



Risk in Perspective

Coronary Heart Disease

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Coronary Heart Disease (CHD) remains a leading cause of mortality and morbidity in the United States despite recent reports of its decline. Billions of dollars are spent annually in the treatment and care of those afflicted by the disease. Many promising preventive strategies and medical technologies to combat this leading cause of illness have been and are being developed. As strategies and technologies are costly, we have developed a tool for forecasting the health benefits and economic costs and savings from programs to prevent or treat CHD. In this issue of **RISK IN PERSPECTIVE**, this tool — the Coronary Heart Disease Policy Model — is described.

THE CORONARY HEART DISEASE POLICY MODEL

A computer simulation model of Coronary Heart Disease in the U.S. population has been developed over the course of several years at the Harvard School of Public Health. It has been designed and calibrated to reflect the current mortality, morbidity, and cost of this disease in the U.S. population. The model can simulate interventions in disease-free target populations (primary prevention), as well as groups having a history of a coronary event (secondary prevention). With further modifications it can be adapted to reflect regional populations within the United States, populations in managed care organizations, or populations of other countries, assuming data are available on the distribution of risk factors and disease in those populations.

The model has the capability to forecast CHD incidence, prevalence, mortality,

and morbidity and its associated resource costs, under varying assumptions regarding risk factors and treatments. The risk factors modeled include age, gender, serum lipids, diastolic blood pressure, smoking, and body mass index. Other risk factors can be added if data are collected to satisfy the data input needs. To date, hormone replacement and aspirin have been added to the model for specific investigations. Recent updates to the model allow for the assessment of health-related quality of life and costs associated with other diseases related to CHD risk factors (such as cancers associated with smoking, or strokes associated with hypertension).

The model is composed of three integrated submodels, the Demographic-Epidemiologic (DE) submodel for those who are 35 to 84 years of age and free of coronary disease, the Bridge submodel for those who are within 30 days of their first coronary event, and the Disease History (DH) submodel for those who have survived at least thirty days after their incident event.

Preventive interventions can be assessed within the DE submodel by adjusting the average value of risk factors within each targeted risk factor subgroup. For example, women who smoke and have a high serum cholesterol level (LDL > 160 mg/dl) can be evaluated for CHD occurrence and events in light of a treatment strategy which reduces their serum LDL level by 19%. In addition to incident CHD cases, the DE submodel also tracks non-CHD mortality and prevention costs.

The Disease History submodel predicts cardiac events, (such as cardiac arrest, angina pectoris, or myocardial infarction), revascularization procedures including coronary artery bypass grafting (CABG) and percutaneous transluminal coronary angioplasty (PTCA), CHD mortality, non-CHD mortality, CHD costs, and non-CHD costs. Secondary prevention interventions can be modeled for patients stratified by risk factor.

NOTED RESEARCH

Several studies have been performed using the model to forecast trends in incidence, prevalence, mortality, and costs of CHD in the U.S. population within the next fifty years. It has been used to evaluate the cost-effectiveness of various strategies aimed at reducing blood pressure and serum cholesterol levels. One of the earlier analyses reported that lowering cholesterol for people *with hypercholesterolemia and existing heart disease* would have favorable cost-effectiveness ratios at all ages and for selected groups would even be cost-saving. Another analysis evaluated the treatment options for individuals with exceptionally high cholesterol levels and concluded that money and lives would be saved with low-dose treatment of men between ages 35 and 44 and women in the same age group with at least one additional risk factor. Using the model we estimated the long-term impact of smoking interventions in men and the expected gains in life expectancy as a result of these smoking cessation interventions. We have analyzed the potential gains in life expectancy from modification of several other risk factors including blood pressure control, serum cholesterol reduction, and weight loss to ideal body weight. From this study we reported that population-wide gains from modification of single risk factors may be modest but gains to individuals at risk are more remarkable. In addition, a cost-effectiveness analysis which reviews population-wide educational programs aimed at reducing serum cholesterol levels found that these programs would achieve health benefits

at a cost equivalent to that of many currently acceptable medical interventions. The table on page 3 exemplifies selected primary prevention interventions analyzed using the CHD Policy Model.

Most recently, using the CHD Policy Model, we examined secular trends in risk factor levels, case-fatality rates, and event rates in patients with CHD to estimate the proportional impact of each on the decline in CHD mortality from 1980 to 1990.⁽⁵⁾ Understanding the proportional contributions of risk factor reductions and improved treatments may better identify interventions which are cost-effective. This analysis suggested that, although there was some decline in mortality through primary prevention, most of the decline in mortality from CHD between 1980 and 1990 was due to improvements in the management of patients who already had the disease. Improvements in primary prevention accounted for 25%, improvements in secondary prevention accounted for 29%, and improved survival after myocardial infarction and chronic management accounted for 43%. This last category includes the effects of beta-blocker drugs, coronary bypass surgery, medical management of acute myocardial infarction, and cardiopulmonary resuscitation.

CURRENT AND FUTURE RESEARCH

Currently the model is being used to evaluate several hormone replacement therapies in postmenopausal women to estimate the reductions in risk of coronary heart disease and the expected gains in life expectancy. In an analysis of aspirin prophylaxis for those individuals with existing disease, we determined that the use of aspirin is cost-saving compared with not using it, with favorable gains in life expectancy.

Studies using the CHD Policy Model are currently underway to address questions posed by research institutions, government agencies, managed care organizations, and industry.

Intervention	Cost per Year of life saved*
For Hypertension ⁽¹⁾	
Propranolol hydrochloride	\$ 16,900
Hydrochlorothiazide	\$ 25,000
Nifedipine	\$ 49,000
Prazosin hydrochloride	\$ 96,000
Captopril	\$ 112,000
For Cholesterol Lowering ^{** (2,3)} (in high risk subgroups)	
Lovastatin (20mg/d)	
Men, 55-64 y.o.	\$ 20,000
Women, 55-64 y.o.	\$ 46,000
Niacin (3g/d)	
Men, 35-84 y.o.	Cost-saving
Women, 35-84 y.o.	\$ 1,800
Stepped care ⁺ (20 mg)	
Men, 35-84 y.o.	\$ 41,000
Women, 35-84 y.o.	\$ 48,000
Cholesterol Lowering Programs in the Community ⁽⁴⁾ (2% reduction in serum cholesterol)	
Program cost, \$ 4.95/person	\$ 3,200
Program cost, \$16.55/person	\$ 38,500

* Converted to 1993 Dollars

** Incremental cost-effectiveness when added to a secondary prevention program

+ Those patients unable to tolerate niacin (3 g/day) are switched to lovastatin

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CHD POLICY MODEL

