increased overall survival compared with patients treated at community centers, possibly due to higher patient volume and an increased rate of neoadjuvant chemotherapy.

David A, Cooke T, Chen Y, Perry A, Canter J, Cress R. **Surgery in high-volume hospitals not commission on cancer accreditation leads to increased cancer-specific survival for early-stage lung cancer**. American journal of surgery. 2015;210(4):643.Quality of oncologic outcomes is of paramount importance in the care of patients with non-small cell lung cancer (NSCLC). We sought to evaluate the relationship of hospital volume for lobectomy on cancer-specific survival in NSCLC patients treated in California, as well as the influence of Commission on Cancer (CoC) accreditation. The California Cancer Registry was queried from 2004 to 2011 for cases of Stage I NSCLC and 8,345 patients were identified. Statistical analysis was used to determine prognostic factors for cancer-specific survival. A total of 7,587 patients were treated surgically. CoC accreditation was not significant for cancer-specific survival, but treatment in high-volume centers was associated with longer survival when compared with low- and medium-volume centers (hazard ratio 1.77, 1.474 to 2.141 and hazard ratio 1.23, 1.058 to 1.438). These data suggest that surgical treatment in high-volume hospitals is associated with longer cancer-specific survival for early-stage NSCLC, but that CoC accreditation is not. Published by Elsevier Inc.

Beshay M, Kotkamp HW, Mertzlufft F, Branscheid D. **Management of thoracic trauma and analysis of risk factors for outcome**. Interactive Cardiovascular and Thoracic Surgery. 2015;21.Objectives: Thoracic trauma is one of the most common injuries. Its management is very challenging and continues to evolve and improve. The purpose of this study is to analyse its risk factors in a high-volume trauma centre with special attention to the outcome. Methods: Between January 2003 and December 2012, data from all patients were prospectively collected and registered at the German Trauma Registry (GTR) thereafter retrospectively analysed. The type of injury, injury severity score (ISS), abbreviated injury scale (AIS), shock room procedures, operative procedures, complications, the use of organ replacement procedures, time of hospital stay, overall survival were analysed. Patients were divided into two groups: group I included patients between January 2003 and

December 2007, and group II patients between January 2008 and December 2012. Results: Six hundred and thirty patients (56%) had thoracic trauma; 540 (48%) had associated extrathoracic injuries. Group I: 285 patients (197 males, mean age 46 years). Group II: 345 (251 males, mean age 49 years). No statistical difference was identified between patients in both groups in terms of gender, type of thoracic injury, or accompanied injuries of other organs. Ninety-day mortality was higher in group I ($P = 0.024$). Complication rates were higher in group I ($P = 0.019$). Patients with higher thoracic ISS and AIS showed higher mortality rate ($P < 0.0001$). Young patients were frequently exposed to severe thoracic injury but had a lower mortality rate ($P = 0.014$). Patients with severe lung contusions had higher mortality ($P < 0.001$). 23 (8%) patients had emergency thoracotomy in Group I vs 14 patients (4%) in Group II ($P = 0.041$). Video-assisted thoracoscopic surgery was performed more frequently in Group II ($P < 0.001$). Conclusions: Thoracic trauma is often under-calculated. Better survival rates is achievable in specialized centres with a multidisciplinary team approach, in the presence of thoracic surgeons. Severe lung contusion, higher thoracic ISS and AIS, and age are independent prognostic factors affecting outcome.

Al-Sahaf M, Lim E. **The association between surgical volume, survival and quality of care**. Journal of Thoracic Disease. 2015;7:S152-S5.Improving surgical outcomes is important to the thoracic surgical community and operative mortality is often used as a benchmark to gauge the quality of lung resection. In lung cancer surgery, increasing hospital volume is associated with better survival although the categorisation of procedure volume is arbitrary. When US and UK data are scrutinised, the association holds true for increasingly higher volumes up to 150 resection per year and more. The reason may be due to better infrastructure, better-staffed units, more resources and wider specialist and technology-based services in higher volume centers. For individual surgeon volume, reports are not consistent. However, studies suggest that surgeon sub-specialty is an important consideration. The results of general thoracic surgeons and cardiac surgeons are reported to be better than general surgeons for lung resection surgery, and the effects of specialty

training was also associated with an increase in the number of patients undergoing lung resection. We conclude that the current evidence strongly supports the association between increasing hospital volume with lower mortality and improved long-term survival following lung resection. Whilst the data presented supports centralization of lung cancer surgery in high volume hospitals, patient choice and the threshold of quality of improvement required to overcome travel and closure of local services need to be considered.

Soares M, Toffart AC, Timsit JF, Burghi G, Irrazábal C, Pattison N, et al. **Intensive care in patients with lung cancer: a multinational study**. Annals of oncology : official journal of the European Society for Medical Oncology / ESMO. 2014;25(9):1829.Detailed information about lung cancer patients requiring admission to intensive care units (ICUs) is mostly restricted to single-center studies. Our aim was to evaluate the clinical characteristics and outcomes of lung cancer patients admitted to ICUs. Prospective multicenter study in 449 patients with lung cancer (small cell, n = 55; non-small cell, n = 394) admitted to 22 ICUs in six countries in Europe and South America during 2011. Multivariate Cox proportional hazards frailty models were built to identify characteristics associated with 30-day and 6-month mortality. Most of the patients (71%) had newly diagnosed cancer. Cancer-related complications occurred in 56% of patients; the most common was tumoral airway involvement (26%). Ventilatory support was required in 53% of patients. Overall hospital, 30-day, and 6-month mortality rates were 39%, 41%, and 55%, respectively. After adjustment for type of admission and early treatment-limitation decisions, determinants of mortality were organ dysfunction severity, poor performance status (PS), recurrent/progressive cancer, and cancer-related complications. Mortality rates were far lower in the patient subset with nonrecurrent/progressive cancer and a good PS, even those with sepsis, multiple organ dysfunctions, and need for ventilatory support. Mortality was also lower in high-volume centers. Poor PS predicted failure to receive the initially planned cancer treatment after hospital discharge. ICU admission was associated with meaningful survival in lung cancer patients with good PS and non-recurrent/progressive disease.

Conversely, mortality rates were very high in patients not fit for anticancer treatment and poor PS. In this subgroup, palliative care may be the best option.

