ORIGINAL CONTRIBUTION

Massachusetts Healthcare Reform and Trends in Emergent Colon Resection

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BACKGROUND: Insurance impacts access to therapeutic options, yet little is known about how healthcare reform might change the pattern of surgical admissions.

OBJECTIVE: We compared rates of emergent admissions and outcomes after colectomy before and after reform in Massachusetts with a nationwide control group.

DESIGN: This study is a retrospective cohort analysis in a natural experiment. *Prereform* was defined as hospital discharge from 2002 through the second quarter of 2006 and *postreform* from the third quarter of 2006 through 2012. Categorical variables were compared by χ^2. Piecewise functions were used to test the effect of healthcare reform on the rate of emergent surgeries.

SETTINGS: The study included acute care hospitals in the Massachusetts Healthcare Cost and Utilization Project State Inpatient Database (2002–2012) and the Nationwide Inpatient Sample (2002–2011).

PATIENTS: Patients aged 18 to 64 years with public or no insurance who underwent inpatient colectomy (via *International Classification of Diseases, Ninth Revision, Clinical Modification* procedural code) were included and patients with Medicare were excluded.

INTERVENTION: Massachusetts health care reform was the study intervention.

MAIN OUTCOME MEASURES: We measured the rate of emergent colectomy, complications, and mortality.

RESULTS: The unadjusted rate of emergent colectomies was lower in Massachusetts after reform but did not change nationally over the same time period. For emergent surgeries in Massachusetts, a piecewise model with an inflection point (peak) in the third quarter of 2006, coinciding with implementation of healthcare reform in Massachusetts, had a lower mean squared error than a linear model. In comparison, the national rate of emergent surgeries demonstrated no change in pattern. Postreform, length of stay decreased by 1 day in Massachusetts; however, there were no significant improvements in other outcomes.

LIMITATIONS: The study was limited by its retrospective design and unadjusted analysis.

CONCLUSIONS: There was a unique and sustained decline in the rate of emergent colon resection among publically insured and uninsured patients after 2006 in Massachusetts, in contradistinction to the national pattern, suggesting improved access to care associated with health insurance expansion. The reasons for lack of improvement in outcomes are multifactorial.

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KEY WORDS: Colectomy; Healthcare reform; Health insurance.

Emergency surgery is costly and results in inferior outcomes for patients.[1] Potential interventions to reduce the use of emergency surgery include improved access to primary care and targeted screening programs.[2]

There is a growing body of evidence showing that improved insurance coverage enhances the use of primary care services, increases contact with providers, and improves self-reported health.[3,4] With the goal of providing near-universal coverage, Massachusetts enacted comprehensive healthcare reform in 2006 based on 3 core tenets: the expansion of public coverage, the universal mandate, and the creation of health insurance exchanges for subsidized and nonsubsidized private insurance.[5,6] The majority of the 400,000 previously uninsured Massachusetts residents obtained coverage via publicly funded programs such as Commonwealth Care and Medicaid.[7]

A link between healthcare reform in Massachusetts and the pattern of emergent operations has not been demonstrated. In a natural experiment, we compared the rates of emergent admissions for colectomy among uninsured patients and those with Medicaid before and after Massachusetts healthcare reform versus nationwide. We hypothesized that rates of emergent admissions would decrease in Massachusetts after healthcare reform.

PATIENTS AND METHODS

Design

This is a retrospective review of inpatient discharge data from Massachusetts compared with a nationwide sample of comparable states. Urgency of colon resection and associated outcomes were compared before and after Massachusetts healthcare reform and between the same time periods nationwide. The pattern of emergent resection rate over time was then compared between Massachusetts (where reform occurred) and the nationwide sample (control group). Each admission in which a colectomy occurred was treated as a separate episode, even if performed on the same patient. Admissions coded as "emergency" or "urgent" cases were collectively referred to as *emergent* in this analysis; the rate of emergent colectomies equals the proportion of emergent/urgent colectomies divided by the total number of colectomies.

Population

Patients 18 to 64 years of age with public or no insurance who had an inpatient colectomy were identified in the Massachusetts State Inpatient Database from 2002 to 2012 compared with the Nationwide Inpatient Sample from 2002 to 2011, both all-payer administrative databases developed by the Healthcare Cost and Utilization Project and the Agency for Healthcare Research and Quality. The Massachusetts State Inpatient Database captures 97% of community inpatient hospital discharges within the state, whereas the Nationwide Inpatient Sample (NIS) provides a 20% sample of discharges from short-term, nonfederal hospitals nationally.[8] Patients with missing elective status (none in Massachusetts and 20,031 in NIS) or with any diagnosis of trauma denoted by *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM codes 800–897 (234 in Massachusetts and 9728 in NIS)) were excluded. Only the 29 states (excluding Massachusetts) that were originally part of the NIS in 2002 and that continued to contribute data for the subsequent 9 years were included so as not to artificially inflate the number of operations performed over time. Public insurance included Medicaid, Health Safety Net, and Commonwealth Care but is referred to collectively as Medicaid. Self-pay, no charge, and free care were categorized as uninsured. Patients with Medicare were not included in this analysis.

