

Rationale and Design of the Cardiac Hospitalization Atherosclerosis Management Program at the University of California Los Angeles

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Despite clear and consistent clinical-trial evidence that secondary-prevention medical therapies reduce mortality in patients with established coronary artery disease, these therapies are underutilized in patients receiving conventional care. To address this issue, a Cardiac Hospitalization Atherosclerosis Management Program (CHAMP) focused on initiation of aspirin, cholesterol-lowering medication (3-hydroxy-3-methylglutaryl-coenzyme A [HMG-CoA] reductase inhibitor titrated to achieve low-density lipoprotein [LDL] cholesterol <100 mg/dL), β -blocker, and angiotensin-converting enzyme (ACE)-inhibitor therapy in conjunction with diet and exercise counseling before hospital discharge in patients with established coronary artery disease was designed and implemented at the University of California Los Angeles (UCLA) Medical Center starting in 1994. This treatment program was based on the hypothesis that initiation of therapy in the hospital setting would result

in higher utilization rates both at the time of discharge and during longer-term follow-up. Implementation of this program involved the use of a focused treatment guideline, standardized admission orders, educational lectures by local thought leaders, and tracking/reporting of treatment rates. To assess the impact of the program, treatment rates and clinical outcome were compared in patients discharged in the 2-year periods before and after CHAMP was implemented. Hospital-based treatment protocols such as CHAMP have the potential to significantly increase treatment utilization of therapies previously demonstrated to improve survival and thus substantially improve the outcome of the 2 million patients diagnosed and hospitalized each year with coronary artery disease. ©2000 by Excerpta Medica, Inc.

Am J Cardiol 2000;85:10A-17A

Coronary artery disease remains the leading cause of morbidity and mortality in the United States, with an estimated 500,000 deaths and over 2 million hospitalizations annually, with a cost exceeding 100 billion dollars.¹ Consistent and compelling clinical trial evidence has demonstrated that risk-factor modification and treatment can markedly decrease the risk for future coronary events and prolong survival in patients with documented coronary artery disease.²⁻⁹ Secondary-prevention medical therapies continue to be underutilized in patients receiving standard medical care despite the fact that these therapies are well tolerated by a wide range of coronary artery disease patients and are readily available in clinical practice, and that there has been wide dissemination of clinical guidelines calling for their use.¹⁰

It has been frequently reported that low-density lipoprotein (LDL)-cholesterol levels are not determined and lipid-lowering therapy is not used in a substantial number of patients with documented cor-

onary artery disease.¹¹⁻¹⁴ This "treatment gap" has been attributed to factors including (1) physician focus on acute problems, (2) time constraints, (3) lack of incentives, (4) lack of resources and facilities, and (5) inadequate specialist-generalist communication.¹⁵ Treatment of patients with coronary artery disease has conventionally been focused on treating myocardial ischemia and symptoms as opposed to focusing on the underlying atherosclerotic disease process.¹⁶ Therapy is intended to be initiated often weeks to months after the coronary artery disease patient's initial presentation. These conventional guidelines were not subjected to clinical studies to determine if they could be effectively applied in the routine clinical practice setting and whether they actually impact treatment utilization rates.

A hospital-based strategy of cardiac risk-factor recognition and atherosclerosis treatment has the potential to address many of the attributable factors that contribute to underutilization of secondary-prevention measures. After a chart review analysis of patients with previously documented coronary artery disease undergoing cardiac catheterization at the University of California Los Angeles (UCLA) Medical Center in 1992 and 1993 revealed a very low rate of LDL documentation and lipid-lowering treatment, an alternative treatment implementation strategy was sought. With the aim of improving treatment utilization, a hospital-based treatment program termed Cardiac Hospitalization Atherosclerosis Management Program

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This work was supported in part by the Ahmanson Foundation, Los Angeles, California.

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(CHAMP) was developed and implemented at the UCLA Medical Center, a university-affiliated teaching hospital. CHAMP was first initiated in January of 1994 under an ongoing medical enterprise quality improvement collaboration—the UCLA Clinical Effectiveness Initiative. The program focused on initiation of aspirin, cholesterol-lowering medication (titrated to LDL <100 mg/dL), β -blocker, and angiotensin-converting enzyme (ACE) inhibitor therapy in conjunction with dietary and exercise counseling in patients with established coronary artery disease before hospital discharge.