Sartipy U. **Better survival after lung cancer surgery in high-volume hospitals**. Thorax. 2014;69(10)

Reames BN, Ghaferi AA, Birkmeyer JD, Dimick JB. **Hospital volume and operative mortality in the modern era**. Annals of Surgery. 2014;260(2):244-51.Objective: To determine whether the relationship between hospital volume and mortality has changed over time. Background: It is generally accepted that hospital volume is associated with mortality in high-risk procedures. However, as surgical safety has improved over the last decade, recent evidence has suggested that the inverse relationship has diminished or been eliminated. Methods: Using national Medicare claims data from 2000 through 2009, we examined mortality among 3,282,127 patients who underwent 1 of 8 gastrointestinal, cardiac, or vascular procedures. Hospitals were stratified into quintiles of operative volume. Using multivariable logistic regression models to adjust for patient characteristics, we examined the relationship between hospital volume and mortality, and assessed for changes over time. We performed sensitivity analyses using hierarchical logistic regression modeling with hospital-level random effects to confirm our results. Results: Throughout the 10-year period, a significant inverse relationship was observed in all procedures. In 5 of the 8 procedures studied, the strength of the volume-outcome relationship increased over time. In esophagectomy, for example, the adjusted odds ratio of mortality in very low volume hospitals compared to very high volume hospitals increased from 2.25 [95% confidence interval (CI): 1.57-3.23] in 2000-2001 to 3.68 (95% CI: 2.66-5.11) in 2008-2009. Only pancreatectomy showed a notable decrease in strength of the relationship over time, from 5.83 (95% CI: 3.64-9.36) in 2000-2001, to 3.08 (95% CI: 2.07-4.57) in 2008-2009. Conclusions: For all

procedures examined, higher volume hospitals had significantly lower mortality rates than lower volume hospitals. Despite recent improvements in surgical safety, the strong inverse relationship between hospital volume and mortality persists in the modern era. Copyright © 2014 Lippincott Williams & Wilkins.

Pezzi M, Mallin K, Mendez AS, Greer GE, Putnam B. **Ninety-day mortality after resection for lung cancer is nearly double 30-day mortality**. The Journal of thoracic and cardiovascular surgery. 2014;148(5):2269.To evaluate 30-day and 90-day mortality after major pulmonary resection for lung cancer including the relationship to hospital volume. Major lung resections from 2007 to 2011 were identified in the National Cancer Data Base. Mortality was compared according to annual volume and demographic and clinical covariates using univariate and multivariable analyses, and included information on comorbidity. Statistical significance (P<.05) and 95% confidence intervals were assessed. There were 124,418 major pulmonary resections identified in 1233 facilities. The 30-day mortality rate was 2.8%. The 90-day mortality rate was 5.4%. Hospital volume was significantly associated with 30-day mortality, with a mortality rate of 3.7% for volumes less than 10, and 1.7% for volumes of 90 or more. Other variables significantly associated with 30-day mortality include older age, male sex, higher stage, pneumonectomy, a previous primary cancer, and multiple comorbidities. Similar results were found for 90-day mortality rates. In the multivariate analysis, hospital volume remained significant with adjusted odds ratios of 2.1 (95% confidence interval [CI], 1.7-2.6) for 30-day mortality and 1.3 (95% CI, 1.1-1.6) for conditional 90-day mortality for the hospitals with the lowest volume (<10) compared with those with the highest volume (>90). Hospitals with a volume less than 30 had an adjusted odds ratio for 30-day mortality of 1.3 (95% CI, 1.2-1.5) compared with those with a volume greater than 30. Mortality at 30 and 90 days and hospital volume should be monitored by institutions performing major pulmonary resection and benchmarked against hospitals performing at least 30 resections per year.

Luchtenborg M, Riaz SP, Coupland VH, Lim E, Jakobsen E, Krasnik M, et al. **High procedure volume is strongly associated with improved survival after lung cancer surgery**. Lung Cancer. 2014;83.Background: Studies have reported an association between hospital volume and survival for non-small cell lung cancer. The present paper explores this association in England, accounting for case-mix and the propensity to resect. Methods: We analysed data on 134,293 patients with NSCLC diagnosed in England between 2004 and 2008 of whom 12,862 (9.6%) underwent surgical resection. Hospital volume was defined according to the number of patients with resected lung cancer in each hospital in each year of diagnosis. We calculated hazard ratios for death in three pre-defined periods according to hospital volume, sex, age, socioeconomic deprivation, comorbidity and the propensity to resect. Results: There was increased survival in hospitals performing more than 150 surgical resections compared with those carrying out less than 70 [HR 0.78 (95% CI 0.67-0.90), p<inf>trend</inf> < 0.01]. The association between hospital volume and survival was present in all three periods of follow-up, but the magnitude of the association was greatest in the early post-operative period. The difference in cumulative survival reached a maximum at around two years postsurgery. Conclusion: High volume hospitals have higher resection rates, operate on patients who are older, have lower socioeconomic status, more comorbidities and despite that they achieve better survival, most notably in the early post-operative period.

Linden A, D'Amico A, Perry Y, Saha-Chaudhuri P, Sheng S, Kim S, et al. **Quantifying the safety benefits of wedge resection: a society of thoracic surgery database propensity-matched analysis**. The Annals of thoracic surgery. 2014;98(5):1705.Wedge resection is often used instead of anatomic resection in an attempt to mitigate perioperative risk. In propensity-matched populations, we sought to compare the perioperative outcomes of patients undergoing wedge resection with those undergoing anatomic resection. The Society of Thoracic Surgery database was reviewed for stage I and II non-small cell lung cancer patients undergoing

wedge resection and anatomic resection to analyze postoperative morbidity and mortality. Propensity scores were estimated using a logistic model adjusted for a variety of risk factors. Patients were then matched by propensity score using a greedy 5- to 1-digit matching algorithm, and compared using McNemar's test. Between 2009 and 2011, 3,733 wedge resection and 3,733 anatomic resection patients were matched. The operative mortality was 1.21% for wedge resection versus 1.93% for anatomic resection (p=0.0118). Major morbidity occurred in 4.53% of wedge resection patients versus 8.97% of anatomic resection patients (p<0.0001). A reduction was noted in the incidence of pulmonary complications, but not cardiovascular or neurologic complications. There was a consistent reduction in major morbidity regardless of age, lung function, or type of incision. Mortality was reduced in patients with preoperative forced expiratory volume in 1 second less than 85% predicted. Wedge resection has a 37% lower mortality and 50% lower major morbidity rate than anatomic resection in these propensity-matched populations. The mortality benefit is most apparent in patients with forced expiratory volume in 1 second less than 85% predicted. These perioperative benefits must be carefully weighed against the increase in locoregional recurrence and possible decrease in long-term survival associated with the use of wedge resection for primary lung cancers.