Procedures and Indications

Inpatient colectomies were queried via ICD-9-CM procedure codes, including right resection (45.72 and 45.73), transverse (45.74), left resection (45.75), sigmoidectomy (45.76), total colectomy (45.8, 45.81, 45.82, and 45.83), abdominoperineal resection (48.5, 48.50, 48.51, 48.52, and 48.59), low anterior resection (48.62 and 48.63), other colectomy (45.71, 45.79, 48.69, 48.64, 48.65, and 48.61), laparoscopic right resection (17.33 and 17.32), laparoscopic left resection (17.35), other laparoscopic resection (17.39 and 17.31), laparoscopic transverse (17.34), and laparoscopic sigmoid resection (17.36). Indications for colectomy were divided into neoplasm (benign and malignant colonic neoplasms or family history), inflammatory disease (IBD or diverticular disease), ischemia/infection, and other. Overlap between indication categories was permitted, because patients can present with multiple indications for a colectomy.

Outcomes

Outcomes of interest were morbidity and mortality during the index hospitalization for colectomy. Ostomy creation, length of stay, rates of postoperative complications (deep vein thrombosis or pulmonary embolism, abdominal complications, infection, or sepsis), discharge with services, and inpatient death were examined. ICD-9-CM codes for outcomes can be found in Appendix 1.

Statistical Analysis

Categorical variables were compared by χ^2 and continuous variables via Wilcoxon rank-sum. Cochran–Armitage trend tests were used to assess for linear trends over time in dichotomous variables. P values of <0.05 were considered significant. Rates of nonelective colectomies were plotted by quarter, and smoothing parameters were used to approximate trends and estimate a natural division in

the data if appropriate. The optimal smoothing parameter value, which minimized the Akaike information criterion, was generated and selected to fit the data by PROC LOESS.[9] Piecewise regression was used to model trends in rates of nonelective colectomy before and after reform. Healthcare reform in Massachusetts was enacted in the second quarter of 2006 (quarter No. 18), so the division between the piecewise functions was placed here, although we also examined the slope of a regression line starting in the second quarter of 2007 (quarter No. 22) to allow time for the changes associated with reform to occur. SAS 9.4 (SAS Institute, Cary, NC) was used for all of the analyses.

Analyses of the NIS were performed using SAS survey procedures to adjust for the complex sample design, and data were weighted to reflect national estimates. The TRENDWT weighting scheme provided by the Healthcare Cost and Utilization Project was used to allow for comparison with future NIS studies. Weighted proportions are presented throughout for NIS analyses.

RESULTS

There were 5962 admissions for colectomy in Massachusetts compared with 163,412 admissions in NIS. In Massachusetts, the number of uninsured decreased, whereas the number of Medicaid discharge records increased ($p < 0.0001$), as shown in Fig. 1C. Nationwide, numbers of admissions for the uninsured and those on Medicaid both increased ($p < 0.0001$), but the ratio of uninsured:Medicaid admissions remained fairly stable (Figs. 1B and D). A similar ratio of uninsured is seen in Massachusetts before reform (Fig. 1A, before 2006). In both Massachusetts and the NIS, the number of emergent colectomies increased, as did the overall number of colectomies performed (both $p < 0.0001$; Fig. 2). However, whereas in Massachusetts there was a significant reduction in the rate of emergent colectomies from 51.8% to 46.1% prereform versus postreform, the rate remained stable nationwide at 58% to 59%. The same trend is seen among colectomies originally coded as purely emergency admissions (representing 69% and 75% of the current emergent cohorts in Massachusetts and the NIS).

In Massachusetts, the populations with the greatest absolute reduction in the rate of emergent colectomy (Fig. 3) were men (–6.3; $p = 0.0008$), white individuals (–6.3; $p = 0.0001$), patients with 1 comorbidity (–10.9; $p < 0.0001$), and patients aged 60 to 64 years (–9.6; $p = 0.003$). Reductions in rates of emergent colectomy were also seen in patients with a neoplasm ($p = 0.02$) and inflammatory disease ($p = 0.0005$) but not for those with ischemia/infection ($p = 0.34$) or other indication ($p = 0.05$). Significant (albeit smaller) decreases in emer-

