California HealthCare Foundation

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Elective Heart Procedures in California:
A Close-Up of Geographic Variation

GEOGRAPHIC VARIATION SERIES. This Close-Up is part of a comprehensive set of reports that examine the rates at which certain procedures are delivered in different communities across the state. These procedures may be considered elective. They include cardiac procedures, carotid endarterectomy, hip and knee replacement, cancer and spinal procedures, hysterectomy, childbirth procedures, and gallbladder surgery. A research summary, "All Over the Map: Elective Procedure Rates in California Vary Widely," provides additional information on regional variation and a complete methodology for the study.[1]

Based on patients' place of residence, the data are from 2005 through 2012, and have been divided into two time periods for purposes of comparison over time. Rates can vary widely, even in contiguous communities. The data account for age, sex, income, education, insurance status, and race. The data are adjusted at the Zip code level for rates of AMI (heart attack) hospitalization and rates of hospitalizations in which the patient had a diabetes diagnosis.

Close-Up

Coronary artery disease is the most common form of heart disease, afflicting about 4% of the population. A common symptom is angina, or pain or pressure in the chest, arms, shoulder, or jaw. Coronary artery disease can also cause a heart attack if blood flow to part of the heart muscle becomes completely blocked. Patients whose angina is stable and predictable, and who have not had a heart attack within the past six weeks, have several diagnostic and treatment options. These procedures may be life-saving for patients in the midst of a heart attack or acute coronary syndrome. For patients who have heart disease but are not acutely ill, the decision about which diagnosis or treatment path to follow should be shared between the clinician and a fully informed patient.

Elective diagnostic tests and treatment choices included in this study:

- Coronary angiography is a diagnostic x-ray examination of the blood vessels or chambers of the heart. A catheter is threaded through an artery in a patient's leg or arm to the coronary arteries (the blood vessels that supply the heart muscle) and a special fluid injected. This fluid is visible by x-ray.
- Angioplasty — sometimes referred to as percutaneous coronary intervention or PCI — involves inserting a catheter into an artery in the arm or leg and threading it into a coronary artery. A balloon in the catheter is inflated to compress the plaque, or fatty buildup, against the blood vessel wall. A stent — a metal mesh tube that is threaded up the catheter and opened inside an artery to help keep it open — may be inserted into the blood vessel.
- Coronary artery bypass graft (CABG) surgery reroutes blood flow around portions of the coronary arteries that are affected by plaque, using healthy blood vessels from the leg or chest.

Patients with stable coronary artery disease have several diagnostic options, each of which involves different tradeoffs. Angiography is the most invasive test and the most accurate. Though rare, the risks of angiography include damage to a blood vessel, irregular heartbeat, stroke, heart attack, and death.