RATIONALE FOR HOSPITAL-BASED MANAGEMENT OF CORONARY ARTERY DISEASE

This program addressed the low rate of secondary-prevention treatment utilization in patients with known coronary artery disease. The design was based, in part, on the hypothesis that a simplified treatment algorithm that (1) focused on initiating secondary protection measures before hospital discharge and (2) utilized inpatient hospital resources would be a more effective way of initiating treatment. Studies in other patient populations such as those with heart failure have demonstrated that disease-management programs initiated at the time of hospitalization result in higher utilization rates of ACE inhibitors, as compared with treatment utilization rates in patients managed conventionally.¹⁷ Initiation of interventions for smoking cessation while patients are hospitalized with acute myocardial infarction have been shown to result in higher cessation rates than interventions initiated in the outpatient setting.¹⁸ There have been substantially higher utilization rates 6 months to 1 year after hospital discharge for therapies such as aspirin and β blockers, which are frequently initiated before hospital discharge, as compared with therapies such as cholesterol-lowering medications, which are conventionally initiated on an outpatient basis.¹⁹

Conventional treatment guidelines such as the National Cholesterol Education Program (NCEP) ATP-I and -II guidelines have recommended delaying baseline lipid assessment and treatment until 6 weeks after acute presentation in recognition that the acute-phase response triggered by acute myocardial infarctions and coronary artery bypass grafting can substantially lower total- and LDL-cholesterol levels.²⁰ A trial of diet and exercise is then recommended as first-line therapy and must be demonstrated to be inadequate before initiating drug treatment. As a result, institution of treatment is postponed to a time when patients may no longer be focused on their underlying atherosclerotic disease process. There are frequently less resources available in the outpatient as opposed to inpatient setting, and coordination of care between cardiologists and generalists may be more difficult. Discharging patients from a cardiac hospitalization without secondary-prevention measures may create the false impression that the patient's revascularization procedure or antianginal medical regimen was definitive treatment of their atherosclerosis and that

they are no longer at risk for recurrent events. Secondary-prevention therapy that is initiated weeks to months after discharge may be viewed by the patient as less important and optional.

One of the perceived barriers to initiating cholesterol-lowering therapy before hospital discharge is the belief that lipid levels are inaccurate in patients hospitalized with a coronary event. Although total- and LDL-cholesterol levels can decrease by as much as 50% within 48 hours of hospitalization for acute myocardial infarction, studies have demonstrated that lipid values obtained on hospital admission are reflective of the baseline state and useful in detecting hyperlipidemia.^{21,22} Lipid panels obtained on hospital admission can be utilized to guide initiation and dosing of lipid-lowering medications. It has also been demonstrated that in patients hospitalized with myocardial infarction, 93% have baseline LDL-cholesterol of >100 mg/dL and/or failed to achieve an LDL-cholesterol level of <100 mg/dL after 3 months of nurse case manager-supervised diet and exercise, and ultimately required initiation of lipid-lowering medications.²³ Even in patients in whom an admission lipid panel is not available, it is unlikely that an LDL <100 mg/dL can be achieved and maintained without the addition of lipid-lowering medications. A case can be made for initiating empiric treatment with a 3-hydroxy-3-methylglutaryl-coenzyme A (HMG-CoA) reductase inhibitor in hospitalized coronary artery disease patients in whom, although intended, a lipid panel was not obtained during hospitalization.

CHAMP was focused on implementing secondary-prevention medical treatment and providing comprehensive risk-reduction counseling for patients with demonstrated coronary artery disease in the hospital setting. The treatment algorithm centered on combination medical therapy in conjunction with diet and exercise counseling targeting the underlying atherosclerotic disease process. The program guided the initiation of aspirin and an HMG-CoA reductase inhibitor in all patients with coronary artery disease at the time of diagnosis and the use of β blockers and ACE inhibitors for selective indications. The treatment algorithm applied was also based on the theory that physician and patient compliance and long-term treatment utilization would be enhanced by initiating secondary-prevention measures, including cholesterol-lowering medications, before hospital discharge. Linking the initiation of lipid-lowering medication and other secondary-prevention measures to the patient's cardiac hospitalization potentially sets up the message that this therapy is important for the prevention of recurrent events and is an essential part of treatment.

