

Charles D. Logan, MD<sup>1,2</sup>; Ryan J. Ellis, MD MS<sup>1,2</sup>; Joe Feinglass, PhD<sup>3</sup>; Amy L. Halverson<sup>1</sup>; Calvin Lung, MD<sup>2</sup>; Samuel Kim, MD<sup>2</sup>; Ankit Bharat, MBBS<sup>2</sup>; Ryan P. Merkow, MD MS<sup>1</sup>; David J. Brentem, MD MS<sup>1</sup> and David D. Odell, MD MS<sup>1,2</sup>  
 1 Surgical Outcomes and Quality Improvement Center, Department of Surgery, Northwestern University, Feinberg School of Medicine, Chicago, IL  
 2 Canning Thoracic Institute, Department of Surgery, Northwestern University, Feinberg School of Medicine, Chicago, IL  
 3 Department of Medicine, Northwestern University, Feinberg School of Medicine, Chicago, IL

## Objectives

Regionalization of surgery for non-small-cell lung cancer (NSCLC) to high-volume centers (HVCs) improves perioperative outcomes but increases travel distance for patients who receive care at these centers. Increased distance may decrease rates of adjuvant chemotherapy (AC). However, the relationship of travel distance, surgical volume, and receipt of AC with outcomes is unknown. The purpose of this study is to evaluate the association of distance, volume, and receipt of AC with overall survival among patients with NSCLC.

## Methods

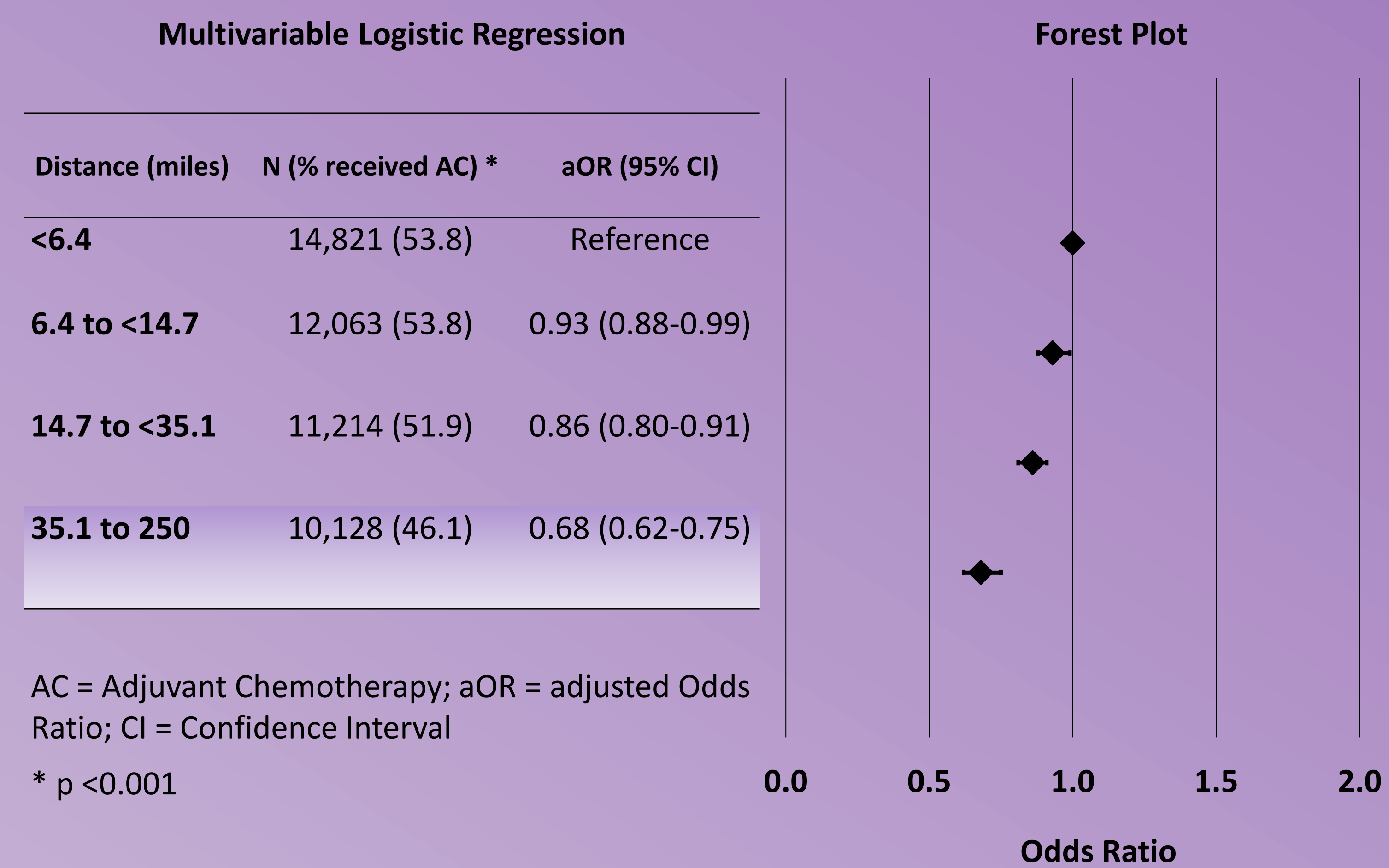
Patients with stage II-IIIa (N0-N1) NSCLC were identified between 2004-2018 using the National Cancer Database. Patient travel distance to their surgical facility was categorized into quartiles (<6.4, 6.4 to <14.7, 14.7 to <35.1, and ≥35.1 miles), and HVCs were defined in accordance with LeapFrog criteria as those performing ≥40 annual resections. Patient characteristics and odds of receiving AC at any center were determined. Survival analysis was performed using Kaplan-Meier curves and adjusted Cox Proportional Hazards models.

