

Process and Outcome of Outpatient Management of Heart Failure: A Comparison of Cardiologists and Primary Care Providers

Edward P. Havranek, MD; Gerard W. Graham; Zhaoxing Pan, MB, MS; and Brian Lowes, MD

Abstract

One of the basic tenets of managed care is that primary care providers should control access to specialists. This model of delivery is widely thought to lower costs without diminishing quality. In patients with heart failure, however, studies have suggested that cardiologists are more likely than primary care physicians to prescribe angiotensin converting enzyme inhibitors, which have been shown to reduce mortality and to decrease hospitalizations. Therefore, in a retrospective cohort of patients with heart failure, we compared the process and outcome of care provided by cardiologists and primary care providers. We reviewed the charts of all patients with heart failure (n = 101) who received care in an integrated system of outpatient clinics and a hospital during a 1-year period. Fifty-three patients received care from primary care providers alone (group A), 25 received care from cardiologists alone (group B), and 23 received care jointly from both primary care providers and cardiologists (group C). Relative to patients in the other groups, patients receiving care from cardiologists were younger but had more comorbidities and were more likely to have ischemic disease. They were more likely to have had a baseline determination of left ventricular ejection fraction (61%, versus 44% in group A) as recommended in Agency for Health Care Policy and Research guidelines for the care of patients with heart failure. Although the difference in the frequency of angiotensin enzyme inhibitor use among the groups was not statistically significant, group B patients received significantly higher doses (67% of the maximum dose, versus 48% for group A and 49% for group C). Group A patients incurred lower yearly average costs for imaging tests (\$434, versus \$715 for group B and \$767 for group C). With respect to hospital days per patient per year, a trend in the direction of fewer days was observed in group B patients (4.4 days, versus 5.6 and 8.1 days for group B and group C, respectively).

From the Section of Cardiology, Denver General Hospital, University of Colorado Health Sciences Center, Denver, CO.

Address correspondence to: Edward P. Havranek, MD, Denver General Hospital #0960, 777 Bannock Street, Denver, CO 80204-4507.

We conclude that, in at least one integrated health-care delivery system, subspecialists and primary care providers differ in the process of care they provide to patients with heart failure, with subspecialist care more closely conforming to accepted guidelines.

(*Am J Man Care* 1996;2:783-789)

The "gatekeeper model," in which primary care providers control access to subspecialty physicians, has been widely assumed to produce healthcare of equal quality to that produced under systems with free access to subspecialists, but at lower cost. As with any sweeping generalization, it is reasonable to believe that exceptions exist.

Congestive heart failure (CHF) affects an estimated 1 to 2 million Americans,¹ but advances in medical management have improved the survival of these patients.² In particular, maximum-tolerated doses of angiotensin converting enzyme (ACE) inhibitors reduce mortality.^{3,4} Despite this knowledge, however, ACE inhibitors are not universally used. Rajfer⁵ noted that, in 1991, cardiologists self-reported prescribing these agents more frequently than did general or family physicians (80% versus 60% in patients with moderate disease). Clarke et al⁶ studied 281 patients with heart failure in the United Kingdom whose care was provided by general practitioners; only 17% received ACE inhibitors.

In addition to lowering mortality, ACE inhibitors reduce hospitalization of patients with CHF. In the Studies on Left Ventricular Dysfunction (SOLVD),⁴ 36.6% of placebo-treated patients were hospitalized during an average of 41.4 months of follow-up; the enalapril-treated group had a significantly lower hospitalization rate of 25.8%. After incorporating these data into a Markov model, Paul et al⁷ estimated that the cost savings associated with the reduction in hospitalization outweighs the cost of drug therapy. Thus, ACE inhibitors may contribute substantially to a decrease in healthcare costs in patients with CHF.

The proper dosage of ACE inhibitors for heart failure remains controversial. However, the beneficial effects of these agents on mortality have been achieved with relatively high doses. In the Cooperative North Scandinavian Enalapril Survival Study (CONSENSUS),³ the average daily dose of enalapril was 18.4 mg (maximum, 40 mg per day); in SOLVD,⁴ it was 16.6 mg (maximum, 20 mg per day). A study comparing the ACE inhibitor captopril with hydralazine⁸ used average captopril doses of 206 mg per day, with 400 mg per day the maximum allowable dose; mortality was lower in the captopril-treated group. Increasing aldosterone levels are responsible for some of the maladaptive physiology of heart failure, and preliminary data on lisinopril⁹ show that higher doses of this ACE inhibitor produce greater suppression of aldosterone activity. Studies of lower doses of ACE inhibitors are inconclusive.¹⁰ On the basis of data such as these, the American College of Cardiology/American Heart Association Task Force treatment recommendations for patients with CHF specify that ACE inhibitor doses should be increased gradually toward the maximum.¹¹

In light of these data, we hypothesized that the outpatient management of heart failure may be an exception to the gatekeeper rule. In particular, we conjectured that, relative to care from primary care providers, care controlled by cardiologists may be of higher quality, which, in turn, may result in lower costs.

... METHODS ...