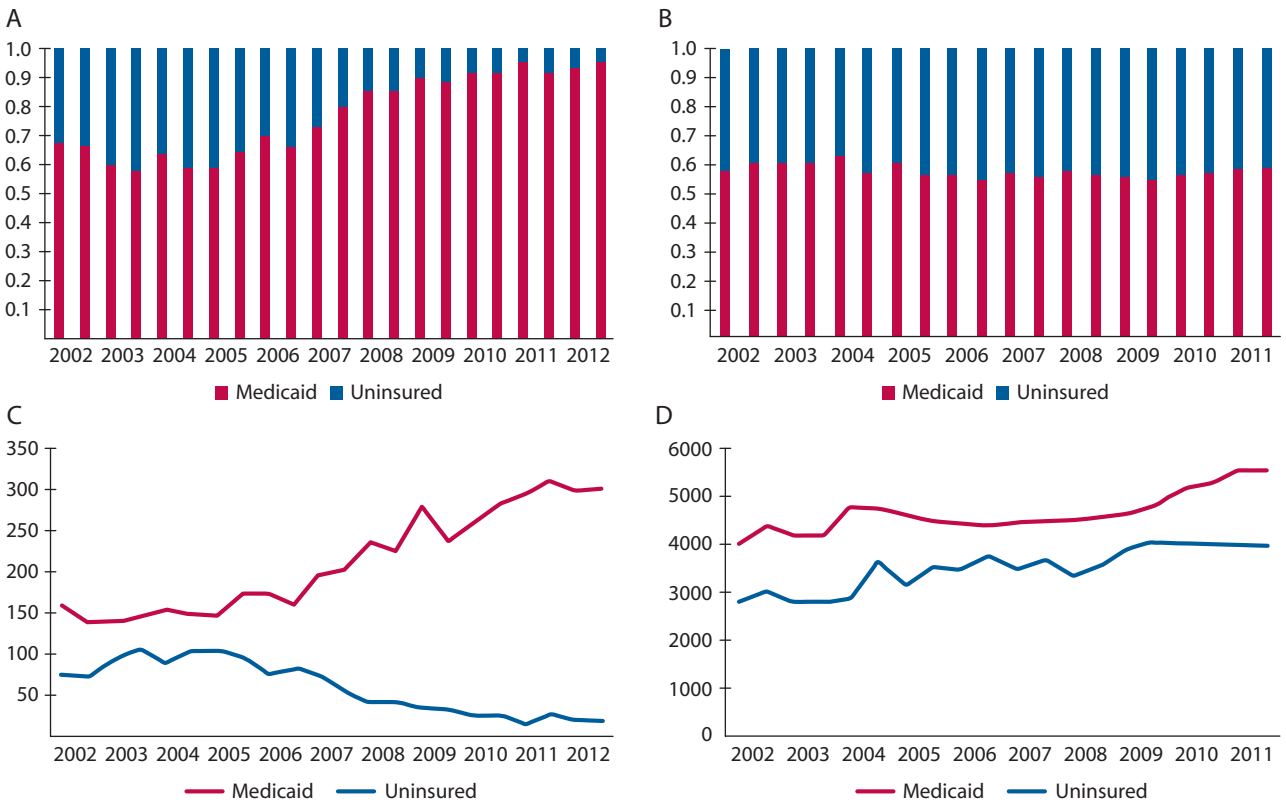

FIGURE 1. Changes in the underinsured population plotted by 6-mo period for Massachusetts (A and C) the Nationwide Inpatient Sample (B and D). The proportion of Medicaid and uninsured patients of the total population are portrayed in the top panels, whereas the raw numbers for each are presented in the bottom panels.

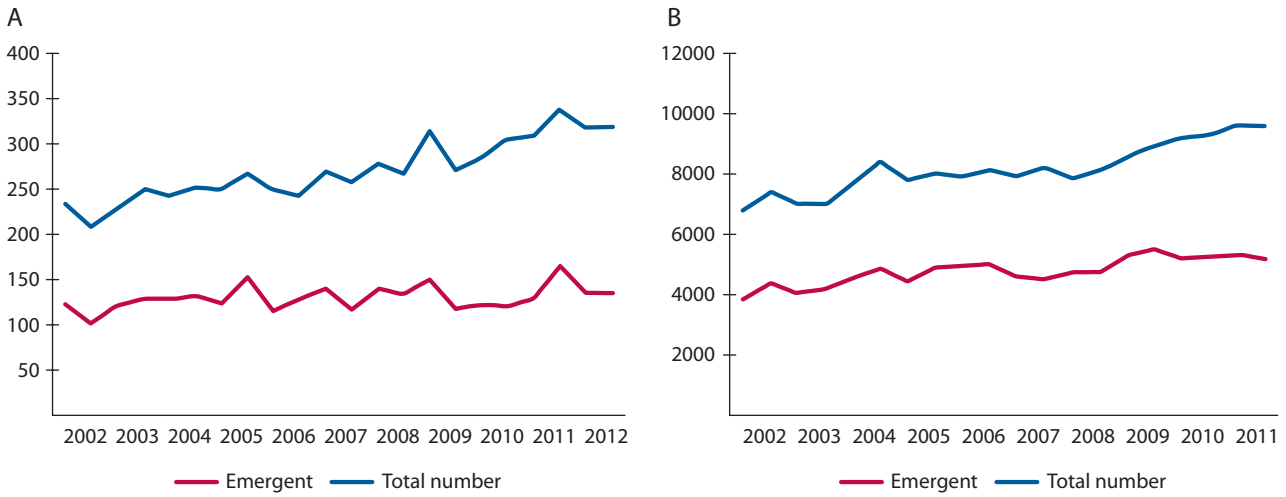

FIGURE 2. Number of colectomies over time in (A) Massachusetts and (B) Nationwide Inpatient Sample.