CHAMP targeted patients with documented coronary artery disease, including those hospitalized with unstable angina, acute myocardial infarction, or ischemic heart failure, and those hospitalized for cardiac procedures including cardiac catheterization, angioplasty/stenting, and coronary bypass. The clinical treatment guideline utilized for this program follows.

CHAMP TREATMENT GUIDELINE

Definitive therapy for patients with coronary artery disease: Coronary atherosclerosis is a progressive disease. Although short-term prognosis may be improved with medical management and revascularization strategies, the underlying atherosclerotic disease process must be addressed to improve long-term patient outcome. The goal, whether during hospitalization for coronary artery disease or an outpatient visit for any reason, is to ensure the initiation and maintenance of therapies that will alter the natural history of this disease, improve clinical outcome, and prolong patient survival.

Therapies that have definitively been shown to lower the risk of subsequent mortality in patients with demonstrated coronary artery disease include aspirin, cholesterol-lowering medications, ACE inhibitors, exercise, and smoking cessation. Medications that lower the risk of myocardial infarction in patients with coronary artery disease as well as prolong survival in patients after myocardial infarction include β blockers. Despite overwhelming clinical-trial evidence supporting their use, these survival-enhancing therapies are underutilized when guided by conventional treatment algorithms. This treatment program guideline aims to optimize the initiation and maintenance of the definitive treatments for coronary atherosclerosis.

PROGRAM OVERVIEW

The program is summarized as follows: (1) The diagnostic and therapeutic focus for patients with coronary artery and other vascular disease should shift to address the underlying atherosclerosis disease process; (2) patients with coronary artery and other atherosclerotic vascular disease should be treated with therapies that have been demonstrated to alter the natural history of atherosclerosis, decrease cardiac events, and improve survival; (3) patients should be treated regardless of whether they have undergone or are undergoing a revascularization procedure and regardless of whether they have symptomatic angina, silent ischemia, or atherosclerosis without ischemia; (4) aspirin, an HMG-CoA reductase inhibitor, diet, and an aerobic exercise program should be considered initial and fundamental therapy for all patients with clinical manifestations of any atherosclerotic vascular disease (coronary artery disease, peripheral vascular disease, and/or carotid artery disease); patients should not be discharged from the hospital or leave their initial outpatient encounter without initiation of the following secondary-prevention measures unless contraindicated: (a) aspirin (81–325 mg once daily) should be started in all patients, unless contraindicated; (b) HMG-CoA reductase inhibitors should be started in all patients even if their cholesterol is in the so-called normal or borderline range (target lipid levels in patients with coronary or other vascular disease: cholesterol \leq 160 mg/dL, LDL cholesterol \leq 100 mg/dL, and HDL cholesterol \geq 45 mg/dL); (c) dietary counseling should be provided; (d) an aerobic exercise program consisting of moderately intense activity for 30–60 minutes 5–7 times a week should be prescribed

along with dietary instructions; and (e) patients should be encouraged to stop smoking and formal cessation treatment and referral provided; (5) β blockers should be started in all patients after myocardial infarction and those with heart failure as well as used preferentially as needed to manage blood pressure or symptoms in all other patients, unless contraindicated; (6) ACE inhibitors should be started in all patients with coronary artery disease, unless contraindicated; (7) therapies such as calcium antagonists and type I antiarrhythmic agents that have been shown to potentially increase the risk of adverse outcome should, in general, be avoided in patients with coronary artery disease; and (8) therapies such as nitrates and percutaneous transluminal coronary angioplasty, which provide symptomatic benefit but have not been shown to impact mortality or the incidence of acute coronary syndromes, should, in general, be reserved for patients who remain unacceptably symptomatic despite therapy with aspirin, statin, ACE inhibitor, β blocker, and an exercise program.

CHAMP treatment algorithm: Patients with established coronary artery, cerebrovascular, and peripheral atherosclerosis are at high risk for vascular events and cardiac death regardless of identifiable risk factors and regardless of whether they have undergone revascularization. Combination therapy targeting the underlying atherosclerotic disease process can markedly improve clinical outcome in patients with atherosclerosis, whereas failure to employ these therapies increases patient mortality. Compliance and treatment utilization can be enhanced by employing secondary-prevention measures before hospital discharge. Patients (including chest pain, unstable angina, acute myocardial infarction, cardiac catheterization, angioplasty, coronary bypass, and ischemic heart failure hospitalizations) should not be discharged from the hospital without initiation of definitive atherosclerosis treatment (Figure 1).

