

# High and Rising Health Care Costs. Part 4: Can Costs Be Controlled While Preserving Quality?

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Several interrelated strategies involving physician leadership and participation have been proposed to contain health care costs while preserving or improving quality. These include programs targeting the 10% of the population that incurs 70% of health care expenditures, disease management programs to prevent costly complications of chronic conditions, efforts to reduce medical errors, the strengthening of primary care practice, decision support tools to avoid inappropriate services, and improved diffusion of technology assessment.

An example of a cost-reducing, quality-enhancing program is post-hospital nurse monitoring and intervention for patients at high risk for repeated hospitalization for congestive heart failure. Disease management programs that target groups with a chronic

condition rather than focusing efforts on high-utilizing individuals may be effective in improving quality but may not reduce costs. Error reduction has great potential to improve quality while reducing costs, although the probable cost reduction is a small portion of national health care expenditures. Access to primary care has been shown to correlate with reduced hospital use while preserving quality. Inappropriate care and overuse of new technologies can be reduced through shared decision-making between well-informed physicians and patients. Physicians have a central role to play in fostering these quality-enhancing strategies that can help to slow the growth of health care expenditures.

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In the first 3 articles, this series on health care costs offered a variety of explanations and remedies for high and rising health care expenditures in the United States (1–3). This final article addresses the question posed at the beginning of the series: Do strategies exist that enable physicians to reduce costs while improving or protecting health care quality?

The first 3 articles discussed various cost-containment methods: making patients more responsible for the costs of their care, encouraging price competition in health care markets, slowing the rate of diffusion of costly new technologies through effective technology assessment programs, reducing the administrative cost burden of the health care system, and counterbalancing the market power of health care providers and suppliers with expenditure caps or global budgets that limit the total amount of money flowing into the health care economy. Most of these approaches are policy initiatives that require the actions of governments or large health insurance plans. Except through political advocacy, physicians cannot readily affect these approaches. Other cost-containment strategies do fall within the purview of physicians' professional work. This article presents quality-preserving cost-control activities that involve physician leadership and cooperation. The strategies discussed overlap with one another; the common theme is the substitution of lower-cost ambulatory care for higher-cost emergency or in-hospital services (Table).

from 1970 to 1996. In 1996, the healthy 50% incurred an average cost of \$122 per person whereas the highest-cost 1% spent \$56 000 per person (4). Serious cost control should focus on the high-cost members of the population.

Common diagnoses among the highest-cost 10% are ischemic heart disease (including congestive heart failure), cancer, diabetes, hypertension, pulmonary conditions, mental disorders, and trauma. Moreover, the highest-cost patients have 3 or more comorbid conditions. Particularly for heart disease and cancer, the bulk of expenditures are for inpatient care. Kidney disease and stroke incur the highest average cost per person, but fewer people have these conditions than heart disease, cancer, trauma, mental disorders, and hypertension (5, 6). Almost all high-cost patients utilize inpatient hospital services (7).

High costs result from prolonged hospitalization, brief hospitalization with intensive use of resources, or repeated hospitalization for the same condition. In a study of high-cost patients, repeated hospitalization was considerably more frequent than single prolonged or cost-intensive hospitalization. About 20% of high-cost patients died during the year of the study. Very sick patients, who were kept alive for long periods through multiple clinical interventions, accounted for fewer than 10% of the high-cost patients. Unexpected complications were important factors that elevated patients from low-cost to high-cost status. The study concluded that repeated hospitalizations for the

## REDUCING USE OF HOSPITAL AND EMERGENCY DEPARTMENTS BY HIGH-COST PATIENTS

Physicians are the first to appreciate a fundamental reality: Ten percent of the population accounts for 70% of health care expenditures. Fifty percent of the population—healthy persons—are responsible for only 3% of health care expenditures. These relationships have held steady

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same illness are an important cause of very high costs (8). A study of hospitalizations for diabetes reached a similar conclusion (9).

Because Medicare data are easy to access and because many high-cost patients are Medicare beneficiaries, analyses of high-cost patients tend to focus on Medicare. Ninety-five percent of Medicare costs are incurred by people with 2 or more chronic conditions; by far, the most expensive Medicare patients in 1999 were elderly persons with 4 or more chronic conditions (10).