gent colectomy rates were observed within women ($p = 0.01$), nonwhite individuals ($p = 0.03$), patients with no comorbidities ($p = 0.02$), patients with multiple comorbidities ($p = 0.003$), and patients between 40 and 59 years old ($p = 0.02$). The only demographic groups exhibiting no significant decrease in rate were patients with

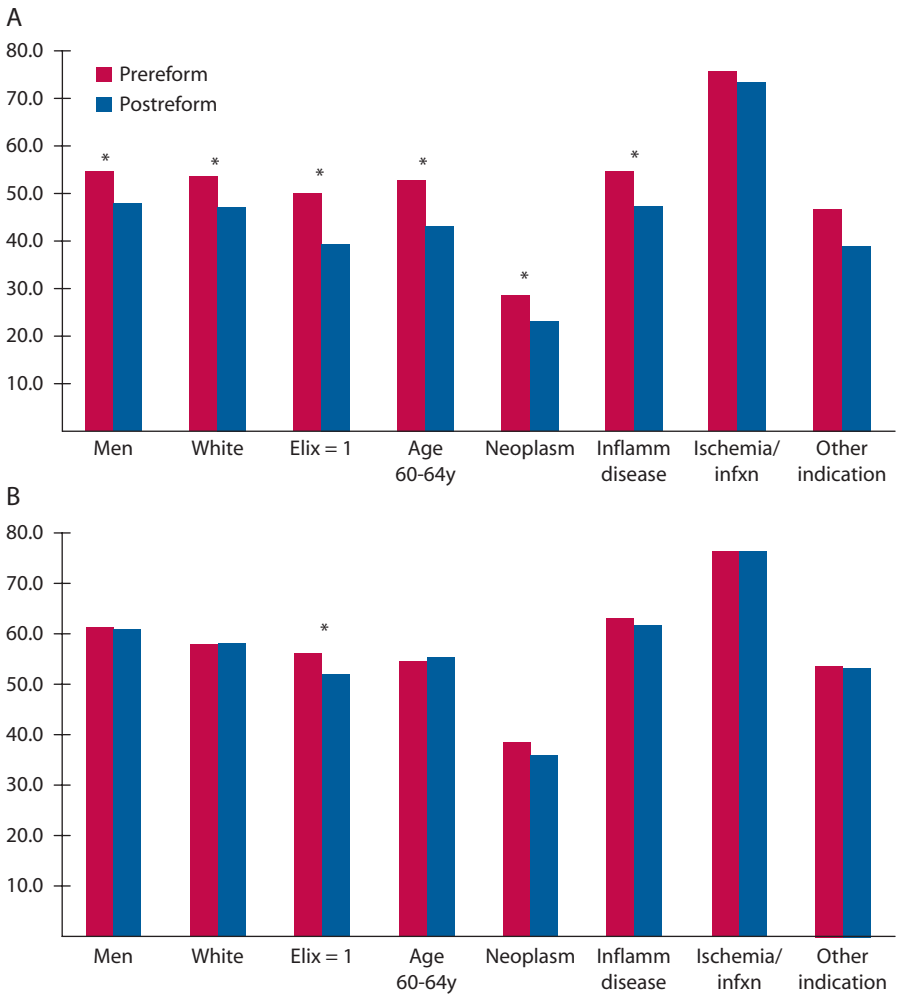

FIGURE 3. Rates of emergent colectomy within demographic groups and indications prereform and postreform in (A) Massachusetts and (B) Nationwide Inpatient Sample. *$P < 0.05$. Elix = Elixhauser; Inflamm = inflammatory; infxn = infection.

TABLE 1. Patient characteristics prereform and postreform in Massachusetts versus the Nationwide Inpatient Sample

