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The Future of Cardiology: Utilization and Costs of Care

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The 20th century has seen an explosion in medical knowledge, spurred by advances in science and new technology, resulting in better diagnostic methods and treatment advances. The outcome has been to extend life and improve quality of life for people, particularly those with heart disease. Life expectancy at birth is now approaching 77 years, from less than 70 years of age in 1960, and less than 50 years in 1900 (1). The value of advances in medicine is evidenced by the growth in medical care services from less than 6% of the U.S. economy in 1960 to 14% of the gross domestic product (GDP), now exceeding $1 trillion a year (1).

The success of advances in the diagnosis and treatment of heart and vascular disease is reflected in part by declining overall mortality for acute myocardial infarction and other diseases of the heart. Even so, heart disease remains the leading cause of death for Americans and other people around the world (1). However, because of demographic changes and the ability to treat previously fatal conditions, absolute numbers of people living with cardiovascular disease will increase in the near future (2). The cost-related impact of these changes is examined in this report.

Expected advances in prevention and treatment technologies are exciting and promise to further reduce heart disease–related mortality and morbidity. In this report, we examine the cost impact of possible future scenarios. Enthusiasm must be tempered, however, by the knowledge that life is limited and there will be competing causes of death, including cancers, Alzheimer's disease, and other diseases. Our examination of the current and future cost of heart disease is limited to direct medical care cost, including the cost of services related to prevention, diagnosis, treatment, and rehabilitation of people with heart disease. No estimates will be made regarding the substantial indirect cost of heart disease to society, including the cost of lost opportunities related to disability and premature death from heart disease.

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Using three scenarios of the future, we examine potential cost implications of some future advances in cardiac sciences in 2010 and 2025. We have chosen to estimate future cost using three different scenarios to simplify assumptions and decrease confounding information. We recognize that these models are based on assumptions and that the most likely future reality will include some aspects of all the scenarios.

Scenario 1 describes the demographic changes facing the U.S. The average age of the U.S. population is increasing, and the percentage of the population over age 65 is growing rapidly. Because the prevalence of heart disease increases with age, as do health care utilization and cost, aging alone will contribute to a substantial increase in cost. The impact of demographic and other factors is calculated using 1999 data.

Scenario 2 examines the potential impact of advances in prevention that might lead to new drugs or gene therapies for preventing atherosclerosis and coronary artery disease (CAD). These would complement or replace current medications used to control diabetes, obesity, high blood pressure, and high cholesterol, thereby preventing heart attacks, strokes, and renal failure. These projections also are based on 1999 data.

Scenario 3 examines the potential impact of improvements in treatment, including new drugs to treat heart failure and widely available heart transplantation, which would rely more heavily on swine hearts.

The three scenarios then are combined to provide an estimate of the combined effects of demographic changes and improvements in prevention and treatment in 2010 and 2025.

METHODOLOGY

Our methods for projecting the future cost of heart disease are based on the most recently available cost data, projecting costs to 1999 so that it can be used as the base year. Future cost increases or decreases in 2010 and 2025 are projected, using 1999 dollars and ignoring the effects of future inflation in prices.

We have chosen to model future costs of heart diseases, including CAD, congestive heart failure, and part of hypertensive disease, as well as other "heart" diseases. Using the ICD-9 CM disease classification, our analysis included

codes from 391–398, 402, 404, 410–416, and 420–429. Excluded are congenital anomalies of the heart, symptoms that might involve the cardiovascular system, and renal and pulmonary sequelae.

In some cases, it is not possible to obtain information on utilization and cost of heart disease alone, but information is available on all cardiovascular diseases, including heart disease, hypertensive disease, and cerebrovascular disease. When possible, cost information is provided on all cardiovascular diseases as well as heart disease alone; heart disease accounts for 60% of the cost of all cardiovascular disease (3,4).

Our work builds directly on the work of Hodgson and Cohen (3), who took the total health care cost in 1995 and identified the proportion represented by all cardiovascular diseases (16.9%) and by heart disease alone (10%). The projections made by the American Heart Association for 1999 (4) use the work of Hodgson and Cohen to predict 1999 cost for heart disease and for all cardiovascular diseases.

