HEALTHCARE COST AND UTILIZATION PROJECT

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Components of Cost Increases for Inpatient Hospital Procedures, 1997–2009

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Introduction

Inpatient hospital costs represent the largest component of health care expenditures in the United States.[1] Between 1997 and 2009, aggregate inflation-adjusted costs for inpatient community hospital stays grew by 3.9 percent annually, driven mostly by change in the intensity of services (cost per stay).[2] Intensity of services includes the increased use of procedures or more complex procedures during a hospital stay.

This Statistical Brief presents recent data from the Healthcare Cost and Utilization Project (HCUP). It also expands prior analyses by examining the growth in costs from 1997–2009 associated with the 20 most common inpatient procedures (among all hospital stays) for the elderly (age 65 and older) and nonelderly (younger than age 65) populations. All differences between estimates provided in the text are statistically significant at the 0.005 level or lower. Costs for 1997 were inflation-adjusted to 2009 dollars.

Findings

General findings

In 2009, there were 39.4 million inpatient stays in U.S. community hospitals (128.4 stays per 1,000 population), which cost $361.5 billion in the aggregate (table 1). The average stay lasted 4.6 days and cost $9,200 ($2,000 per day), which was slightly shorter but more expensive than the average inpatient stay in 1997 (4.9 days; $6,600 per stay; $1,400 per day).[3]

Highlights

- Hospital stays for nonelderly patients cost $207.6 billion in 2009 and aggregate hospital costs were highest for stays with the following principal procedures: respiratory intubation ($11.9 billion), spinal fusion ($7.9 billion), and Cesarean section ($7.4 billion).
- Stays for elderly patients cost $153.9 billion in 2009 and aggregate hospital costs were highest for stays that listed the following principal procedures: respiratory and mechanical ventilation ($7.9 billion), cardiac pacemaker or cardioverter/ defibrillator procedures ($5.8 billion), and knee arthroplasty ($5.8 billion).
- Among nonelderly stays, 8 principal procedures were associated with rapid increases in *stays per population*, including spinal fusion, knee arthroplasty, cardiac pacemaker or cardioverter/de-fibrillator procedures, hip replacement, and Cesarean section.
- Increasing *intensity of services* (cost per day) was the major driver of aggregate costs for nonelderly hospital stays with such principal procedures as colorectal resection, appendectomy, PTCA, cholecystectomy, and hysterectomy.
- Among elderly stays, rapid increases in *stays per population* contributed to cost growth for stays with such principal procedures as spinal fusion, blood transfusion, hemodialysis, and respiratory intubation.
- Aggregate costs of elderly hospital stays with the following principal procedures were driven by increases in *intensity of service*: cardiac pacemaker or cardioverter/ defibrillator procedures, PTCA, hip replacement, and echocardiogram.

[1] Hartman M, Martin A, McDonnell P, Catlin A. National Health Spending in 2007: Slower Drug Spending Contributes to Lowest Rate of Overall Growth Since 1998. Health Affairs. 28(1): 246–261, January 2009.

[2] Wier LM, Pfuntner A, Maeda J, Stranges E, Ryan K, Jagadish P, Collins Sharp B, Elixhauser A. *HCUP Facts and Figures: Statistics on Hospital-based Care in the United States, 2009*. 2011. Agency for Healthcare Research and Quality, Rockville, MD. Available at http://www.hcup-us.ahrq.gov/reports.jsp. (Accessed February 29, 2012).

[3] Table 1 and figure 1 were included in an earlier Statistical Brief: Stranges E, Kowlessar N, and Elixhauser A. *Components of Growth in Inpatient Hospital Costs, 1997-2009.* HCUP Statistical Brief #123. November 2011. Agency for Healthcare Research and Quality, Rockville, MD. Available at http://www.hcup-us.ahrq.gov/reports/statbriefs/sb123.pdf. (Accessed February 29, 2012).

