

## Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

**eTable 1. Diagnostic and procedure codes used to identify surgical procedures**

	<i>ICD-9-CM</i> Procedure code	<i>ICD-9-CM</i> Diagnosis code (if applicable)	Reference (if applicable)
<b><i>Discretionary</i></b>			
<b>Knee replacement</b>	81.54, 81.55	N/A	Birkmeyer et al <sup>1</sup>
<b>Inguinal hernia repair</b>	53.0, 53.1, 53.17	N/A	N/A
<b>Transurethral resection prostate</b>	60.2, 60.29	N/A	N/A
<b>Hip replacement</b>	79.10, 79.15, 79.30, 79.35, 78.55, 81.51, 81.52	(Excluding) 820, 820.3, 820.31, 820.32, 820.8 820.9	Birkmeyer et al <sup>1</sup>
<b>Back surgery</b>	03.0, 03.1, 03.2, 03.21, 03.4 03.5, 80.5, 80.50,81.0, 03.01-03.09, 80.50 - 80.59, 81.00- 81.08	N/A	Birkmeyer et al <sup>1</sup>
<b><i>Nondiscretionary</i></b>			
<b>Hip fracture repair</b>	79.10, 79.15, 79.30, 79.35, 78.55, 81.51, 81.52	820, 820.3, 820.31, 820.32, 820.8 820.9	Birkmeyer et al <sup>1</sup>
<b>Appendectomy</b>	47.0, 47.01, 47.09	N/A	Livingston and Fairlie <sup>3</sup>
<b>Radical cystectomy</b>	57.71	88, 1880-1889	Begg et al <sup>2</sup>
<b>Esophagectomy</b>	424, 424.0, 424.1, 424.2	150, 150.0-150.9	Begg et al <sup>2</sup>
<b>NephrectomyPartial Nephrectomy</b>	554 , 555, 555.1, 555.2	189, 189.0, 189.1, 189.8, 189.9	Begg et al <sup>2</sup>
<b>Pancreatectom<sup>v</sup></b>	526, 527, 525.1, 525.2, 525.3, 524.9	157, 1570-1579	Begg et al <sup>2</sup>
<b>Colectomy</b>	457, 458, 485, 486, 4571-4583, 4861-4869	153, 154, 1530-1539, 1540-1548	Begg et al <sup>2</sup>
<b>Lung surgery</b>	32, 322-325, 3220-3259	162, 1620-1629	Begg et al <sup>2</sup>
<b>Uterine surgery</b>	683, 689, 6830-6879	182, 1820-1828	N/A

**eTable 2. Net change in the rates of discretionary and nondiscretionary surgery resulting from Massachusetts health care reform**

	All			White			Non-white		
	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change
<b>Discretionary</b>	0.83	.02	9.30%	0.95	.003	10.60%	0.87	<.001	19.90%
<b>Nondiscretionary</b>	-0.21	.01	-4.50%	-0.09	.14	-2.20%	0.15	.4	3.90%
	Low income			Newly insured					
	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change			
<b>Discretionary</b>	0.6	.004	6.70%	0.86	.02	10.60%			
<b>Nondiscretionary</b>	-0.36	<.001	-6.30%	-0.32	<.001	-6.90%			

Results of the multivariable difference-in-differences (DID) analysis showing change in rates of discretionary and non-discretionary surgery in Massachusetts compared to control states. Reform transition point is defined as July 2007. Coefficient refers to the DID estimator and % change refers to coefficient divided by pre-reform rate. Low income refers to patients residing in Massachusetts counties with low median income. Newly insured refers to patients residing in Massachusetts counties with high numbers of individuals gaining insurance from 2006-2008.

**eTable 3. Net change in rates of discretionary and nondiscretionary surgery: sensitivity analysis with entire reform period removed**

	All			White			Non-white		
	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change
<b>Discretionary</b>	0.91	.02	10%	0.93	.005	10%	0.78	<.001	18%
<b>Nondiscretionary</b>	-0.19	.03	-4%	-0.17	.01	-4%	-0.07	.71	-2%
	Low income			Newly insured					
	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change			
<b>Discretionary</b>	0.74	.001	8%	1.05	.006	13%			
<b>Nondiscretionary</b>	-0.41	<.001	-7%	-0.34	.001	-6%			

Results of the multivariable difference-in-differences (DID) analysis showing change in rates of discretionary and non-discretionary surgery in Massachusetts compared to control states. In this sensitivity analysis, we removed the entire reform period from January 2006 through June 2007. Coefficient refers to the DID estimator and % change refers to coefficient divided by pre-reform rate. Low income refers to patients residing in Massachusetts counties with low median income. Newly insured refers to patients residing in Massachusetts counties with high numbers of individuals gaining insurance from 2006-2008.