To simplify the comparison of costs over time, all future costs are stated in terms of 1999 dollars. This simplification holds the value of the dollar constant, ignoring any future effects of inflation on the value of a dollar and on total health care cost. In the calculation of the cost-effectiveness of prevention (scenario 2), future cost is discounted at the rate of 3% per year to estimate present value.

A generally accepted measure of effectiveness or benefits from a life-saving medical intervention is the number of quality-adjusted life years (QALYs) added to the patient's life. The QALY is the number of years added to life, including an adjustment to take into account the extent of disability, pain, or other limitations. This adjustment can be made using patient utilities for different health states; for example, one year of additional life with angina (without congestive heart failure) is equivalent to 0.84 QALYs (5). Our scenarios will use QALYs to calculate the cost of preventive interventions per QALY.

Various costs of care are estimated for major categories of service, including hospital (inpatient and outpatient), physician, nursing home, drugs, home health, and other health care costs using national data sources (6). Costs include all services paid for by Medicare, Medicaid, and private insurance, as well as out-of-pocket expenditures paid by patients. The overall contribution of circulatory system disease to total U.S. health care expenditures is discussed.

RESULTS

Total U.S. Health Care Expenditures

The U.S. health care system is the most expensive in the world. The U.S. spent over 14% of its GDP, or one in every seven dollars, on health care in 1998. Total health care expenditures are approximately $1 trillion, divided among the following: hospital care, 38%; physician services, 22%; other professional and dental services, 12%; drugs, 11%; nursing home and home health care, 12%; and other costs, 5% (Fig. 1). The fastest growing category is drugs, whereas the growth in home health care has slowed, and expenditures for hospital and physician services now account for a smaller proportion of total costs than they did in 1990 (6). Hospital expenditures declined from 42% of total health care expenditures in 1990 to 38% by 1997, and physician expenditures declined from 24% in 1990 to 22% by 1997.

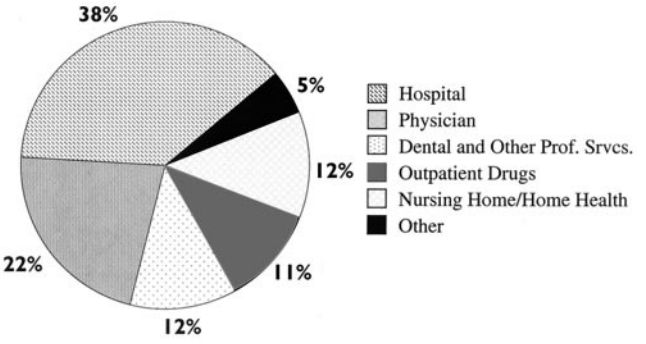

Figure 1. Distribution of total U.S. health care expenditures by type of service (HCFA 1999).

Expenditures for Heart Disease

Extrapolating forward to 1999, total U.S. health care expenditures are expected to be $1,059 billion, of which $178 billion (16.8%) will be for all cardiovascular diseases and $102 billion (9.6%) will be for heart disease alone (4). Hospital care, including inpatient medications, is expected to account for 60% of the cost of heart disease, and the remaining 40% breaks down as follows: 13% for physician services, 7% for outpatient drugs, 4% for home health care, and 16% for nursing home care (Fig. 2).

Hospital Services

Inpatient services. The most recent hospitalization data show that there were 6.1 million discharges for all cardiovascular diseases, representing 19.7% of the 30.9 million

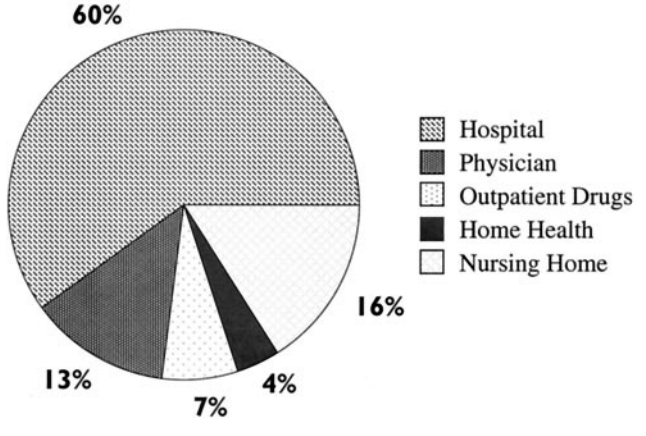

Figure 2. Distribution of U.S. health care expenditures for heart diseases by type of service, 1999 estimates (AHA 1998).