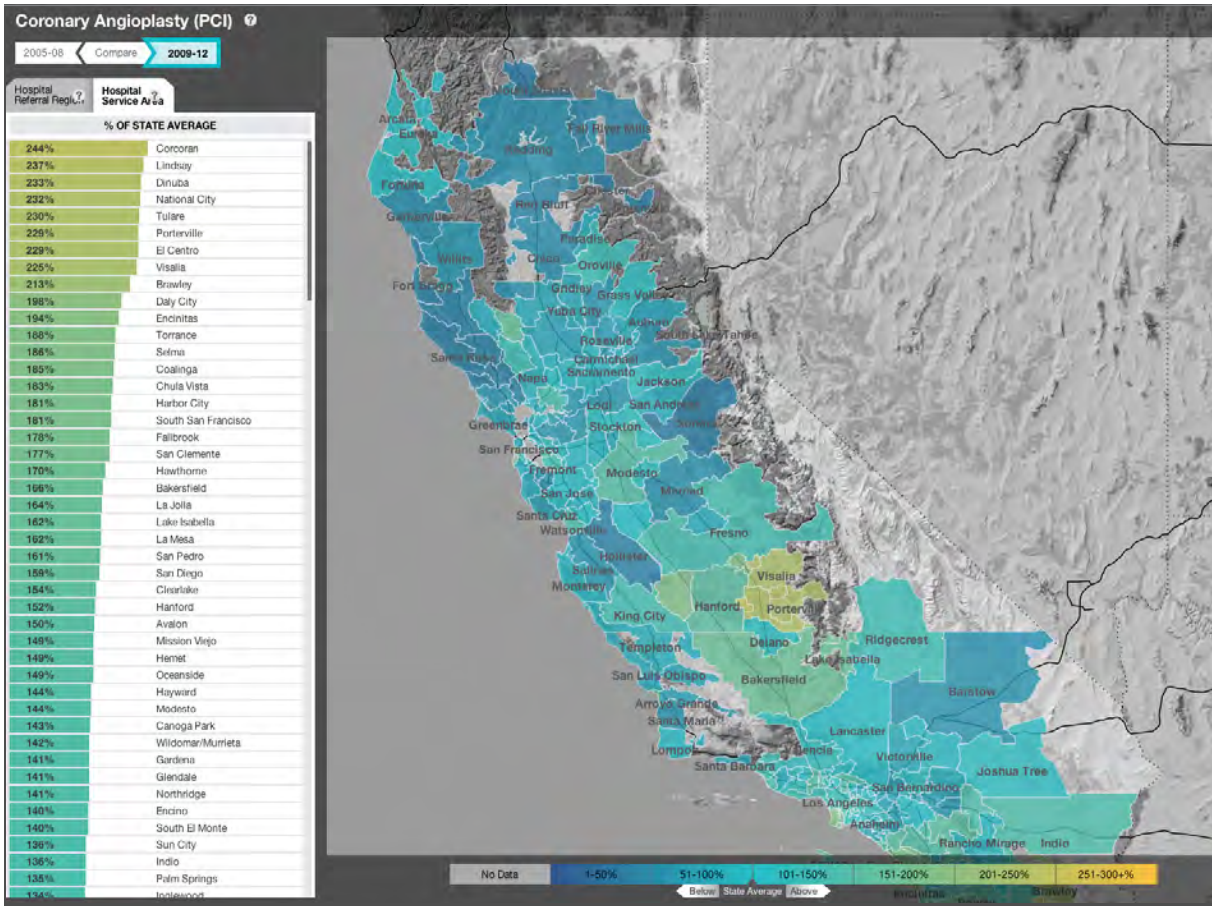
Treatments options also involve tradeoffs. All patients with coronary artery disease are generally treated with medication, such as aspirin, statins (cholesterol-lowering drugs), beta blockers, and/or ACE inhibitors. These may be coupled with recommendations for lifestyle changes, such as quitting smoking, losing weight, and exercising.

Angioplasty (PCI) and CABG are invasive procedures intended to relieve symptoms. For most people, meaning those without severe disease, angioplasty and CABG do not prevent heart attacks or improve survival compared to medication alone. These procedures treat large blockages — the ones that typically cause angina — while heart attacks are often caused by blockages that occur when smaller, unstable plaques rupture. Angioplasty and CABG may improve survival compared to medical therapy alone for select patients with severe disease (those with large blockages in critical arteries, or large blockages in addition to either heart failure or diabetes).[2]

While elective angioplasty and stents provide symptom relief in the first year for 80% of patients with angina, patients should consider the risks as well. Among patients undergoing elective PCI in the US, the rate of in-hospital death is approximately 0.15%, and the rate of heart attack associated with the procedure is approximately 1.9%. Among patients age 70 or older, the risk of in-hospital death following elective PCI is approximately 0.2%, and the rate of heart attack associated with the procedure is about 2%.[3] For 2009, the CABG mortality rate after 30 days was 2.5%, and the CABG stroke rate was 1.25%.[4]

Residents of some hospital service areas (HSAs) undergo heart procedures at much higher or much lower rates than those in other HSAs. State averages should not be taken as the correct or "right" rate for elective procedures; they are used only as the comparator for analysis, not as a benchmark. There is no recommended baseline for elective procedures. See Figure 1.

Figure 1. Geographic Variation in Elective PCI, California, 2009-12



Note: This is a static representation of a portion of the data that can be seen on an interactive map at: **www.chcf.org.**

