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The Impact of the 2006 Massachusetts Healthcare Reform on Spine Surgery Patient Payer-Mix and Age

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ABSTRACT

Object Several similarities exist between the Massachusetts Healthcare Reform of 2006 and the Affordable Care Act (ACA). Our prior neurosurgical research showed a decrease in uninsured surgeries without a significant change in surgical volume after the Massachusetts reform. An analysis of the payer-mix status and age of spine surgery patients, before and after the policy, should provide insight into the future impact of the ACA on spine surgery in the U.S.

Methods Using the Massachusetts State Inpatient Database and spine ICD-9 procedure codes, demographic information was obtained on patients undergoing spine surgery from 2001 to 2012. Payer-mix status was assigned as Medicare, Medicaid, Private, Uninsured or Other, which included government-funded programs and workers' compensation. A comparison of the payer-mix status and patient age, before and after the policy, was performed. New York data were used as control.

Results We analyzed 81,821 Massachusetts and 248,757 New York spine surgeries. After 2008, there was a decrease in Uninsured and Private spine surgeries, with a subsequent increase in the Medicare and Other categories for Massachusetts. Medicaid case numbers did not change. This correlated to an increase in surgeries performed on the age group 65-84, with a decrease in surgeries for those 18-44. New York showed an increase in all insurance categories and all adult age groups.

Conclusions: After the Massachusetts reform, spine surgery decreased in Private and Uninsured surgeries, with the majority of these surgeries transitioning to Medicare. Moreover, individuals who were less than age 65 did not show an increase in spine surgery, despite having greater access to health insurance. In a healthcare system that requires insurance, the decrease in Private Insurance is primarily due to an increasing elderly population. The Massachusetts model continues to show this type of policy is not causing extreme shifts in the payer-mix, and suggests that spine surgery will continue to thrive in the current U.S. healthcare system.

Key Words: Patient Protection and Affordable Care Act; Massachusetts Health Care Reform; uninsured patients; neurosurgical procedures; physician compensation; payer-mix status; spine surgery

INTRODUCTION

With the passage of the Affordable Care Act (ACA) in 2009, significant debate has developed as to the financial implications of this policy. This bill has many similarities to the Massachusetts Healthcare Reform of 2006, including subsidies for lower-income families, individual and business mandates and state-based exchanges.³ Because of these parallels, prior research has utilized Massachusetts as a predictor of the ACA's impact on the future of the U.S. healthcare system.^{5,7,10,12} Our prior analysis showed neurosurgical procedure volume or rate of volume change were relatively unchanged after the healthcare reform in Massachusetts.¹² Though no significant change in volume occurred after the policy, there was a significant decrease in uninsured surgeries for all major neurosurgical subspecialties after the reform.¹² These results showed more procedures were performed on insured individuals, and thus those who could provide reimbursement for their surgeries.¹² Despite this potential benefit to reimbursement, the complete impact of this policy remains unclear.

To better understand the financial effect of the Massachusetts Reform, it is important to appreciate the changes in the payer-mix that occurred after the policy, as well as shifts in age of the spine surgery population. Prior research in orthopedic surgery has shown minimal change in the payer-mix of joint replacement surgeries after the Massachusetts reform,⁹ but to our knowledge, this is the first study to analyze any payer-mix trends in spine surgery after the Massachusetts reform. This study uses Massachusetts as a model to better understand the future impact of the ACA on the payer-mix status and age of spine surgery patients in the U.S.

MATERIAL AND METHODS

The State Inpatient Database for Massachusetts and New York (control state) was used to obtain the payer status and age of all spine surgery patients from 2001 to 2012. This was done using the HCUPnet online service, which is a segment of the Healthcare Cost and Utilization Project (HCUP). This resource provides demographic information on all hospital discharges within each state. Prior research has utilized New York as a control, given its similar geographic location to Massachusetts, and also because it offers annual data for all years analyzed in our study.^{5,12}

The payer status options provided on the Inpatient Database are Medicare, Medicaid, Private Insurance, Uninsured or Other. The Other category included Worker's Compensation, TRICARE/CHAMPUS, CHAMPVA, Title V and Preferred Provider Organizations (PPO). The age of patients is provided in the following categories: less than 1-year old, 1-17, 18-44, 45-64, 65-84 and greater than 85 years old. Table 1 shows an all-inclusive list of ICD-9-CM procedure codes used for our spine surgery analysis. These codes have been used in prior studies analyzing trends in neurosurgery.^{8,12} Annual data on payer status and patient age from 2001 to 2012 was obtained using the following State Inpatient Database protocol: 1) specific procedures by ICD-9-CM and 2) all listed procedures.