hospital discharges in 1997. Heart disease accounted for 4.2 million discharges, or 13.6% of all hospital discharges, occurring at the rate of 1,550 discharges per 100,000 population (7). Americans received 5.4 million inpatient cardiovascular procedures, with some of the frequent cardiac procedures being coronary artery bypass graft (CABG) surgeries on 366,000 patients, 1.1 million cardiac catheterizations, and 317,000 pacemaker insertions or replacements. As would be expected, cardiovascular procedure rates were highest among patients age 65 and older (8,608 per 100,000), and the number of procedures declines with younger age (3,297 for ages 45–64, and less than 50 per 100,000 for patients under 45 years).

Ambulatory surgery. Operative and diagnostic procedures are being done more frequently on an outpatient basis and no longer require hospitalization, even though most ambulatory surgery is done in a hospital facility. In 1996, 898,000 (2.9%) of the 31.5 million procedures done in ambulatory settings, or 340 per 100,000 persons, were operations on the cardiovascular system (8). The most frequently performed cardiac procedure was catheterization, which accounted for 472,000 (52.6%) of these procedures. Adding together inpatient and ambulatory catheterization procedures, the total was 1.57 million in 1997, or an overall rate of 600 per 100,000.

Emergency and outpatient department services. In 1997, 4.5 million patient visits (4.7% of all visits) to hospital emergency departments were diagnosed as cardiovascular disease (9). This figure represents 1,700 visits per 100,000 people per year. In addition, there were 77 million visits to hospital outpatient departments in 1997. Cardiovascular disease accounted for 4.8 million of the 77 million visits (6.6%), or 1,800 visits per 100,000 people per year. One of the most commonly occurring diagnoses was essential hypertension (3.1 million visits), which accounted for a majority of all cardiovascular disease visits (10).

Projected 1999 expenditures for hospital services. Projecting expenditures from 1997 to 1999, hospital costs are expected to be $60.3 billion for heart disease and $89.2 billion for all cardiovascular disease. Total U.S. hospital costs in 1999 are expected to be $395 billion, of which cardiovascular disease will comprise 22.6%, including 15.3% for heart disease.

Physician Services

Statistics are available for physician office-based services; no comparable data are available for inpatient physician services in the U.S. In 1997, there were 787 million office visits to physicians (11). Including all physician specialties, the primary diagnosis for 80.2 million physician visits was cardiovascular disease, representing 10.2% of all physician office visits, or 30,000 per 100,000 people. These diagnoses included 29.7 million visits (3.5%) for hypertension; 10.7 million (1.4%) for ischemic heart disease; and 9.2 million (1.2%) for other heart diseases, excluding ischemia. Physicians identifying themselves as cardiovascular specialists reported 17.3 million visits, or 2.2% of the 787 million physician visits, representing 6,500 visits per 100,000 people. Drugs were prescribed during 83% of these visits, with an average of 4.6 drugs prescribed per visit.

Projected 1999 physician expenditures for all cardiovascular disease are $26.8 billion; for heart disease alone, expenditures total $13.8 billion (4). Total physician expenditures are expected to be $233 billion in 1999, with 11.5% for all cardiovascular disease and 5.9% for heart disease.

Prescription Drugs

Prescription drug cost is rising more rapidly than other health expenditure. In 1999, outpatient prescription cost was expected to be $6.6 billion for heart disease (6.5% of total heart disease cost) and $16 billion for all cardiovascular disease, accounting for 9% of all cardiovascular disease costs (4). As a percentage of total 1999 U.S. health care expenditures, outpatient heart disease drugs represent 0.6%, and all cardiovascular disease drugs account for 1.6%.