Table 1. Nonelderly and elderly population inpatient hospital stays, 1997 and 2009

	Nonelderly stays (ages 0–64)			Elderly stays (age 65 and older)			All stays	
	1997*	2009	Average annual growth 1997–2009	1997*	2009	Average annual growth 1997–2009	1997*	2009
Number of stays (thousands)	22,200	25,900	1.3%	12,500	13,500	0.7%	34,700	39,400
Stays per 1,000 population	93.6	96.8	0.3%	362.7	342.2	-0.5%	127.7	128.4
Aggregate costs (billions)	$123.3	$207.6	4.4%	$106.1	$153.9	3.1%	$229.4	$361.5
Average length of stay (days)	4.1	4.1	0.1%	6.4	5.4	-1.3%	4.9	4.6
Cost per stay ($)	$5,600	$8,000	3.1%	$8,500	$11,400	2.4%	$6,600	$9,200
Cost per day ($)	$1,400	$1,900	3.0%	$1,300	$2,100	3.8%	$1,400	$2,000

*Aggregate costs, costs per stay and costs per day in 1997 are inflation-adjusted to 2009 dollars

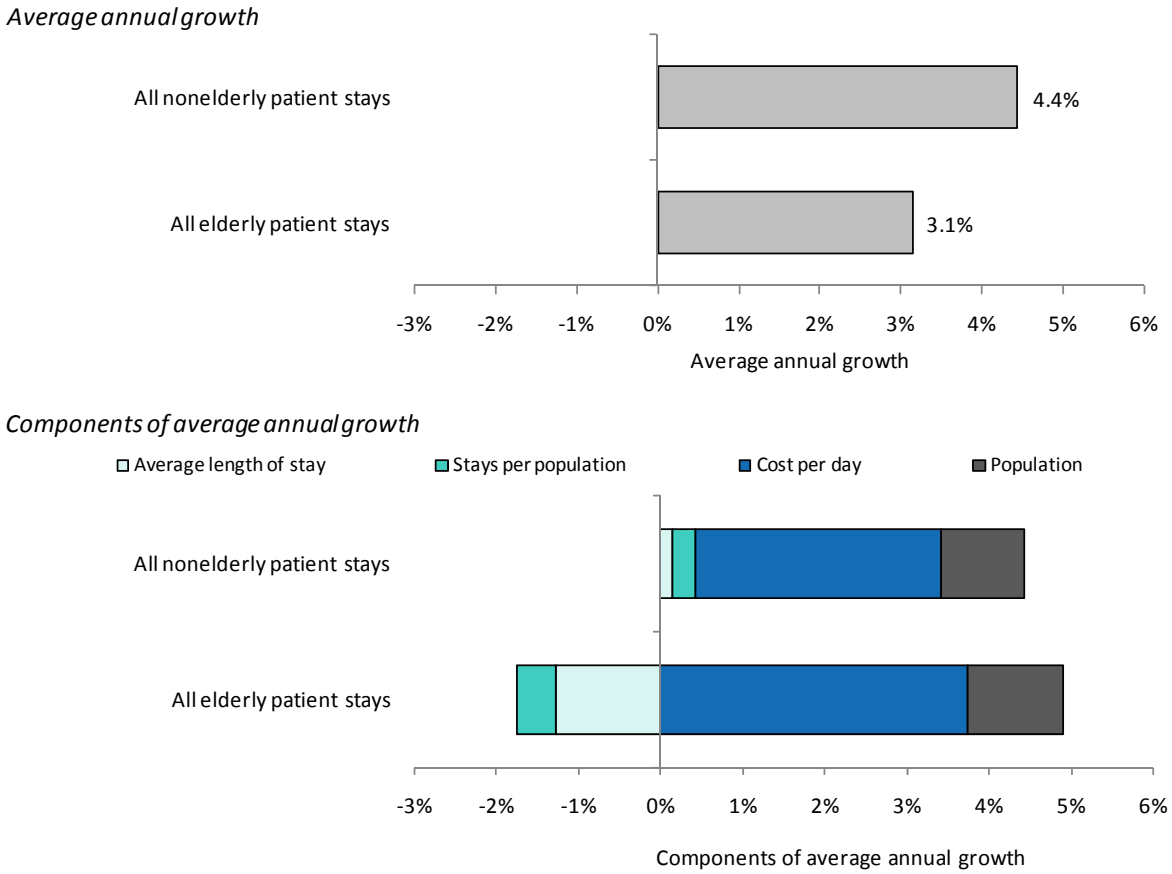
Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 1997 and 2009

Between 1997 and 2009, the average annual growth in aggregate costs for all stays was 3.9 percent, which outpaced the 1.1 percent annual growth in number of stays (data not shown). Growth in aggregate costs reflects changes in a number of factors: cost per day, average length of stay, number of stays per population, and the size of the population as a whole. As shown in figure 1, the aggregate cost for stays of nonelderly patients grew at a similar rate to costs for elderly patients—the average annual growth was 4.4 percent for nonelderly and 3.1 percent for elderly patients.