Lauk O, Hoda MA, de PM, Friess M, Klikovits T, Klepetko W, et al. **Extrapleural pneumonectomy after induction chemotherapy: perioperative outcome in 251 mesothelioma patients from three high-volume institutions**. The Annals of thoracic surgery. 2014;98(5):1748.Several publications have suggested that induction chemotherapy followed by extrapleural pneumonectomy (EPP) for patients with malignant pleural mesothelioma (MPM) patients is associated with exceedingly high morbidity and mortality, and the role of EPP is controversially debated. The present retrospective study analyzed the perioperative outcome in 251 consecutively treated patients at three high-volume mesothelioma centers. 251 MPM patients completed EPP after platinum-based induction chemotherapy at three institutions for

thoracic surgery over more than 10 years. The rates of 30-day and 90-day mortality and of major morbidities (pulmonary embolism, postoperative bleeding, acute respiratory distress syndrome, empyema, bronchopleural fistula (BPF), chylothorax, patch failure) were recorded. Perioperative outcome was correlated to risk factors such as smoking history (pack years), age at operation, body mass index, spirometry results, C-reactive protein, American Society of Anesthesiologists classification, chemotherapy regimen used, blood loss during operation, duration of operation, and characteristics of the tumor (laterality, histologic subtype, pT and pN stage) to find factors predicting 30-day and 90-day mortality or major morbidity. The overall 30-day mortality was 5%. Within 90 days after operation, 8% of the patients died. The rates of 30-day and 90-day mortality were significantly higher in patients with high preoperative C-reactive protein values ($p=0.001$ and $p<0.0005$). The spirometry values forced expiratory volume in 1 second and forced vital capacity exhaled (FVCex) were both associated with 30-day and 90-day mortality ($p=0.001$ and $p<0.0005$; and $p=0.002$ and $p<0.0005$). Major morbidity occurred in 30% of the patients, significantly more often after right-sided EPP ($p=0.01$) and after longer operations ($p<0.0005$). Empyema ($p<0.0005$) and acute respiratory distress syndrome ($p=0.02$) were associated with longer duration of operation. EPP after induction chemotherapy is a demanding procedure but can be performed with acceptable morbidity and mortality if patients are well selected and treated at dedicated high-volume MPM centers.

Lanuti M, Hong H-J, Ali S, Stock C, Temel J, Mathisen D, et al. **Observations in lung cancer over multiple decades: an analysis of outcomes and cost at a single high-volume institution**. European journal of cardio-thoracic surgery : official journal of the European Association for Cardio-thoracic Surgery. 2014;46(2):254.This study reviews survival outcomes and cost of lung cancer care over multiple decades at a single high-volume institution. All patients with a diagnosis of lung cancer were analysed at a single institution from 1959 to 2010. Data were extracted from a tumour registry, which was linked to a longitudinal

medical record, clinical data repository and social security master death index. In-depth survival analyses by stage were performed using Kaplan-Meier methods from 1981 to 2010. The analysis contains hospital billing data on 1025 lung cancer patients from 2004 to 2010. A total of 17 025 patients with lung cancer were identified over the study period. The 1-year, 5-year and 10-year all-cause mortality rates were 41, 78 and 87%, respectively. Non-small-cell lung cancer comprised 73% (n = 12 361) of cases where the median survival = 2.5 years and the population was 94% Caucasian. Lung cancer was most prevalent between ages 60-79 years of life. Female gender and adenocarcinoma were increasingly more prevalent over the decades. The 5-, 10- and 15-year survival for non-small-cell lung cancer (NSCLC) patients were 27, 15 and 5%, respectively. Death rates measured at 1 year after diagnosis were reduced; however, 5-year survival over each subsequent decade did not significantly change. In patients where the full scope of cost data were available, the median cost/patient with any stage NSCLC = $40 500, where 63% of the cost is expended in the first year after diagnosis. The average length of treatment for NSCLC was 20.2 months. The greatest single category of expense was chemotherapy (31%), followed by surgery (24%), inpatient medical (17%), radiation therapy (12%) and diagnostics (5%). For surgically treated patients, Stage II-IV costs were roughly twice those of Stage I. There has been no evident improvement over the past 3 decades in 5-year survival (~27%) in patients diagnosed with NSCLC at a single high-volume institution. Improvement in 1-year survival is thought to be attributed to improvements in diagnosing lung cancer earlier. Most of the healthcare expenditure for lung cancer is incurred during the first year after diagnosis despite stage.

Ivanovic J, Seely JE, Anstee C, Villeneuve PJ, Gilbert S, Maziak E, et al. **Measuring surgical quality: comparison of postoperative adverse events with the american college of surgeons NSQIP and the Thoracic Morbidity and Mortality classification system**. Journal of the American College of Surgeons. 2014;218(5):1024.Monitoring surgical outcomes is critical to quality improvement;

however, different data-collection methodologies can provide divergent evaluations of surgical outcomes. We compared postoperative adverse event reporting on the same patients using 2 classification systems: the retrospectively recorded American College of Surgeons (ACS) NSQIP and the prospectively collected Thoracic Morbidity and Mortality (TM&M) system. Using the TM&M system, complications and deaths were documented daily by fellows and reviewed weekly by staff for all thoracic surgical cases conducted at our institution (April 1, 2010 to December 31, 2011). The ACS NSQIP recording was performed 30 to 120 days after index surgery by trained surgical clinical reviewers on a systemic sampling of major cases during the same time period. Univariate analyses of the data were performed. During the study period, 1,788 thoracic procedures were performed (1,091 were designated "major," as per ACS NSQIP inclusion criteria). The ACS NSQIP evaluated 182 of these procedures, representing 21.1% and 16.7% of patients and procedures, respectively. Mortality rates were 1.4% in TM&M vs 2.2% in ACS NSQIP (p = 0.42). Total patients and procedures with complications reported were 24.4% and 31.1% by TM&M vs 20.2% and 39.0% by ACS NSQIP (p = 0.23 and 0.03), respectively. Rates of reported cardiac complications were higher in TM&M vs ACS NSQIP (5.8% vs 1.1%; p = 0.01), and wound complications were lower (2.5% vs 6.0%; p = 0.01). Although overall rates were similar, significant differences in collection, definitions, and classification of postoperative adverse events were observed when comparing TM&M and ACS NSQIP. Although both systems offer complementary value, harmonization of definitions and severity classification would enhance quality-improvement programs.