Nursing Homes and Home Health

In 1995, 1.39 million Americans were nursing home residents (7). A primary diagnosis of cardiovascular disease was given to 27.1% of these individuals, including 10.9% with heart disease, 2.4% with cerebrovascular disease, and 3.6% with essential hypertension. Projecting to 1999, nursing home cost for heart disease is expected to be $16.1 billion, and nursing home cost for all cardiovascular disease will likely be $35.1 billion. Total nursing home cost is expected to be $90.1 billion in 1999, with 39% being spent on all cardiovascular disease and 17.9% on heart disease.

In 1996, 2.5 million patients were using home health or hospice services, with a total of 8.2 million discharges from care occurring during the year (12). Classifying the 2.5 million patients by primary diagnosis reveals that 623,000 (25%) had cardiovascular disease, with 268,000 (10.8%) having heart disease and 108,000 (4.3%) having essential hypertension. Projected 1999 home health expenditures for heart disease are $4.0 billion, and $8.9 billion for all circulatory diseases.

Trends in Utilization

The growth in cardiovascular procedure volumes has been substantial over the past two decades. While volume for many procedures has doubled or tripled during this time period, hospitalization for cardiovascular disease has grown modestly. In 1979, there were approximately five million discharges with a principal diagnosis (first listed) of cardiovascular disease; by 1997, this number had increased only 20% to 6.1 million. The same trends occurred for CAD discharges and stroke. By contrast, discharges for congestive heart failure have approximately doubled from 1979 to 1997, totaling more than 900,000 in 1997 (4).

Hospitalizations have not increased as much as procedural volumes, partially because of the movement of proce-

Table 1. Estimated U.S. Population Age Distribution and Prevalence of Heart Disease: 1990–2025 (2)

	Percent of U.S. Population Age 65+	Prevalence of Heart Disease	Heart Disease Prevalence (millions)	Percent Males With Heart Disease
2000	12.6%	16.4%	23.4	49.9%
2010	13.2%	15.6%	27.1	51.1%
2025	18.3%	16.8%	34.3	52.2%

dures to ambulatory care settings. In 1996, 898,000 ambulatory procedures were performed on the cardiovascular system, and there were more than five million inpatient procedures. One of the high-volume procedures is cardiac catheterization, with 1.1 million inpatient procedures done in 1997. The most recent data available (1996) indicate that an additional 472,000 procedures were done in ambulatory surgery settings for a total number of catheterizations at more than 1.5 million procedures. This estimate represents an overall growth in cardiac catheterization procedures since 1979 of greater than 315% (4). In 1997, 366,000 patients underwent CABG surgery, representing an increase of more than 228% since 1979. Similar trends were noted for heart transplantation. In 1997, 2,290 heart transplants were performed in the 275 U.S. transplant centers, compared with 57 in 1980. The numbers of transplants performed continue to fall far short of the estimated requirement of 40,000 among those age 65 and younger (12,4). Growth in procedure rates is expected to continue to grow faster than hospital discharges in the near future.

1999 Heart Disease Costs: Summary and Limitations

Resources spent on services to prevent, diagnose, treat, or rehabilitate individuals with heart disease were expected to be $102 billion in 1999, accounting for approximately 10% of total U.S. health care expenditures. The majority were for hospital care (60%), followed by nursing home (16%) and physician services (13%), as shown in Figure 2. Cardiovascular procedures are being done more often in ambulatory surgery settings, most of which are hospital based. Other factors contributing to changes in the diagnostic mix of heart-disease patients admitted to hospitals include mortality trends. In particular, as the mortality rate for acute myocardial infarction has declined in recent years, there has been a growth in admissions for congestive heart failure. As a result there is greater demand for heart transplants, currently the most costly heart disease intervention. The high cost is not primarily from the complexity of the procedure or physician charges but instead is from drug costs and long hospital stays.

Our estimates of the future cost of heart disease were based on the 1999 cost of heart disease. The national averages used mask substantial variability in practice by geographic region. Several factors contribute to these variations, including geographic differences in the availability of services, differences in ability to pay and insurance coverage, and differences in physician practice patterns (13–15). One concern is that not all needs for cardiovascular care are currently being met. To the extent that the current health care system is failing to meet needs, our estimates of future use and cost of heart disease care will be understated.