If most high-cost patients were near death, the opportunity to reduce spending on those individuals would be limited. However, only one fifth of people in the top 5% of Medicare spending in a given year died by the end of that year. Among Medicare beneficiaries who were consistently high spenders over 5 years (1995 to 1999), 60% were alive at the end of that period (7). Opportunities exist for cost reduction among persistently high-cost patients who are not near death, particularly because a substantial proportion of their costs are inpatient related. To take full advantage of this opportunity, high-cost patients must be identified and interventions made before these patients become high spenders (7). One successful cost-reduction program for high-cost patients is the improved management of congestive heart failure.

#### Post-Hospital Management of Congestive Heart Failure

Congestive heart failure is the most common indication for hospitalization among older adults (11). In 1995, Rich and colleagues (12) studied a nurse-directed program of patient education with post-hospital telephone calls and home visit follow-up for patients with congestive heart failure. Within 90 days, hospital readmissions decreased markedly and quality of life improved, resulting in a cost reduction of \$460 per patient in the intervention group compared with controls (12). Eleven randomized, controlled trials of similar nurse-led post-hospital interventions for congestive heart failure have been published; 7 of 8 trials that reported cost data saved money. Eight of the 11 trials found that readmission rates decreased from 22% to 45% in the intervention group. For the 9 trials in which multidisciplinary follow-up teams were used, the summary risk ratio for readmission for heart failure was 0.77 (95% CI, 0.68 to 0.86), indicating a reduction in readmissions of 23%. Quality outcomes improved or remained the same (11, 13).

Recent publications suggest that these programs are not cost-effective for all patients with congestive heart failure (14, 15). The programs that successfully reduce costs are targeted to high-risk patients, are initiated in the hospital or shortly after discharge, and include postdischarge face-to-face encounters with nurse care managers rather than telephone-only contact (16). Because these programs reduce hospital revenues, hospitals are unlikely to sponsor them. The Medicare program, which realizes the savings, is the logical entity to require or reimburse such programs.

**Table. Thinking about Specific Cost-Reduction Programs**

It is helpful to ask 5 questions about concrete cost-reduction programs in specific institutions.

1. Who benefits from a cost reduction effort: purchaser, insurer, provider, patient, or society?
2. Are financial incentives aligned to promote cost reduction? An organization that earns more money by providing more services is unlikely to engage in cost reduction. Cost-containment programs in globally budgeted institutions, such as Kaiser Permanente or the Veterans Affairs systems, may not generalize to other settings because these institutions have aligned their financial incentives in favor of cost reduction.
3. Is it possible to identify the patients whose health expenditures might be lowered? Ideally, efforts would be made to identify and case-manage patients whose costs are likely to be high in the future.
4. Is the timeline for cost reduction short or long? How does the timeline affect the "business case" for cost-reduction programs? Few health plans will invest in cost-control efforts whose savings will be delayed for 10 or 20 years.
5. Will the cost reduction effort truly protect quality of care?

#### Other Post-Hospital Programs

The concept of nurse-run post-hospital programs can be extended from patients with congestive heart failure to elderly people with multiple diagnoses. In 1 study, such a program markedly reduced the readmission rate, causing mean total charges to be 63% less for the intervention group than the control group (17).

Forty percent to 50% of patients with chronic obstructive pulmonary disease—another high-cost diagnosis—who are discharged from hospitals are readmitted during the following year. A patient education program with regular follow-up was associated with a 40% reduction in admissions for chronic obstructive pulmonary disease and improved quality of life compared with controls (18).

Fewer hospitalizations could not only reduce costs but also avoid serious illnesses in elderly persons. Many functionally independent elderly persons are no longer independent after hospital discharge. Bed rest rapidly reduces muscle strength and aerobic ventilatory capacity, thereby increasing the risk for falls, confusion, and future dependency. The vertebral bone loss caused by 10 days of bed rest requires 4 months to restore, thereby increasing risk for fracture. The cascade of physiologic decline initiated by a hospitalization may prove irreversible (19).