The study was conducted at Denver Health and Hospitals, a public, integrated healthcare system that comprises 10 community health centers and a 349-bed acute care hospital with subspecialty and primary care outpatient facilities. The hospital is a major teaching facility for the University of Colorado Health Sciences Center. The network is administratively unified, with one medical record per patient. Most of the system's patients are indigent.

A heterogeneous group of providers, including general internists, family physicians, internal medicine residents in continuity clinics, nurse practitioners, and physicians' assistants administers primary care. Staff cardiologists and cardiology fellows supervised by staff cardiologists in a continuity clinic provide outpatient cardiology care. All physicians are salaried.

In 1994, the healthcare system had 18,272 hospital admissions and approximately 500,000 outpatient visits. During the study period, less than 10% of revenue came from one of the system's managed care plans,

indicating that "gatekeeping" had little or no effect on physician behavior in this project.

We identified all patients with heart failure who had been seen in any one of the Denver General Hospital outpatient clinics or in any of the community health centers as of June 1, 1994. The charts of patients with any of the following during the 6 months preceding the index date were screened: a hospital discharge diagnosis of CHF, a prescription for furosemide (the only formulary loop diuretic available at Denver Health and Hospitals), an echocardiogram showing left ventricular dysfunction, a radionuclide ventriculogram demonstrating a left ventricular ejection fraction of less than 40%, or visit to the cardiology clinic after having received a diagnosis of CHF.

If a diagnosis of CHF appeared on the problem list, the chart was reviewed for the presence of CHF as defined by the Framingham Study criteria.¹² According to this study, a diagnosis of heart failure is made if two major criteria or one major plus two minor criteria are present. The major criteria are paroxysmal nocturnal dyspnea, neck vein distention or increased central venous pressure, rales, cardiomegaly shown on a chest radiograph, pulmonary edema, a third heart sound, hepatojugular reflux, and weight loss of more than 4.5 kg in response to diuretic treatment. The minor criteria are bilateral ankle edema, nocturnal cough, dyspnea with ordinary exertion, hepatomegaly, pleural effusion, and a heart rate of more than 120 bpm.

Data were collected retrospectively for the 1-year period from June 1, 1994, to May 30, 1995. The main outcome measure was days of hospitalization during the study period. According to guidelines promulgated by the Agency for Health Care Policy and Research (AHCPR), echocardiography or ventriculography should be used to determine left ventricular systolic function before starting treatment.¹³ We reviewed charts to determine if baseline evaluation of left ventricular systolic function had been performed according to AHCPR guidelines.

Of the ACE inhibitors, only captopril, enalapril, and lisinopril were available on the formulary during the study period. We audited the charts to determine whether any of these agents had been administered at any time during the study period, as well as the maximum ACE inhibitor dose used during that time. To compare ACE inhibitor dosages, the maximum doses were defined as 40 mg per day for lisinopril and enalapril, and as 225 mg per day for captopril.

To measure the quality of general medical care, we performed a chart review for adherence to specific healthcare maintenance guidelines that had been de-

defined by an expert panel for our system. A retrospective chart review would fail to measure reliably health-care maintenance activities (eg, advice on smoking cessation) that physicians do not record on the charts. We therefore chose to examine activities that would generate separate reports, and that we expected healthcare providers would have performed during the 1-year study period. These activities included yearly Pap testing, yearly examinations for occult blood in stool, and yearly influenza vaccinations.

The infrastructure of the information system did not permit accurate measurement of the true costs of inpatient and outpatient care in the Denver Health and Hospitals system. Therefore, as indicators of costs of care, we recorded the number of outpatient visits, including emergency department visits, and the number of outpatient imaging tests (chest radiographs, echocardiograms, and radionuclide ventriculograms) performed. We computed total costs of imaging tests for each patient by multiplying the number of tests by its charge and adding the results. At Denver General Hospital as of December 31, 1994, charges were \$125 for chest radiographs, \$1,120 for radionuclide ventriculograms, and \$720 for two-dimensional echocardiograms.

A Pearson chi-squares test was used to compare proportions. Student's *t* test or analysis of variance was used to compare continuous variables between groups, with a log transformation for variables not normally distributed. In addition, to ensure consistent results, we conducted nonparametric Wilcoxon rank sum tests whenever the *t* test applied. Data analysis was performed with SAS version 6.08 (SAS Institute Inc, Cary, NC).

... RESULTS ...

We identified 101 patients who met the definition of heart failure and who received follow-up care in an outpatient clinic. Of these, 53 were cared for by pri-

mary care providers alone (group A), 25 received care from cardiologists alone (group B), and 23 were managed jointly by both primary care providers and cardiologists (group C).

Baseline characteristics are shown in Table 1. Given the retrospective nature of data collection and the variability with which providers recorded data, it was not possible to determine accurately the baseline ejection fraction or New York Heart Association functional class. Patients in group B were younger than those in either group A or group C but had a greater number of comorbidities. Moreover, they were more likely to have ischemic cardiomyopathy.