Scenario 1: Impact of Population Changes

Scenario. The growth and aging of the U.S. population is expected to contribute to increased cost for the care of heart disease. In Table 1, Foot (2) estimates that the prevalence of heart disease (16.4% of the U.S. population in 2000) will change relatively little in 10 years (15.6%) and in 25 years (16.8%). However, because of a growing population, the number of people with heart disease is expected to increase from 23.4 million in 2000 to 27.1 million in 2010 and 34.2 million in 2025.

Assumptions and calculations. The estimated cost of heart disease in 1999 is $101.8 billion, including hospital, physician, drug, nursing home, and other health care costs. This cost equals approximately $4,350 per person with heart disease. Projecting the per-person cost to 2010 and 2025 results in total costs of $118 billion and $149 billion, respectively. These projections assume the same rates of diagnosis and treatment, and use of the same technologies as today. This calculation provides an estimate of the cost impact of demographic changes alone, including some increase in overall longevity, but no heart disease–specific changes in mortality.

Impact on costs. Demographic changes will lead to a 15% increase in expenditures for heart disease treatment by 2010 and a 46% increase by 2025, as measured in 1999 dollars.

Scenario 2: Impact of Improvements in Prevention of Cardiovascular Disease

Scenario. Let us assume that there are new "magic-bullet" drugs or nutriceuticals available by 2010 that can be taken by those with risk factors to prevent atherosclerosis and CAD. The drug cost is high, estimated to be $250 per month or approximately $8 per day in 1999 dollars. Future savings would be expected to occur because of the reduction in acute myocardial infarction and invasive treatments for CAD. By 2010, there would be little impact, but by 2025 the prevalence of CAD will have declined by 25%. Prevention of CAD is expected to add an average of two QALYs for people without CAD.

Assumptions and calculations. Currently 50% of people with heart disease have atherosclerotic disease. We assume the preventive drug or drugs will be taken by 50% of those who would be expected to benefit, and about 25% of ischemic disease and its costs will be prevented by 2025.

Coronary artery disease (ICD-9: 410–414) affects approximately half of those with heart disease and accounts for 51% of the total heart disease cost, estimated to be $51.9 billion in 1999 and $75.8 billion in 2025 if no preventive drugs are available. The potential is to save at least a quarter of this amount, or $19 billion, in 2025 with prevention. Among patients with CAD (estimated to be 17.2 million people or 8.4% of the population), we assume that half (8.6 million or 4.2% of the population) will take the drug regularly, and for one quarter (4.3 million or 2.1%) the disease will be prevented and cost of treatment saved. The cost of the drug or drugs for 8.6 million people would be $25.8 billion annually. Other costs would include periodic physician visits, which many of these individuals would already have. Before 2025, we assume, drug costs would be incurred for 15 years before any substantial savings would be achieved through prevention of subsequent CAD.

Cost impact. In 2010, an additional $25.8 billion a year will be spent for the preventive drug or drugs, adding 22% to heart-disease expenditures that year. No savings are expected before 2025, when CAD expenditures would be reduced by $19 billion because of prevention, but the continuing medication cost of $25.8 billion annually results in a net increase in cost of $6.8 billion in 2025. This figure represents an overall increase in 2025 heart-disease cost of 5%. If the cost of drugs is 50% lower than projected ($4 a day or $125 a month), there will be a net savings in 2025 of $6.1 billion or 4% of 2025 projected heart disease cost. However, if the cost of drugs is 50% higher, then overall cost would increase $19.7 billion, adding 13% to 2025 costs.

Cost-effectiveness. The preventive drug is assumed to be taken starting in 2010 for 15 years before the expected onset of CAD and for the next 10 years of life, adding two good years of life for 25% of the people who would have developed CAD. Future cost would be discounted at the rate of 3% per year.

The cost per QALY from prevention would be $41,000. If the cost of drugs is 50% lower ($4 a day), then the cost per QALY would decrease to $14,500, whereas a 50% increase in the cost of drugs ($12 a day) would increase the cost per QALY to $68,000.