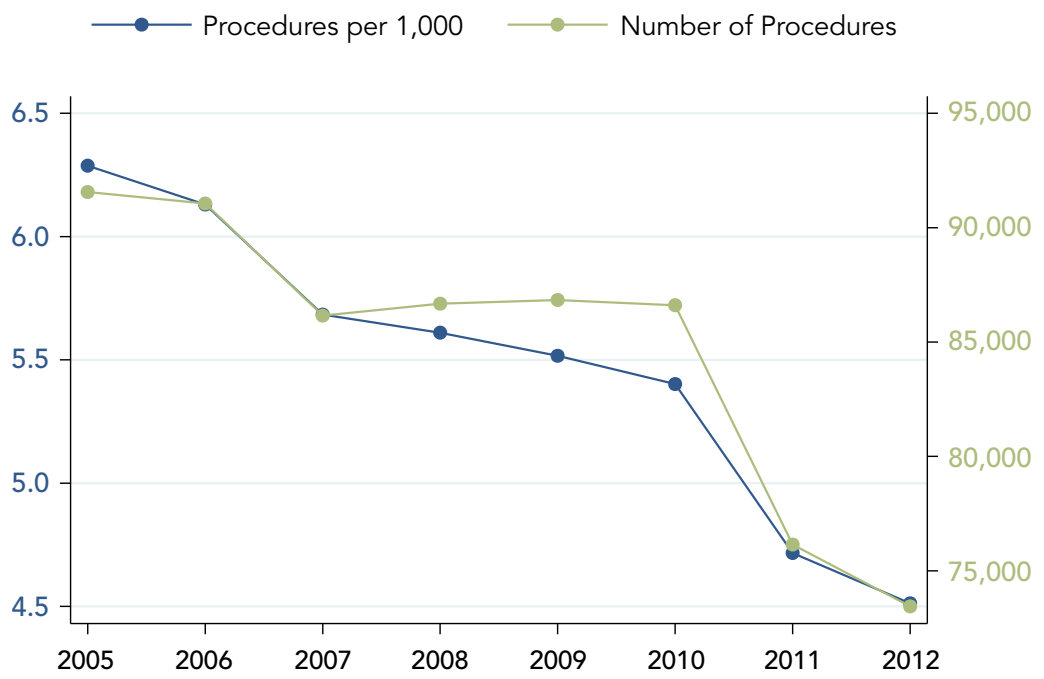
The high and low extremes for angiography by HSA are shown in Figure 2 for both data-collection periods, 2005-08 and 2009-12.

The statewide rate for angiography dropped from a high of 6.3 procedures per 1,000 in 2005 to a low of 4.5 procedures per 1,000 by 2012. See Figure 3.

Figure 2. Angiography, 10 Lowest and Highest HSAs 2005-08 and 2009-12

2005-08		2009-12	
10 Lowest HSAs, adjusted rate per 1,000			
Weaverville	1.97	Garberville	2.27
Garberville	2.26	Sebastopol	2.47
Mount Shasta	2.71	Hollister	2.52
Sonoma	2.74	Fort Bragg	2.60
Red Bluff	2.87	Mount Shasta	2.63
Templeton	2.90	Mountain View	2.67
Fall River Mills	2.94	Healdsburg	2.67
Greenville	3.03	Santa Rosa	2.68
Sebastopol	3.04	Ukiah	2.70
Redding	3.11	Templeton	2.77
10 Highest HSAs, adjusted rate per 1,000			
Bakersfield	12.47	Visalia	9.92
Porterville	12.65	Selma	10.13
Dinuba	12.71	Fresno	10.37
Deer Park	12.89	Porterville	10.48
Coalinga	13.05	Lake Isabella	10.59
Lake Isabella	13.23	Coalinga	11.05
Tulare	13.25	Bakersfield	11.20
Hanford	16.25	Clearlake	11.25
Corcoran	19.96	Dinuba	11.45
Clearlake	21.35	Corcoran	14.97

Figure 3. Angiography, Statewide Trends in the Number and Rate of Procedures, 2005 to 2012



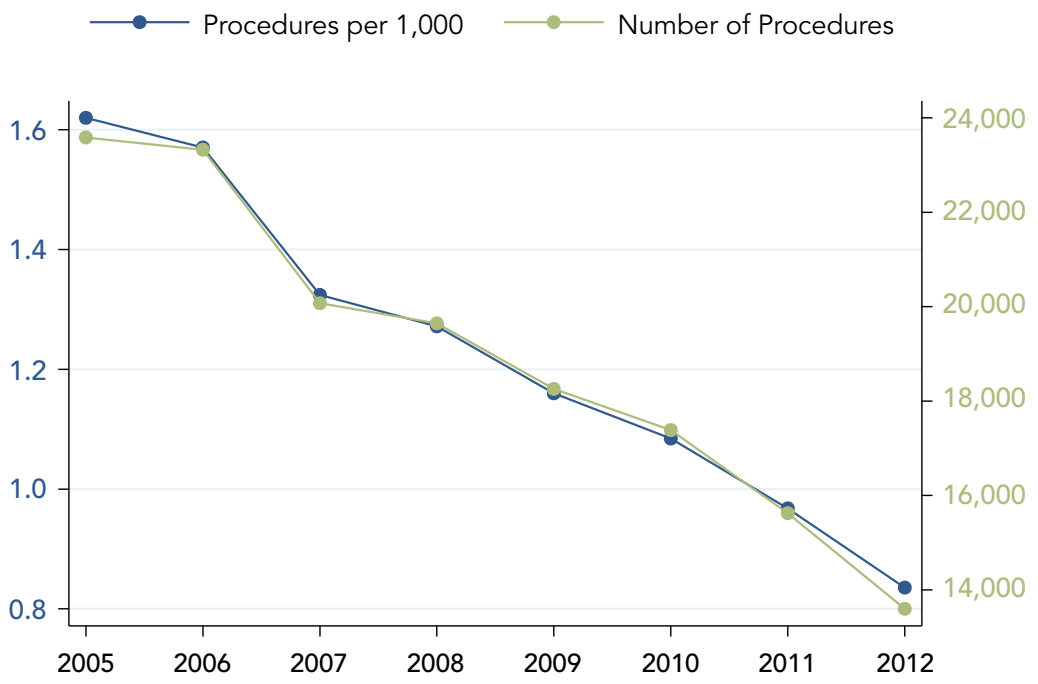
The high and low extremes for PCI by HSA are shown in Figure 4 for both data-collection periods, 2005-08 and 2009-12.