Physicians are ideally suited to encourage post-hospital interventions for high-utilizing patients with congestive heart failure and other chronic conditions, thereby contributing to cost reduction and quality enhancement.

#### DISEASE MANAGEMENT PROGRAMS

"Disease management" is a general term for programs that focus on 1 or more chronic illnesses and attempt to improve quality and reduce costs incurred by people with chronic conditions. Post-hospital heart failure interventions are an example. The success of programs such as those targeting high-risk patients with heart failure has helped drive enthusiasm for disease management. Disease

management programs may or may not be high-user interventions, depending on whether they target entire groups with chronic conditions or restrict their focus to high-risk patients.

Because care of chronic illness consumes 78% of national health care expenditures (20), the disease management movement has become a growth industry in the United States (21). The premise is that consistent intervention in chronic disease, guided by evidence-based medicine and coordinated care, results in better care, less illness, and lower costs.

Do disease management programs truly cut costs? Some do and some do not. The programs for management of congestive heart failure described earlier reduce expenditures because they target individuals, most of whom are in the top 10% of health care spenders. Programs for children with moderate or severe persistent asthma who have been hospitalized have been shown to save money, whereas similar programs for children with less severe asthma do not reduce costs (22). The cost-saving congestive heart failure and asthma interventions are programs only for high users of health care resources. Disease management vendors who proclaim cost savings often restrict their efforts to high users rather than large groups (23, 24).

Savings are difficult to demonstrate for programs aimed at all patients with chronic conditions of high prevalence (most of whom are not yet high users), particularly conditions whose complications manifest themselves far in the future. A review of diabetes programs involving components of Edward Wagner's Chronic Care Model—planned visit clinics, case management, reminder prompts, and performance feedback reports—found that 7 of 9 studies reported reduced health care use or reduced costs. However, most of these programs were experimental and of short duration, and in some cases costs increased again when the research protocol ended (22). A study of 4 disease management programs (for coronary artery disease, heart failure, diabetes, and asthma) at Kaiser Permanente from 1996 to 2002 found that the programs were associated with substantial quality improvement but not cost savings (25, 26). A recent report from the U.S. Congressional Budget Office also raises questions about the cost-saving promise of disease management (15).

Under most fee-for-service arrangements, the costs of disease management programs may be borne by the provider organization, whereas savings (if they exist) accrue to the insurer. Integrated systems with global budgets (for example, Kaiser Permanente and Veterans Affairs hospitals) both bear the program costs and reap the benefits of reduced use of hospitals and emergency departments. Analyses of “costs to whom” and the related alignment of incentives are an essential part of constructing the elusive business case for chronic disease management (27). In the case of diabetes, effective cost reduction requires identifying which patients will be the high-cost patients of the future and effectively intervening with those patients (7). Although some prediction models

for future high-cost patients exist (28), they have not always proven to be reliable (7).

The time frame for return on investment poses challenges to the cost-control potential of disease management programs. If a person with diabetes receives excellent care, thereby delaying the onset of end-organ complications, are costs saved through reductions in myocardial infarctions and end-stage renal disease, or are costs increased because the patient lives longer and incurs more expenditures by virtue of needing medical care for more years? Lubitz and associates (29) compared noninstitutionalized patients in good health at 70 years of age with those in poor health at 70 years of age. People in good health lived longer, thereby incurring more years of medical expenditures; those in poor health had more expenditures per year for fewer years. The data showed that total health expenditures from 70 years of age to death were equal for the 2 groups, suggesting that improved chronic care before 70 years of age neither increases nor reduces health expenditures over the lifetime of the patient (29). A business-case “home run” in diabetes management would be hit by a program that lasts at least 20 years within the organization reaping the cost reductions; is utilized by patients who remain in that organization for at least 20 years; and markedly reduces the rate of myocardial infarctions, strokes, leg amputations, and end-stage renal disease among its participants. Such home runs are rare.