Scenario 3: Impact of Improvements in Treatment Technologies

Scenario 3A. Suppose medications that reverse heart failure become available by 2010, and by 2025 these drugs have reduced hospitalizations for congestive heart failure. Assuming that the cost of medication is $250 a month or approximately $8 a day in 1999 dollars and there is 50% compliance, the potential savings could be 40% of congestive heart failure hospital cost. Physician charges and other costs would be expected to remain about the same.

Assumptions and calculations. If no changes in treatment occur by 2025, hospital costs for congestive heart failure are expected to be 11.3% of the total heart disease cost of $149 billion. Taking 40% of the $16.8 billion congestive heart failure hospital cost provides an estimate of $6.7 billion in potential savings. To estimate the cost of the new drug, assume that approximately 20% of people with heart disease who have congestive heart failure, or 6.8 million people, would be treated in 2025. Assuming 50% compliance with the full prescription, the drug cost would be $10.2 billion in 2025.

Cost impact. In 2025, treatment of congestive heart failure will increase costs by $3.5 billion, adding 2% to the total projected heart disease cost. If the cost of drugs is 50% lower ($4 a day), then there will be a net savings of $1.6 billion; a 50% increase in the cost of drugs ($12 a day) would lead to an overall increase of $8.6 billion in the cost of heart disease.

Scenario 3B. Assume that by 2010, swine heart transplantation has become common at roughly half the cost of a human transplant and that by 2025, the use of organs from swine has surged from a few thousand in 2010 to approximately 58,000 transplants a year, meeting the full demand.

Assumptions and calculations. Assume transplant costs average $150,000 per transplant, plus $10,000 per year for ongoing medical management. This estimate is somewhat more than half of the 1996 costs reported: $253,000 in the first year, with annual follow-up costs of $21,200 per year (12). In 1996, it was estimated that 40,000 people, or about 1,700 per 100,000 people with heart disease, needed replacement hearts each year, but only 5% of those needing a transplant received one. By 2025, it is assumed that all patients who need a transplant will have one, which will represent about 58,000 transplants a year at that time. Assuming that people live an average of 10 years with a transplanted heart, there will be approximately 522,000 who will need ongoing medical management. The estimated annual costs for transplantation will be $8.7 billion in 1999 dollars, and the annual medical management cost will be $5.2 billion, totaling $13.9 billion. Assume that this aggressive heart transplant program reduces the total cost of treating congestive heart failure by 50%. Congestive heart failure represents 18.7% of all heart disease costs, projected to total $149 billion in 2025. The savings would be 9.35% of the $149 billion of all heart disease costs, or $13.9 billion in 2025.

Cost impact. In 2025, the cost of heart transplants will equal the cost savings expected to be achieved by an expected 50% reduction in total expenditures for congestive heart failure. If reductions in congestive heart failure expenditures were to be greater than 50%, then there would be a net savings; less than 50% reductions would increase costs

over savings. However, if the cost of heart transplants does not decline by 50%, as predicted, then the additional cost would be $14.5 billion at current value (1999 dollars), adding 9.7% to total heart disease costs in 2025.

Combined Scenarios for Demographic Changes, Prevention, and Treatment

Scenario. The future is likely to represent the combined effects of demographic changes (Scenario 1), possible advances in the prevention of atherosclerosis and CAD (Scenario 2), and possible advances in the treatment of heart failure and heart transplantation (Scenario 3).

Assumptions and calculations. Assuming that a 25% reduction in CAD is achieved by 2025 (Scenario 2), for purposes of cost calculations we assume that this reduction will lead to a 50% reduction in congestive heart failure and a 50% reduction in the need for heart transplants.

In 2010, demographic changes will have increased the numbers of people with heart disease by 15%, and expenditures will have increased by $16 billion. The new CAD preventive drug is assumed to have been introduced in 2010, adding $25.9 billion (1999 dollars) to costs without substantially reducing the cost of treating CAD until 2025.