Figure 1 also shows that growth in the aggregate cost for stays of nonelderly patients was driven largely by growth in the cost per day, which reflects the intensity of services provided. Growth in the population accounted for much of the remainder of the growth in aggregate costs. Changes in the number of stays per population and in the average length of stay made small contributions to the growth in the aggregate cost for stays of nonelderly patients.

Growth in the aggregate cost for stays of elderly patients was also driven by growth in the cost per day; however, it was dampened by a substantial decline in the average length of stay for elderly patients as well as by a decrease in the number of stays per population. Without declines in the average length of stay and the number of stays per population, growth in the aggregate cost for stays of elderly patients would have exceeded that of nonelderly patients.

Figure 1. Average annual growth in aggregate hospital costs of elderly and nonelderly patient stays, 1997-2009



Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 1997 and 2009

Costs for stays associated with the most common principal procedures, 2009

Table 2 shows the stays per population and total aggregate costs in 1997 and 2009, as well as the average annual growth in aggregate costs for nonelderly and elderly patient stays during this time period. Details are provided on the 20 most common principal procedures performed during hospital stays across all ages in 2009.

Stays per 1,000 for the nonelderly population rose from 93.6 in 1997 to 96.8 in 2009. The most common principal procedures listed for hospital stays among the nonelderly population in 2009 were Cesarean section (5.2 stays per 1,000 population), circumcision (3.8 stays per 1,000 population), and repair of current obstetric laceration (2.3 stays per 1,000 population).

Stays for nonelderly patients cost a total of $207.6 billion in 2009 and aggregate hospital costs were highest for stays in which the following principal procedures were listed: respiratory intubation and mechanical ventilation ($11.9 billion), spinal fusion ($7.9 billion), and Cesarean section ($7.4 billion).

Hospital stays with the most rapidly-growing aggregate costs among nonelderly patients listed the following principal procedures: spinal fusion (14.9 percent average annual growth), blood transfusion (12.1 percent average annual growth), and knee arthroplasty (11.7 percent average annual growth).

Stays per 1,000 for the elderly population fell from 362.7 in 1997 to 342.2 in 2009. The most common principal procedures listed for hospital stays among elderly patients in 2009 were blood transfusion (11.7 stays per 1,000 population), knee arthroplasty (9.7 stays per 1,000 population), and respiratory intubation and mechanical ventilation (9.3 stays per 1,000 population).

Hospital stays for elderly patients cost a total of $153.9 billion in 2009 and aggregate hospital costs were highest for stays with the following principal procedures: respiratory intubation and mechanical ventilation ($7.9 billion); insertion, revision, replacement, or removal of a cardiac pacemaker or cardioverter/defibrillator ($5.8 billion); and knee arthroplasty ($5.8 billion).

The most rapidly-growing aggregate hospital costs for the elderly listed the following principal procedures: spinal fusion (19.0 percent average annual growth), blood transfusion (12.4 percent average annual growth), and hemodialysis (8.6 percent average annual growth).

Table 2. Twenty most common principal procedures during hospital stays in 2009: nonelderly and elderly patient stays, 1997–2009

	Nonelderly patient stays (ages 0–64)					Elderly patient stays (age 65 and older)				
	Stays per 1,000 population		Aggregate costs for the hospital stay (billions)		Average annual growth in costs 1997–2009	Stays per 1,000 population		Aggregate costs for the hospital stay (billions)		Average annual growth in costs 1997–2009
CCS principal procedure	1997	2009	1997*	2009		1997	2009	1997*	2009	
All stays	93.6	96.8	$123.3	$207.6	4.4%	362.7	342.2	$106.1	$153.9	3.1%
Cesarean section	3.4	5.2	3.7	7.4	5.9%	**	**	**	**	**
Circumcision	4.6	3.8	1.3	1.7	2.3%	**	**	**	**	**
Respiratory intubation and mechanical ventilation	1.1	1.8	5.9	11.9	6.0%	6.3	9.3	3.9	7.9	5.9%
Blood transfusion	0.4	1.1	0.7	2.9	12.1%	4.4	11.7	1.1	4.3	12.4%
Upper gastrointestinal endoscopy; biopsy	1.1	1.3	1.7	3.0	5.0%	10.3	8.5	2.5	3.1	1.8%
Arthroplasty knee	0.5	1.1	1.2	4.5	11.7%	6.1	9.7	2.6	5.8	6.8%
Percutaneous transluminal coronary angioplasty (PTCA)	1.1	1.2	3.0	5.4	5.0%	7.8	8.1	3.3	5.6	4.4%
Repair of current obstetric laceration	2.4	2.3	1.3	1.9	2.9%	**	**	**	**	**