Filosso PL, Venuta F, Oliaro A, Ruffini E, Rendina EA, Margaritora S, et al. **Thymoma and inter-relationships between clinical variables: A multicentre study in 537 patients**. European Journal of Cardio-thoracic Surgery. 2014;45(6):1020-7.OBJECTIVES: In thymomas, the roles of Masaoka-Koga stage, histology and the presence of myasthenia gravis (MG) have been considered fundamental for patient management and outcomes. In this study, we retrospectively

evaluated several clinical variables, with the aim of outlining their relationships and clinical/prognostic significance in resected thymoma patients. METHODS: A retrospective search of our surgical database for patients operated on for thymoma in six Italian high-volume thoracic surgery centres between 2000 and 2011 was conducted. The following clinical variables were evaluated: Masaoka-Koga Stage, tumour histology, the presence of MG, other autoimmune syndromes or second tumours, the completeness of tumour resection and the development of recurrences. RESULTS: Five hundred and thirty-seven (273 males-51%) were retrospectively included in this study. Our results indicate that: (i) MG correlates with early Masaoka-Koga stage and B-type thymoma; (ii) Stage III-IVa tumours correlate with B-type tumour; (iii) autoimmune paraneoplastic syndromes correlate with Stage I-II thymoma; (iv) second malignancies correlate with the absence of paraneoplastic disorders and weakly with B-type tumour and (v) overall survival was influenced by Masaoka-Koga stage and completeness of surgical resection. CONCLUSIONS: In thymomas, Masaoka-Koga stage, histology, MG, other autoimmune syndromes and second malignancies are inter-related, but only Masaoka-Koga tumour stage, amid these clinical variables, has been demonstrated to be a strong prognostic indicator of survival. © The Author 2014. Published by Oxford University Press on behalf of the European Association for Cardio-Thoracic Surgery. All rights reserved.

Filosso PL, Guerrera F, Rendina AE, Bora G, Ruffini E, Novero D, et al. **Outcome of surgically resected thymic carcinoma: a multicenter experience**. Lung cancer (Amsterdam, Netherlands). 2014;83(2):205.Thymic carcinoma (TC) is a rare and invasive mediastinal tumor, with poor prognosis. Most of the previous published papers are single-institution based, reporting small series of patient, sometimes including palliative resection. This study collected patients with TC treated in 5 high-volume Italian Thoracic Surgery Institutions. A multicenter retrospective study of patients operated for TC between 2000 and 2011 was conducted. Exclusion criteria were: Neuroendocrine thymic neoplasms, debulking/palliative resection and tumor biopsy. Cause specific survival (CSS) was the primary endpoint. Four hundred and seventy-eight patients underwent surgery for thymic malignancies: 40 of them (8.4%)

had TC. Eleven (27.5%) received induction chemotherapy because of their radiological invasiveness. A complete resection (R0) was achieved in 36 (90%; 9/11 submitted to induction chemotherapy). Adjuvant radio/chemotherapy was offered to 37 patients, according to the type of surgical resection and tumor invasiveness. Three, 5 and 10-year survival rates were 79%, 75% and 58%. Recurrences developed in 10 patients. R0 resection ($p<0.0003$) and absence of tumor recurrences ($p=0.03$) resulted significant prognostic factors at univariate analysis. Independent CSS predictor was the achievement of a complete resection ($p<0.05$). TC is a rare and invasive mediastinal tumor. A multimodal approach is indicated especially in TC invasive forms. The achievement of a complete surgical resection is fundamental to improve survival.

Farjah F, Varghese TK, Costas K, Krishnadasan B, Farivar AS, Hubka M, et al. **Lung resection outcomes and costs in Washington state: A case for regional quality improvement**. Annals of Thoracic Surgery. 2014;98(1):175-82.Background A regional quality improvement effort does not exist for thoracic surgery in the United States. To initiate the development of one, we sought to describe temporal trends and hospital-level variability in associated outcomes and costs of pulmonary resection in Washington (WA) State. Methods A cohort study (2000-2011) was conducted of operated-on lung cancer patients. The WA State discharge database was used to describe outcomes and costs for operations performed at all nonfederal hospitals within the state. Results Over 12 years, 8,457 lung cancer patients underwent pulmonary resection across 49 hospitals. Inpatient deaths decreased over time (adjusted p-trend = 0.023) but prolonged length of stay did not (adjusted p-trend = 0.880). Inflation-adjusted hospital costs increased over time (adjusted p-trend < 0.001). Among 24 hospitals performing at least 1 resection per year, 5 hospitals were statistical outliers in rates of death (4 lower and 1 higher than the state average), and 13 were outliers with respect to prolonged length of stay (7 higher and 6 lower than the state average) and costs (5 higher and 8 lower than the state average). When evaluated for rates of death and costs, there were hospitals with

fewer deaths/lower costs, fewer deaths/higher costs, more deaths/lower costs, and more deaths/higher costs. Conclusions Variability in outcomes and costs over time and across hospitals suggest opportunities to improve the quality and value of thoracic surgery in WA State. Examples from cardiac surgery suggest that a regional quality improvement collaborative is an effective way to meaningfully and rapidly act upon these opportunities. © 2014 by The Society of Thoracic Surgeons.