All data was controlled for differences in population using a surgery/100,000 value. The annual population for both Massachusetts and New York was calculated using the 2000 and 2010 U.S. Census state populations (www.census.gov). From these two data points, a linear relationship was assumed to calculate the annual state population for both Massachusetts and New York from 2001 to 2012.²

For the statistical analysis, the data was divided into two groups. Group 1 consisted of surgeries during the calendar years 2001 to 2007, and group 2 were surgeries during the calendar years 2008 to 2012. To test whether there were significant differences between the two groups, an ANCOVA (analysis of covariance) was utilized to test whether there were significant differences in slopes and intercepts of the regression lines.

To test whether group 1 and group 2 had different slopes:

$$\text{Full model: } Y_{ij} = \mu + \tau I_{ij} + \gamma X_{ij} + \beta X_{ij} I_{ij} + \varepsilon_i \quad (1)$$

$$\text{Reduced model: } Y_{ij} = \mu + \tau I_{ij} + \gamma X_{ij} + \varepsilon_i \quad (2)$$

where:

μ is an overall mean;

τ is the fixed treatment effects of group 1

X_{ij} is the centered data of the j^{th} observation in group i

I_{ij} is an indicator and $I_{ij} = 1$ if X_{ij} is in group 1, otherwise, $I_{ij} = -1$.

If the coefficient of the interaction was significant ($\beta \neq 0$), there were significant differences between the slopes of the regression lines of the two groups, and thus a statistical difference between the two groups. If the coefficient of the interaction was not significant ($\beta = 0$), a difference of intercepts was then tested:

$$\text{Full model: } Y_{ij} = \mu + \tau I_{ij} + \gamma X_{ij} + \varepsilon_i \quad (3)$$

$$\text{Reduced model: } Y_{ij} = \mu + \gamma X_{ij} + \varepsilon_i \quad (4)$$

If the coefficient of the indicator was significant ($\tau \neq 0$), there were significant differences between the intercepts of the regression lines of the two groups, and thus significant differences between the two groups. Otherwise, we could not reject the null hypothesis that payer mix or age of the two groups is the same.

There was a small subset of data in which the payer mix or age was unknown. This accounted for only 0.7% of the total surgeries analyzed. A popular method when dealing with missing data is to reproduce the data use into existing patterns. This was done by increasing the weight of the responding data to us as a represent of the missing data. For Medicare, Medicaid, Private, Uninsured and Others, the adjustment percentage was:

$$\text{adjusted percentage} = \frac{\text{initial percentage}}{1 - \text{percentage of missing data}}$$

The adjusted cases/100,000 is the product of total cases and the corresponding adjusted percentage with respect to each category.

RESULTS

The demographic breakdown of all spine surgeries performed in Massachusetts and New York from 2001 to 2012 is displayed in Table 2. During the time period studied, there were 81,821 spine surgeries in Massachusetts and 248,757 in New York. The age breakdown of the Massachusetts population was: 3666 (4.49%) for 0-17, 21,769 (26.61%) for 18-44, 37,306 (45.59%) for 45-64, 18,217 (22.26%) for 65-84 and 856 (1.05%) for 85 years and older. In New York the age breakdown was: 11,181 (4.49%) for 0-17, 67,829 (27.27%) for 18-44, 116,779 (46.95%) for 45-64, 51,051 (20.52%) for 65-84 and 1909 (0.77%) for 85 years and older. From 2000 to 2010, the Massachusetts population of individuals 65 or older increased from 13.5% to 13.7%, while New York showed an increase in this same age group of 12.8% to 13.5%. In Massachusetts, 38,909 (47.55%) of spine surgery patients were male and 42,908 (52.45%) were female. While in New York, 117,100 (47.07%) were male and 131,654 (52.93%) were female. There was a small subset of data for which the age or gender was unknown. In Massachusetts, this was 11 (0.011%) and in New York, it was 11 (0.004%). The payer status was also unknown in Massachusetts for 55 (0.07%) surgeries and in New York for 0 (0%) surgeries.