Table 2. Twenty most common principal procedures during hospital stays in 2009: nonelderly and elderly patient stays, 1997–2009 (continued)

	Nonelderly patient stays (ages 0–64)					Elderly patient stays (age 65 and older)				
	Stays per 1,000 population		Aggregate costs for the hospital stay (billions)		Average annual growth in costs 1997–2009	Stays per 1,000 population		Aggregate costs for the hospital stay (billions)		Average annual growth in costs 1997–2009
CCS principal procedure	1997	2009	1997*	2009		1997	2009	1997*	2009	
Diagnostic cardiac catheterization; coronary arteriography	1.4	1.2	2.3	3.1	2.5%	9.9	6.6	2.7	2.8	0.3%
Hysterectomy; abdominal and vaginal	2.1	1.5	2.7	3.2	1.4%	2.0	1.2	0.5	0.5	0.2%
Hip replacement; total and partial	0.3	0.6	0.9	2.6	9.0%	6.4	6.9	2.8	4.5	4.1%
Spinal fusion	0.5	1.2	1.5	7.9	14.9%	0.7	3.0	0.4	3.3	19.0%
Cholecystectomy and common duct exploration	1.1	1.1	1.9	3.0	3.9%	4.0	3.0	1.5	1.8	1.5%
Hemodialysis	0.4	0.8	0.6	1.8	9.9%	2.5	4.2	0.6	1.7	8.6%
Alcohol and drug rehabilitation/detoxification	1.4	1.2	1.0	1.3	2.2%	0.5	0.4	0.1	0.1	3.1%
Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator	0.2	0.3	0.8	2.4	10.0%	4.9	6.3	2.7	5.8	6.7%
Appendectomy	0.9	1.0	1.2	2.3	5.2%	0.4	0.6	0.1	0.3	5.1%
Colorectal resection	0.4	0.5	1.6	2.9	5.3%	4.5	3.5	2.8	3.3	1.5%
Diagnostic ultrasound of heart (echocardiogram)	0.4	0.4	0.6	1.0	5.2%	4.0	3.9	0.9	1.3	3.5%
Treatment; fracture or dislocation of hip and femur	0.3	0.3	0.8	1.3	4.1%	6.0	4.9	2.0	2.7	2.6%

Note: Procedures are ordered by their frequency among all hospital stays in 2009

*Aggregate costs in 1997 are inflation-adjusted to 2009 dollars

**Data for procedures with fewer than 300 stays are suppressed

Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 1997 and 2009

Components of the growth in costs by principal procedure, 1997–2009
Figure 2 shows the average annual growth in aggregate costs for nonelderly patient stays, as well as the components of hospital cost growth by the 20 most common principal procedures listed for hospital stays. Hospital stays with these principal procedures accounted for almost half of the total increase in aggregate costs.

Among the 20 most common principal procedures listed in stays for the nonelderly, increases in stays per population were the most important factor driving overall costs for eight of them:

- spinal fusion
- blood transfusion
- knee arthroplasty
- insertion, revision, replacement, or removal of a cardiac pacemaker or cardioverter/defibrillator
- hemodialysis
- hip replacement, total or partial
- respiratory intubation and mechanical ventilation
- Cesarean section.