Falcoz P-E, Puyraveau M, Rivera C, Bernard A, Massard G, Mauny F, et al. **The impact of hospital and surgeon volume on the 30-day mortality of lung cancer surgery: A nation-based reappraisal**. The Journal of thoracic and cardiovascular surgery. 2014;148(3):841.Our objective was to analyze the time trend variation of 30-day mortality after lung cancer surgery, and to quantify the impact of surgeon and hospital volumes over a 5-year period in France. We used Epithor, the French national thoracic database and benchmark tool, which catalogues more than 180,000 procedures of 89 private and public hospitals in France. From January 2005 to December 2010, 19,556 patients who underwent major lung resection (lobectomy, bilobectomy, pneumonectomy) were included in our study. Multilevel logistic models were designed to investigate the relationship between 30-day mortality and surgeon (model 1) or hospital (model 2) volumes. The 3 levels considered were the patient, the surgeon, and the hospital. From 2005 to 2007, the 30-day mortality of patients who underwent major lung resection averaged 10%, and then decreased until it reached 3.8% in 2010 (P < .0001). A significant decrease in 30-day mortality was observed over time (P = .0046). During the study period, the mean annual number of procedures per surgeon was 46.1 (standard deviation [SD] = 23.6) and per hospital was 97.9 (SD = 50.8). Model 1 showed that surgeon volume had a significant impact on 30-day mortality (P = .03), whereas model 2 failed to show that hospital volume influenced 30-day mortality (P = .75). Since 2007, when France's first National Cancer Plan became effective, 30-day mortality of primary lung cancer surgery has decreased and currently measures 3.8%. Low mortality was correlated with higher surgeon volume but was not influenced by hospital volume, which cannot be considered a proxy measure for determining the safety of lung cancer surgery.

Burt BM, Cameron RB, Mollberg NM, Kosinski AS, Schipper PH, Shrager JB, et al. **Malignant pleural mesothelioma and the Society of Thoracic Surgeons Database: An analysis of surgical morbidity and mortality**. Journal of Thoracic and Cardiovascular Surgery. 2014;148(1):30-5.Background To date, reported surgical morbidity and mortality for pleurectomy/decortication and extrapleural pneumonectomy performed for malignant pleural mesothelioma primarily represent the experience of a few specialized centers. For comparison, we examined early outcomes of pleurectomy/decortication and extrapleural pneumonectomy from a broader group of centers/surgeons participating in the Society of Thoracic Surgeons-General Thoracic Database. Methods All patients in the Society of Thoracic Surgeons-General Thoracic Database (version 2.081, representing 2009-2011) who underwent pleurectomy/decortication or extrapleural pneumonectomy for malignant pleural mesothelioma were identified. Patient characteristics, morbidity, mortality, center volume, and procedure were examined using univariable and multivariable analyses. Results A total of 225 patients underwent pleurectomy/decortication (n = 130) or extrapleural pneumonectomy (n = 95) for malignant pleural mesothelioma at 48 centers. Higher volumes of procedures (<5/y) were performed at 3 pleurectomy/decortication and 2 extrapleural pneumonectomy centers. Patient characteristics were statistically equivalent between pleurectomy/decortication and extrapleural pneumonectomy groups, except those undergoing extrapleural pneumonectomy were younger (63.2 +/- 7.8 years vs 68.3 +/- 9.5 years; P <.001) and more likely to have received preoperative chemotherapy (30.1% vs 17.8%; P =.036). Major morbidity was greater after extrapleural pneumonectomy, including acute respiratory distress syndrome (8.4% vs 0.8%; P =.005), reintubation (14.7% vs 2.3%; P =.001), unexpected reoperation (9.5% vs 1.5%; P =.01), and sepsis (4.2% vs 0%; P =.03), as was mortality (10.5% vs 3.1%; P =.03). Multivariate analyses revealed that extrapleural pneumonectomy was an independent predictor of major morbidity or mortality (odds ratio, 6.51; P =.001). Compared with high-volume

centers, increased acute respiratory distress syndrome was seen in low-volume centers performing extrapleural pneumonectomy (0% vs 12.5%; P =.05). Conclusions Extrapleural pneumonectomy is associated with greater morbidity and mortality compared with pleurectomy/decortication when performed by participating surgeons of the Society of Thoracic Surgeons-General Thoracic Database. Effects of center volume require further study. © 2014 by The American Association for Thoracic Surgery.

Anderson JE, Chang DC. **Does the effect of surgical volume on outcomes diminish over time**. JAMA Surgery. 2014;149(4):398-400

Bhamidipati M, Stukenborg J, Ailawadi G, Lau L, Kozower D, Jones R. **Pulmonary resections performed at hospitals with thoracic surgery residency programs have superior outcomes**. The Journal of thoracic and cardiovascular surgery. 2013;145(1):60.Pulmonary resections are performed at thoracic residency (TR), general surgery residency (GSR), no surgery residency, and no residency hospitals. We hypothesize that morbidity and mortality for these procedures are different between hospitals and that operations performed at TR teaching hospitals have superior results. Records of adults who underwent pneumonectomy, lobar, segmentectomy, and nonanatomic wedge resections (N = 498,099) were evaluated in an all-payer inpatient database between 2003 and 2009. Hospital teaching status was determined by linkage to Association of American Medical College's Graduate Medical Education Tracking System. Multiple hierarchical regression models examined the in-hospital mortality, occurrence of any complication, and failure to rescue. The mean annual pulmonary resection volume among hospitals was TR (16%), GSR (17%), no surgery residency (28%), and no residency (39%). Unadjusted mortality for all procedures was lowest at TR hospitals (P < .001). Likewise, any complication was least likely to occur at TR hospitals (P < .001). After case-mix adjustment, the risk of any complication after segmentectomy or nonanatomic wedge resection was lower at TR hospitals than in GSR hospitals (P < .001). Among pneumonectomy recipients, TR hospitals reduced the adjusted odds

ratio of failure to rescue by more than 25% compared with no surgery residency (P < .001). Likewise, in patients who underwent pneumonectomy, TR centers were associated with reducing the odds ratio of death by more than 30% compared with GSR hospitals (P < .001). In comparison with other hospitals, including GSR hospitals, TR hospitals have lower morbidity and mortality. These results support using hospitals with a TR as an independent prognostic indicator of outcomes in pulmonary resections.

Tieu B, Schipper P. **Specialty matters in the treatment of lung cancer**. Seminars in thoracic and cardiovascular surgery. 2012;24(2):99.The effect of surgeon volume, hospital volume, and surgeon specialty on operative outcomes has been reported in numerous studies. Short-term and long-term outcome comparisons for pulmonary resection for lung cancer have been performed between general surgeons (GS), cardiothoracic surgeons (CTS), and general thoracic surgeons (TS), using large administrative and inpatient databases. In the United States, general surgeons perform more pulmonary resection than thoracic surgeons. Studies have found that in cases involving thoracic surgeons, there is a lower operative mortality and morbidity, improved long-term survival, better adherence to established practice standards, and a lower cost compared with cases involving general surgeons. Some specific processes of care that account for these improved economic, operative, and oncological outcomes have been identified. Others are not yet specifically known and associated with specialization in thoracic surgery.

