Effect of Insurance Expansion on Utilization of Inpatient Surgery

Chandy Ellimoottil, MD; Sarah Miller, PhD; John Z. Ayanian, MD, MPP; David C. Miller, MD, MPH

IMPORTANCE Enhanced access to preventive and primary care services is a primary focus of the Affordable Care Act, but the potential effect of this law on surgical care is not well defined.

OBJECTIVE To estimate the differential effect of insurance expansion on utilization of discretionary vs nondiscretionary inpatient surgery with Massachusetts health care reform as a natural experimental condition.

DESIGN, SETTING, AND PARTICIPANTS We used the state inpatient databases from Massachusetts and 2 control states (New Jersey and New York) to identify nonelderly adult patients (aged 19-64 years) who underwent discretionary vs nondiscretionary surgical procedures from January 1, 2003, through December 31, 2010. We defined discretionary surgery as elective, preference-sensitive procedures (eg, joint replacement and back surgery) and nondiscretionary surgery as imperative and potentially life-saving procedures (eg, cancer surgery and hip fracture repair).

EXPOSURE All surgical procedures in the study and control populations.

MAIN OUTCOMES AND MEASURES Using July 1, 2007, as the transition point between the prereform and postreform periods, we performed a difference-in-differences analysis to estimate the effect of insurance expansion on rates of discretionary and nondiscretionary surgical procedures in the entire study population and for subgroups defined by race, income, and insurance status. We then extrapolated our results from Massachusetts to the entire US population.

RESULTS We identified a total of 836 311 surgical procedures during the study period. Insurance expansion was associated with a 9.3% increase in the use of discretionary surgery in Massachusetts (P = .02). Conversely, the rate of nondiscretionary surgery decreased by 4.5% (P = .009). We found similar effects for discretionary surgery in all subgroups, with the greatest increase observed for nonwhite participants (19.9% [P < .001]). Based on the findings in Massachusetts, we estimated that full implementation of national insurance expansion would yield an additional 465 934 discretionary surgical procedures by 2017.

CONCLUSIONS AND RELEVANCE Insurance expansion in Massachusetts was associated with increased rates of discretionary surgery and a concurrent decrease in rates of nondiscretionary surgery. If similar changes are seen nationally under the Affordable Care Act, the value of insurance expansion for surgical care may depend on the relative balance between increased expenditures and potential health benefits of greater access to elective inpatient procedures.

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Although much of the enthusiasm for the ACA revolves around providing patients with previously inaccessible preventive and primary care services, the effect of this reform on complex and expensive hospital-based care, including inpatient surgery, remains undefined. For instance, owing to a large unmet need, insurance expansion might yield greater utilization of surgery across the board. An alternative scenario is that rates of surgery will change mainly for certain procedures and patient populations. In support of the latter hypothesis, existing data suggest that access to imperative surgical procedures like hip fracture repair and colectomy for cancer may not be affected by insurance status.7,8 Conversely, decisions about the use of other, more discretionary, procedures (eg, joint replacement and back surgery) may be strongly influenced by insurance coverage,7-13 and utilization of such surgical procedures could change most prominently among populations who are at the highest risk for being currently uninsured.14,15

Previous investigators have used the outcomes of health care reform in Massachusetts to forecast the ACA’s effect on racial disparities with inpatient surgery.14,15 Herein, we build on this work by examining the effect of the Massachusetts insurance expansion on the use of discretionary vs nondiscretionary surgical procedures. We specifically compare the pre-reform and post-reform rates of discretionary and nondiscretionary surgical procedures in Massachusetts with the rates for 2 control states where no similar reform was implemented. In addition, we assess whether the impact of insurance expansion varies across subgroups that differed in their baseline (ie, prereform) risk for being uninsured.14,15

Our primary data sets were the State Inpatient Databases for Massachusetts and 2 Northeastern control states (New York and New Jersey).16 We selected New Jersey and New York as controls because both states (1) are in close geographic proximity to Massachusetts; (2) had a steady rate of nonelderly uninsured persons during the study period17; and (3) had data available in the State Inpatient Databases before and after implementation of health care reform in Massachusetts. In addition to the State Inpatient Databases, we used US Census data to account for population growth during the study interval and to obtain county-level measures of insurance status and household income.17-19 Because we used publicly available data, this study was deemed exempt from review by the University of Michigan institutional review board.

