Published in final edited form as:

Plast Reconstr Surg. 2015 November ; 136(5): 640e–647e. doi:10.1097/PRS.0000000000001697.

The Effect of Medicaid Expansion on Delivery of Finger and Thumb Replantation Care to Medicaid Beneficiaries and the Uninsured

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Abstract

Purpose—Despite advances in replantation, over 80% of finger and thumb amputation injuries in the United States result in revision amputation. Although numerous factors contribute to this, disparities in access and delivery of replantation care play a substantial role. With ongoing Medicaid expansion under the Affordable Care Act, it is prudent to understand whether expansion of coverage changes utilization of replantation care.

Methods—We used the 2001 Medicaid expansion in New York State (NY) to evaluate changes in replantation for Medicaid beneficiaries and the uninsured. Data for patients having undergone replantation between 1998–2006 were obtained from the NY State Inpatient Database. We used an interrupted time series to evaluate the effect of Medicaid expansion on the probability that Medicaid beneficiaries or uninsured patients received replantation. Census data were used for population-adjusted case volume analysis.

Results—After expansion, the likelihood of Medicaid as the primary payer for replantation increased 0.0059% per quarter, reaching a 1.7% increase five years after expansion. With population-based analysis, this indicates that Medicaid covered 12 additional replantation cases in NY annually. After expansion, 11 fewer of the replantation cases in NY each year were provided to patients without health care coverage.

Conclusion—Medicaid expansion resulted in a modest but significant increase in replantation for Medicaid beneficiaries. Additionally, fewer patients that underwent replantation remained uninsured. Considering the substantial cost and effort burden of replantation, these findings supports the benefits of Medicaid expansion in delivery and payer coverage of replantation.

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Financial Disclosure:

None of the authors has a financial interest to disclose.

Keywords

Affordable Care Act; finger amputation injuries; finger replantation; hand surgery; Medicaid expansion; natural experiment thumb replantation

Over 45,000 traumatic finger and thumb amputation injuries occur annually in the United States.^{1–3} Although treatment of these injuries has improved substantially with the advent and improvement of replantation techniques, more than 80% of finger and thumb amputation injuries are not treated with replantation.^{4, 5} Although some of these injuries do not meet replantation criteria⁶, there are numerous additional factors that limit delivery of this complex reconstructive care. Provider access and payer status play a large role in preventing adequate amputation care nationwide.^{4, 5, 7}

Some hand surgeons do not provide replantation care owing to limitations in their practice model or case volume and experience.⁸ Many others do not provide this care because of financial and hospital system constraints.^{8, 9} Although regionalization of replantation care has been proposed as an approach to combat some of these limitations in provider access^{4, 10}, issues of inadequate compensation – often caused by a lack of insurance coverage in the finger amputation patient population – must also be addressed. Uninsured patients have lower rates of replantation when compared to patients with private insurance, workers' compensation, or Medicaid.^{4, 11}

One of the most contentious topics during the debates about the Affordable Care Act (ACA) is whether expansion of Medicaid coverage results in improved access to care and utilization of services for existing Medicaid beneficiaries and the uninsured that would be subsequently covered.^{12–16} The effect of expansion in increasing utilization of subspecialty surgical procedures by Medicaid beneficiaries has been previously shown.¹⁷ Under the ACA expansion, Medicaid coverage extends to working age patients. Hence it is pertinent to evaluate how changes in this government-sponsored health care coverage influences utilization of services pertinent to working-age patients, including management of traumatic hand injuries. We used the largest pre-ACA Medicaid-only expansion, in New York State (NY) in 2001^{18, 19}, to evaluate the effects of Medicaid expansion on utilization of finger and thumb replantation surgery by Medicaid beneficiaries and uninsured patients.

METHODS

Medicaid Expansion in New York State

In 1999, the Health Care Reform Act (HCRA) became NY law.^{18, 19} Under the HCRA, eligibility for public health insurance coverage was expanded to include parents of dependent children with incomes up to 150% of the Federal Poverty Level (FPL), as well as childless, non-disabled adults earning up to 100% FPL.¹⁹ These NY citizens became eligible for Medicaid via the Family Health Plus (FHP) program starting in October (4th quarter) of 2001. This was implemented across all of NY except for in New York City (NYC), where it was delayed 1.5 years in the aftermath of the September 11th terrorist attacks. However, from 9/11/01 to 4/1/03, Disaster Relief Medicaid (DRM) was implemented with eligibility parameters identical to those under the HCRA.¹⁹ Under DRM, patients were given Medicaid

coverage and classified in the State Inpatient Database in the same group as those receiving Medicaid under FHP. As it was phased out in April of 2003, those who remained eligible were shifted from DRM to FHP-Medicaid.