Even though the cost-containment potential of disease management programs is uncertain, these programs aspire to the dual goals of quality improvement and cost containment. Disease management programs initiated by health insurance plans and managed by vendor companies often fail to involve physicians in a central role. In contrast, programs that develop within provider organizations—hospitals; physician groups; and group-model health maintenance organizations, such as Kaiser Permanente, Group Health in Seattle, and HealthPartners in Minnesota—offer important innovations in which physicians can lead and participate.

## REDUCING MEDICAL ERRORS

Quality problems are generally categorized as underuse, overuse, and misuse (30). High-user and chronic disease management programs attempt to correct underuse of ambulatory and home-care programs in order to reduce overuse of hospitals and emergency departments. Error reduction is aimed at misuse.

Unexpected complications, often resulting from medical errors, may catapult hospitalized patients from the low-cost to the high-cost category (8). One study estimated savings from eliminating preventable errors during hospitalization as being in the range of \$5 billion to \$10 billion per year (31). Another estimate placed savings at \$17 billion per year (32). These amounts may be small in relation to total health expenditures, but they are substantial.

Solutions to the problem of medical errors involve physician-driven activities that combine cost reduction with quality improvement. One example of an error-reduction intervention is computerized physician order entry for inpatients (33). Physicians have resisted this intervention when it was poorly implemented (34). An alternative would be for all physicians to participate in planning in-hospital computerization so that the innovation is implemented in an effective and physician-friendly manner.

### STRENGTHENING PRIMARY CARE

Primary care has the potential to reduce costs while preserving quality. Studies of ambulatory care-sensitive conditions (conditions, such as diabetes or congestive heart failure, for which timely, appropriate diagnosis and treatment may result in reduced hospitalization) have shown that hospitalization rates and expenditures for those conditions are higher in areas with fewer primary care physicians (35) and limited access to primary care (36). Systems that link patients with primary care physicians are associated with reduced hospitalizations for ambulatory care-sensitive conditions (37, 38). Adults 18 to 64 years of age in urban California communities with poorer access to primary care had higher hospitalization rates for 5 ambulatory care-sensitive chronic conditions than did similar patients with better access to primary care (39).

Strengthening primary care may also result in more appropriate use of specialists (40). Schroeder and Sandy (41) have labeled specialty care as “the invisible driver of health care costs.” Costs are higher in regions with higher ratios of specialist to generalist physicians (42, 43). Baicker and Chandra (44) showed that states with more specialists have higher per capita Medicare spending, suggesting that this relationship may be driven by the use of more intensive, costly interventions. Although specialists provide higher-quality care for some conditions, the large Medical Outcomes Study showed that primary care physicians, using fewer resources, deliver care similar in quality to that of specialists for such conditions as diabetes and hypertension (45, 46).

Both specialists and primary care physicians can encourage efforts to strengthen primary care structures that may reduce unnecessary hospitalizations while maintaining quality. These efforts may or may not involve an increased number of primary care physicians per capita (depending on the geographic region); more important, they include modes of primary care reimbursement that are adequate and that promote better quality, and redesign of primary care practices to improve the basic management of ambulatory care-sensitive conditions.

### REDUCING INAPPROPRIATE CARE

Eliminating inappropriate care is a well-recognized strategy to reduce costs while improving quality. Although appropriateness is difficult to measure (47), well-recog-

nized criteria, which were clinically tested in several cases, have been developed for the appropriateness of various procedures (48).

Examples of inappropriate or possibly inappropriate care abound in the literature (49). Some studies have examined variation in rates of procedures; others may have applied appropriateness criteria to specific cases by using chart audits. More than 20% of patients with cancer receive chemotherapy in the last 3 months of life, and this percentage is similar for patients whose cancer is responsive to chemotherapy and those whose disease is unresponsive (50). Estimates of unnecessary inpatient hospital days have ranged from 25% to 50% (51, 52). A recent analysis of Medicare beneficiaries 65 to 75 years of age found that 15% of coronary artery bypass surgeries were performed for an uncertain indication and 10% were inappropriate; 54% of angioplasties had an uncertain indication and 14% were inappropriate (53). Increasing rates of spinal fusion surgery for conditions for which no evidence of benefit exists—with high rates of reoperation and complications—suggest substantial inappropriate care (54, 55).