Puskas D, Kilgo D, Thourani H, Lattouf M, Chen E, Vega JD, et al. **The society of thoracic surgeons 30-day predicted risk of mortality score also predicts long-term survival**. The Annals of thoracic surgery. 2012;93(1):26.The Society of Thoracic Surgeons Predicted Risk of Mortality (PROM) score is a well-validated predictor of 30-day mortality after cardiac procedures. This study investigated the ability of PROM to predict longer-term survival. From January 1, 1996, to December

31, 2009, 24,222 patients with PROM scores underwent cardiac procedures at an academic center. Long-term all-cause mortality was determined from the Social Security Death Index. Logistic and Cox survival regression analyses evaluated the long-term predictive utility of the PROM. Area under the receiver operator characteristic curve measured the discrimination of PROM at 1, 3, 5, and 10 years. Kaplan-Meier curves were stratified by quartiles of PROM risk to compare long-term survival. All analyses were performed for the whole sample and for 30-day survivors. The overall 30-day mortality was 2.78% (674 of 24,222). PROM predicted 30-day mortality extremely well (area under the receiver operator characteristic, 0.794) and predicted longer-term survival almost as well. Among all patients and 30-day survivors, area under the receiver operator characteristic values for PROM at 1, 3, 5, and 10 years were remarkably similar to the 30-day end point for which PROM is calibrated. PROM was highly predictive of Kaplan-Meier survival for patients surviving beyond 30 days. Among 30-day survivors, each percent increase in PROM score was associated with a 9.6% increase (95% confidence interval, 9.3% to 10.0%) in instantaneous hazard of death ($p<0.001$). The PROM algorithm accurately predicts death at 30-days and during 14 years of follow-up with almost equally strong discriminatory power. This may have profound implications for informed consent and for longitudinal comparative effectiveness studies.

Park S, Detterbeck C, Boffa J, Kim W. **Impact of hospital volume of thoracoscopic lobectomy on primary lung cancer outcomes**. The Annals of thoracic surgery. 2012;93(2):372.This study evaluated hospital operative volume of video-assisted thoracoscopic surgery (VATS) lobectomy in primary lung cancer as a predictor of short-term outcomes after pulmonary lobectomy on a national scale. Some previous analyses comparing VATS vs open lobectomy outcomes have been limited by inaccuracies in patient cohort identification. The 2008 Healthcare Utilization Project-Nationwide Inpatient Sample database was culled using the International Classification of Diseases (9th Clinical Modification) procedure codes specifically distinguishing VATS vs open lobectomies (32.41 and 32.49, respectively)

available only after October 2007. High hospital VATS volume was defined as 95th percentile or higher (>20 VATS/year). Univariable and multivariable analyses were used to identify independent predictors of the following outcome measures: 30-day in-hospital morbidity and mortality, hospital length of stay (LOS), and hospital costs. We identified 6,292 primary lung cancer patients undergoing pulmonary lobectomy, including 1,523 undergoing VATS (24%). Compared with open, VATS patients had fewer complications (38% vs 44%, p<0.001) and median LOS (5 vs 7 days; p<0.001). In multivariable analysis, VATS was an independent predictor of fewer total complications (odds ratio, 0.83; p=0.004) and shorter LOS (2.3±0.3-day difference, p<0.001). Patients undergoing VATS at high-volume VATS hospitals had shorter median LOS (4 vs 6 days, p=0.001) compared with low-volume VATS hospitals. Multivariable analysis showed high hospital VATS volume independently predicted shorter LOS (0.9±0.4-day difference, p=0.001). In a national database, VATS lobectomy was associated with fewer complications and shorter LOS than open lobectomy in primary lung cancer patients. Among patients undergoing VATS, high hospital volume was also associated with shorter LOS.

LaPar J, Bhamidipati M, Lau L, Jones R, Kozower D. **The Society of Thoracic Surgeons General Thoracic Surgery Database: establishing generalizability to national lung cancer resection outcomes**. The Annals of thoracic surgery. 2012;94(1):216.The Society of Thoracic Surgeons General Thoracic Surgery Database (GTDB) has demonstrated outstanding results for lung cancer resection. However, whether the GTDB results are generalizable nationwide is unknown. The purpose of this study was to establish the generalizability of the GTDB by comparing lung cancer resection results with those of the Nationwide Inpatient Sample (NIS), the largest all-payer inpatient database in the United States. From 2002 to 2008, primary lung cancer resection outcomes were compared between the GTDB (n = 19,903) and the NIS (n = 246,469). Primary outcomes were the proportion of procedures performed nationally that were captured in the GTDB and differences in mortality rates and hospital length of stay. Observed differences in patient

characteristics, operative procedures, and postoperative events were also analyzed. Annual GTDB lung cancer resection volume has increased over time but only captures an estimated 8% of resections performed nationally. The GTDB and NIS databases had similar median patient age (67 vs 68 years) and female sex (50% vs 49%), lobectomy was the most common procedure (64.7% vs 79.7%; p < 0.001), and pneumonectomies were uncommon (6.3% vs 7.2%; p < 0.001). Compared with NIS, the GTDB had significantly lower unadjusted discharge mortality rates (1.8% vs 3.0%), median length of stay (5.0 vs 7.0 days; p < 0.001), and postoperative pulmonary complication rates (18.5% vs 23.6%, p < 0.001). The GTDB represents a small percentage of the lung cancer resections performed nationally and reports significantly lower mortality rates and shorter hospital length of stay than national results. The GTDB is not broadly generalizable. These results establish a benchmark for future GTDB comparisons and highlight the importance of increasing participation in the database.

Kozower BD, Stukenborg GJ. **Lung Cancer Resection Volume: Is Procedure Volume Really an Indicator of Quality?** Seminars in Thoracic and Cardiovascular Surgery. 2012;24(2):93-8.The majority of lung cancer resection studies indicate that hospital and surgeon procedure volume are inversely associated with mortality. It makes intuitive sense that performing large numbers of these procedures leads to better outcomes. However, controversy exists regarding the strength and validity of this volume-outcome association. Because thresholds of procedure volume are used to recommend the regionalization of care, investigation of the volume-outcome relationship is imperative. This review will examine the methodology used in the volume-outcome relationship literature and highlight important areas of concern. Careful examination of the literature demonstrates that lung cancer resection volume is not strongly associated with mortality and should not be used as a proxy measure for quality.