In patients with coronary, cerebral, or peripheral atherosclerosis during hospitalization (1) send admission cardiovascular lipid panel; (2) prescribe aspirin, statin, ACE inhibitor, exercise, and dietary counseling; and (3) prescribe β blocker as indicated and discontinue calcium antagonist. After hospital discharge: (1) obtain fasting cardiovascular lipid panel and liver function tests at 6-week follow-up; (2) adjust statin dose to achieve LDL-cholesterol level \leq 100 mg/dL; (3) recheck in 6 months, review medications on each subsequent visit, and reinforce adherence to the atherosclerosis treatment regimen.

Medical regimen for patients with atherosclerosis:

ASPIRIN: Patients should continue on aspirin 81–325 mg per day indefinitely after discharge. In patients with coronary artery disease, aspirin lowers the risk of myocardial infarction, unstable angina, need for revascularization, and death. Pooling data from the 4 largest trials suggests a 48% reduction in the risk of myocardial infarction and a 51% reduction in the risk of death. This benefit continues beyond 10 years.⁸ Patients that have definite contraindications to aspirin

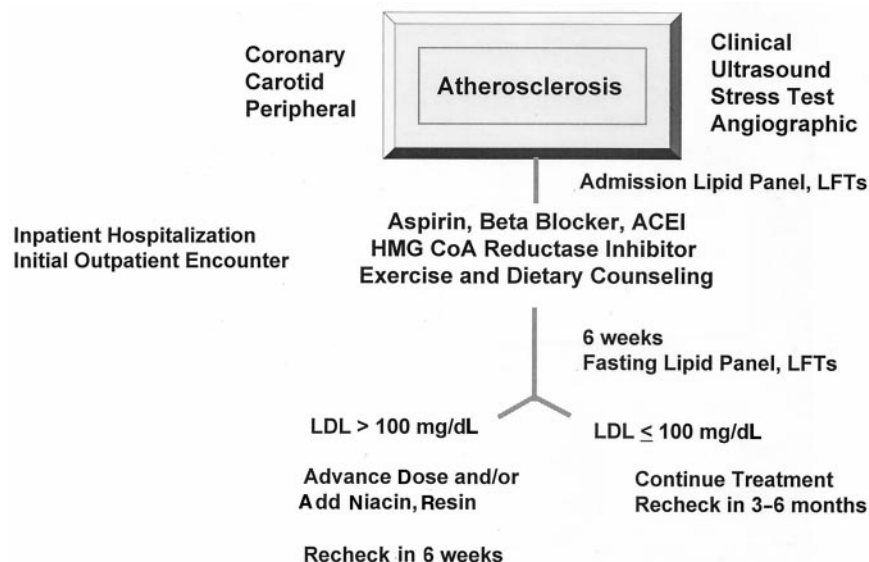


FIGURE 1. The University of California Los Angeles (UCLA) Cardiac Hospitalization Atherosclerosis Management Algorithm for patients with clinically evident atherosclerosis. ACEI = angiotensin-converting enzyme inhibitor; LDL = low-density lipoprotein; LFT = liver function test.

should be considered for treatment with ticlopidine 250 mg twice daily or clopidogrel 75 mg daily.

CHOLESTEROL-LOWERING MEDICATIONS: Patients with coronary artery disease should be started on an HMG-CoA reductase inhibitor to lower cholesterol and treat the underlying atherosclerotic disease process. The target lipid levels in patients with coronary artery disease are total serum cholesterol <160 mg/dL, LDL cholesterol <100 mg/dL and a high-density lipoprotein (HDL) cholesterol >45 mg/dL. HMG-CoA reductase inhibitors are the most effective and best-tolerated cholesterol-lowering medication and should be considered as the preferred first-line agent. Initiation of an HMG-CoA reductase inhibitor in patients with documented coronary artery disease results in a reduction in myocardial infarction, unstable angina, need for revascularization, hospitalization, and all-cause mortality compared with patients treated with diet alone. This is true regardless of whether the patient has undergone coronary artery bypass grafting, percutaneous transluminal coronary angioplasty, or is being treated medically.