By 2025, demographic changes will have further increased the numbers of people with heart disease by 46%, increasing heart disease cost by $47 billion over the 1999 amount. Also, by 2025, benefits from the prevention of CAD will contribute to a reduction in the cost of treatment of $19 billion, partially offsetting the continuing preventive drug cost of $25.8 billion annually. As a result of the effectiveness of CAD prevention, there will have been a 50% reduction in congestive heart failure and the need for heart transplants, which will reduce the cost of drugs for reversing heart failure to $5.1 billion (assuming 50% compliance), providing a savings of $6.7 billion in reduced hospitalizations but leading to a $1.6 billion net increase in cost. The estimated need for heart transplants is 29,000 in 2025 at an estimated annual cost of $4.4 billion, plus an annual medical management cost of $2.6 billion, totaling $7.0 billion. This equals the projected savings from reduced hospitalizations for congestive heart failure.

Cost impact. In 2010, heart-disease costs will have increased because of demographic changes and the introduction of a preventive treatments, totaling $143.9 billion or an increase of 41% over the $102 billion spent in 1999. By 2025, there will be further increases in heart disease cost because of continuing demographic changes, combined with costs and projected savings from preventive treatment of coronary artery disease, new drugs to reverse heart failure, and advances in heart transplants, totaling $157.5 billion in the cost of heart disease, or a 54% increase over the 1999 cost.

Limitations

The crystal ball that we have used to predict the future is built on a foundation of current physician, hospital, and nursing home practices, their costs, and the products emerging from research that hold promise for prevention and better treatments. The opportunity for error in cost predictions is large, even though we think predicting future heart disease treatments that will be used in practice over the next 10–25 years is not unreasonable. The greater confidence in the latter is based on the lag between when new knowledge becomes available and when it becomes useful and practical to provide it to patients across the U.S.

Other potential biases that should be recognized include reductions in inpatient care and the growth of outpatient services that hold the promise of reducing cost. Also, as new techniques are developed, some will save costs, particularly if they are less invasive and require shorter recovery periods. At the same time, individuals with congenital heart diseases are living longer, and their need for care can be expected to increase as the number of adults increases. There may be other treatment successes that will add to costs as we add years to people's lives. These possibilities are not explicitly taken into account in this report, nor are potential cost savings from changes in service delivery.

DISCUSSION

Our aging population is driving costs for heart disease care higher and higher. Expenditures for heart disease increase with age; average cost of heart diseases is more than four times higher for people over age 75 than for those under age 65. Although cardiovascular disease accounts for almost 17% of all health expenditures, this proportion doubles for people age 85 and older to 35% (3). We need to consider priorities for prevention versus treatment and rehabilitation and how to pay for preventive and curative care. In doing so, we need to examine cost and effectiveness carefully, taking into account that we may need to incur preventive care costs early to obtain benefits that may be delayed many years. This work represents an initial effort to examine specific scenarios and estimate their potential impact on future costs of heart disease in the U.S. (Fig. 3).

Prevention is almost always preferred over the suffering of heart disease and its treatment sequelae; however, current prevention technologies are not being used fully. Slightly more than half of all Americans with hypertension are receiving treatment, but only approximately half of these people have their blood pressure under control (1). Those at risk must be identified and must adopt the preventive treatments and health behaviors. Once these preventive strategies are adopted, these patients must adhere to the preventive regimen over time, possibly decades. Experience suggests that many will not adopt or adhere over time. Another consideration is cost. The number of people with the target risk factor—for example, hypercholesterolemia—will far exceed the number of people who will develop the target condition. Cost-effectiveness analysis is one method for comparing the costs of preventive services over time with the benefits (added years of life), which may not occur until

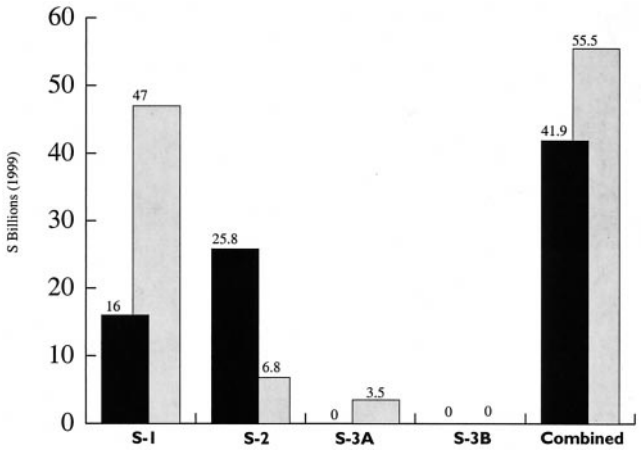

Figure 3. Project costs of scenarios 1, 2, 3, and combined scenarios in 2010 and 2025.

years later. Scenario 2 predicts a new drug to prevent coronary heart disease, which would extend life at an average cost of $41,000 per QALY.