Methods

Data Sources

Our study population included all nonelderly adult patients (aged 19-64 years) who underwent selected surgical procedures from January 1, 2003, through December 31, 2010. We excluded patients who did not reside in Massachusetts or the control states.

As a comparison group, we also identified a set of nondiscretionary inpatient surgical procedures. We defined these as imperative surgical procedures that address an immediately threatening diagnosis (eg, cancer or acute appendicitis). A priori, we specifically classified major surgical procedures for cancer,22 appendicitis, and hip fracture repair as nondiscretionary procedures (eTable 1 in the Supplement). In addition to clinical judgment, our selection of these procedures was based on existing literature, suggesting that they have relatively lower levels of preference and insurance sensitivity.7-9,23-25 We hypothesized that, compared with discretionary procedures, rates of nondiscretionary surgical procedures will be affected less by insurance expansion. Ultimately, our analysis included 5 discretionary and 9 nondiscretionary surgical procedures (eTable 1 in the Supplement).

Our outcome of interest was the rates of discretionary and nondiscretionary inpatient surgical procedures in Massachusetts and the control states. For this analysis, we defined discretionary procedures as inpatient surgical procedures with high levels of preference sensitivity, potential medical management alternatives, and a large degree of geographic variation.7-9 We hypothesized that the rate of these procedures will increase with insurance expansion. Based on this framework, we decided a priori to include knee replacement, hip replacement, transurethral resection of the prostate, back surgery, and inguinal hernia repair as discretionary surgical procedures. We removed all patients undergoing emergent surgery from the discretionary group.

In our first analytic step, we compared the characteristics of patients who underwent surgery in Massachusetts vs the control states from 2003 through 2010. Next, we calculated the mean (unadjusted) rates of discretionary and nondiscretionary surgery in Massachusetts and the control states before and after July 1, 2007.

We then performed a difference-in-differences (DID) analysis to estimate the effect of health care reform on rates of discretionary vs nondiscretionary surgery. Difference-in-differences analysis is a widely used empirical strategy to study the effects of policy changes.14,15,26-29 In the present study, we compared the difference in the prereform and postreform rates of surgical procedures.
of surgery in Massachusetts with the difference in the prereform and postreform rates of surgery in the 2 control states where no reform occurred (ie, we compared the DID between Massachusetts and the control states). This analytic technique allows us to adjust for secular trends (changes in time that are not due to the policy change) by removing the observed change in surgery rates in the comparison states. For example, the recent use of laparoscopic surgery is driven by factors unrelated to legislative policy change. If we simply compared the rate of laparoscopic surgery in Massachusetts before and after the reform without accounting for this national trend, we would overstate the effect of the reform. We implemented the DID analysis by fitting separate ordinary least square regression models for discretionary and nondiscretionary procedures. The dependent variable for each model was the total number of surgical procedures in each state per quarter per 10,000 individuals. We included variables specifying the state where the surgery was performed and reform status (ie, whether the surgery was performed before or after July 1, 2007). Our models also included an interaction term for the state and reform status variables. The coefficient on this interaction term represents the DID estimator. If significant and positive, the coefficient represents an increase in the mean rate of surgery after reform compared with the control states. Finally, we included an unemployment variable in the models to account for the 5% rise in unemployment from 2006 through 2009 (a result of economic recession), and we adjusted for seasonal differences in rates of surgery.

Subgroup Analysis
Because the implications of insurance expansion may vary across patient populations, we decided a priori to perform separate analyses for the following patient subgroups: (1) non-Hispanic white; (2) nonwhite; (3) low income; and (4) newly insured. The nonwhite category included black patients and those of Hispanic origin. Using county-level data as a proxy, we defined low-income patients as those living in the tercile of counties in Massachusetts with the lowest median income. We also specified a subgroup of patients with the greatest likelihood of being newly insured after the implementation of health care reform. This group included patients living in the 5 Massachusetts counties with the greatest number of individuals gaining insurance from 2006 through 2008. After defining these subgroups, we applied the DID framework described above to compare rates of discretionary and nondiscretionary surgical procedures.