These benefits are seen early such that patients should be started on therapy before or at the time of hospital discharge. The starting dose of statin should be a dose estimated to achieve an LDL <100 mg/dL based on the baseline lipid panel. In patients for whom the baseline LDL is known, the use of the UCLA LDL Treatment to Goal Guide is recommended. In patients for whom the baseline cholesterol/LDL is pending or not known, empiric doses may be used: lovastatin 40 mg qhs, pravastatin 40 mg qhs, simvastatin 20–40 mg qhs. Patients who fail to achieve target lipid levels (LDL <100 mg/dL) at 6 weeks after initiation of therapy should have their dose increased or an additional agent (niacin or cholesterol-binding resin) added. Patients with coronary artery disease will live

longer when treated with an HMG-CoA reductase inhibitor. In the Scandinavian Simvastatin Survival Study (4S), there was a 34% risk reduction in major cardiac events, a 42% risk reduction in cardiovascular mortality, and a 30% reduction in all-cause mortality associated with statin treatment.⁴ The Cholesterol and Recurrent Events (CARE) and Long-Term Intervention with Pravastatin in Ischaemic Disease (LIPID) trials demonstrated that even patients with “normal” levels of total cholesterol and LDL cholesterol benefit from treatment with an HMG-CoA reductase inhibitor.^{3,24} Patients should be educated that these medications are for the treatment of atherosclerosis, not because the patient has “failed” dietary treatment, and that use of these medications lowers the risk of recurrent events, need for revascularization, hospitalizations, strokes, and mortality.

BETA BLOCKERS: These agents should be considered in all patients with coronary artery disease, because they reduce the risk of myocardial infarction and make it more likely that a patient will survive an infarction.¹⁰ These agents should be considered first-line agents for the symptomatic control of angina. In addition, these agents prolong survival in patients with previous myocardial infarction as well as reduce the risk of unstable angina in patients with coronary artery disease. These agents also attenuate the remodeling process after myocardial infarction and reduce the risk of developing heart failure. In a patient with coronary artery disease and hypertension, β blockers are an excellent first-line agent. The duration of benefit with long-term therapy has not been fully defined but appears to extend for ≥ 5 years in patients after myocardial infarction. Use target doses as clinically tolerated.

ACE INHIBITORS: These agents have potent vascular and cardiac protective effects.⁹ These agents are potentially indicated in all patients with atherosclerosis. Pa-

tients after myocardial infarction have improved survival and less heart failure when treated with ACE inhibitors. All patients with myocardial infarction without contraindications should be started on ACE inhibitors within 24 hours and treated long term. The risk of myocardial infarction or unstable angina and even the need for revascularization is reduced. Patients with left ventricular dysfunction should be started and maintained on an ACE inhibitor indefinitely. ACE inhibitors have been demonstrated to benefit patients with coronary artery disease and/or peripheral vascular disease by reversing endothelial dysfunction, lowering the risk of atherosclerosis progression, reducing myocardial infarction, reducing stroke, and reducing cardiovascular mortality. This benefit appears to be independent of blood pressure status. Use target doses.

NITRATES: These agents should be considered second-line agents after β blockers for the symptomatic control of angina. There are no long-term data showing that nitrates improve prognosis in patients with coronary artery disease, so their use is indicated solely for symptom relief. Patients who are not having symptomatic angina do not need to be routinely discharged on long-acting nitrates. When long-acting nitrates are indicated, a daily nitrate-free interval is necessary to decrease tolerance. Patients should be discharged with sublingual nitroglycerin—to be taken as needed—as well as instructions for its use.

CALCIUM ANTAGONISTS: These agents decrease chest pain but do not decrease the risk of a cardiac event or improve survival.^{5,25} They should, in general, not be prescribed to patients with known coronary artery disease. Calcium antagonists should be considered for palliative use only in patients who have failed to respond to all other therapy. In patients after myocardial infarction, the risk of a subsequent cardiac event and mortality is not reduced and may in fact be increased with calcium antagonists. In patients with coronary artery disease, there may be an increased risk of myocardial infarction. In patients after angioplasty, there is an increased risk of adverse events with calcium antagonists compared with placebo. In patients with angina, there is an increased risk of coronary events with calcium antagonists as compared with angina control with β blockers. In patients with coronary artery disease and hypertension, these agents should be reserved for those who are intolerant of or fail to have their blood pressure controlled with β blockers, ACE inhibitors, angiotensin-receptor blockers, diuretics, α blockers, or their combinations.