Data Sources

Data from the NY State Inpatient Database (SID) for 1998–2006 were used. This database uses diagnosis and procedural codes from the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), and was built as part of the Healthcare Cost and Utilization Project (HCUP) under the Agency for Healthcare Research and Quality (AHRQ). The SID contains all discharge records from acute care hospitals in NY.²⁰

Study Population

Using ICD-9-CM procedure codes, we selected all patients 19–64 years old who underwent replantation procedures for treatment of traumatic finger and thumb amputations. Owing to lack of specificity with some ICD-9-CM procedure codes, we optimized case capture by using ICD-9-CM codes for tendon and muscle repairs, as well as reattachment of fingers and thumb. This includes codes: 82.0, 82.4, 82.41, 82.44, 82.45, 82.46, 82.5, 82.53, 82.54, 82.7, 82.72, 83.73, 84.21, 84.22, and 84.23. To ensure capture of only replantation cases, we used diagnosis codes to filter for the patients and procedures associated with the appropriate traumatic amputation diagnoses. These codes were 885, 885.0, 885.1, 886, 886.0, 886.1, 887, 887.0, 887.1, 887.2, 887.3, 887.5, 887.6, and 887.7. Our procedure and diagnosis code list was reviewed and verified for completeness by our University billing and coding specialists. There is no evidence in the relevant literature or in our clinical practice that the indications and criteria for replantation changed during the time period of this study.

Statistical Analysis

We used a two-step analysis to evaluate longitudinal (quarter to quarter) changes in proportion of replantation surgeries provided to Medicaid beneficiaries and the uninsured. The two steps allowed us to convert visit level cross-sectional data into longitudinal data, which allowed us to evaluate the trend in access to replantation care over time for both patient groups. This methodology has been reported previously.¹⁷

In step 1, we used logistic regression models to predict the adjusted proportion of patients undergoing any of the selected surgeries during each 3-month block (quarter) between 1998 and 2006. In these logistic models, “Medicaid” or “Uninsured” status was the dependent variable and time categorized by quarters was the key predictor independent variable. The models controlled for age, race, sex, and the overall pre-expansion Medicaid burden of the treating hospital, allowing us to better isolate the effect of having Medicaid (or being uninsured) on undergoing replantation. Understanding that some variation will exist between hospitals, we corrected standard errors for patient clustering at the level of the hospital to minimize the effect of this hospital-to-hospital variability on our results. From these logistic regression models, we estimated the probabilities of Medicaid beneficiaries and the uninsured receiving the selected procedures during each quarter. Separate models were used to evaluate the Medicaid population and the uninsured population.

In step 2, we used the results from step 1 and performed linear regression on the quarterly probability of “Medicaid” and “Uninsured” patients receiving replantation to examine if Medicaid expansion changed these quarterly probabilities over the study period. This allowed us to follow how replantation care delivery to Medicaid patients or uninsured patients changed over time before and after expansion. In these linear models, the probability of Medicaid/Uninsured patients receiving replantation was the dependent variable. Predictor variables included a dichotomous pre-post intervention variable and a continuous variable representing each quarter of the study.

We then calculated the abrupt change in percent Medicaid and percent uninsured receiving replantation right after expansion to see if there was an immediate effect of the policy change. We also determined how the percentage of Medicaid/uninsured patients undergoing replantation changed in each quarter over the 5 year post-expansion period, i.e. the slope, to follow the change over time, and also calculated the absolute effect of the expansion at the end of the study period.²¹

Lastly, based on NY demographic data ²² we also calculated population-adjusted numbers of patients treated in each quarter across the study period to evaluate the absolute number of Medicaid and uninsured patients who received the replantation surgeries.

RESULTS

A total of 5,014 patients in NY underwent finger or thumb replantation surgery over the nine-year study period; 2,227 of these cases occurred in the 3.5 years evaluated prior to Medicaid expansion, whereas the remaining 2,787 occurred after expansion (“intervention”). Of the 5,014 cases, 728 were performed on Medicaid beneficiaries and 880 were performed on uninsured patients. Additional demographic data and descriptive statistics grouped by payer (Medicaid or uninsured), as well as by pre- or post-expansion period, can be found in table 1. Logistic regression results from step 1 of the longitudinal analysis are available in the appendix.