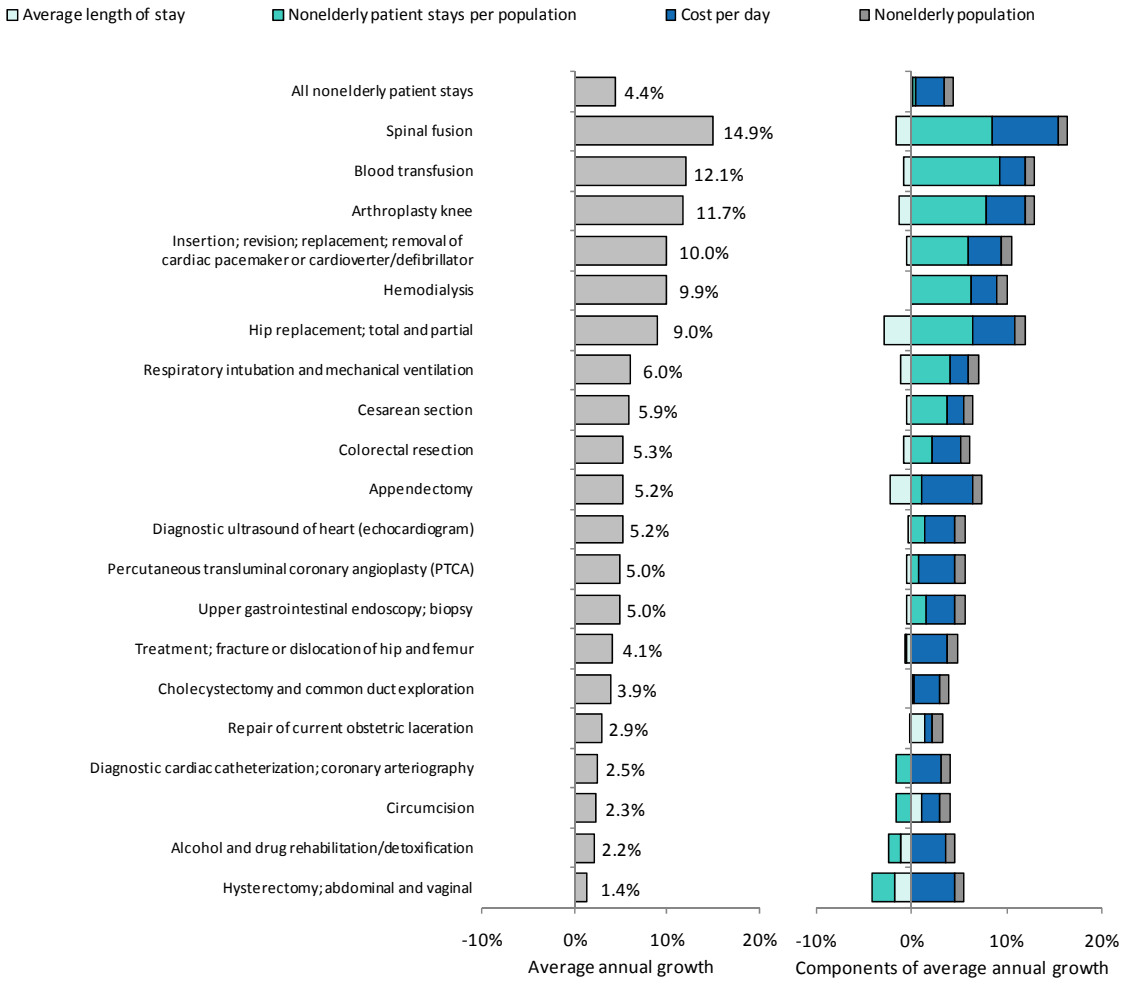
Increasing intensity of services (cost per day) was the major driver for growth in the aggregate cost for stays with the following principal procedures listed:

- colorectal resection
- appendectomy
- diagnostic ultrasound of the heart (echocardiogram)
- percutaneous transluminal coronary angioplasty (PTCA)
- upper gastrointestinal endoscopy (with or without biopsy)
- treatment, fracture or dislocation of hip and femur
- cholecystectomy and common duct exploration
- diagnostic cardiac catheterization, coronary arteriography
- circumcision
- alcohol and drug rehabilitation/detoxification
- hysterectomy, abdominal or vaginal.

Cost per day would have driven up costs for hospital stays with abdominal/vaginal hysterectomy as the principal procedure even further were it not for a decrease in the average length of stay and the rate of hysterectomy procedures among nonelderly patients.

Changes in the length of stay accounted for almost half of the small increase in cost associated with hospitalizations during which repair of current obstetric lacerations was listed as the principal procedure. However, in general, changes in length of stay affected cost growth only modestly. Changes in length of stay was a dampening factor for cost growth for some hospital stays—notably stays during which spinal fusion, total or partial hip replacement, appendectomy, and abdominal or vaginal hysterectomy were listed as principal procedures.

Figure 2. Average annual growth in aggregate hospital costs for nonelderly patient stays associated with the 20 most common principal procedures, 1997-2009



Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 1997 and 2009

Figure 3 shows the average annual growth in the aggregate cost for elderly patient stays, as well as the components of cost growth, for the 20 most common principal procedures listed for hospital stays.