ANTIARRHYTHMIC AGENTS: Type I antiarrhythmic agents increase the risk of sudden death in patients with coronary artery disease.²⁶ This is because all type I antiarrhythmic agents markedly lower the fibrillation threshold of ischemic myocardium. Even when used to maintain sinus rhythm for atrial fibrillation or when guided by electrophysiologic study or Holter monitoring, these agents increase the risk of overall mortality for coronary artery disease patients. These agents should be avoided in all patients with coronary artery disease except those with implantable cardioverter defibrillators or in whom the risk/benefit ratio has

been carefully considered. Amiodarone should be considered the only safe antiarrhythmic agent in patients with coronary artery disease. Compared with placebo, amiodarone was neutral with respect to sudden death and mortality in trials with patients after myocardial infarction.

EXERCISE: Patients should receive specific instructions for a daily aerobic exercise program. Exercise increases HDL, reduces the risk of myocardial infarction, and improves survival in patients with coronary artery disease. Either a home-based program or supervised cardiac rehabilitation can be recommended. This is an essential component of the management of patients with coronary artery disease and is highly effective in preventing subsequent cardiac events. Patients should be offered referral to a cardiac rehabilitation program their area. In addition to a specific exercise prescription, patients require instructions on activities that are permissible and those that should be avoided (e.g., heavy lifting).

SMOKING CESSATION: Particular attention should be paid to smoking cessation. Patients who continue to smoke after presenting with unstable angina have 5.4 times the risk of death from all causes compared with patients who stop smoking. Patients should be offered intensive smoking cessation intervention during hospitalization. This should include both physician and nurse counseling focusing on relapse prevention. Patients should receive a relapse prevention manual and be given written information about the outpatient behavior modification programs available and the option of nicotine replacement therapy and/or bupropion SR [sustained release]. The recommendation for smoking cessation should be clearly documented in the medical record.

DIET: Studies of HMG-CoA reductase inhibitors, which demonstrated reduction in mortality, have utilized these medications in conjunction with dietary counseling. Patients and family members, if available, should receive counseling on the NCEP Step 2 Diet during the hospitalization. Information on the outpatient dietary modification programs available should be provided.

PATIENT EDUCATION: The patient and his or her family member or advocate should be instructed on the use of medications and monitoring of symptoms. The purpose, dose, and major side effects of each medication prescribed should be explained. Written medication sheets and a medication schedule should be provided to each patient. Recurrent symptoms lasting more than 1–2 minutes should prompt the patient to stop his or her activities, sit down, and place a nitroglycerin tablet under the tongue. This may be repeated at 5-minute intervals. If symptoms persist after 3 nitroglycerin tablets, the patient should seek transportation to the nearest hospital emergency department either by ambulance or the fastest available transport (e.g., call 911). The warning signs of a heart attack should be discussed with each patient and their immediate plan of action reviewed. Patients should be instructed to contact their primary care physician or cardiologist if they have a change in symptom pattern,

and discuss whether changes in the management plan are warranted. Patient delays in seeking medical attention are a major contributor to diminished benefit with reperfusion therapy. Detailed patient education has been demonstrated to reduce the time to treatment in acute myocardial infarction.

FOLLOW-UP: Continuation of the therapies targeting the underlying atherosclerotic disease process markedly improves clinical outcome in patients with atherosclerosis. The continued use of the beneficial therapies prescribed should be strongly reinforced during patient follow-up. The medications the patient is taking should be reviewed on each visit. If ≥ 1 of the survival-enhancing medications is not prescribed, the specific contraindication or intolerance should be clearly documented in the medical record. A fasting lipid panel should be obtained at 6 weeks to evaluate whether target lipid levels have been achieved and to guide cholesterol-lowering medication dosing adjustments. The need for daily aerobic exercise should be reinforced and the patient's progress monitored. Stress testing does not appear to be indicated in the routine follow-up of patients with coronary artery disease and should, in general, be performed for specific reasons such as a change in symptoms or in following patients with silent ischemia.