Sensitivity Analyses
We performed sensitivity analyses to examine the robustness of our findings to several key assumptions. First, we excluded patients who had surgery during the reform implementation period before our transition point (ie, from January 1, 2006, through June 30, 2007). This step removed from the analysis newly insured patients who had surgery after parts of the reform were enacted, but before our transition point (July 1, 2007). Including such patients may attenuate the effects of reform. Second, we repeated our analysis after excluding patients who were aged 19 to 64 years and covered by Medicare (eg, were disabled or had end-stage renal disease) because these individuals should have not experienced a substantive change in their insurance status during the reform period. Third, we performed the DID analysis for each of the individual surgical procedures constituting the discretionary and nondiscretionary groups to assess whether changes in the rates of single procedures might be driving our overall results. Fourth, we excluded inguinal hernia repair from our discretionary surgery group because utilization of this procedure declined from 2003 through 2010, reflecting the secular trend of shifting these procedures to the ambulatory setting. Finally, using 2003 as the reference year, we fit models that estimated the change in surgery rates in Massachusetts relative to the comparison states in each year as if reform occurred in that year (ie, a placebo analysis). We expected that no change would occur in the rate of surgery for 2004, 2005, or 2006 (ie, “placebo” years before the reform) relative to 2003. All analyses were performed using computerized software (STATA, SE, version 13; StataCorp), and at the 5% significance level.

Calculation of National Estimates for Inpatient Surgical Procedures
To arrive at national estimates for the effect of insurance expansion on the utilization of inpatient surgery, we first determined the number of new procedures performed in Massachusetts. Assuming that these new procedures were due to insurance gains, we calculated the percentage of newly insured individuals who underwent surgery. We then used a recent Congressional Budget Office estimate of the number of individuals who will be newly insured through national insurance expansion (25 million by 2017) to yield corresponding estimates for the entire US population.

Results
We identified a total of 836,311 nonelderly patients who underwent surgery (22.2% in Massachusetts, 54.8% in New York, and 22.9% in New Jersey) from January 1, 2003, through December 31, 2010. Table 1 presents the prereform and postreform characteristics of patients from Massachusetts and the control states. Although the percentage of surgical patients receiving free care in Massachusetts declined from 3.3% to 1.4% after reform, no similar change was observed in the control states. During the entire study interval, the percentage of patients in Massachusetts receiving free care for nondiscretionary surgery exceeded that for discretionary surgery (eFigure in the Supplement).

In Massachusetts, the unadjusted mean rate of discretionary surgery increased by 9.7% from the prereform (35.8 cases/y per 10,000 individuals) to the postreform (39.2 cases/y per 10,000 individuals) periods (Table 2). In contrast, the mean rate of discretionary surgery in the control states increased by only 0.5%. The mean rate of nondiscretionary surgery decreased slightly by 2.6% in Massachusetts after reform and increased slightly by 1.8% in the control states (Table 2). The DID analysis demonstrated that insurance expansion was associated with a 9.3% net increase in the rate of discretionary surgery (P = .02).
and a 4.5% net decrease in the rate of nondiscretionary surgery ($P = .009$) in Massachusetts (Figure 1 and eTable 2 in the Supplement).

### Subgroup Analyses

For each subgroup, we observed an increase in the unadjusted mean rates of discretionary procedures in Massachusetts vs the control states; concurrently, rates of nondiscretionary surgery remained stable or decreased during the same period (Table 2). Based on the DID analysis, the effect of insurance expansion was greatest for the nonwhite population, for whom health care reform was associated with a 19.9% increase in the rate of discretionary surgery ($P < .001$) (Figure 2 and eTable 2 in the Supplement). Although variable in magnitude, insurance expansion yielded analogous increases in discretionary surgery for all other subgroups of interest (Figure 2 and eTable 2 in the Supplement). Our sensitivity analyses revealed no substantive changes in the principal findings (Table 3 and eTables 3-6 in the Supplement). When we analyzed procedures individually, utilization increased for all discretionary procedures.