**eTable 4. Net change in rates of discretionary and nondiscretionary surgery: sensitivity analysis with nonelderly Medicare patients removed**

	<b>All</b>			<b>White</b>			<b>Non-white</b>		
	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change
<b>Discretionary</b>	0.67	.03	8.3%	0.80	.004	9.8%	0.65	.001	17.8%
<b>Nondiscretionary</b>	-0.23	.002	-5.1%	-0.12	.07	-3.0%	0.13	.43	3.6%
	<b>Low income</b>			<b>Newly insured</b>					
	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change			
<b>Discretionary</b>	0.36	.05	4.6%	0.72	.02	9.7%			
<b>Nondiscretionary</b>	-0.39	<.001	-7.3%	-0.33	<.001	-7.5%			

Results of the multivariable difference-in-differences (DID) analysis showing change in rates of discretionary and non-discretionary surgery in Massachusetts compared to control states. In this sensitivity analysis, we removed all non-elderly patients who were still covered by Medicare. Reform transition point is defined as July 2007. Coefficient refers to the DID estimator and % change refers to coefficient/pre-reform rate. Low income refers to patients residing in Massachusetts counties with low median income. Newly insured refers to patients residing in Massachusetts counties with high numbers of individuals gaining insurance from 2006-2008.

**eTable 5. Net change in rate of discretionary surgery: sensitivity analysis with inguinal hernia repair removed**

	All			White			Non-white		
	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change
<b>Discretionary, no IHR</b>	0.77	.03	8.7%	0.92	.006	10.4%	0.82	<.001	19.1%
	Low income			Newly insured					
	Coefficient	<i>P</i> value	% Change	Coefficient	<i>P</i> value	% Change			
<b>Discretionary, no IHR</b>	0.54	.008	6.1%	0.81	.03	10.1%			

Results of the multivariable difference-in-differences (DID) analysis showing change in rates of discretionary in Massachusetts compared to control states. In this sensitivity analysis, we removed inguinal hernia repair (IHR). From 2003-2010, there was a decline in the absolute number of inpatient surgeries performed, likely representing a secular shift towards the use of the outpatient setting for this procedure. Reform transition point is defined as July 2007. Coefficient refers to the DID estimator and % change refers to coefficient/pre-reform rate. Low income refers to patients residing in Massachusetts counties with low median income. Newly insured refers to patients residing in Massachusetts counties with high numbers of individuals gaining insurance from 2006-2008.

**eTable 6. Net change in rates of discretionary and nondiscretionary surgery in each year from 2004-2010**

	Discretionary		Non-discretionary	
	Coefficient	<i>P</i> value	Coefficient	<i>P</i> value
<b>July 2004</b>	-0.17	.81	0.19	.32
<b>July 2005</b>	-0.20	.78	0.10	.60
<b>July 2006</b>	-0.18	.80	-0.02	.94
<b>July 2007</b>	0.13	.85	-0.11	.59
<b>July 2008</b>	0.65	.37	-0.14	.49
<b>July 2009</b>	0.85	.24	0.04	.83
<b>July 2010</b>	0.91	.21	-0.12	.54

Results of the multivariable difference-in-differences (DID) analysis showing change in rates of discretionary and non-discretionary surgery in Massachusetts compared to control states. For this sensitivity analysis, we performed a DID analysis for each individual year regardless of reform status (placebo analysis). Using 2003 as the reference year, we estimated the change in surgery rates in Massachusetts relative to the control states for each year.