Other opportunities for prevention may come from screening for genetic risks at birth and providing people with individualized risk profiles by 2025. For some people, reduction of alcohol, changes in diet, and routine exercise may be more important to heart health than for others. Our current risk information provides average risks by age, gender, and comorbidity, not by individual, genetically specific risks, something we may be able to provide in the future. Individuals may still find it hard to adopt all heart-healthy behaviors, but they may be more highly motivated by knowledge of their own genetic susceptibilities and risks.

Diagnosis and treatment of heart disease are likely to remain the major foci of cardiovascular medicine and will incur a majority of heart disease costs until 2025. Scenario 3 includes two possibilities, a new medication to reverse heart failure and the availability of swine hearts for heart transplantation. The predicted $3.5 billion net cost of reversing heart failure is probably reasonable, whereas, the projection of no increase in cost for heart transplants may be overly optimistic. It is important to remember that, historically, advances in treatment generally have not been less expensive than current treatments. Even if our predictions are optimistic, one can be confident that there will be demand for advances in treatment that may add to years of life and maintain a high level of functioning throughout these years.

Financing heart disease care into the next century will be an important and difficult challenge. As noted previously, current financing of health care is not meeting the needs of all Americans. Individuals who are poor, uninsured, and from minority populations are not enjoying the full benefits of the preventive and therapeutic services we have available today. Ensuring access to high-quality care would increase the current costs of the health care system, possibly by 10%. Even among people who are insured, it is estimated that not all of the needs of heart disease patients are being met. What it would cost to meet all of these needs is uncertain, but one might guess that it could add 10%–30% to costs. Adding this sum to our combined-scenario estimate of a 54% cost increase by 2025, including demographic changes, plus advances in prevention and treatment, we might expect the total heart disease cost to rise as much as 64%–84% assuming we can find a way to pay for this additional cost.

How do we finance these increases? The federal and state governments' shares of health care expenditures continue to increase. In 1997, total health care expenditures were $969 billion, of which government paid 45%, private insurance paid 32%, and the remainder was mainly paid out of pocket (6). The government share will rise as the population ages and a higher proportion of citizens are over age 65 and receiving Medicare. Extrapolating from 1972 and 1997, when the government paid 41% and 45% of all costs, respectively, one could expect the government share to exceed 50% by 2010. Out-of-pocket costs are increasing as employers have shifted more of the costs of health benefits to the employees. By 2010, we can expect the percentage paid by private insurance to have declined, possibly to below 30%, and the portion paid out of pocket to be rising. These trends can be expected to lead to tighter cost controls over the use of government dollars. Increases in out-of-pocket payments can be expected to reduce the number of people who can afford health insurance as well as the access to care for people with lower incomes, where expenditures on health care compete with housing, transportation, and food costs.

What are reasonable options for the future financing of preventive and curative treatments for heart disease? One positive scenario would be sufficient growth in GDP that we could accommodate increases in heart disease costs without increasing the proportion of GDP dedicated to health care, now at 14%. The GDP would have to increase in real terms by 64%–84% by 2025, assuming that all other health care costs were increasing at the same rate as heart disease costs. Another possibility is that heart disease cost will be increasing at a faster rate than total health care cost in the future. This change may occur if people perceive the benefits of heart disease intervention and treatment to be greater than treatments for other diseases or if factors driving costs of other diseases are less intense than factors driving costs of heart disease. If this change occurs, then the proportion of total health care cost expended on heart disease will rise above its current level of approximately 10%.

Among the challenges of the new millennium will be to find creative and innovative ways to provide more efficient and more effective care to the growing number of people with heart disease. If we can meet this challenge, then the full range of new and exciting prevention and treatment technologies should be available to all Americans. If we fail, then many Americans will never be able to afford and benefit from the scientific miracles to come.

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