### Table 1. Demographics of Patients Undergoing Surgery Before and After Massachusetts Health Care Reform

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>% of Patients</th>
<th>Massachusetts Before Reform</th>
<th>Massachusetts After Reform</th>
<th>Control States Before Reform</th>
<th>Control States After Reform</th>
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</thead>
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<tr>
<td>Surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Discretionary</td>
<td></td>
<td>65.4</td>
<td>69.1</td>
<td>60.8</td>
<td>62.6</td>
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<tr>
<td>Nondiscretionary</td>
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<td>34.6</td>
<td>30.9</td>
<td>39.2</td>
<td>37.4</td>
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<td>Age, y</td>
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<td></td>
<td></td>
<td></td>
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<td>19-40</td>
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<td>23.8</td>
<td>20.3</td>
<td>26.9</td>
<td>24.5</td>
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<td>41-64</td>
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<td>76.1</td>
<td>79.7</td>
<td>73.1</td>
<td>75.5</td>
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<td>Female sex</td>
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<td>51.4</td>
<td>50.4</td>
<td>51.5</td>
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<tr>
<td>Race</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>White</td>
<td></td>
<td>87.4</td>
<td>85.9</td>
<td>72.3</td>
<td>69.7</td>
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<td>Black</td>
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<td>4.3</td>
<td>5.0</td>
<td>10.2</td>
<td>10.6</td>
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<td>Hispanic</td>
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<td>4.8</td>
<td>6.0</td>
<td>10.1</td>
<td>11.2</td>
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<tr>
<td>Other</td>
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<td>3.5</td>
<td>3.1</td>
<td>7.4</td>
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<tr>
<td>Payer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medicare</td>
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<td>7.5</td>
<td>9.1</td>
<td>6.7</td>
<td>7.6</td>
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<tr>
<td>Medicaid</td>
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<td>9.8</td>
<td>8.5</td>
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<td>72.1</td>
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<td>Self-pay</td>
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<td>0.7</td>
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<td>5.8</td>
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<td>Free care</td>
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<td>3.3</td>
<td>1.4</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>4.5</td>
<td>7.0</td>
<td>8.6</td>
<td>8.8</td>
</tr>
</tbody>
</table>

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**Table 2. Annual Rates of Discretionary and Nondiscretionary Surgical Procedures Before and After Massachusetts Health Care Reform**

<table>
<thead>
<tr>
<th>Population Characteristic</th>
<th>Rate, % of Patients</th>
<th>Discretionary Procedures Before Reform</th>
<th>Discretionary Procedures After Reform</th>
<th>Nondiscretionary Procedures Before Reform</th>
<th>Nondiscretionary Procedures After Reform</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
<td>35.8</td>
<td>39.2</td>
<td>18.5</td>
<td>18.0</td>
</tr>
<tr>
<td>All</td>
<td></td>
<td>28.9</td>
<td>29.0</td>
<td>18.3</td>
<td>18.7</td>
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<tr>
<td>White</td>
<td></td>
<td>35.9</td>
<td>40.4</td>
<td>16.7</td>
<td>16.6</td>
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<tr>
<td>White</td>
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<td>27.2</td>
<td>28.0</td>
<td>14.6</td>
<td>14.8</td>
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<td>Nonwhite</td>
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<td>17.5</td>
<td>21.7</td>
<td>15.2</td>
<td>17.0</td>
</tr>
<tr>
<td>Nonwhite</td>
<td></td>
<td>14.6</td>
<td>15.3</td>
<td>13.6</td>
<td>14.8</td>
</tr>
<tr>
<td>Low income&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>35.9</td>
<td>39.2</td>
<td>22.8</td>
<td>21.8</td>
</tr>
<tr>
<td>Low income&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td>22.8</td>
<td>23.8</td>
<td>16.6</td>
<td>17.0</td>
</tr>
<tr>
<td>Newly insured&lt;sup&gt;d&lt;/sup&gt;</td>
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<td>32.5</td>
<td>36.0</td>
<td>18.5</td>
<td>17.5</td>
</tr>
<tr>
<td>Newly insured&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td>28.9</td>
<td>29.0</td>
<td>18.3</td>
<td>18.7</td>
</tr>
</tbody>
</table>