**eTable 7. Estimated number of additional discretionary procedures with national insurance expansion**

<b>No. of newly insured (%)</b>	<b>Estimated No. of additional discretionary surgical procedures</b>
25,000,000 (100)	465,934
18,750,000 (75)	349,451
12,500,000 (50)	232,967
6,250,000 (25)	116,484
2,500,000 (10)	46,493
1,250,000 (5)	23,297
250,000 (1)	4,659

Number of newly insured is based on Congressional Budget Office (CBO) estimates. Estimated number of additional discretionary surgeries is based on increase in discretionary surgeries observed in Massachusetts after insurance expansion. To arrive at national estimates we first calculated the number of additional discretionary procedures that were performed in Massachusetts using the coefficient from our difference-in-differences (DID) analysis (eTable 2).

$$\begin{aligned} & ((\text{DID coefficient}) \times (4 \text{ quarters})) / 10,000 = \text{number of new procedures per person (NPP)} \\ & (0.83 \times 4) / 10,000 = 0.000332 \end{aligned}$$

We then multiplied the NPP by the total population of Massachusetts to arrive at the total number of new procedures.

$$\begin{aligned} & \text{NPP} \times \text{population of MA} = \text{number of procedures (NP)} \\ & 0.000332 \times 6,634,906 = 2,203 \end{aligned}$$

We then used the Census Small Area Insurance Estimates to identify the number of individuals who gained insurance from 2006 to 2008 (n=118,192). We made the assumption that 100% of the additional procedures were due to newly insured individuals (i.e., no change in rate of surgery for those who already had insurance). Using this assumption, we calculated the percentage of newly insured patients who received a discretionary surgery.

$$\begin{aligned} & \text{NP/number of newly insured} = \% \text{ of newly insured patients undergoing discretionary surgery} \\ & 2,203/118,192 = 1.86\% \end{aligned}$$

We used this figure and the CBO estimate of number of individuals who will gain insurance if the insurance expansion provisions are fully implemented to arrive at our national estimates.

**eFigure. Percentage of patients in Massachusetts who obtained free care for discretionary and nondiscretionary surgery, 2003-2010**

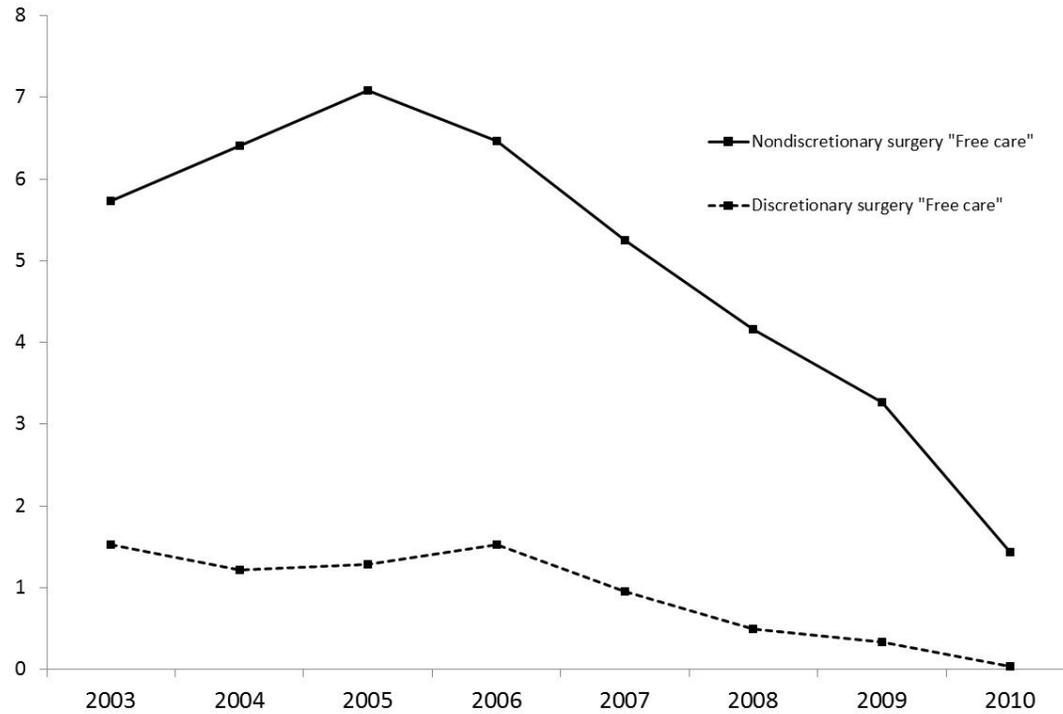


Figure shows the percent of patients in Massachusetts who underwent discretionary and non-discretionary surgery whose primary payer was listed as “no charge” in the Massachusetts State Inpatient Database.

## eReferences.

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2. Begg CB, Cramer LD, Hoskins WJ, Brennan MF. Impact of hospital volume on operative mortality for major cancer surgery. *JAMA*. 1998;280(20):1747–51.
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