Figure 1A shows the payer-mix breakdown for all spine surgeries in Massachusetts from 2001 to 2012. This shows that after 2007, there was a decrease in both Uninsured (test slope $p=0.0625$, test intercept $p=0.0095$) and Private (test slope $p=0.0003$) surgeries, with a subsequent increase in Medicare (test slope $p=0.0005$) and Other (test slope $p=0.1470$, test intercept $p=0.032$) categories. Medicaid spine surgeries remained unchanged throughout the time period studied. Figure 1B shows the payer-mix breakdown for all spine surgeries in New York from 2001 to 2012. This graph shows the relentless increase in all payer groups, including: Medicare (test slope $p=0.0062$), Medicaid (test slope $p=0.0073$), Private (test slope $p=0.0161$), Uninsured (test slope $p=0.9400$, test intercept $p=0.0445$) and Other (test slope $p=0.0002$) after 2007.

Figure 2A shows the age breakdown for all spine surgeries in Massachusetts from 2001 to 2012. There was an increase in spine surgeries performed on individuals 65-84 years

old (test slope $p < 0.0001$) and a decrease in spine surgeries on 18-44 year olds (test slope $p = 0.0004$) after 2007. The age groups 0-17, 45-64 and 85 years and older did not show a change in surgery volume after 2007. Figure 2B shows the age breakdown for spine surgeries performed in New York from 2001 to 2012. This shows an increase in spine surgeries for those between the ages of 18-44, 45-64 and 65-84 after 2007. Ages 0-17 and 85+ did not change after 2007.

DISCUSSION

Massachusetts has been extensively utilized as a model to predict the impact of the ACA on the U.S. healthcare system.^{5,7,10,12} The similarities in the policies allow for observations in a healthcare system that mandates individuals to obtain health insurance. Prior research has shown the majority of neurosurgical case volume or rate of volume change did not vary after the Massachusetts healthcare reform.¹² Despite a constant in procedure volume, uninsured surgeries decreased for all subspecialties in neurosurgery.¹² In order to better understand the effect of this policy, it is important to analyze the manner in which uninsured surgeries have transitioned to insured surgeries. As spine surgery continues to increase within neurosurgery¹², it offers an opportunity to analyze payer-mix changes within a growing subspecialty of the field. To our knowledge, this is the first study to analyze the payer-mix changes of spine surgery in Massachusetts after its healthcare reform.

The results of our study showed the transitions in the payer-mix status of spine surgery patients in Massachusetts after 2008. There was a decrease in Private Insured and Uninsured patients. This was compensated by an increase in both Medicare and the Other categories of payers. The Other category, which includes Worker's Compensation, TRICARE/CHAMPUS, CHAMPVA, Title V and Preferred Provider Organizations (PPO), accounted for only 9.4% of the surgeries performed from 2008 to 2012. Medicare surgeries, however, were 31.5% of all spine surgeries performed from 2008 to 2012, suggesting the decrease in Private Insured surgeries primarily transitioned to Medicare surgeries. This differed from the control state, New York, in that all payer categories increased from 2008 to 2012. New York Medicare surgeries accounted for only 13.1% of

all surgeries after 2008 and the Other group was 8.9%. These results suggest the primary shift from the Private and Uninsured surgery decrease was an increase in Medicare spine surgeries after the Massachusetts reform. Increases in Medicare surgeries have also been observed in orthopedic surgery, where Nwachukwu et al. found rises in both total knee and total hip replacements for Medicare patients from 2005 to 2011, nationally.¹¹ Very little research, however, has identified Medicare surgery changes within Massachusetts. In addition to understanding the payer-mix changes within Massachusetts, it is important to analyze the shifts in the age of spine surgery patients. Our data shows that spine surgeries increased only for individuals 65-84 years old in Massachusetts after the reform, thus affecting the primary age group of individuals on Medicare. This is a logical change and explains the decrease in Private Insured patients as the population aged. Our data suggests that in an insurance mandated system, the primary driver in decreased private insured spine surgeries is the aging population transitioning to Medicare.