In summary, the CHAMP treatment algorithm consisted of obtaining a baseline complete lipid panel upon admission in all patients with known or suspected coronary artery disease. Aspirin in a dose of 325 mg was initiated at time of initial presentation and maintained at 81 mg or 325 mg in all patients without contraindications. β -blocker therapy was initiated or continued upon initial presentation in all patients with acute myocardial infarction or unstable angina, and was recommended preferentially to manage anginal symptoms, heart rhythm, and blood pressure in other patients, unless contraindicated. ACE inhibitor therapy was initiated in all patients with myocardial infarction 12–24 hours after admission, in all patients with heart failure or asymptomatic left ventricular dysfunction, and preferentially to manage blood pressure, unless contraindicated. HMG-CoA reductase inhibitor therapy was initiated in all patients with LDL cholesterol >100 mg/dL during the hospitalization. In patients in whom a baseline lipid panel was not obtained or was obtained >12 hours after acute myocardial infarction symptom onset, HMG-CoA reductase inhibitors were initiated and dosed empirically. Routine use of long-acting nitrates and calcium antagonists was proscribed unless patients had failed alternative therapy. Counseling on smoking cessation, diet, and exercise was provided during hospitalization by the individual physicians and cardiac nurses with patient education materials provided. The algorithm recommended obtaining a fasting lipid panel and liver function tests on an outpatient basis at 6 weeks, and if the LDL cholesterol remained >100 mg/dL, adjusting the HMG-CoA reductase inhibitor dose, or if already maximized, adding additional lipid-lowering therapy of niacin, binding resin, or fibrate. Repeat lipid testing and follow-up visits at 6 and 12 months to encourage

compliance were also recommended in the treatment algorithm.

IMPLEMENTATION OF CHAMP

To facilitate implementation and utilization of the program, this guideline was disseminated to all physicians with hospital privileges; internal medicine, family medicine, and emergency medicine and cardiac surgical house staff; and all emergency medicine and cardiac nurses. Educational conferences describing the scientific and clinical evidence supporting the treatment algorithm were provided. The guideline was redistributed to house staff 1 week before their cardiac care rotations, and a monthly educational lecture was provided. Cardiac nurses participated in educational conferences and in-services to encourage their role in providing patient counseling on risk factors during the cardiac hospitalization. Patient-education materials on the progressive risks of atherosclerosis and the benefits of compliance with medical therapy and nonpharmacologic measures were distributed to patients during the hospitalization. Preprinted admission and postcatheterization orders were developed that included check boxes for ordering a lipid panel and for each of the recommended therapies.

Treatment utilization rates at hospital discharge before implementation of CHAMP and at quarterly intervals after implementation of the program were provided to attending physicians, nurses, and house staff. Although treatment was strongly encouraged in the guidelines and treatment algorithm, the final decision to initiate therapy and with which agent and dose was left to the individual treating physician. Existing medical and nursing staff was utilized and no additional resources were provided other than medications, modification of preprinted orders, and the guideline itself. Utilization data were collected, in part, in conjunction with UCLA Medical Center's participation in the National Registry of Myocardial Infarction.

EVALUATION OF PROGRAM IMPACT

To assess the safety of initiating HMG-CoA reductase inhibitors in cardiac patients before hospital discharge, the first 1,400 patients treated at UCLA were monitored for side effects or early rehospitalization. The medical regimens initiated during the hospitalization and continued at discharge were well tolerated as shown in Table I. There were only 3 documented increases in liver function tests >3 times control (0.21%) and no incidences of rhabdomyolysis or rehospitalization attributed to the initiated HMG-CoA reductase inhibitors before hospital discharge.

To assess the impact of the program on utilization, treatment rates and clinical outcome were compared in patients discharged after myocardial infarction in the 2-year period before (1992–1993) and the 2-year period after (1994–1995) CHAMP was implemented. From January 1, 1992 to December 31, 1995, 548 consecutive men and women were hospitalized for acute myocardial infarction at the UCLA Medical Center, meeting the eligibility criteria, 246 in the pre-CHAMP period of 1992–1993 and 302 in the

Primary Diagnosis	n	Admit Statin Rx, %	Discharge Statin Rx, %	Abnormal LFT	Rehosp due to Rx
Unstable angina	224	14	82	1	0
Acute MI	302	8	86	0	0
Chest pain	326	15	74	0	0
PTCA	340	8	92	0	0
Heart failure	371	22	76	2	0
CABG	216	16	68	0	0
Total	1,779	14	80	3/1,423	0/1,423

CABG = coronary artery bypass graft; LFT = liver function tests >3 times control requiring discontinuation of therapy; MI = myocardial infarction; PTCA = percutaneous transluminal coronary angioplasty.