Elimination of inappropriate prescriptions could also generate cost savings. In 1 study, 40% of prescriptions written for hypertension did not conform to evidence-based guidelines (56). For elderly patients with hypertension in the United States in 2001, physician noncompliance with guidelines cost about \$1.2 billion (56).

As noted in article 3 of this series (3), states and regions featuring high-intensity medical practice with high per capita Medicare costs do not provide better quality of care, as measured by use of various preventive or treatment processes associated with improved outcomes, than do states and regions with more conservative practice patterns (57–59). A major difference between conservative and high-intensity regions is the number of physicians involved in the care of a given patient. High-intensity practice is likely to involve inappropriate and harmful care (60).

Achievement of quality-enhancing cost reduction by reduction of inappropriate care is difficult. It is easier to judge appropriateness after, rather than before, an intervention has been performed. Shared decision making, in which educated and active patients are involved in treatment decisions, may be the best remedy for costly, inappropriate care. In 6 of 7 studies, shared decision making was associated with 21% to 44% reductions in more invasive surgical options—including coronary revascularization, hysterectomy, mastectomy, back surgery, and prostatectomy—without adverse outcomes (61).

High-quality shared decision making requires patients who can engage in discussions as informed partners, which in turn requires use of patient decision aids. These are evidence-based tools that allow physicians to accurately inform patients of available options and their consequences. These tools are not widely utilized at present (61). For chronic illnesses, such as diabetes, shared decision making is associated with better health-related behaviors and im-

proved clinical outcomes (62, 63). Physicians can seek to minimize inappropriate care by using decision aids that bring evidence-based knowledge to the point of care and by engaging patients in shared decision making.

### DIFFUSION OF TECHNOLOGY ASSESSMENT

Article 2 in this series reviewed the evidence that new technologies are adopted more rapidly in the United States compared with other developed nations, thereby increasing their use and cost (2). Although novel technologies may benefit patient care, high rates of use of these technologies could represent inappropriate care. Technology assessment—the process of determining which technologies are clinically indicated for which patients (64)—is an important tool to assist physicians in limiting inappropriate use of medical advances. The results of technology assessment can be incorporated into patient decision aids and used when engaging patients in shared decision making.

### CONCLUSION

The 4-part series that concludes with this article explains that the high and rising health care expenditures in the United States are caused by a variety of factors. The most important of these are the market power of physicians, hospitals, and pharmaceutical companies, which has enabled these providers and suppliers to garner high prices for their services and products, and the rapid diffusion of high-cost innovative technologies.

Several measures may contain rising health care costs. Among these are encouragement of competition among providers and health insurance plans, linking of provider payment to health technology assessment so that new technologies are not utilized inappropriately, placing of controls on prices of services and products or on the quantities of services provided, and institution of expenditure caps or global budgets that limit the total amount of money flowing into the health system.

Most of these cost-containment measures do not connect closely with physician practice. They are instituted, strengthened, weakened, or discontinued by governments or large health insurance plans. However, several approaches to high and rising health care costs are directly tied to daily medical practice. It is these physician-connected strategies—which may help to control health care expenditures while protecting quality—that have been the topic of this final article.

We believe that high and rising costs are a serious menace to the future of our health care system. As expenditures rise, Medicare, Medicaid, and private insurers reduce coverage; costs are shifted to individuals, thereby reducing access to needed care for some. Most of us, as physicians, have experienced how rising costs can create difficulties in caring for our patients: For example, the growing cost of prescription drugs, which are frequently not covered by insurance, has often restricted our thera-

peutic choices for elderly patients. Escalating patient responsibility for payment in an environment of rising prices will further restrict physicians' diagnostic and treatment options for the sizable proportion of patients with limited financial means. If cost increases are not moderated, our satisfaction at being able to offer patients beneficial clinical innovations may give way to frustration, as our patients become unable to afford those same innovations.

