


ORIGINAL ARTICLE

Lung transplantation and Affordable Care Act Medicaid expansion in the era of lung allocation score – a retrospective study

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SUMMARY

This study evaluated the impact of Medicaid eligibility expansion (ME) on lung transplant (LT) listings and Medicaid coverage. Data on LT candidates aged 18–64 were obtained from the Scientific Registry of Transplant Recipients ($N = 9153$). The impact of ME was evaluated by comparing LT listings in 2011–2013 with listings in 2014–2016, as well as comparing states that had and had not adopted ME in 2014. LT listings increased by 7.7% nationally post-ME. In ME states, LT listings increased by 15.2%, whereas nonexpansion states decreased by 1.5%. LT candidates with Medicaid increased after ME nationally (8.3% vs. 9.9%, $P = 0.006$) and in ME states (9.7% vs. 11.5%, $P = 0.036$), but not in nonexpansion states (6.6% vs. 7.7%, $P = 0.170$). Following multivariable adjustment, LT listings in ME states had 58% greater odds for Medicaid compared to nonexpansion states ($P < 0.001$). Expansion of Medicaid provided greater healthcare access and increased LT listings, but only within states that adopted eligibility expansion.

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Introduction

Access to transplantation has traditionally favored candidates with private insurance. Medicaid represents the largest source of health insurance in the United States and is jointly funded by states and the federal government, providing coverage to low-income families and individuals. Specific provisions of the Patient Protection and Affordable Care Act (ACA) of 2010 were explicitly designed to even the playing field by expanding eligibility for Medicaid public insurance in a bid to reduce the numbers of Americans without health insurance [1]. It required states to provide Medicaid coverage for all

adults aged 18–65 years with incomes up to 138% of the federal poverty level, regardless of age, family, or employment. This optional state-level expansion of public insurance eligibility achieved a nearly 10–30% reduction in the uninsured rate in states such as Kentucky and Arkansas and suggested substantial gains in healthcare access through utilization [2].

The increase in expansion directly benefited socially disadvantaged and low-income groups with chronic illnesses and improved access to primary care and preventive medicine [3]. Medicaid transplant recipients are more likely to be young, female, non-Caucasian, lack pretransplant employment, reside in a rural residence,

and have a lower education level when compared to those with Medicare or private insurance. Because they are often also less likely to have access to specialty surgical services, they represent a unique at-risk group likely to benefit from such provisions [4]. A recent report cited an increase in heart transplant wait list rates among African Americans with heart failure, post-expansion [5]. Overall, however, there is a paucity of published data pertaining to the impact of this expansion on access to surgical services as a whole, including transplantation.

In theory, expanded Medicaid enrollment would permit broader access to timely diagnosis of end-stage lung disease, referral to lung transplant (LT) centers for evaluation, and attenuate existing disparities in access to evaluation, wait-listing, and transplantation. To the best of our knowledge, no study has explicitly evaluated these trends in the LT population and we sought, therefore, to evaluate this effect in the contemporary era of the lung allocation scoring (LAS) system, which was implemented in 2005. The purpose of this study was to examine the influence of the optional expansion of Medicaid eligibility on the number of LT listings and on Medicaid coverage of candidates. We hypothesized that there would be an increase in access as determined by the rate of listing for potential LT candidates and transplants performed in states that implemented the expansion in Medicaid eligibility in 2014.

Materials and methods

Data were obtained from the Scientific Registry of Transplant Recipients (SRTR), which were submitted by the Organ Procurement and Transplantation Network on donors, wait listed candidates, and recipients in the United States and overseen by the Health Resources and Services Administration (HRSA) of the US Department of Health and Human Services. Data included in this study pertained to LT candidates aged 18–64 years, representing adult patients eligible for Medicaid based on age ($N = 9153$) and avoiding those eligible for children's health insurance programs or age-based Medicare coverage. Two groups of LT candidates were created to examine the impact of the ACA Medicaid expansion program: patients listed in 2011–2013 (pre-ACA Medicaid expansion) and patients listed in 2014–2016 (post-ACA Medicaid expansion). In addition, LT listings in states that adopted Medicaid expansion in 2014 were compared to those in states that did not adopt Medicaid expansion. Candidates in states that adopted Medicaid expansion after January 2014 ($n = 1751$) or

without a state listed ($n = 77$) were excluded from the sample. Specifically, state participation in Medicaid expansion was based on expanded Medicaid eligibility by January 2014. Therefore, states that deferred or delayed Medicaid expansion to a later date such as Pennsylvania, Michigan, Alaska, Indiana, and New Hampshire were excluded.