Among elderly patients, costs for hospital stays during which the following four procedures were listed as principal procedures grew faster than average due to large increases in hospitalization rates (stays per population):

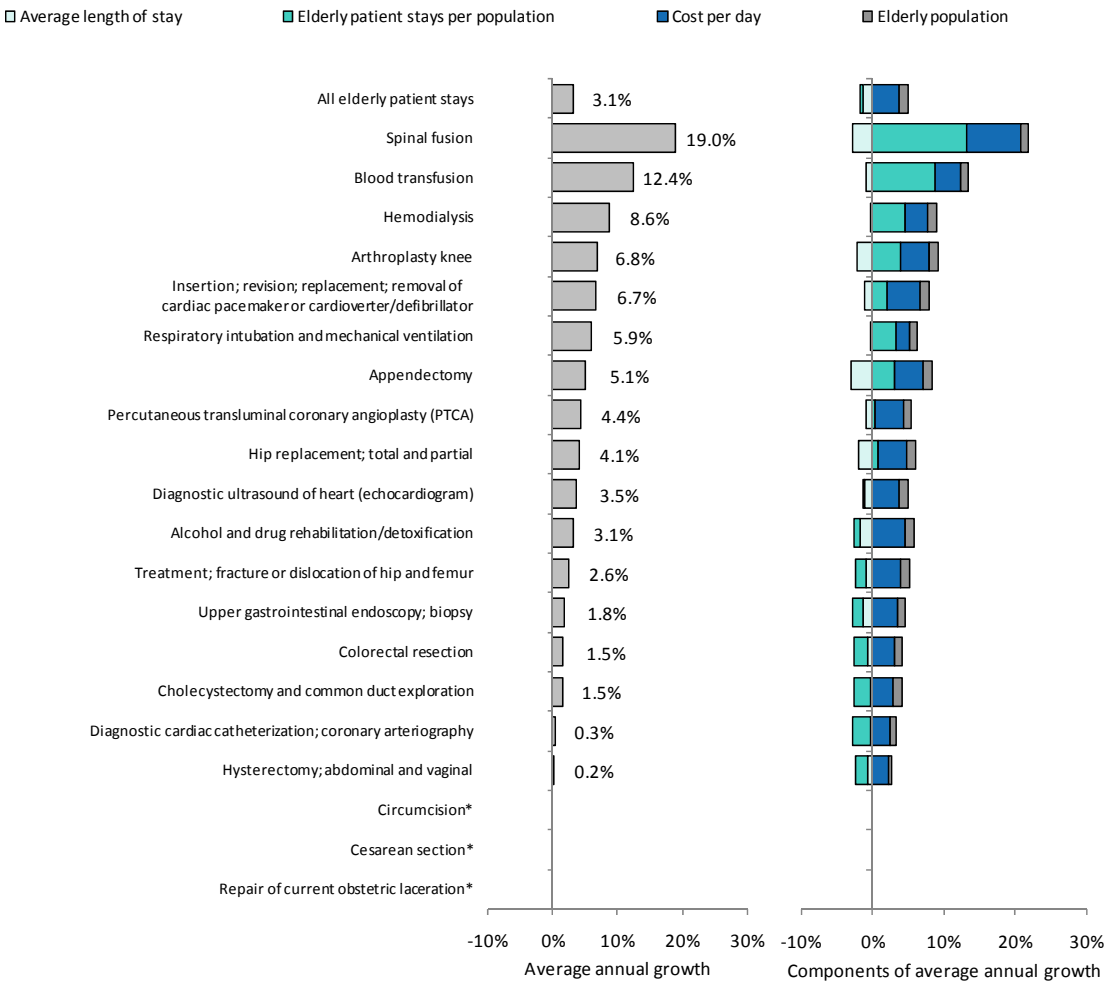
- spinal fusion
- blood transfusion
- hemodialysis
- respiratory intubation and mechanical ventilation.

Aggregate costs for hospital stays during which the following procedures were listed as principal procedures also grew rapidly, but were predominantly driven by large increases in the intensity of services (cost per day):

- insertion, revision, replacement, or removal of a cardiac pacemaker or cardioverter/defibrillator
- appendectomy
- percutaneous transluminal coronary angioplasty (PTCA)
- total or partial hip replacement
- diagnostic ultrasound of the heart (echocardiogram).