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<sup>a</sup> The reform transition point is defined as July 1, 2007.  
<sup>b</sup> Includes New York and New Jersey.  
<sup>c</sup> Includes worker’s compensation, Health Safety Net, other government payment, other nonmanaged care plans, and CommCare (a free or subsidized health care insurance program).  
<sup>d</sup> Indicates patients residing in Massachusetts counties with high numbers of individuals gaining insurance from 2006 through 2008.
Insurance expansion in Massachusetts led to greater use of discretionary inpatient surgical procedures. Not surprisingly, this effect was greatest for populations at highest risk for being uninsured in Massachusetts before reform. By translating the Massachusetts experience to the national level, we estimated that insurance expansion will result in almost half a million new procedures performed by 2017 (eTable 7 in the Supplement).

Discussion

Insurance expansion in Massachusetts led to greater use of discretionary inpatient surgical procedures. Not surprisingly, this effect was greatest for populations at highest risk for being uninsured in Massachusetts before reform. By translating the Massachusetts experience to the national level, we estimated that insurance expansion will result in almost half a million new discretionary surgical procedures (ie, knee and hip replacements, back surgery, inguinal hernia repair, and transurethral resection of the prostate) by 2017.

Previous investigators have demonstrated convincingly that health care utilization rates rise when previously uninsured patients acquire health insurance. The present study clarifies this broader relationship by demonstrating that, for inpatient surgical care, the effect of policies aimed at increasing coverage is not uniform. Instead, patients in need of imperative or nondiscretionary inpatient surgery appear to get this care whether or not they have insurance. In contrast, insurance expansion is an important driver of utilization rates for the relatively large population of patients who are potential candidates for discretionary or elective procedures. Once coverage is available, many of these move forward with surgical treatment. Similar findings have been observed in patients newly eligible for the Medicare program.

We also observed lower rates of nondiscretionary surgery in Massachusetts relative to control states after health care reform. This change was most apparent for patients from counties with high rates of low-income and newly insured individuals. Several potential explanations exist. First, better access to primary and specialty care in Massachusetts might have contributed to some reduction in the need for nondiscretionary surgery (eg, increased use of colonoscopy may have led to lower rates of surgically treated cancer). However, the time needed to see such a change is likely longer than our study period. Second, although insurance expansion did not appear to crowd out access to hospitalization for Medicare beneficiaries, this effect may be significant for surgical procedures, particularly if greater use of elective surgical procedures competes for finite hospital resources.
appendectomy, the observed reduction in postreform rates may indicate that insured patients are presenting early and surgeons are able to perform uncomplicated procedures that do not require an inpatient stay.21,25-29 Ultimately, a better understanding of these issues will be needed to clarify the relationship between insurance expansion and nondiscretionary surgical care.

For discretionary procedures, our finding that the nonwhite population was most strongly affected by insurance expansion is also consistent with findings reported by other investigators.14,15,40 Taken together, these data suggest that insurance expansion may achieve an intended consequence of attenuating racial disparities in access to care, at least for certain inpatient surgical procedures. However, whether greater access to such procedures will ultimately close existing gaps between white and nonwhite populations with respect to overall health status remains unclear.