French B, Farjah F, Flum R, Heagerty J. **A general framework for estimating**

volume-outcome associations from longitudinal data. Statistics in medicine. 2012;31(4):366.Recently, there has been much interest in using volume-outcome data to establish causal associations between measures of surgical experience or quality and patient outcomes following a surgical procedure, such as coronary artery bypass graft, total hip replacement, and radical prostatectomy. However, there does not appear to be a standard approach to a volume-outcome analysis with respect to specifying a volume measure and selecting an estimation method. We establish the recurrent marked point process as a general framework from which to approach a longitudinal volume-outcome analysis and examine the statistical issues associated with using longitudinal data analysis methods to model aggregate volume-outcome data. We review assumptions to ensure that linear or generalized linear mixed models and generalized estimating equations provide valid estimates of the volume-outcome association. In addition, we provide theoretical and empirical evidence that bias may be introduced when an aggregate volume measure is used to address a scientific question regarding the effect of cumulative experience. We conclude with the recommendation that analysts carefully specify a volume measure that most accurately reflects their scientific question of interest and select an estimation method that is appropriate for their scientific context. Copyright © 2011 John Wiley & Sons, Ltd.

LaPar J, Nagji S, Bhamidipati M, Kozower D, Lau L, Ailawadi G, et al. **Seasonal variation influences outcomes following lung cancer resections**. European journal of cardio-thoracic surgery : official journal of the European Association for Cardio-thoracic Surgery. 2011;40(1):83.The effect of seasonal variation on postoperative outcomes following lung cancer resections is unknown. We hypothesized that postoperative outcomes following surgical resection for lung cancer within the United States would not be impacted by operative season. From 2002 to 2007, 182507 isolated lung cancer resections (lobectomy (n = 147 937), sublobar resection (n = 21650), and pneumonectomy (n = 13916)) were evaluated using the Nationwide Inpatient Sample (NIS) database. Patients were stratified

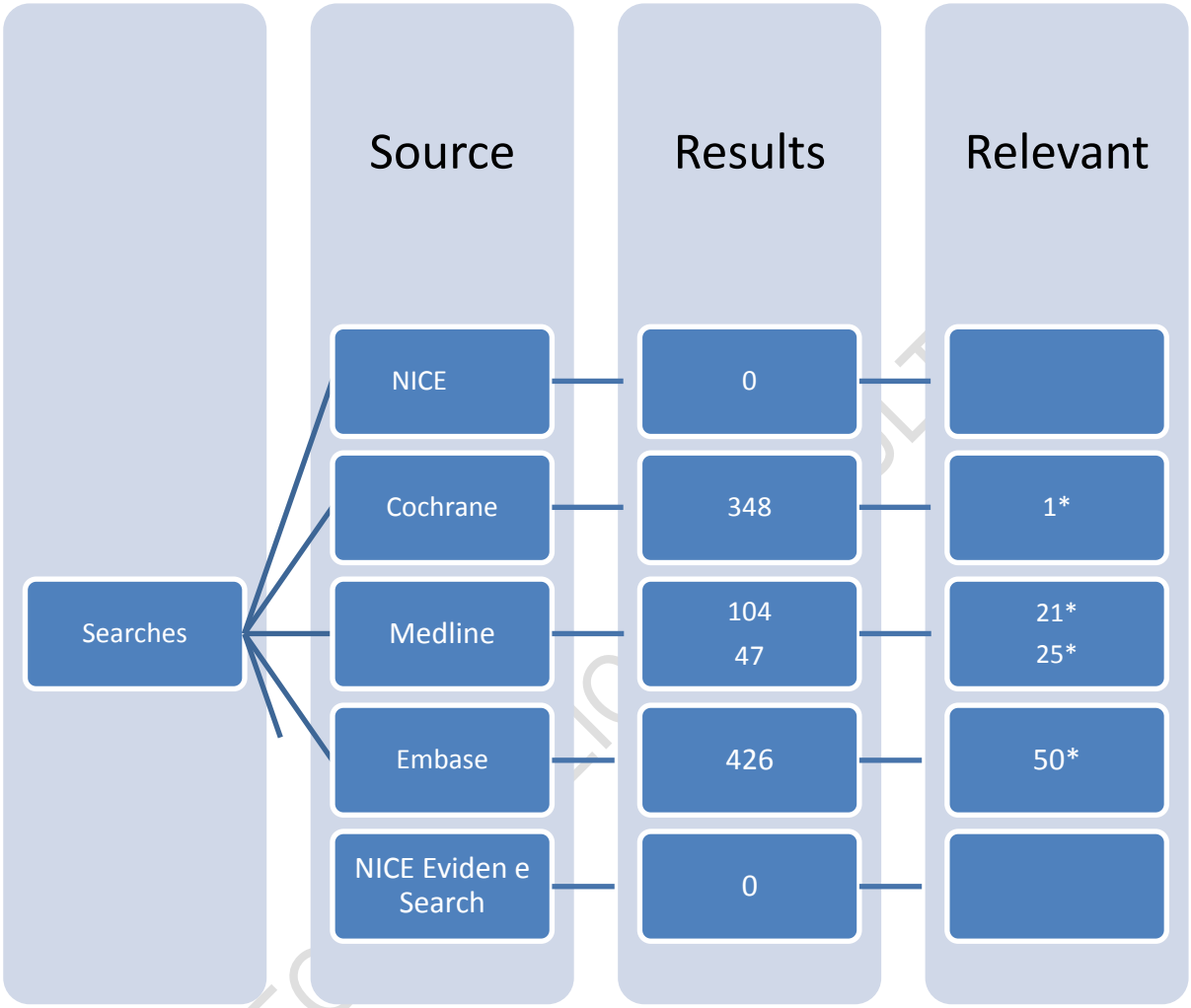
according to operative season: spring (n = 47382), summer (n = 46131), fall (n = 45370) and winter (n = 43624). Multivariate regression models were applied to assess the effect of operative season on adjusted postoperative outcomes. Patient co-morbidities and risk factors were similar despite the operative season. Lobectomy was the most common operation performed: spring (80.0%), summer (81.3%), fall (81.8%), and winter (81.1%). Lung cancer resections were more commonly performed at large, high-volume (>75th percentile operative volume) centers (P < 0.001). Unadjusted mortality was lowest during the spring (2.6%, P < 0.001) season compared with summer (3.1%), fall (3.0%) and winter (3.2%), while complications were most common in the fall (31.7%, P < 0.001). Hospital length of stay was longest for operations performed in the winter season (8.92 ± 0.11 days, P < 0.001). Importantly, multivariable logistic regression revealed that operative season was an independent predictor of in-hospital mortality (P < 0.001) and of postoperative complications (P < 0.001). Risk-adjusted odds of in-hospital mortality were increased for lung cancer resections occurring during all other seasons compared with those occurring in the spring. Outcomes following surgical resection for lung cancer are independently influenced by time of year. Risk-adjusted in-hospital mortality and hospital length of stay were lowest during the spring season.