	Massachusetts					*Nationwide Inpatient Sample*				
	Prereform (N = 2184)		*Postreform (N = 3778)*			*Before Massachusetts reform (N = 68,065)*		*After Massachusetts reform (N = 95,347)*		
Variable	*n*	*%*	*n*	*%*	*p*	*n*	*%*	*n*	*%*	*p*
Sex					0.37					0.048
Men	1137	52.1	1921	50.8		33,645	49.4	48,199	50.6	
Women	1047	47.9	1857	49.2		34,420	50.6	47,148	49.4	
Age, y					0.0003					<0.0001
<45	774	35.4	1172	31.0		24,273	35.7	31,246	32.8	
45–59	1020	46.7	1958	51.8		31,378	46.1	47,495	49.8	
60–64	390	17.9	648	17.2		12,413	18.2	16,607	17.4	
Race					0.26					<0.0001
Non-Hispanic white	1467	67.2	2580	68.3		27,238	40.0	44,032	46.2	
Nonwhite	675	30.9	1108	29.3		18,895	27.8	31,412	32.9	
Unknown	42	1.9	90	2.4		21,932	32.2	19,904	20.9	
Insurance					<0.0001					0.02
Medicaid	1370	62.7	3289	87.1		39,926	58.7	53,494	56.1	
Uninsured	814	37.3	489	12.9		28,139	41.3	41,853	43.9	
Elixhauser score					<0.0001					<0.0001
0	805	36.9	970	25.7		22,087	32.5	20,794	21.8	
1	582	26.6	1023	27.1		18,112	26.6	22,724	23.8	
≥2	797	36.5	1785	47.2		27,866	40.9	51,829	54.4	
Indication[a]					0.19					0.03
Neoplasm	565	25.9	995	26.3		18,770	27.6	25,027	26.2	
Inflammatory	898	41.1	1584	41.9		23,354	34.3	34,321	36.0	
Ischemia/infection	481	22.0	850	22.5		18,560	27.3	25,902	27.2	
Other	240	11.0	349	9.2		7381	10.8	10,098	10.6	
Elective status					<0.0001					0.31
Urgent/emergent	1131	51.8	1742	46.1		40,231	59.1	55,438	58.1	
Elective	1053	48.2	2036	53.9		27,834	40.9	39,910	41.9	

[a]Overlap was possible.

other or missing race ($p = 0.80$) and patients under the age of 45 years ($p = 0.05$). In contrast, in the NIS, the only significant decreases in emergent colectomy rates were seen within the nonwhite population ($p = 0.004$) and patients with 1 comorbidity ($p = 0.003$) or multiple comorbidities ($p = 0.04$).

As shown in Table 1, there was no change in the sex of patients receiving colectomies before and after reform in Massachusetts ($p = 0.37$) compared with a greater proportion of men in NIS ($p = 0.048$). In the postreform era in both Massachusetts and the NIS, colectomies were less likely to have been performed on the youngest age group ($p = 0.0003$ and $p < 0.0001$) but more likely to have been performed on individuals with more comorbidities (both $p < 0.0001$). Rates of Medicaid increased in Massachusetts ($p < 0.0001$) and decreased in NIS ($p = 0.02$). Although no change was observed in Massachusetts for the category of indication for colectomy ($p = 0.19$), colectomies were performed at a decreased rate for cancer nationwide after 2006 ($p = 0.03$).

A scatterplot with a smoothing function depicting the rate of emergent colectomy is shown in Figure 4A. For Massachusetts, the mean squared error for a piecewise regression model with a division at the second quarter of 2006 was 0.00165, which is lower than that of a simple linear model (0.00169). Although the slope of the prereform function is –0.00068468, the slope postreform is steeper at –0.00398, depicting a more rapid decrease in emergent colectomies after reform in Massachusetts (Fig. 5). Similarly, when assuming the postreform function begins at the second quarter of 2007, the slope remains negative (–0.00263), also depicting a decline in the rate. In contrast, the scatterplot of emergent colectomy nationwide follows no observable pattern (Fig. 4B).

For both Massachusetts and the NIS, emergent colectomies were associated with a 3- to 4-fold increase in the rates of ostomy formation, a difference in 4 days for median length of stay and higher rates of complications, need for services after discharge, and inpatient mortality (Table 2).

Prereform versus postreform in Massachusetts, there was a decrease in the length of stay by a median of 1 day ($p < 0.0001$) and an increase in intra-abdominal complications ($p = 0.003$) but no significant differences for other outcomes (Table 3). Nationwide, there were higher rates of intra-abdominal complications ($p < 0.0001$) and infection/sepsis ($p < 0.0001$), as well as increased discharge with services ($p = 0.007$). However, there was a significant