Longitudinal time series analysis showed a significant post-expansion change in the probability that any patient receiving replantation was a Medicaid beneficiary. Prior to expansion there was a declining trend in the probability of treated patients being Medicaid beneficiaries ($p=0.06$, -0.37% per quarter [95% CI -0.76 , 0.02]), although this result did not reach statistical significance. However, after expansion, there was a significant reversal to a positive and growing trend of replant patients being Medicaid beneficiaries ($p=0.01$, 0.59% per quarter [95% CI 0.14 , 1.04]) (Table 2). When compared to the expected proportion from a predicted trajectory had there been no Medicaid expansion, the proportion of Medicaid beneficiaries that actually received replantation procedures was 1.7% greater [95% CI 1.35, 2.05] within the first 5 years post-expansion (Figure 1). In contrast, Medicaid expansion did not have a significant effect on the proportion of uninsured patients receiving these surgeries (Table 2). Although there was a notable increasing trend observed prior to expansion that leveled-off after expansion (Figure 2), these findings did not reach statistical significance.

The results above reflect proportions of case volume delivered to Medicaid beneficiaries and the uninsured. However, these proportions can also be analyzed as population-based rates. Within 5 years after intervention, the significant increase in proportion of replant surgery volume for Medicaid beneficiaries resulted in an increase of over 0.16 cases/1,000,000 population per quarter – an increase from a predicted 0.035 cases/1,000,000 to 0.197 cases/1,000,000 (Figure 3). For the over 19 million people in the state of NY, this translates to over 3 cases per quarter, indicating that over 12 additional replantation procedures were provided annually to Medicaid beneficiaries within 5 years after expansion of Medicaid. This represents a nearly 15% increase in total number of annual replant cases for Medicaid beneficiaries.

For uninsured patients, a different effect was seen. As we discussed above, although the time series analysis did not reach statistical significance, the trend for uninsured patients changed from continuously increasing to remaining constant. Using the population-based analysis, we identified that this trend change resulted in a decrease of 0.15 cases/1,000,000 population per quarter – from a predicted 0.25 cases/1,000,000 down to an actual 0.10 cases/1,000,000 (Figure 4). For NY State as a whole, that is a decrease from 19 replantation procedures down to less than 8 replantation procedures that were provided to uninsured patients annually.

DISCUSSION

Medicaid beneficiaries comprised a significantly greater proportion of the patients receiving replantation procedures after expansion of Medicaid coverage in NY in 2001. The increase of 12 cases per year provided to Medicaid beneficiaries that we calculated alongside our regression results supports the modest yet potentially impactful difference made by coverage expansion. This increase in relative and absolute rates of procedure volume occurred alongside a plateau and subsequent decline in volume of services provided to those who remained uninsured.

This result is promising, considering that previous reports have highlighted that self-pay and Medicaid patients have lower replantation rates^{4, 11, 23}, and that Medicaid beneficiaries and the uninsured face many difficulties in receiving specialty care.^{24–27} Similar results were reported by Earp et al who showed that the need to provide hand surgery care for uninsured patients at an inner city level 1 trauma center significantly declined after institution of universal coverage in Massachusetts.²⁸ However, the shift in payer status in that study may have been attributed to the private insurance coverage provided under Massachusetts' laws rather than Medicaid.^{29, 30} In New York, we identified a shift to increased utilization of replantation surgeries by Medicaid beneficiaries due to expansion in Medicaid alone.

Additionally, fewer patients who required these emergency surgical procedures were without coverage to offset the astronomical costs, and the pre-expansion trend of increasing replantation care for the uninsured leveled out and began to decline. This result highlights another proposed benefits of coverage expansion, as fewer NY hand trauma victims were without insurance at a time of catastrophe.^{31, 32} This financial benefit of Medicaid coverage has been shown to reduce the need for patients to borrow money or skip paying other bills to pay medical expenses by up to 40%.^{33, 34} Similarly, those on Medicaid are up to 80% less

likely to report unmanageable medical expenses as compared to the uninsured.³³ The results in our study indicate that hand trauma patients in NY may see similar benefits as more replantation patients were covered by Medicaid, while the number who were uninsured at time of replantation declined.

Providers and hospitals may also attain this financial benefit. Considering that replantation care is more often provided at tertiary referral centers and academic centers, the financial burden of the uninsured is disproportionately placed on these institutions.^{4, 11} This is especially true of emergent hand surgery transfers, as patients without insurance or on Medicaid are transferred significantly more frequently to urban academic centers than those with private insurance coverage.³⁵ Although Medicaid reimbursement is often lower than that of private payers, when compared to the financial challenges of caring for the uninsured with complex hand trauma, the profit margin benefit of Medicaid coverage to the hand surgeon and the institution is substantial.³⁶

This study has limitations. As with any retrospective database study, our analysis and results are dependent on accuracy of data capture. Although we used numerous approaches to validate the data, we cannot assure complete accuracy in reporting or entry. The SID does not provide adequate data on surgeon reimbursement to include cost and charge capture in our analysis, although with a trend of declining reimbursement for hand trauma management²³ this is less likely to have resulted in the increase in care delivery found in this study. Additionally, whether these patients were covered under Medicaid before the injury or were enrolled during the injury-related hospitalization cannot be clarified in this database study; however, these patients still benefitted from Medicaid coverage regardless of when they were enrolled. We also cannot determine whether the change in trend of uninsured care was due to direct transition of these patients on to Medicaid or if these were separate groups of patients, although this would not detract from the overall benefit of increased care delivery to the medically underserved.