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### References

1. Bodenheimer T. High and rising health care costs. Part 1: seeking an explanation. *Ann Intern Med.* 2005;142:847-54.
2. Bodenheimer T. High and rising health care costs. Part 2: technologic innovation. *Ann Intern Med.* 2005;142:932-7.
3. Bodenheimer T. High and rising health care costs. Part 3: the role of health care providers. *Ann Intern Med.* 2005;142:996-1002.
4. Berk ML, Monheit AC. The concentration of health care expenditures, revisited. *Health Aff (Millwood).* 2001;20:9-18. [PMID: 11260963]
5. Cohen JW, Krauss NA. Spending and service use among people with the fifteen most costly medical conditions, 1997. *Health Aff (Millwood).* 2003;22:129-38. [PMID: 12674416]
6. Thorpe KE, Florence CS, Joski P. Which medical conditions account for the rise in health care spending? *Health Affairs.* Web Exclusive. 25 August 2004. W-4-437-445. Accessed at <http://content.healthaffairs.org/cgi/content/full/hlthaff.w4.437/DC1> on 24 November 2004.
7. Lieberman SM, Lee J, Anderson T, Crippen DL. Reducing the growth of Medicare spending: geographic versus patient-based strategies. *Health Affairs.* Web Exclusive. 10 December 2003. W3-603-613. Accessed at <http://content.healthaffairs.org/cgi/content/full/hlthaff.w3.603v1/DC1> on 24 November 2004.
8. Zook CJ, Moore FD. High-cost users of medical care. *N Engl J Med.* 1980;302:996-1002. [PMID: 6767975]
9. Jiang HJ, Stryer D, Friedman B, Andrews R. Multiple hospitalizations for patients with diabetes. *Diabetes Care.* 2003;26:1421-6. [PMID: 12716799]
10. Wolff JL, Starfield B, Anderson G. Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. *Arch Intern Med.* 2002;162:2269-76. [PMID: 12418941]
11. Rich MW. Heart failure disease management programs: efficacy and limitations [Editorial]. *Am J Med.* 2001;110:410-2. [PMID: 11286961]
12. Rich MW, Beckham V, Wittenberg C, Leven CL, Freedland KE, Carney RM. A multidisciplinary intervention to prevent the readmission of elderly patients with congestive heart failure. *N Engl J Med.* 1995;333:1190-5. [PMID: 7565975]
13. McAlister FA, Lawson FM, Teo KK, Armstrong PW. A systematic review of randomized trials of disease management programs in heart failure. *Am J Med.* 2001;110:378-84. [PMID: 11286953]
14. DeBusk RF, Miller NH, Parker KM, Bandura A, Kraemer HC, Cher DJ, et al. Care management for low-risk patients with heart failure: a randomized, controlled trial. *Ann Intern Med.* 2004;141:606-13. [PMID: 15492340]
15. Congressional Budget Office. An Analysis of the Literature on Disease Management Programs, October 13, 2004. Accessed at [www.cbo.gov](http://www.cbo.gov) on 29 November 2004.
16. Wagner EH. Deconstructing heart failure disease management [Editorial].