Other

National Institute for Health Research. Evaluating models of service delivery: reconfiguration principles. 2010. Available from: http://www.nets.nihr.ac.uk/projects/hsdr/081304063

Society for Cardiothoracic Surgery in Great Britain and Ireland. 2011 National thoracic surgery activity and outcomes report. 2011. Available from: http://www.scts.org/modules/resources/info.aspx?id=46

Appendix: Search strategies



*From the x97 results x12 are duplicates (ie the same journal article)

NICE www.nice.org.uk

Thor* and "high volume"	1 result
Thoracic surgery	83results

None specifically on high volume although there are various guidelines about surgery eg http://www.nice.org.uk/guidance/conditions-and-diseases/respiratory-conditions

The Cochrane library www.thecochranelibrary.com

ID	Search	Hits
#1	MeSH descriptor: [Thoracic Surgery] explode all trees	187
#2	MeSH descriptor: [Thoracic Neoplasms] explode all trees	5752
#3	MeSH descriptor: [Pneumothorax] explode all trees	269
#4	lung adj5 surg*	180
#5	lung adj5 resection	43
#6	"Thoracic sepsis"	0
#7	Thorax adj5 sepsis	14
#8	Thora* and malignanc*	389
#9	Thora* and sepsis 374	
#10	MeSH descriptor: [Survival Analysis] explode all trees	17604
#11	MeSH descriptor: [Survival Rate] explode all trees	9222
#12	MeSH descriptor: [Treatment Outcome] explode all trees	111009
#13	MeSH descriptor: [Hospitals, High-Volume] explode all trees	9
#14	"post operative survival"	11
#15	"volume outcome"	41
#16	"high volume"	746
#17	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9	6928
#18	#10 or #11 or #12 or #13 or #14 or #15 or #16	125565
#19	#17 and #18	2566

Line # 19 browsed Cochrane Reviews (50), other reviews (183), methods studies (0), technology assessments (8), economic evaluations (107) and Cochrane Groups (0)
Did not look at trials (2218).

Line #1 – browsed all Results (187)
Cochrane Reviews (0), other reviews (16), trials (148), methods studies (0), technology assessments (13), economic evaluations (10) and Cochrane Groups (0)

1 other review relevant

NICE Evidence search www.evidence.nhs.uk

Thora* Surgery and "high volume"	234
Thora* Surgery and "high volume centre"	5

X2 results National Institute for Health Research and Society for Cardiothoracic surgery.

Medline http://www.library.nhs.uk/hdas/

1	exp THORACIC SURGERY/	11668
2	exp THORACIC NEOPLASMS/	274500
3	exp PNEUMOTHORAX/	15090
4	(lung adj5 surg*).ti,ab	13333
5	(lung adj5 resection).ti,ab	7908
6	"Thoracic sepsis".ti,ab	7
7	(Thorax adj5 sepsis).ti,ab	5
8	(Thora* AND malignanc*).ti,ab	3104
9	(Thora* AND sepsis).ti,ab	1108
10	exp SURVIVAL ANALYSIS/	206362
11	exp SURVIVAL RATE/	135154
12	exp TREATMENT OUTCOME/	729085
13	exp HOSPITALS, HIGH-VOLUME/	460
14	"post operative survival".ti,ab	228
15	"volume outcome".ti,ab	456
16	"high volume".ti,ab	8842
17	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9	310333
18	10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16	965802
19	17 AND 18	38365
20	19 [Limit to: Publication Year 2010-2016]	14936
21	1 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9	34174
22	18 AND 21	5853
23	22 [Limit to: Publication Year 2010-2016]	2200

24	1 AND 18	338
25	**24 [Limit to: Publication Year 2010-2016]**	**104**
26	10 OR 11 OR 12 OR 14	958596
27	17 AND 26	38256
28	13 OR 15 OR 16	9266
29	26 AND 27 AND 28	77
30	**29 [Limit to: Publication Year 2010-2016]**	**47**

From line 25 x21 relevant
From line 30 x25 relevant

Embase http://www.library.nhs.uk/hdas/

1	exp THORACIC SURGERY/	453898
2	exp THORACIC NEOPLASMS/	5904
3	exp PNEUMOTHORAX/	30038
4	(lung adj5 surg*).ti,ab	15969
5	(lung adj5 resection).ti,ab	9670
6	"Thoracic sepsis".ti,ab	8
7	(Thorax adj5 sepsis).ti,ab	2
8	(Thora* AND malignanc*).ti,ab	5904
9	(Thora* AND sepsis).ti,ab	1925
10	exp SURVIVAL ANALYSIS/	738573
11	exp SURVIVAL RATE/	174510
12	exp TREATMENT OUTCOME/	1125170
13	exp HOSPITALS, HIGH-VOLUME/	596
14	"post operative survival".ti,ab	303
15	"volume outcome".ti,ab	588
16	"high volume".ti,ab	14153
17	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9	493393
18	10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16	1736807
19	17 AND 18	107821
20	19 [Limit to: Publication Year 2010-2016]	53892
21	1 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9	468417
22	18 AND 21	104496
23	22 [Limit to: Publication Year 2010-2016]	52035
24	1 AND 18	100769
25	24 [Limit to: Publication Year 2010-2016]	50049
26	10 OR 11 OR 12 OR 14	1725887
27	17 AND 26	107089
28	13 OR 15 OR 16	14647
29	26 AND 27 AND 28	634

30 **29 [Limit to: Publication Year 2010-2016]** **426**

From line 30 – x50 relevant

British Thoracic Society https://www.brit-thoracic.org.uk/

“High volume” 0 results