Medicaid enrollment, and utilization of services, is not an instantaneous event.^{19, 37} The increasing trend over the 5 post-expansion years studied represents this expected delay in utilization of expanded coverage. Considering that Medicaid administration varies in each state, and provider participation in Medicaid is also variable^{38, 39}, these results may not be transferable to all expansions of Medicaid. Although the NY expansion was the largest Medicaid-only expansion in the pre-ACA era^{19, 37}, in number of eligible as well as enrolled beneficiaries, this limitation in transferability is not avoidable.

The findings in this study represent changes in a small sub-segment of surgical care in the US. What is not clear is whether these additional services for Medicaid beneficiaries occur in the same hospitals already accepting high numbers of Medicaid beneficiaries, or if additional providers and hospital systems began to accept Medicaid payments for these services. To see the effect of policy change on care delivery and cost coverage is critical to understanding ongoing policy changes, as well as predicting how these systems will continue to evolve. Should the trends identified in this study be seen in other states as Medicaid expansion occurs under the ACA, and with other acute surgical procedures that

have high rates of uninsured patients requiring care, it will be important to also understand how provider and cost-sharing burden changes across different health care systems.

Acknowledgments

Support for this work was provided (in part) by the Plastic Surgery Foundation® (to AMG). Additional support was provided by the National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health under Award Number 2K24-AR053120-06 (to KCC). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Figure 1.

Interrupted time series results showing probability of Medicaid as the primary payer for replantation surgery, before and after expansion. Intervention occurs at 15th quarter (red line).

Figure 2.

Interrupted time series results showing probability of patient being uninsured and receiving replantation surgery, before and after expansion. Intervention occurs at 15th quarter (red line).

Figure 3. Population-adjusted number of cases provided to Medicaid beneficiaries, alongside predicted trajectory of case numbers had expansion not occurred.

Figure 4. Population-adjusted number of cases provided to the uninsured, alongside predicted trajectory of case numbers had expansion not occurred.

Table 1
Description of patient-level and treating facility-level variables

Demographics (% or number) for each group are shown by payer status and by time period in the study.

	n = 5,014			
	Medicaid (n=728)		Uninsured (n=880)	
	Pre	Post	Pre	Post
N (% of total)	295 (5.9)	433 (8.6)	388 (7.7)	492 (9.8)
Age (%)				
19 – 34	54.2	58.9	59.8	59.4
35 – 49	32.9	31.4	32.5	29.1
50 – 64	13.1	9.7	7.7	11.5
Race (%)				
White	28.5	27.7	30.7	32.9
Black	24.4	28.2	21.9	22.2
Hispanic	22	20.8	11.3	18.9
Other	21	21.5	29.4	24.2
Unspecified	4.1	1.9	6.7	1.8
Sex (n)				
Male	226	344	337	450
Female	69	89	51	42
Hospital Pre-intervention Medicaid Penetration (%)[†]				
1 st quartile	1.7	--	9.3	--
2 nd quartile	10.9	--	13.4	--
3 rd quartile	32.5	--	17.3	--
4 th quartile (highest)	54.9	--	60.1	--

Pre-expansion (15 quarters)

Post-expansion (21 quarters)

[†] Observations in the post-expansion period were assigned variable values for the pre-intervention Medicaid penetration of the hospital in which they were admitted.

Variance weighted least squares regression results of interrupted time series analyses

Table 2

The coefficient for each variable indicates the effect of having Medicaid coverage (or being uninsured) on probability of receiving finger or thumb replantation from quarter to quarter, representing the trend of change in the pre and post expansion periods.

SURGERY FOR REPLANTATION OF FINGER AND/OR THUMB						
	Medicaid			Uninsured		
	Coefficient	SE	p	Coefficient	SE	p
Change at time of Medicaid expansion	0.0178	0.0213	0.40	-0.0009	0.0352	0.98
Trend prior to expansion	-0.0037	0.0020	0.06	0.0049	0.0036	0.17
Trend after expansion	0.0059	0.0023	0.01*	-0.0048	0.0041	0.24

Standard error

* significant result with $p < 0.05$