## Results

Overall, 48,226 patients with surgically resected stage II-IIIa (N0-N1) NSCLC met criteria for inclusion. Of the cohort, 51.7% received AC, 16.7% traveled <6.4mi to LVCs, and 15.2% traveled ≥35.1mi to HVCs (p<0.001). Among stage II-IIIa patients who traveled ≥35.1mi to HVCs, 46.0% received AC vs 54.1% who traveled <6.4mi to LVCs (aOR 0.66, 95% CI 0.58-0.74; p<0.001; reference). Patients with Stage II-IIIa NSCLC who traveled ≥35.1mi were more likely than patients who traveled <6.4 miles to be male (57.2% vs 49.5%), from rural areas (40.6% vs 1.6%). For patients who traveled <6.4 miles and received treatment at an LVC, the median time to initiation of adjuvant chemotherapy was 45 (IQR 35-60) days. Patients with Stage II-IIIa NSCLC who traveled ≥35.1mi to HVCs and did not receive AC had higher mortality than those who traveled <6.4mi to LVCs and received AC (aHR for mortality 1.31, 95% CI 1.21-1.42). Median overall survival was lower for patients who traveled long distances (35.1 to 250 miles) for surgical treatment at HVCs and did not receive AC (median OS 38.8 months) compared with patients who traveled short distances (<6.4 miles) and were surgically treated at LVCs and received AC (median OS 54.6 months, reference).



**Figure 1:** Forest Plot Evaluating the Association of Increasing Travel Distance and Odds of Receipt of Adjuvant Chemotherapy for Patients with Resected Stage II-IIIa (N0-N1) NSCLC



**Table 1:** Association of Increasing Travel Distance, Hospital Surgical Volume, and Odds of Receipt of Adjuvant Chemotherapy for Patients with Resected Stage II-IIIa (N0-N1) NSCLC

Parameter	Total 48,226 (100%) N	Received AC 24,953 (51.7%) %	No AC 23,273 (48.3%) %	aOR (95% CI)
<b>Hospital Surgical Volume / Travel Distance (miles)</b>				
LVC / <6.4	8,055	54.1	45.9	Reference
LVC / 6.4 to <14.7	5,309	52.7	47.3	0.87 (0.81-0.94)
LVC / 14.7 to <35.1	4,039	51.3	48.7	0.82 (0.75-0.90)
LVC / ≥35.1 to 250	2,772	46.4	53.6	0.67 (0.60-0.76)
<b>HVC</b>				
HVC / <6.4	6,766	53.4	46.6	0.93 (0.85-1.02)
HVC / 6.4 to <14.7	6,754	54.6	45.4	0.93 (0.84-1.02)
HVC / 14.7 to <35.1	7,175	52.3	47.7	0.83 (0.75-0.92)
HVC / ≥35.1 to 250	7,356	46.0	54.0	0.66 (0.58-0.74)