- Ann Intern Med. 2004;141:644-6. [PMID: 15492346]
17. Naylor M, Brooten D, Jones R, Lavizzo-Mourey R, Mezey M, Pauly M. Comprehensive discharge planning for the hospitalized elderly. A randomized clinical trial. *Ann Intern Med.* 1994;120:999-1006. [PMID: 8185149]
  18. Bourbeau J, Julien M, Maltais F, Rouleau M, Beaupre A, Begin R, et al. Reduction of hospital utilization in patients with chronic obstructive pulmonary disease: a disease-specific self-management intervention. *Arch Intern Med.* 2003;163:585-91. [PMID: 12622605]
  19. Creditor MC. Hazards of hospitalization of the elderly. *Ann Intern Med.* 1993;118:219-23. [PMID: 8417639]
  20. Anderson G, Horvath J. *Chronic Conditions: Making the Case for Ongoing Care.* Baltimore: Johns Hopkins Univ Pr; 2002.
  21. Bodenheimer T. Disease management—promises and pitfalls. *N Engl J Med.* 1999;340:1202-5. [PMID: 10202174]
  22. Bodenheimer T, Wagner EH, Grumbach K. Improving primary care for patients with chronic illness: the chronic care model, Part 2. *JAMA.* 2002;288:1909-14. [PMID: 12377092]
  23. Villagra VG, Ahmed T. Effectiveness of a disease management program for patients with diabetes. *Health Aff (Millwood).* 2004;23:255-66. [PMID: 15318587]
  24. Fetterolf D, Wennberg D, Devries A. Estimating the return on investment in disease management programs using a pre-post analysis. *Dis Manag.* 2004;7:5-23. [PMID: 15035830]
  25. Fireman B, Bartlett J, Selby J. Can disease management reduce health care costs by improving quality? *Health Aff (Millwood).* 2004;23:63-75. [PMID: 15584100]
  26. Crosson FJ, Madvig P. Does population management of chronic disease lead to lower costs of care? *Health Aff (Millwood).* 2004;23:76-8. [PMID: 15537587]
  27. Leatherman S, Berwick D, Iles D, Lewin LS, Davidoff F, Nolan T, et al. The business case for quality: case studies and an analysis. *Health Aff (Millwood).* 2003;22:17-30. [PMID: 12674405]
  28. Dove HG, Duncan I, Robb A. A prediction model for targeting low-cost, high-risk members of managed care organizations. *Am J Manag Care.* 2003;9:381-9. [PMID: 12744300]
  29. Lubitz J, Cai L, Kramarow E, Lentzner H. Health, life expectancy, and health care spending among the elderly. *N Engl J Med.* 2003;349:1048-55. [PMID: 12968089]
  30. Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington, DC: National Academy Pr; 2001.
  31. Zhan C, Miller MR. Excess length of stay, charges, and mortality attributable to medical injuries during hospitalization. *JAMA.* 2003;290:1868-74. [PMID: 14532315]
  32. Medical Errors: The Scope of the Problem. Fact Sheet. Rockville, MD: Agency for Healthcare Research and Quality; 2000. Publication no. AHRQ 00-P037. Accessed at [www.ahrq.gov/qual/errback.htm](http://www.ahrq.gov/qual/errback.htm) on 7 December 2004.
  33. Bates DW, Leape LL, Cullen DJ, Laird N, Petersen LA, Teich JM, et al. Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. *JAMA.* 1998;280:1311-6. [PMID: 9794308]
  34. Cedars-Sinai Medical Center suspends use of computerized physician order entry system. *Los Angeles Times.* 22 January 2003:B.1.
  35. Parchman ML, Culler S. Primary care physicians and avoidable hospitalizations. *J Fam Pract.* 1994;39:123-8. [PMID: 8057062]
  36. Basu J, Friedman B, Burstin H. Managed care and preventable hospitalization among Medicaid adults. *Health Serv Res.* 2004;39:489-510. [PMID: 15149475]
  37. Zhan C, Miller MR, Wong H, Meyer GS. The effects of HMO penetration on preventable hospitalizations. *Health Serv Res.* 2004;39:345-61. [PMID: 15032958]
  38. Backus L, Moron M, Bacchetti P, Baker LC, Bindman AB. Effect of managed care on preventable hospitalization rates in California. *Med Care.* 2002;40:315-24. [PMID: 12021687]
  39. Bindman AB, Grumbach K, Osmond D, Komaromy M, Vranizan K, Lurie N, et al. Preventable hospitalizations and access to health care. *JAMA.* 1995;274:305-11. [PMID: 7609259]
  40. Franks P, Clancy CM, Nutting PA. Gatekeeping revisited—protecting patients from overtreatment. *N Engl J Med.* 1992;327:424-9. [PMID: 1625720]