The statewide rate for PCI dropped from a high of 1.6 procedures per 1,000 in 2005 to a low of 0.8 per 1,000 by 2012. See Figure 5.

Figure 4. PCI, 10 Lowest and Highest HSAs 2005-08 and 2009-12

2005-08		2009-12	
10 Lowest HSAs, adjusted rate per 1,000			
Chester	0.32	Mount Shasta	0.35
Weaverville	0.34	Chester	0.37
Fort Bragg	0.41	Sebastopol	0.39
Sonoma	0.50	Sonora	0.39
Garberville	0.52	Santa Rosa	0.43
Red Bluff	0.53	Sonoma	0.43
Ukiah	0.53	Fort Bragg	0.43
Sebastopol	0.56	Greenville	0.45
Santa Maria	0.58	Healdsburg	0.46
Healdsburg	0.60	Ukiah	0.47
10 Highest HSAs, adjusted rate per 1,000			
Daly City	2.92	Daly City	2.00
Coalinga	3.08	Brawley	2.16
El Centro	3.12	Visalia	2.27
Dinuba	3.18	Porterville	2.31
Corcoran	3.46	El Centro	2.32
Visalia	3.48	Tulare	2.32
King City	3.71	National City	2.34
Porterville	3.83	Dinuba	2.35
Lindsay	5.21	Lindsay	2.39
Clearlake	5.74	Corcoran	2.46

Figure 5. PCI, Statewide Trends in the Number and Rate of Procedures, 2005 to 2012



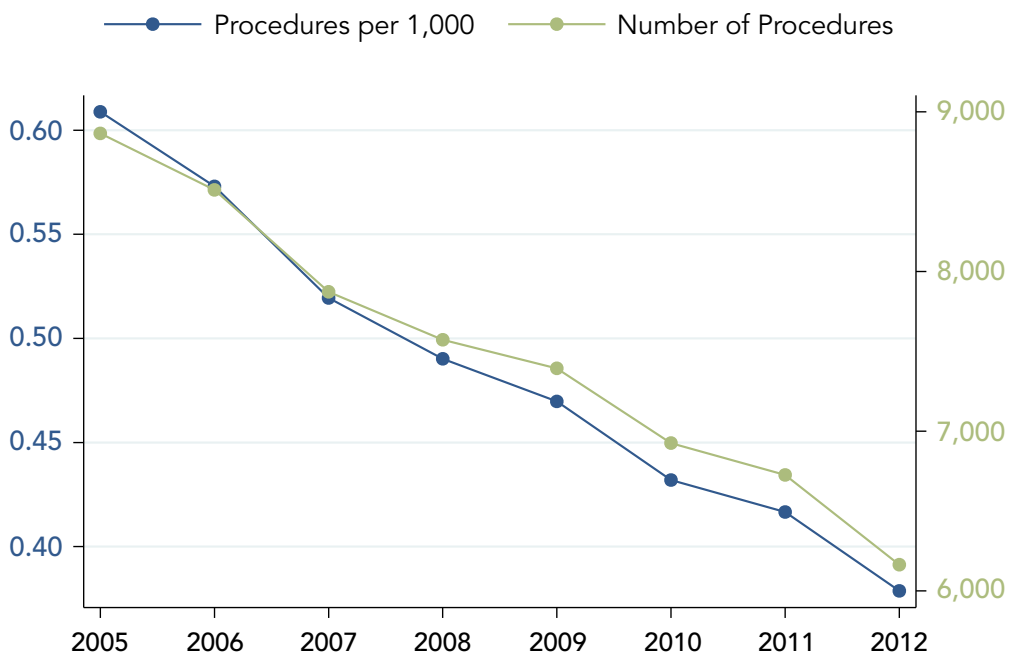
The high and low extremes for CABG by HSA are shown in Figure 6 for both data-collection periods, 2005-08 and 2009-12.