Statistical analysis

Continuous data are presented as mean \pm standard deviation or median (interquartile range) and categorical data are presented as frequency (percent). One-way Chi-square analyses were used to compare count data (i.e., number of candidates before and after Medicaid expansion) using equal numbers in each group set for expected values. Univariate group comparisons were conducted with independent-samples *t* tests or Mann-Whitney *U* tests for continuous variables and Chi-square tests or Fisher's Exact tests, as appropriate. Multivariable logistic regression was used to examine the factors associated with use of Medicaid insurance in LT candidates. The factors included in the model were selected *a priori* and included age (years), gender, race, education, employment status, diabetes, cigarette use history, initial LAS, ACA Medicaid expansion era, and state participation in Medicaid expansion. Cases with missing data on factors in the model were excluded listwise, with working status having the greatest number of missing values. Analyses were performed with IBM SPSS Statistics version 24.0 (IBM Corp., Armonk, NY, USA) and a two-tailed *P* value < 0.05 was considered statistically significant.

Results

A total of 9153 candidates listed for LT who met the inclusion criteria were included in the sample. These patients had a mean age of 50.3 ± 12.7 years. Forty-eight percent (48%) were female (Table 1). Nationally, LT listings increased by 7.7% in the postexpansion era (4407 vs. 4746, $P < 0.001$). In states that adopted Medicaid expansion, LT listings increased by 15.2% postexpansion (2427 vs. 2796, $P < 0.001$), whereas listings in nonexpansion states decreased by 1.5%, but this change was not statistically significant (1980 vs. 1950, $P = 0.632$; Fig. 1). The percentage of LT candidates who were registered for the wait list with Medicaid coverage increased significantly postexpansion (8.3% vs. 9.9%, $P = 0.006$). The increased Medicaid utilization in candidates postexpansion was only observed in the

Table 1. Patient characteristics for adult lung transplant listings between 2011 and 2016 (N = 9153).

	Pre-ACA n = 4407	Post-ACA n = 4746	P value
Age (years)	50.0 ± 12.8	50.6 ± 12.5	0.032
Female	2082 (47)	2281 (48)	0.433
Caucasian	3500 (79)	3624 (76)	<0.001
Medicaid	365 (8)	471 (10)	0.006
Greater than high school education	2519 (60)	2615 (58)	0.032
Working for income	490 (15)	561 (17)	0.167
Cigarette use	2242 (51)	2336 (49)	0.114
Diabetes	952 (22)	1043 (22)	0.780
Creatinine	0.8 (0.6–0.9)	0.8 (0.7–0.9)	0.185
Initial LAS	41.7 ± 17.9	42.4 ± 17.4	0.057

ACA, Affordable Care Act; LAS, lung allocation score.

Data presented as mean ± standard deviation, median (interquartile range), or frequency (percent).

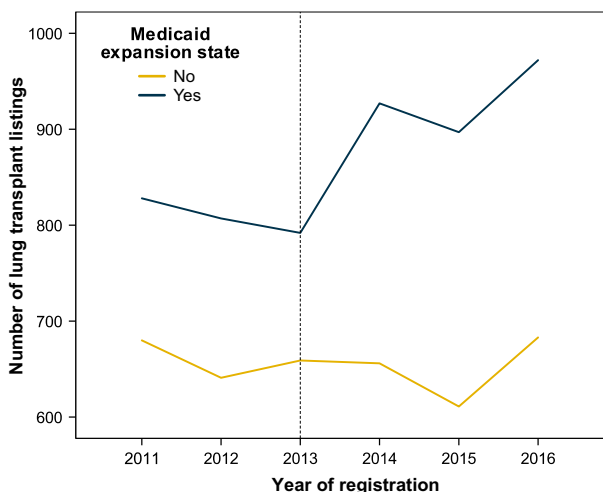


Figure 1 Number of patients listed for lung transplant by registration year and home state Medicaid expansion status regardless of insurance coverage.