  41. Schroeder SA, Sandy LG. Specialty distribution of U.S. physicians—the invisible driver of health care costs [Editorial]. *N Engl J Med.* 1993;328:961-3. [PMID: 8446146]
  42. Starfield B. *Primary Care.* New York: Oxford Univ Pr; 1998.
  43. Welch WP, Miller ME, Welch HG, Fisher ES, Wennberg JE. Geographic variation in expenditures for physicians' services in the United States. *N Engl J Med.* 1993;328:621-7. [PMID: 8429854]
  44. Baicker K, Chandra A. Medicare spending, the physician workforce, and beneficiaries' quality of care. *Health Affairs.* Web Exclusive. 7 April 2004. Accessed at <http://content.healthaffairs.org/cgi/content/full/hlthaff.w4.184v1/DC1> on 24 November 2004.
  45. Greenfield S, Rogers W, Mangotich M, Carney MF, Tarlov AR. Outcomes of patients with hypertension and non-insulin dependent diabetes mellitus treated by different systems and specialties. Results from the medical outcomes study. *JAMA.* 1995;274:1436-44. [PMID: 7474189]
  46. Greenfield S, Nelson EC, Zubkoff M, Manning W, Rogers W, Kravitz RL, et al. Variations in resource utilization among medical specialties and systems of care. Results from the medical outcomes study. *JAMA.* 1992;267:1624-30. [PMID: 1542172]
  47. Naylor CD. What is appropriate care? [Editorial] *N Engl J Med.* 1998;338:1918-20. [PMID: 9637815]
  48. Shekelle PG. Are appropriateness criteria ready for use in clinical practice? [Editorial] *N Engl J Med.* 2001;344:677-8. [PMID: 11228286]
  49. Leape LL. Unnecessary surgery. *Annu Rev Public Health.* 1992;13:363-83. [PMID: 1599594]
  50. Emanuel EJ, Young-Xu Y, Levinsky NG, Gazelle G, Saynina O, Ash AS. Chemotherapy use among Medicare beneficiaries at the end of life. *Ann Intern Med.* 2003;138:639-43. [PMID: 12693886]
  51. Brook RH. Practice guidelines and practicing medicine. Are they compatible? *JAMA.* 1989;262:3027-30. [PMID: 2810647]
  52. Axene DV, Doyle RL, van der Burch D. Analysis of Medically Unnecessary Inpatient Services. New York: Milliman & Robertson; 1997.
  53. Schneider EC, Leape LL, Weissman JS, Piana RN, Gatsonis C, Epstein AM. Racial differences in cardiac revascularization rates: does "overuse" explain higher rates among white patients? *Ann Intern Med.* 2001;135:328-37. [PMID: 11529696]
  54. Deyo RA, Nachemson A, Mirza SK. Spinal-fusion surgery—the case for restraint. *N Engl J Med.* 2004;350:722-6. [PMID: 14960750]
  55. Deyo RA. Cascade effects of medical technology. *Annu Rev Public Health.* 2002;23:23-44. [PMID: 11910053]
  56. Fischer MA, Avorn J. Economic implications of evidence-based prescribing for hypertension: can better care cost less? *JAMA.* 2004;291:1850-6. [PMID: 15100203]
  57. Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 1: the content, quality, and accessibility of care. *Ann Intern Med.* 2003;138:273-87. [PMID: 12585825]
  58. Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 2: health outcomes and satisfaction with care. *Ann Intern Med.* 2003;138:288-98. [PMID: 12585826]
  59. Medicare Payment Advisory Commission. Variation and Innovation in Medicare. June 2003. Accessed at [www.medpac.gov/publications](http://www.medpac.gov/publications) on 25 January 2005.
  60. Fisher ES. Medical care—is more always better? [Editorial] *N Engl J Med.* 2003;349:1665-7. [PMID: 14573739]
  61. O'Connor AM, Llewellyn-Thomas HA, Floor AB. Modifying unwarranted variations in health care: shared decision making using patient decision aids. *Health Affairs.* Web Exclusive. 7 October 2004. VAR-63-72. Accessed at <http://content.healthaffairs.org/cgi/content/full/hlthaff.var.63/DC2> on 24 November 2004.
  62. O'Brien MK, Petrie K, Raeburn J. Adherence to medication regimens: updating a complex medical issue. *Med Care Rev.* 1992;49:435-54. [PMID: 10123082]
  63. Heisler M, Bouknight RR, Hayward RA, Smith DM, Kerr EA. The relative importance of physician communication, participatory decision making, and patient understanding in diabetes self-management. *J Gen Intern Med.* 2002;17:243-52. [PMID: 11972720]
  64. Banta D. The development of health technology assessment. *Health Policy.* 2003;63:121-32. [PMID: 12543525]

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