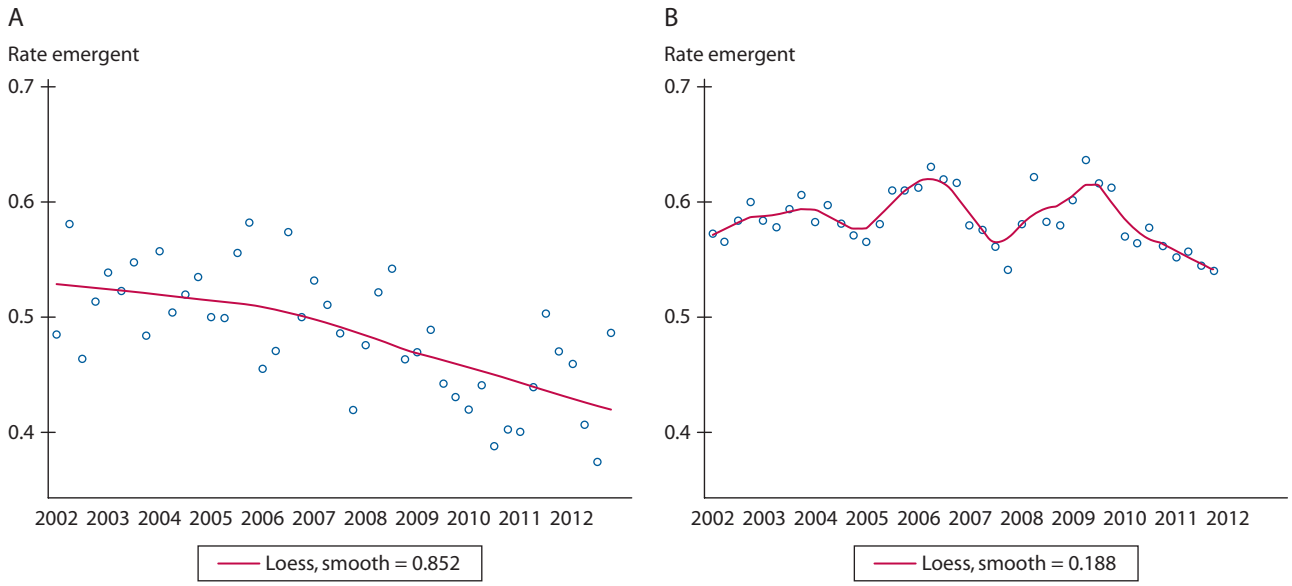

FIGURE 4. Trends in rate of emergent colon resection in (A) Massachusetts (2002–2013) and (B) Nationwide Inpatient Sample (2002–2011) depicted as scatterplots with smoothing functions. Each data point represents a quarter.

decrease nationwide in overall mortality from 3.3% to 2.9% ($p = 0.04$).

DISCUSSION

In a population enriched with patients on Medicaid after healthcare reform in Massachusetts, there was a decrease in the rate of emergent inpatient colon resections that was not seen nationwide. Although decreases were seen across virtually all demographic groups, the largest absolute declines were observed among patients who were men, aged 60 to 64 years, of white race, and those with 1 comorbidity. No significant decrease was seen in patients under 45 years of age. Emergent surgery was associated with significantly higher rates of ostomy creation, need for services after discharge, and rates of morbidity and in-hospital mortality, as well as longer length of stay. However, other than a shorter length of stay, the increase in coverage in Massachusetts was not associated with improved outcomes after surgery.

Previous studies have shown numerous benefits to expanding public coverage. The first is in access to definitive surgical management for vulnerable populations. Healthcare reform in Massachusetts has been associated

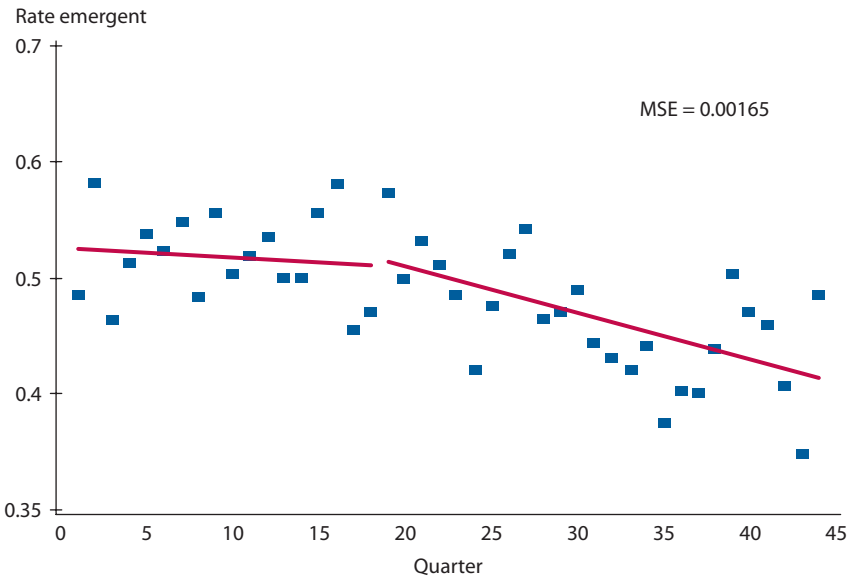

FIGURE 5. Piecewise analysis of rate of emergent colon resection in Massachusetts before and after reform with division at second quarter of 2006 (quarter No. 18). MSE = mean squared error.

TABLE 2. Outcomes for elective versus nonelective colectomy in Massachusetts and the Nationwide Inpatient Sample