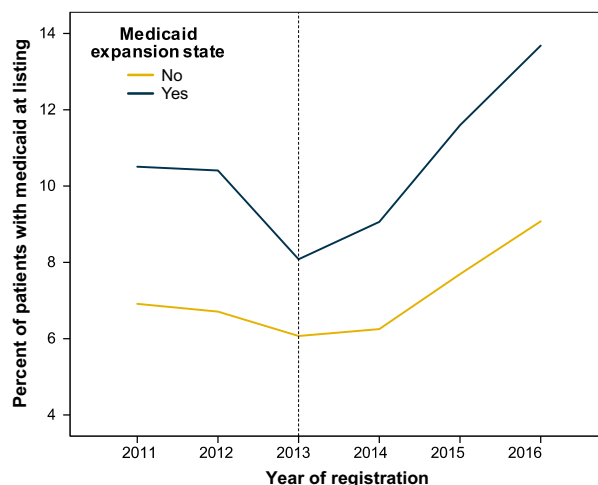


Figure 2 Impact of registration year and home state Medicaid expansion status on percent of patients with Medicaid insurance coverage at time of lung transplant listing.

states that adopted Medicaid expansion (9.7% vs. 11.5%, $P = 0.036$), but not in nonexpansion states (6.6% vs. 7.7%, $P = 0.170$; Fig. 2). Although LT listings increased post-Medicaid expansion, as did Medicaid coverage at the time of listing, there was no increase in the proportion of patients who were transplanted after Medicaid expansion (74% vs. 74%, $P > 0.999$). However, given the overall increase in listings, the absolute number of LT performed increased by 249 patients after Medicaid expansion (8% increase, $P = 0.002$). In the expansion states, the absolute number of LT performed increased by 264 ($P < 0.001$) whereas the absolute number decreased by 15 in the nonexpansion states

($P = 0.783$). The absolute number of LT performed increased after Medicaid expansion in patients with ($P = 0.003$) and without ($P = 0.023$) Medicaid coverage (Fig. 3).

After multivariable adjustment, the factors associated with greater odds for use of Medicaid insurance at the time of wait list registration were younger age, non-Caucasian race, less than college education level, not working for income, cigarette use history, and home state participation in Medicaid expansion (Table 2). Initial LAS was not associated with use of Medicaid insurance ($P = 0.402$). Lung transplant listings in states that adopted Medicaid expansion were associated with 58%

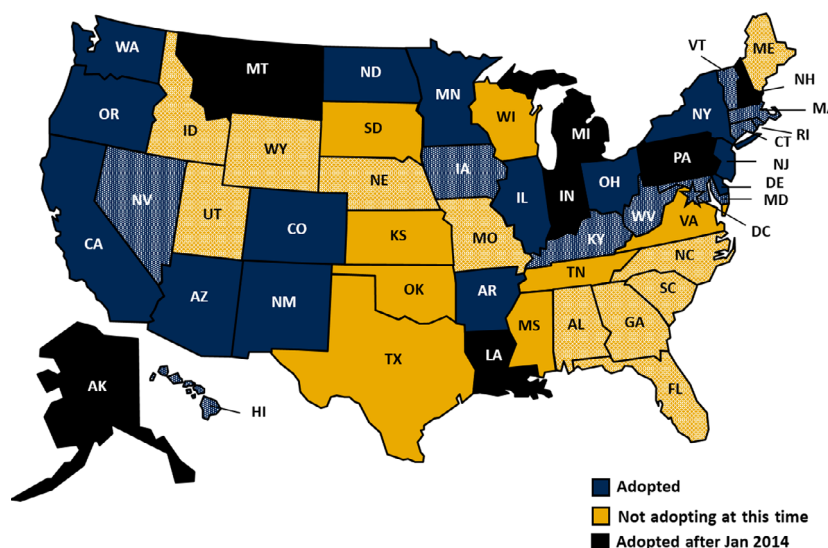


Figure 3 Impact of Medicaid expansion program on lung transplant listings showing 56% of expansion states and 42% of nonexpansion states with increased lung transplant listings (solid color states = increased lung transplant listings; patterned states = no change or decreased lung transplant listings). Source: "Status of State Action on the Medicaid Expansion Decision," KFF State Health Facts, updated November 8, 2017.