Our study has several limitations. First, no standard definition exists for discretionary and nondiscretionary surgery. Thus, although we classified procedures a priori based on the existing literature and clinical experience, we cannot know with certainty whether any single procedure was truly discretionary or not. Second, because we looked only at utilization of surgical procedures, we do not know whether insurance expansion affected other factors such as the timing or the quality of surgery.6,34 Third, our analysis did not include outpatient surgical procedures. Accordingly, we could not examine trends in the utilization of cataract surgery, cystoscopy, gastrointestinal tract endoscopy, and other procedures for which utilization may be particularly sensitive to changes in insurance status or the supply of health care professionals.6,44 Fourth, because our outcome variable was a state-level rate, we did not adjust for patient-level variables in our regression models. Nonetheless, although we found some baseline differences in age, race, and payer mix between patients in the control states and Massachusetts, at the state level these demographic differences were stable at over time and therefore unlikely to affect our estimates. Finally, some inherent limitations of using the Massachusetts experience to predict the effect of the ACA must be acknowledged. For example, health care reform in Massachusetts was not a discrete event, and steps toward improving access occurred as early as 1985 when a free care pool was established to cover hospital services for low-income patients who lacked health insurance. At the time of the reform, Massachusetts had low baseline rates of uninsured population and a strong safety-net foundation of well-established community health centers. Because of these early reforms, the effect of insurance expansion on the rate of nondiscretionary surgery in Massachusetts may be less pronounced than what would be expected in states with fewer existing provisions for uninsured patients. Nonetheless, the Massachusetts experience is the most reasonable natural experiment of broad insurance expansion and has been used widely to forecast effects of the ACA.21,27-29,31,45-46

These limitations notwithstanding, our findings may help many stakeholders anticipate the effects of national insurance expansion through the ACA. Relevant to policy makers and payers, our results suggest that expected long-term cost savings from national insurance expansion may be dampened to some extent by the increased use of certain expensive inpatient elective surgical procedures.6,34 To this point, health care spending in Massachusetts has grown substantially in the last 5 years.45-49 From a policy perspective, the value of such expenditures will depend on whether, and to what extent, greater access to such procedures actually improves quality and/or quantity of life for newly insured individuals.

Our findings are also relevant to physicians and specialty societies because they suggest that some surgical disciplines (eg, orthopedic surgery) could experience a rapid growth in demand with implementation of the ACA. This growth could have important implications for postgraduate training programs and for patients seeking access to such care, particularly in areas with fewer surgical specialists.50,51 Finally, for patients who currently lack coverage, insurance expansion offers the promise of secondary improvements in overall health status and qual-

<table>
<thead>
<tr>
<th>Surgical Procedure</th>
<th>Total No.</th>
<th>Prereform Rate</th>
<th>Coefficient</th>
<th>P Value</th>
<th>Net Change, %</th>
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<td>Appendectomy</td>
<td>54,833</td>
<td>2.90</td>
<td>-0.18</td>
<td>.001</td>
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<td>0.36</td>
<td>-0.01</td>
<td>.67</td>
<td>-2</td>
</tr>
<tr>
<td>Nephrectomy</td>
<td>114,137</td>
<td>0.26</td>
<td>0.02</td>
<td>.29</td>
<td>6</td>
</tr>
<tr>
<td>Inguinal hernia repair</td>
<td>4,410</td>
<td>0.12</td>
<td>0.05</td>
<td>.03</td>
<td>38</td>
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<tr>
<td>Nondiscretionary</td>
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<td>0.05</td>
<td>.03</td>
<td>38</td>
</tr>
</tbody>
</table>

*Indicates results of difference-in-differences (DID) analysis performed on each individual surgical procedure.

†Indicates the number of procedures performed in Massachusetts from 2003 through 2010.

‡Indicates procedures performed for malignant disease.
ity of life through access to procedures that treat debilitating conditions such as severe osteoarthritis.52 However, as seen in Massachusetts, if payers ultimately experience greater expenditures as a consequence of covering more elective inpatient surgical procedures, then all patients may ultimately face higher premiums.53

Conclusions

Our collective findings suggest that insurance expansion leads to greater utilization of discretionary inpatient procedures that are often performed to improve quality of life rather than to address immediately life-threatening conditions. Moving forward, research in this area should focus on whether greater utilization of such procedures represents a response to unmet need or changes in treatment thresholds driven by patients, providers, or some combination of the two. In addition, investigators should examine and define the individual and societal-level returns (eg, better health outcomes, increased productivity, and reduced rates of disability) achieved with such surgical interventions. In the end, the value of insurance expansion for surgical care may depend on the relative balance between increased expenditures and the measurable health benefits derived from greater access to elective inpatient surgery.

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