Variable	*Emergent*	*Elective*	*p*
Massachusetts			
Number	2873	3089	
Rate of ostomy, n (%)	1091 (38.0)	267 (8.6)	<0.0001
Median length of stay, d	10 (7–16)	6 (4–8)	<0.0001
Inpatient postoperation complications, n (%)			
DVT/PE	74 (2.6)	17 (0.6)	<0.0001
Abdominal complication	769 (26.8)	548 (17.7)	<0.0001
Infection/sepsis	947 (33.0)	534 (17.3)	<0.0001
Discharge with services, n (%)[a]	1262 (43.9)	913 (29.6)	<0.0001
Inpatient death, n (%)[a]	117 (4.1)	13 (0.4)	<0.0001
Nationwide Inpatient Sample			
Number	95,668	67,744	
Rate of ostomy	33,172 (34.7)	8056 (11.9)	<0.0001
Median length of stay, d	10 (7–16)	6 (5–9)	<0.0001
Inpatient postoperation complications			
DVT/PE	2475 (2.6)	766 (1.1)	<0.0001
Abdominal complication	22,712 (23.7)	11,599 (17.1)	<0.0001
Infection/sepsis	28,479 (29.8)	10,614 (15.7)	<0.0001
Discharge with services[b]	28,074 (29.3)	1085 (19.3)	<0.0001
Inpatient death[b]	4364 (4.6)	634 (0.9)	<0.0001

DVT = deep vein thrombosis; PE = pulmonary embolism.
[a]Less than 3% are missing.
[b]Less than 4% are missing.

with reduced racial disparities in the receipt of minimally invasive surgery and upfront cholecystectomy, as well as an increased likelihood of pancreatic cancer resection for government-subsidized and self-pay patients.[10–12] Declines in inpatient length of stay and admission through the emergency department have also been observed.[13] Lack of insurance contributes to increased risk of appendiceal and aneurysmal rupture, and patients who gain public insurance are less likely to have advanced symptomatology of surgical disease.[14–16] However, there is a paucity of research about their use of emergency surgery. In addition to the frailty that accompanies pathophysiological deterioration, emergent surgery can be particularly hazardous in the colorectal population because of the risks of gross contamination associated with the manipulation of a distended and unprepared bowel.[17,18] Studies have shown

TABLE 3. Outcomes before and after Massachusetts reform in Massachusetts and the Nationwide Inpatient Sample

Variable	*Prereform*	*Postreform*	*p*
Massachusetts			
Number	2184	3778	
Rate of ostomy, n (%)	513 (23.5)	845 (22.4)	0.32
Median length of stay, d	8 (5–12)	7 (5–11)	<0.0001
Inpatient postoperation complications, n (%)			
DVT/PE	34 (1.6)	57 (1.5)	0.88
Abdominal complication	436 (20.0)	881 (23.3)	0.003
Infection/sepsis	520 (23.8)	961 (25.4)	0.16
Discharge with services, n (%)[a]	806 (38.1)	1369 (37.3)	0.57
Inpatient death, n (%)[a]	56 (2.6)	74 (2.0)	0.13
Nationwide Inpatient Sample			
Number	68,065	95,347	
Rate of ostomy, n (%)	16,915 (24.9)	24,313 (25.5)	0.24
Median length of stay, d	8 (6–13)	8 (6–13)	0.30
Inpatient postoperation complications, n (%)			
DVT/PE	1308 (1.9)	1934 (2.0)	0.47
Abdominal complication	13,214 (19.4)	21,097 (22.1)	<0.0001
Infection/sepsis	14,605 (21.5)	24,488 (25.7)	<0.0001
Discharge with services, n (%)[b]	16,183 (23.8)	24,976 (26.2)	0.007
Inpatient death, n (%)[b]	2237 (3.3)	2762 (2.9)	0.04

DVT = deep vein thrombosis; PE = pulmonary embolism.
[a]Less than 3% are missing.
[b]Less than 4% are missing.

substantial variation in adjusted rates of emergency colon surgery across the United States, suggesting room for improvement.[19]

To our knowledge, this is the first study examining patterns in emergency surgery of the colon associated with healthcare reform in Massachusetts. We demonstrate that, in the population of underinsured patients receiving inpatient colectomy for any indication in Massachusetts, rates of Medicaid coverage increased. Associated with this increase in insurance coverage was a decline in the rate of emergency surgery. However, this did not translate into a statistically significant improvement in outcomes, including the need for an ostomy, postoperative complications, discharge services, or inpatient mortality. This lack of improvement in outcomes in Massachusetts is likely attributed to a shortage of power in the smaller Massachusetts population, although it can also be related to a rise in patient comorbidities, the difficulty level of the operations attempted, or heterogeneity in the indications and procedures. However, Massachusetts did achieve a 1-day lower median length of stay postreform (in contrast to the NIS) and an absolute drop of 0.4% in an already low mortality rate. Overall, the literature is notoriously mixed regarding outcomes after the expansion of Medicaid.[20–22] Moreover, previous studies suggest that the underinsured as a whole are at high risk for postoperative complications, a finding only partially explained by acuity of presentation and likely related to other factors such as health literacy and socioeconomic status, issues that are unaffected by healthcare reform.[23–25]