greater odds for use of Medicaid insurance at wait list registration compared to listings in nonexpansion states (OR = 1.58, $P < 0.001$). The comparison of preexpansion and postexpansion eras was not independently associated with use of Medicaid insurance (OR = 1.16, $P = 0.128$). Examining these factors associated with using Medicaid coverage, patients with non Caucasian race (21% vs. 24%, $P < 0.001$), lower education level (40% vs. 42%, $P = 0.032$), and home state that adopted Medicaid expansion (55% vs. 59%, $P < 0.001$) were represented on the wait list in greater proportions after Medicaid expansion. There was no difference between the expansion eras on age, employment status, or cigarette use history.

Discussion

Broadening access to care has been a long-standing vision of the federal government. Indeed, Healthy People 2020 is a policy initiative whose implementation was designed to eliminate disparities in health care with specific focus on improving access by socially disadvantaged and medically underserved groups. Access has two individual components, geographic availability and utilization [4]. Insurance penetration and coverage theoretically influence the opportunities for potential transplant candidates to obtain referral for evaluation, listing and transplantation, as long as transplant services are actually available. The results of our analysis indicate that states that adopted ACA Medicaid expansion

Table 2. Factors associated with Medicaid insurance coverage at time of listing.

	OR	95% CI	<i>P</i> value
Age (years)	0.95	0.94–0.96	<0.001
Female	0.96	0.79–1.16	0.643
Caucasian	0.49	0.40–0.60	<0.001
College educated	0.49	0.40–0.59	<0.001
Working for income	0.35	0.24–0.52	<0.001
Diabetes	1.01	0.82–1.26	0.911
Cigarette use history	1.54	1.22–1.95	<0.001
Initial LAS	0.998	0.99–1.003	0.402
Post-ACA expansion era	1.16	0.96–1.39	0.128
State participated in expansion	1.58	1.30–1.91	<0.001

ACA, Affordable Care Act; CI, confidence interval; LAS, lung allocation score; OR, odds ratio.

were associated with increased candidate listings, increased use of Medicaid insurance at the time of wait list registration, and an increase in absolute number of LT performed. Furthermore, these increases notably occurred among minority groups and those with lower levels of education. Perhaps, just as importantly, these gains did not occur in states that did not adopt the expansion. The option for broader coverage may proffer a safety net that permits the individual recipient to seek care for a medical problem that they may have chosen to ignore out of financial concern. There certainly could potentially be unrelated reasons at play such as

improved negotiated contracts with private payers or a spurt of cases of end-stage lung disease but these appear much less plausible in view of the relative stability over the past decade.

The same phenomenon has not been observed in trends in liver transplantation where Medicaid expansion increased the number of enrollees using Medicaid, but did not translate into a similar increase in the number on the wait list or indeed produce any changes in the socioeconomic composition of the recipients [1]. This latter finding suggests that some candidates may have merely switched to Medicaid from other forms of commercial insurance when given the opportunity, resulting in the absence of any meaningful change in the demographic profile of the recipients. This result also indicates that the expansion may alter insurance status without necessarily permitting broader access to those of different ethnicities, or lower education attainment, or to the unemployed. Oliveira *et al.* [6] went further to report that Medicaid expansion increases coverage without any increase in access to transplant listing among patients with end-stage liver disease. Tumin *et al.* [1] further confirmed these findings and reported that the socioeconomic and demographic profiles of recipients remained substantively similar in the postexpansion era.