The average rate for CABG has fallen from a high of 0.6 procedures per 1,000 in 2005 to a low of fewer than 0.4 procedures per 1,000 by 2012. See Figure 7.

Figure 6. CABG, 10 Lowest and Highest HSAs 2005-08 and 2009-12

2005-08		2009-12	
10 Lowest HSAs, adjusted rate per 1,000			
Mount Shasta	0.24	Garberville	0.18
Fort Bragg	0.29	Mount Shasta	0.20
Sun City	0.33	Berkeley	0.23
Sebastopol	0.33	Joshua Tree	0.23
Santa Rosa	0.36	Gardena	0.24
Red Bluff	0.36	San Luis Obispo	0.25
San Luis Obispo	0.37	Willits	0.25
Chester	0.37	Fort Bragg	0.25
Templeton	0.37	San Leandro	0.26
Lancaster	0.38	Templeton	0.26
10 Highest HSAs, adjusted rate per 1,000			
Clearlake	0.90	Porterville	0.68
S. San Francisco	0.90	Manteca	0.70
Daly City	0.93	Marysville	0.73
Oakdale	0.94	King City	0.74
Modesto	0.99	Tracy	0.74
Lakewood	1.00	Paramount	0.78
El Centro	1.00	Modesto	0.78
Napa	1.02	Stockton	0.80
Marysville	1.15	Yuba City	0.85
Yuba City	1.16	Lakewood	0.86

Figure 7. CABG, Statewide Trends in the Number and Rate of Procedures, 2005 to 2012



Procedures Chosen for the Study

Procedures studied were based on patient discharge data for elective angiography, elective PCI, and elective CABG. Certain cases were excluded, including those involving acute myocardial infarction (commonly known as heart attack), unstable angina, and shock. Cases where patients were admitted through the emergency room of the discharging hospital or transferred from another acute care institution were also excluded. This analysis controlled for age, sex, income, education, insurance status, and race, as well as rates of acute myocardial infarction and diabetes.

Authors

The original content of this report, published in September 2011, was developed by Vanessa Hurley, MPH, and Shannon Brownlee, MS. It was updated in November 2014.

About the Foundation

The California HealthCare Foundation works as a catalyst to fulfill the promise of better health care for all Californians. We support ideas and innovations that improve quality, increase efficiency, and lower the costs of care. For more information, visit us online at www.chcf.org.

Endnotes

1. The research for this report was developed by Laurence Baker, PhD, a consultant to this project and professor of health research and policy, and chief of health services research, Stanford University School of Medicine, in collaboration with Maryann O'Sullivan, JD, an independent health policy consultant. Analysis and interpretation of the estimates were performed by Frances Tompkins, data consultant. Lance Lang, MD, chaired an advisory committee of clinicians in various specialties, which was also consulted in the production of this report to review the analysis and to ensure the accuracy of medical content. For a complete list of advisory committee members, see the research summary "All Over the Map: Elective Procedure Rates in California Vary Widely," www.chcf.org. Data were obtained from the Office of Statewide Health Planning and Development.
2. This section was written using the following sources:
   - Shannon Brownlee et al., *Improving Patient Decision-Making in Health Care: A 2011 Dartmouth Atlas Report Highlighting Minnesota* (Lebanon, NH: Dartmouth Atlas Project, 2011).
   - National Heart, Lung, and Blood Institute, "What Are the Risks of Coronary Angioplasty?," www.nhlbi.nih.gov.
   - *Treatment Choices for Coronary Artery Disease* (Boston: Health Dialog, 2009).
   - "Heart Disease: Should I Have an Angiogram?," Kaiser Permanente, accessed October 10, 2010, members.kaiserpermanente.org.
   - "Heart Disease: Should I Have Bypass Surgery?," Kaiser Permanente, accessed October 10, 2010, members.kaiserpermanente.org.
3. National Cardiovascular Data Registry (NCDR), data on elective PCI (n=161,748) from 1,189 US hospitals for calendar year 2010, accessed July 19, 2011, www.ncdr.com.
4. Society of Thoracic Surgeons National Adult Cardiac Surgery Database, accessed April 2010, www.sts.org.