There are various explanations for the decline in rates of emergent surgery seen in Massachusetts after reform. One likely possibility is an increase in rates of screening/colonoscopy leading to early detection of colonic disease among a newly insured population.[26,27] Another related explanation is an increase in preemptive management or preventative care facilitated by contact with a primary care provider. These possibilities are substantiated by the significant declines in the rates of emergent surgery among Massachusetts patients with neoplasms or inflammatory diseases, which are amenable to preventative care, but not with ischemia/infection, which are inherently emergent indications. It is important to note that, in both Massachusetts and nationwide, the number of elective surgeries and emergent surgeries performed increased over time, a finding corroborated in the state of Washington for diverticulitis.[28] However, in Massachusetts, the number of elective surgeries increased more rapidly than the emergent ones, resulting in a decrease in the rate of emergency surgery. It is unknown whether these elective surgeries were previously performed emergently before reform or whether they are new cases that never would have been performed before. If the latter is true, it is uncertain whether these new operations are in fact indicated or a manifestation of overuse (the woodwork effect).[29] Future studies that characterize measures of appropriateness will be helpful for the interpretation of these results.

This study has several limitations. First, this is an unadjusted analysis of trends. Massachusetts is a distinctive state both in terms of demographics and medical environment (provider and hospital density). We attempted to provide an analogous control group by comparing with multiple states that vary in geography and diversity. As in all large database studies that rely on ICD-9-CM codes, there is the potential for undercoding or miscoding, and the appropriateness of a given procedure cannot be ascertained. In both the Massachusetts State Inpatient Database and the NIS, patients who had more than 1 colon resection could be represented more than once in the data sets because we are unable to determine admissions for unique patients. In addition, ≈10% of the cohort from the NIS was missing elective status and was thereby excluded from the analysis; these patients were more likely to be nonwhite, to have Medicaid, and to have a colectomy for ischemia or infection but were otherwise similar to our cohort and consistently missing over time. Our analysis did not include a washout period after the passage of the legislation, which theoretically would allow rates of insurance to stabilize. Yet, in addition to testing the division of the piecewise function at the introduction of healthcare reform, we also examined the slope in the rate of emergent colectomy starting 1 year later. Finally, this study does not account for changes in practice, such as the rising use of endoscopic stents instead of surgery for advanced colon cancer. However, these secular trends are likely universal and should not differ appreciably between Massachusetts and the nation. There could be other unexplained reasons for the decline in the rate of emergent colectomy in Massachusetts.

Although previous studies have focused on surgical use, this is the first study to address the timing of surgery in patients receiving colon resection over the course of healthcare reform in Massachusetts. In an analysis of nonelderly patients residing in counties with high numbers of newly insured in Massachusetts, Ellimoottil et al[30] found a decrease in overall rates of nondiscretionary surgery (made up of both elective and emergent cases) in Massachusetts relative to control states but could not comment on the timing of those surgeries. In addition to providing an unmoving picture of rates of emergency surgery before and after reform, we depict a dynamic analysis of trends via a novel method. We also highlight regional variation in the demographics, indications, and outcomes of patients receiving surgery of the colon. We observed a surprisingly high rate of emergent surgery in this study, which is partly attributable to the combination of operations performed on both an emergent and urgent basis, but could also be a reflection of the overall burden of emergent surgery among the underinsured. Ultimately, this study provides

a reassuring view of access to surgical specialist care for underinsured patients after healthcare reform: patients in Massachusetts were less likely to receive emergent surgery compared with their national counterparts and compared with the prereform era. These decreases in rates of emergent surgery were seen among virtually all of the demographic groups.

In this study, we saw an increased uptake of Medicaid and a corresponding increase in the rate of elective surgery that overtakes the rise in emergent surgery in Massachusetts postreform. This decline in the rate of emergent colon resection was not seen in the rest of the United States, suggesting improved access to care among the underinsured after healthcare reform.

As state Medicaid expansions are actively debated across the country, these results have important implications for both policymakers and clinicians. Although the explanations for the phenomena that we observed are variable, this hypothesis-generating study suggests that health insurance may have the capacity to influence the timing of surgical care and that the benefits are experienced within almost all demographic strata. Our results, which may also be applicable to other general surgery procedures, can be corroborated by prospective studies that examine patterns in admissions for underinsured patients. Expanding coverage among vulnerable populations is not the only solution to disparities in access but may be an important first step in eliminating barriers to high-quality health care for all people.

APPENDIX 1.

Complication	*ICD-9-CM code*
Ostomy	46.10, 46.11, 46.13, 46.20, 46.21, 46.22, 46.23
DVT/PE	451.1, 451.11, 451.19, 451.2, 451.81, 453.4, 453.40, 453.41, 453.42, 453.8, 453.9, 415.x
Abdominal complication	569.7, 569.5, 998.6, 997.4, 569.81, 569.60, 569.69, 569.62
Infection/sepsis	998.00, 998.0, 998.01, 998.02, 998.59, 998.51, 569.61, 590.10, 590.11, 590.80, 519.2, 590.1, 599.0, 683, 320, 510, 513, 480, 481, 482, 483, 485, 486, 484, 008, 009, 569.5

DVT = deep vein thrombosis; PE = pulmonary embolism; ICD-9-CM = *International Classification of Diseases, Ninth Revision, Clinical Modification.*

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