Those results are meaningful but starkly different from ours which revealed an improved access in under-represented socioeconomic and demographic profiles, achieving the very goal the expansion set out to achieve. Indeed, Medicaid expansion has been separately linked to significant increases in the likelihood of having a personal physician, decreased reliance on the emergency department (ED) as a usual location of care, allowed substantial reductions in cost-related barriers to care, and prompted better compliance with prescription medications. It has also been responsible for decreased difficulty in paying medical bills, reduced annual out-of-pocket medical spending, and resulted in significant improvements in self-reported quality of life [2]. Tumin *et al.* [7] evaluated the impact of Medicaid expansion in patients with chronic obstructive pulmonary disease and confirmed a reduction in low-income adults without health insurance from 32% to 21%, underscoring the benefit proffered by Medicaid expansion among disadvantaged populations. Sommers *et al.* [2] confirmed these findings in rural Kentucky and Arkansas, where Medicaid expansion was associated with increased access to primary care, outpatient utilization, reduced out of pocket spending, reduced ED visits, increased screening, and improved self-reported health. Indeed, Arkansas

was the first state to be granted approval to expand Medicaid under the ACA and opted to include a private option, allowing use of Medicaid funds to purchase private health plans within the insurance marketplace. The result was improved access to primary care, prescription medications, and preventive care [8]. Regardless, therefore, of the means by which it is accomplished, either by Medicaid expansion or the use of alternative models of coverage expansion, the expansion was shown to increase access to quality health care and improve health equity [9].

Where Medicaid expansion has increased insurance coverage without enabling broader access to solid organ transplantation, it may be postulated that the solution to increased access goes beyond the mere provision of coverage [1]. Dubay *et al.* [5] reported no differences in waiting time for Medicaid recipients when compared with Medicare and private insurees, once listed. It is, thus, a worthwhile consideration to go further and evaluate barriers to listing as well as those most likely to be encountered immediately following listing as these might serve to stall the pathway to transplantation. Our results identified an increased proportion of non-Caucasian candidates in the postexpansion era, as well as those with lower education attainment suggesting that some of the barriers to listing such as lack of comprehension or transportation may have been mitigated likely through increased access to Medicaid, health education resources, and skilled providers. It is well established that nonprivate insurance recipients have worse post transplantation outcomes, longer lengths of stay, and lower post-LT survival [5]. Significant barriers thus exist before, and after, listing and judging success within the Medicaid population should likely extend prior to and then beyond listing so as to quantify actual volume of transplants performed in candidates drawn from the vulnerable populations.

Disparities in outcomes may be further fueled by an implicit bias by providers that triggers a tacit reluctance to list or transplant newly insured, under-insured or established Medicaid enrollees, because of the identifiable risk factors that jeopardize their candidacy and outcomes. These include late diagnoses, late evaluations, poor compliance, comorbidities, restricted socioeconomic reserved and health literacy, and even the implicit bias itself by health providers [1,10]. These patients also have comparatively higher hospitalization charges [11]. Private payor reimbursement is also often higher than Medicare-Medicaid reimbursement and this may further influence decision making. Each of these characteristics may incrementally erode access to

transplantation and highlight the existence of subtle, often complex dynamics at play in evaluating candidacy for transplantation that may inadvertently galvanize the barriers to listing or indeed transplanting these patients for fear of compromised outcomes.

Our study has several limitations. First, it pertains only to LT candidates within the confines of the United States, and indeed those in states that opted for expansion or no expansion in 2014 and thus, not necessarily generalizable. Second, the absence of granular detail prevents an in-depth evaluation of the quantitative and qualitative influences on wait list decision-making algorithms, both objective and subjective particularly pertinent to implicit bias and or unmeasured factors pertaining to wait listing and candidate selection. The retrospective nature of the analysis and the reliance on registry data each increase the potential for a multitude of unmeasurable confounders. Third, the relative recency of the Medicaid expansion does not allow for robust long-term survival analysis. In addition, the full impact of Medicaid expansion on LT may not be evident in this early cohort. Fourth, we are unable to quantify the reasons for enrollment or indeed whether the new enrollees also carried private insurance. Fifth, this study analyzes the expansion as a binary event in 2014 without an evaluation of the nuanced policy differences among expansion states. For example, although both Kentucky and Arkansas expanded Medicaid, Arkansas opted for a private option, using Medicaid funding to purchase private health insurance from the ACA marketplace for low-income adults. Differences, nevertheless, between these options in terms of access and utilization have reportedly been negligible [2]. Finally, our study design does not proffer any causal inference and it is plausible that a host of unmeasured confounders are at play and in this vein, we recognize that this is merely a single evaluation of one aspect of the ACA and does not represent the overall impact of healthcare reform.