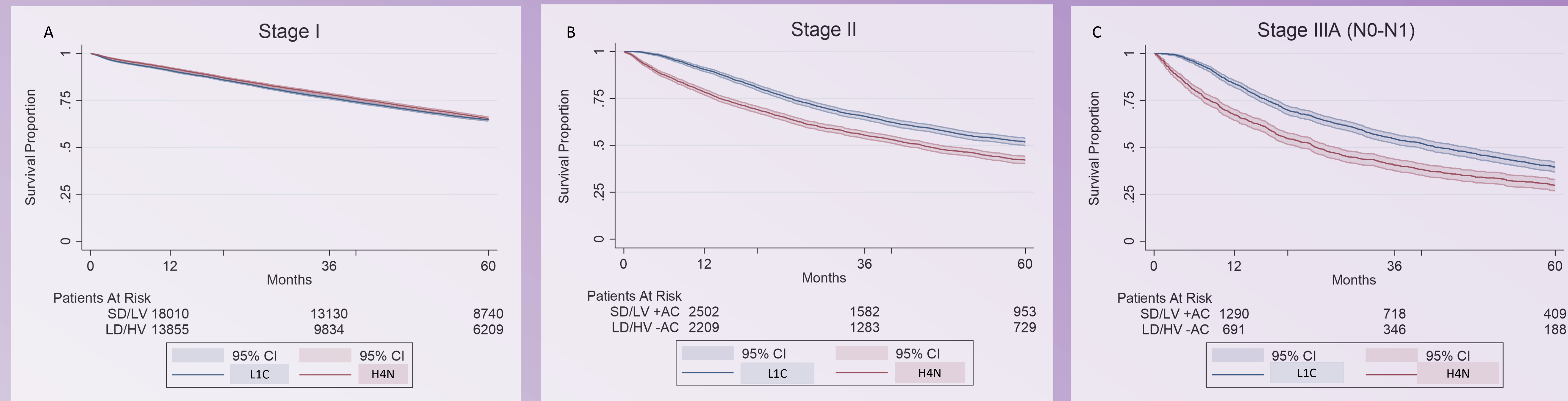
AC = Adjuvant Chemotherapy; aOR = adjusted Odds Ratio; CI = Confidence Interval; LVC = Low-Volume Center; HVC = High-Volume Center

**Table 3:** Cox Proportional Hazards Models Evaluating the Association of Travel Distance, Surgical Volume, and Receipt of Adjuvant Chemotherapy Subgroups with Survival for Resected Pathological Stage II-IIIa (N0-N1) NSCLC

Subgroup	Cox Proportional Hazards Models	
	Unadjusted HR (95% CI)	Adjusted aHR (95% CI)
L1C	Reference	Reference
H4N	1.39 (1.30-1.49)	1.31 (1.21-1.42)

L1C = short distance (<6.4 miles), low-volume (<40 annual resections), successfully received AC  
 H4N = long distance (35.1 to 250 miles), high-volume (≥40 annual resections), failed to receive AC  
 HR = Hazard Ratio; CI = Confidence Interval; aHR = adjusted Hazard Ratio

**Figure 2:** Kaplan-Meier Curves Evaluating the Association of Travel Distance, Surgical Volume, Receipt of Adjuvant Chemotherapy, and Survival. (A) Stage I, (B) Stage II, and (C) Stage IIIa (N0-N1)



**Table 2:** Kaplan-Meier Survival Estimates Evaluating the Association of Travel Distance, Surgical Volume, and Receipt of Adjuvant Chemotherapy Subgroups with Survival for Resected Pathological Stage II-IIIa (N0-N1) NSCLC

Subgroup	12 months		36 months		60 months	
	N	SF (95% CI)	N	SF (95% CI)	N	SF (95% CI)
L1C	3792	0.88 (0.87-0.89)	2300	0.61 (0.60-0.63)	1362	0.47 (0.46-0.49)
H4N	2900	0.75 (0.74-0.77)	1629	0.51 (0.50-0.53)	917	0.39 (0.37-0.41)

SF = Survivor Function, CI = Confidence Interval, L1C = short distance (<6.4 miles), low-volume (<40 annual resections), successfully received AC  
 H4N = long distance (35.1 to 250 miles), high-volume (≥40 annual resections), failed to receive AC

## Conclusions

Longer travel distance is associated with decreased odds of receiving adjuvant chemotherapy. Furthermore, patients with stage II-IIIa (N0-N1) NSCLC who traveled ≥35.1mi to high-volume centers for surgery and did not receive adjuvant chemotherapy had lower overall survival compared to patients who traveled <6.4mi to low-volume centers for surgery but received adjuvant chemotherapy. Understanding the reason for lack of receipt of adjuvant chemotherapy is necessary to improve delivery and maximize the benefit of travel to high-volume centers for surgery.

## References

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