period after implementation of CHAMP, 1994–1995. During the baseline period, the hospital discharge utilization rates for aspirin were 78%, for β blockers 12%, and for ACE inhibitors 4%, as shown in Table II. During this period, 68% of patients were discharged on calcium antagonists and 62% on long-acting nitrates. The utilization of lipid-lowering medications at time of hospital discharge was only 6% in the pre-CHAMP patient group. It has been preliminarily reported that after CHAMP, there were substantial improvements in treatment utilization.²⁷ The hospital discharge utilization rates for aspirin increased to 92% ($p < 0.001$), for β blockers to 61% ($p < 0.001$), and for ACE inhibitors to 56% ($p < 0.001$, Table II). The utilization of lipid-lowering medications at time of hospital discharge increased from 6% in the pre-CHAMP patient group to 86% in the post-CHAMP group ($p < 0.0001$). There was a substantial decrease in the utilization of long-acting nitrates and calcium antagonists.

The utilization rates during longer-term follow-up were also impacted. At 1 year after discharge, 91% of the patients were being treated with a cholesterol-lowering medication as compared with only 10% 1 year after hospital discharge in the pre-CHAMP period. One year after discharge, 58% of patients had LDL levels documented to be < 100 mg/dL compared with only 6% of patients in the pre-CHAMP period ($p < 0.0001$). The impact of this increased treatment utilization on clinical outcomes is currently being analyzed.

Discharge Therapy	Pre-CHAMP (1992–1993) (n = 256), %	Post-CHAMP (1994–1995) (n = 302), %
Aspirin	78	92
β blocker	12	61
Nitrate	62	34
Calcium antagonists	68	12
ACE inhibitors	4	56
HMG-CoA RI	6	86

ACE = angiotensin-converting enzyme; CHAMP = Cardiac Hospitalization Atherosclerosis Management Program; HMG-CoA RI = 3-hydroxy-3-methylglutaryl-coenzyme A reductase inhibitor.

CLINICAL IMPLICATIONS

Previous studies have demonstrated that quality improvement programs can increase hospital utilization of specific therapies such as aspirin and β -blocker therapy. CHAMP differs from previously reported quality improvement programs in that it also integrated measurement and management of lipids into the inpatient cardiac-care setting. This program provides the first direct support for the American Heart Association (AHA) Science Advisory “When to Start Cholesterol Lowering Therapy in Patients with Coronary Heart Disease” issued in 1997, which recommended that a cholesterol-reducing medication be instituted simultaneously with nonpharmacologic therapy at time of hospital discharge in patients with coronary artery disease and LDL levels > 130 mg/dL.²⁸ The CHAMP algorithm extends treatment beyond this recommendation in that lipid-lowering medications were initiated during hospitalization (not just at the time of discharge) and were intended for all patients with LDL > 100 mg/dL or in whom the baseline LDL was not documented.

The CHAMP protocol was associated with a significant increase in treatment utilization at the time of hospital discharge of medications previously demonstrated to improve survival in patients with coronary artery disease. The preliminary results of this study demonstrate that initiation of cholesterol-lowering medications before hospital discharge appears to be safe, results in a high rate of utilization during longer term follow-up, and results in a significant increase in patients reaching an LDL-cholesterol level of < 100 mg/dL. Although applied in a university teaching hospital, the methods utilized to improve treatment rates are readily adaptable to a variety of healthcare delivery systems.

These initial observations with CHAMP have demonstrated that coronary artery disease risk-factor modification and treatment can be systematically integrated into the treatment provided during cardiac hospitalization utilizing existing resources and medical personnel and that they appear to be considerably more effective than conventional guidelines and care. Widespread application of CHAMP or other hospital-based treatment protocols has the potential to affect coronary artery disease treatment rates with proven cost-effective therapies and thus presumably reduce

the risk of future coronary events and prolong life in the large number of patients hospitalized each year with coronary artery disease. The inpatient setting can provide an important opportunity to initiate secondary-prevention medical therapies in patients hospitalized with coronary artery disease.

Acknowledgment: The authors wish to acknowledge the physicians and nurses at the UCLA Medical Center whose dedication to improving patient care made this program possible. We would also like to thank Stephanie Kagimoto for outstanding administrative assistance.

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