Growth in the hospitalization rate and cost per day contributed equally to the average annual growth in costs for stays listing a principal knee arthroplasty procedure. Aggregate costs of hospital stays with other principal procedures grew very slowly (3.1 percent or less average annual growth); increases in the cost per day were the main factor in cost growth among these procedures.

Figure 3. Average annual growth in aggregate hospital costs for elderly patient stays associated with the 20 most common principal procedures, 1997-2009



* Data for procedures with fewer than 300 stays are suppressed.
Source: AHRQ, Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project, Nationwide Inpatient Sample, 1997 and 2009

Data Source

The estimates in this Statistical Brief are based upon data from the HCUP NIS for 1997 and 2009. Supplemental sources included data on regional population estimates from "Table 1: Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2000 to July 1, 2009 (NST-EST2009-01)," Population Division, U.S. Census Bureau, Release date: December 2009. http://www.census.gov/popest/data/historical/2000s/vintage_2009/index.html (Accessed April 30, 2012).

Many hypothesis tests were conducted for this Statistical Brief. Thus, to decrease the number of false-positive results, we reduced the significance level to .005 for individual tests.

Definitions

Procedures, ICD-9-CM, and Clinical Classifications Software (CCS)
The *principal procedure* is the procedure that is performed for definitive treatment rather than performed for diagnostic or exploratory purposes (i.e., the procedure that was necessary to take care of a complication). If two procedures appear to meet this definition, the procedure most related to the principal diagnosis is selected as the principal procedure.

ICD-9-CM is the International Classification of Diseases, Ninth Revision, Clinical Modification, which assigns numeric codes to procedures. There are about 4,000 ICD-9-CM procedure codes.

CCS categorizes procedure codes into clinically meaningful categories.[4] This "clinical grouper" makes it easier to quickly understand patterns of procedure use. CCS categories identified as "Other" are typically not reported; these categories include miscellaneous, otherwise unclassifiable procedures that may be difficult to interpret as a group.

Types of hospitals included in HCUP
HCUP is based on data from community hospitals, defined as short-term, non-Federal, general and other hospitals, excluding hospital units of other institutions (e.g., prisons). HCUP data include obstetrics and gynecology, otolaryngology, orthopedic, cancer, pediatric, public, and academic medical hospitals. Excluded are long-term care, rehabilitation, psychiatric, and alcoholism and chemical dependency hospitals. However, if a patient received long-term care, rehabilitation, or treatment for psychiatric or chemical dependency conditions in a community hospital, the discharge record for that stay will be included in the NIS.

Unit of analysis
The unit of analysis is the hospital discharge (i.e., the hospital stay), not a person or patient. This means that a person who is admitted to the hospital multiple times in one year will be counted each time as a separate "discharge" from the hospital.

Costs and charges
Total hospital charges were converted to costs using HCUP Cost-to-Charge Ratios based on hospital accounting reports from the Centers for Medicare & Medicaid Services (CMS).[5] *Costs* will reflect the

[4] HCUP Clinical Classifications Software (CCS). Healthcare Cost and Utilization Project (HCUP). U.S. Agency for Healthcare Research and Quality, Rockville, MD. Available at http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp. Updated March 2012. (Accessed April 30, 2012).
[5] HCUP Cost-to-Charge Ratio Files (CCR). Healthcare Cost and Utilization Project (HCUP). 2001–2009. U.S. Agency for Healthcare Research and Quality, Rockville, MD. Available at http://www.hcup-us.ahrq.gov/db/state/costtocharge.jsp. Updated August 2011. (Accessed April 30, 2012).

actual expenses incurred in the production of hospital services, such as wages, supplies, and utility costs; *charges* represent the amount a hospital billed for the case. For each hospital, a hospital-wide cost-to-charge ratio is used. Hospital charges reflect the amount the hospital billed for the entire hospital stay, not for the procedure itself, and do not include professional (physician) fees. For the purposes of this Statistical Brief, costs are reported to the nearest hundred. Costs are adjusted to 2009 dollars using the GDP deflator.[6]

Mean cost per day is calculated as the mean cost per stay divided by the mean length of stay.

About HCUP

HCUP is a family of powerful health care databases, software tools, and products for advancing research. Sponsored by the Agency for Healthcare Research and Quality (AHRQ), HCUP includes the largest all-payer encounter-level collection of longitudinal health care data (inpatient, ambulatory surgery, and emergency department) in the United States, beginning in 1988. HCUP is a Federal-State-Industry Partnership that brings together the data collection efforts of many organizations—such as State data organizations, hospital associations, private data organizations, and the Federal government—to create a national information resource.