An important component to this study is an analysis of the changes that occurred in Medicaid surgeries post policy. Our results show no significant change in Medicaid spine surgeries after the Massachusetts reform. There have been similar results reported in other specialties. Earp et al. showed no change in Medicaid orthopedic hand surgeries after the passage of the Massachusetts policy, but did demonstrate a decrease in uninsured procedures with a subsequent increase in insured surgeries.⁴ This finding is consistent with our age analysis. Medicaid is available to low-income individuals below the age of 65. Our age analysis found a decrease in surgeries for those 18-44 years old and no change on those 0-17 and 45-64 years old. Other studies have analyzed the age of surgery patients in Massachusetts. Ellimoottil et al. also showed a decrease in urological surgeries performed on those from 19-40 years old after the Massachusetts' reform.⁶ These results suggest that despite the younger generation having more access to health insurance, there has not been an increase in surgeries for the Medicaid and younger populations.

Our study has several limitations. The first of which is that spine surgery is classically more common in the aging population, making it difficult to completely understand the

effect of mandated insurance on the younger. Despite this age bias, our control state, New York, did show an increase in spine surgeries performed on younger individuals, both the 18-44 years old and 45-64 years old groups, confirming there was a true change in the age of spine surgery patients due to the policy change in Massachusetts. Another limitation to extrapolating observations in Massachusetts to the national healthcare system is that the demographics of Massachusetts differ from national averages. This is most notable in both the racial make-up of the state and the average household income. The national Caucasian average was 77.2% in the 2010 Census, compared to Massachusetts at 83.2%.¹ Moreover, both African American (8.1% vs 13.2%) and Hispanic (10.5% vs 17.1%) populations were lower in Massachusetts than national averages in the 2010 Census.¹ In addition to the racial differences seen in Massachusetts, the median income level is also higher in Massachusetts (\$66,866) compared to the national average (\$53,046).¹ These demographic differences make extrapolation of national healthcare trends difficult. Despite these differences, however, Massachusetts is the only state to utilize a healthcare system similar to the ACA, and thus provides the most similar model to observe trends in a healthcare system that mandates insurance.

Concerns regarding the financial impact of the ACA on medicine continue to dominate the national discussion. Objective data have shown that in a healthcare system which mandates insurance, surgical procedures continue to show positive outcomes. Prior research supports increases in inpatient procedures for lower and medium-income populations, decreases in racial disparities for minimally invasive surgeries, and no significant change in case volume for neurosurgical procedures.^{5,10,12} This study has added to the ongoing analysis of the Massachusetts healthcare reform. Within spine surgery, the primary shift of the payer-mix can be explained by the aging population transitioning from Private Insurance and Uninsured to Medicare. Further research is needed to understand the impact of the ACA on procedure reimbursement rates. A decrease in Uninsured surgeries with a subsequent increase in Medicare has a theoretical increase in reimbursement. A counter to this is the decrease in Private insurance of the aging population. It is unclear whether the increase in Medicare surgeries will financially compensate for the decrease in Privately insured spine surgeries.

Conclusion

Using Massachusetts as a model for the ACA, this study has established the primary shift in the payer-mix of spine surgery patients is the aging population transitioning to Medicare. This change is expected given an increasing elderly population and is not a direct effect of mandated health insurance. This analysis continues to support the conclusion that a healthcare system which requires insurance does not have significant negative impacts on access to healthcare or reimbursements to physicians.

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Figure Legends

Fig. 1. Payer-mix breakdown of all spine surgeries in Massachusetts (**A**) and New York (**B**) from 2001 to 2012.

Fig. 2. Age breakdown for all spine surgeries in Massachusetts (A) and New York (B) from 2001 to 2012.