Despite these limitations, however, the analysis allows a snapshot of the impact of Medicaid expansion and the broader impact of the ACA on LT listing, identifying the increase in listing and increased number of transplants as a surrogate for access to transplant care. This finding is of particular relevance for marginalized groups and the medically underserved as this may proffer their only gateway to transplantation. We make no assumptions, however, that expanding eligibility for Medicaid is a panacea. It is likely that a more comprehensive approach is necessary in expanding access to healthcare resources as a whole in order to improve listing rates and ultimately transplant outcomes in low-income populations. This approach will likely require a multi-pronged health policy initiative that earnestly strives to identify those barriers to health access and literacy seeking to achieve comprehensive primary care for socially disadvantaged individuals with chronic end-stage lung disease and administering and coordinating culturally sensitive care and system navigation. These efforts should likely involve language interpretation, improvement in patient-provider communication, increased health literacy, and care tailored to cultural norms, beliefs, and values of patients. Many states have witnessed recent policy changes and even reversal of expansion in a current bid to upend the provisions of the ACA. These changes may serve to nullify the gains made thus far in the management of end-stage lung disease. Furthermore, this may jeopardize any meaningful analyses of impact in the future and halt any further progress.

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Conflicts of interest

The authors have declared no conflict of interest.

REFERENCES

1. Tumin D, Beal EW, Mumtaz K, *et al.* Medicaid participation among liver transplant candidates after the Affordable Care Act Medicaid expansion. *J Am Coll Surg* 2017; **225**: 173.e2.
2. Sommers BD, Blendon RJ, Orav EJ, Epstein AM. Changes in utilization and health among low-income adults after Medicaid expansion or expanded private insurance. *JAMA Intern Med* 2016; **176**: 1501.
3. 2018 The Effects of Medicaid Expansion under the ACA: Updated Findings from a Literature Review 2018. Available at: <https://www.kff.org/medicaid/issue-brief/the-effects-of-medicaid-expansion-under-the-aca-updated-findings-from-a-literature-review-march-2018/>.
4. Hayanga AJ, Kaiser HE, Sinha R, Berenholtz SM, Makary M, Chang D. Residential segregation and access to surgical care by minority populations in US counties. *J Am Coll Surg* 2009; **208**: 1017.
5. DuBay DA, MacLennan PA, Reed RD, *et al.* Insurance type and solid organ transplantation outcomes: a historical

- perspective on how Medicaid expansion might impact transplantation outcomes. *J Am Coll Surg* 2016; **223**: 611.e4.
6. Oliveira GH, Al-Kindi SG, Simon DI. Implementation of the Affordable Care Act and solid-organ transplantation listings in the United States. *JAMA Cardiol* 2016; **1**: 737.
 7. Tumin D, Jackson EJ Jr, Hayes D Jr. Medicaid expansion and chronic obstructive pulmonary disease among low-income adults in the United States. *Clin Respir J* 2018; **12**: 1398.
 8. Maylone B, Sommers BD. Evidence from the private option: the Arkansas experience. *Issue Brief (Commonw Fund)* 2017; **6**: 1.
 9. Nguyen KH, Sommers BD. Access and quality of care by insurance type for low-income adults before the Affordable Care Act. *Am J Public Health* 2016; **106**: 1409.
 10. Bryce CL, Angus DC, Arnold RM, *et al.* Sociodemographic differences in early access to liver transplantation services. *Am J Transplant* 2009; **9**: 2092.
 11. Hayanga JWA, Shigemura N, Aboagye JK, *et al.* ECMO support in lung transplantation: a contemporary analysis of hospital charges in the United States. *Ann Thorac Surg* 2017; **104**: 1033.