HCUP would not be possible without the contributions of the following data collection Partners from across the United States:

Alaska State Hospital and Nursing Home Association
Arizona Department of Health Services
Arkansas Department of Health
California Office of Statewide Health Planning and Development
Colorado Hospital Association
Connecticut Hospital Association
Florida Agency for Health Care Administration
Georgia Hospital Association
Hawaii Health Information Corporation
Illinois Department of Public Health
Indiana Hospital Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Louisiana Department of Health and Hospitals
Maine Health Data Organization
Maryland Health Services Cost Review Commission
Massachusetts Division of Health Care Finance and Policy
Michigan Health & Hospital Association
Minnesota Hospital Association
Mississippi Department of Health
Missouri Hospital Industry Data Institute
Montana MHA - An Association of Montana Health Care Providers
Nebraska Hospital Association
Nevada Department of Health and Human Services
New Hampshire Department of Health & Human Services
New Jersey Department of Health
New Mexico Department of Health
New York State Department of Health
North Carolina Department of Health and Human Services
Ohio Hospital Association

[6] Table 1.1.4. Price Indexes for Gross Domestic Product. Bureau of Economic Analysis. Available at http://www.bea.gov/national/nipaweb/SelectTable.asp. June 24, 2011. (Accessed April 30, 2012).

Oklahoma State Department of Health
Oregon Association of Hospitals and Health Systems
Oregon Health Policy and Research
Pennsylvania Health Care Cost Containment Council
Rhode Island Department of Health
South Carolina State Budget & Control Board
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems
Virginia Health Information
Washington State Department of Health
West Virginia Health Care Authority
Wisconsin Department of Health Services
Wyoming Hospital Association

About the NIS

The HCUP Nationwide Inpatient Sample (NIS) is a nationwide database of hospital inpatient stays. The NIS is nationally representative of all community hospitals (i.e., short-term, non-Federal, nonrehabilitation hospitals). The NIS is a sample of hospitals and includes all patients from each hospital, regardless of payer. It is drawn from a sampling frame that contains hospitals comprising about 95 percent of all discharges in the United States. The vast size of the NIS allows the study of topics at both the national and regional levels for specific subgroups of patients. In addition, NIS data are standardized across years to facilitate ease of use.

For More Information

For more information about HCUP, visit http://www.hcup-us.ahrq.gov/.

For additional HCUP statistics, visit HCUPnet, our interactive query system, at http://hcupnet.ahrq.gov/.

For information on other hospitalizations in the U.S., download *HCUP Facts and Figures: Statistics on Hospital-based Care in the United States in 2009*, located at http://www.hcup-us.ahrq.gov/reports.jsp.

For a detailed description of HCUP, more information on the design of the NIS, and methods to calculate estimates, please refer to the following publications:

Introduction to the HCUP Nationwide Inpatient Sample, 2009. Online. May 2011. U.S. Agency for Healthcare Research and Quality. Available at http://hcup-us.ahrq.gov/db/nation/nis/NIS_2009_INTRODUCTION.pdf. (Accessed April 30, 2012).

Houchens R, Elixhauser A. *Final Report on Calculating Nationwide Inpatient Sample (NIS) Variances, 2001*. HCUP Methods Series Report #2003-2. Online. June 2005 (revised June 6, 2005). U.S. Agency for Healthcare Research and Quality. Available at http://www.hcup-us.ahrq.gov/reports/CalculatingNISVariances200106092005.pdf. (Accessed April 30, 2012).

Houchens RL, Elixhauser A. *Using the HCUP Nationwide Inpatient Sample to Estimate Trends. (Updated for 1988–2004).* HCUP Methods Series Report #2006–05. Online. August 18, 2006. U.S. Agency for Healthcare Research and Quality. Available at http://www.hcup-us.ahrq.gov/reports/methods/2006_05_NISTrendsReport_1988-2004.pdf. (Accessed April 30, 2012).

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AHRQ welcomes questions and comments from readers of this publication who are interested in obtaining more information about access, cost, use, financing, and quality of health care in the United States. We also invite you to tell us how you are using this Statistical Brief and other HCUP data and tools, and to share suggestions on how HCUP products might be enhanced to further meet your needs. Please e-mail us at hcup@ahrq.gov or send a letter to the address below:

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