With respect to the process of care, Table 2 indicates that group A patients were least likely to have had a determination of left ventricular systolic function by echocardiography, radionuclide ventriculography, or contrast ventriculography, as recommended in the AHCPR guidelines.¹³ Eight patients in group A who had been treated for CHF that was presumed to be secondary to systolic dysfunction were shown through chart review not to have systolic dysfunction. Patients in all three groups were equally likely to have been given ACE inhibitors, but those in group B were treated with a higher percentage of the maximum dose.

With regard to healthcare maintenance, higher rates of Pap testing in group A patients represented a clear trend; however, probably owing to the small number of women whose charts were reviewed, this difference was not statistically significant. Group A patients were also more likely than either group B or group C patients to have had both stool testing for occult blood and influenza vaccinations.

As indicators of the cost of outpatient care, we performed between-group comparisons of the average charges per patient per year for imaging tests and of the number of outpatient visits per year (Table 3). As shown in the table, mean charges for imaging tests were greater for patients in groups B and C than for

Table 1. Baseline Characteristics of the Study Population

	Group A	Group B	Group C	P Values*	
				B vs A	B vs C
Mean Age (yr)	62.0	53.8	60.5	0.085	0.031
Gender (% Male)	58%	68%	78%	0.420	0.424
Ethnicity (H/A/C)	15/14/18	8/6/8	5/5/12	0.934	0.453
Etiology (% Ischemic)	42%	67%	59%	0.064	0.607
Comorbidities (No.)	2.5	3.3	2.7	0.029	0.196

H = Hispanic; A = African American; C = Caucasian.

*P values are two-tailed.

Table 2. Process Variables

	Group A	Group B	Group C	P Values*	
				B vs A	B vs C
LVEF Determination Made (%)	21	44	61	0.033	0.240
ACE Inhibitor Treatment (%)	81	88	87	0.428	0.913
Maximum ACE Inhibitor Dose (%)	48	67	49	0.001	0.001
Stool for Occult Blood (%)	11	5	4	0.939	0.817
Pap Test for Women (%)	32	0	0	0.068	NS
Influenza Vaccination (%)	40	8	26	0.004	0.093

LVEF = left ventricular ejection fraction; ACE = angiotensin converting enzyme; NS = not significant

*P values are two-tailed.

those in group A. The number of outpatient visits per year was highest in group C; the difference between groups A and B was not significant.

The number of hospital days per patient per year did not differ between groups. The power to detect a 20% difference in hospital days between groups was only 7%.

... DISCUSSION ...

Widespread acceptance of the gatekeeper model for healthcare delivery is based on broad generalizations from scarce data. Berenson and Holahan¹⁴ reported that the growth of Medicare physician allowed charges between 1985 and 1988 was smallest for general and family practitioners (7.7%) and was greatest for cardiologists (21.3%) and gastroenterologists (21.7%). Franks et al¹⁵ argue that, because more than 90% of health maintenance organizations (HMOs) use primary care providers in gatekeeper roles, and because care provided by HMO physicians is of lower intensity (and is therefore less expensive) than other care, the gatekeeper model is responsible for less expensive care.

Furthermore, studies largely have demonstrated that this care is of comparable quality to that found in the fee-for-service sector. The most frequently quoted data are those from the Medical Outcomes Study.¹⁶ In that study, cardiologists and endocrinologists had higher rates of resource utilization than did

internists and family practitioners, even after adjustment for severity of illness. Resource utilization was judged by the percentage of patients hospitalized during the year preceding the study, office visits per patient per year, prescription drugs per patient, and mean dollar value of tests per patient per year. Flég et al¹⁷ analyzed survey data obtained from cardiologists, general internists, and family physicians on the outpatient management of patients with heart failure. They reported that cardiologists were most likely to order echocardiograms, exercise tests, and radionuclide ventriculograms, and that these providers comprised 71% of high-cost users.

Our study demonstrates that cardiologists and primary care providers provide different processes of care to patients with CHF, and cardiologists' care more closely conforms to established guidelines. In patients who received care from cardiologists alone, systolic function was assessed more frequently and ACE inhibitors were prescribed in higher doses, but more money was spent on outpatient imaging tests. Other, less tangible differences are likely to exist as well. These process-of-care differences were associated with a difference in the number of hospital days per patient per year that did not reach statistical significance, possibly because only a small number of patient-days were studied.

Although we could not assess baseline differences in illness severity, the chart review revealed that patients receiving care from cardiologists had more

Table 3. Cost and Outcome Indicators

	Group A	Group B	Group C	P Values*	
				B vs A	B vs C
Imaging Tests, Mean Charge (\$)	426	715	767	0.142	0.844
Outpatient Visits per Year (No.)	11.8	9.9	14.0	0.322	0.0427
Hospital Days per Patient per Year (No.)	5.6	4.4	8.1	0.183	0.110

*P values are two-tailed.

comorbid conditions than did those who saw primary care providers. The relatively poorer performance by cardiologists in ordering healthcare maintenance interventions suggests that specialists neglect non-cardiac problems. An alternative explanation is that patients in group B had poorer prognoses, so that they were not deemed appropriate candidates for healthcare maintenance. We were unable to obtain the data necessary to test this hypothesis.

The impact of these differences on overall costs must be assessed more fully. Our data suggest that outpatient care for patients with CHF is more expensive when provided by subspecialists than by primary care providers, as the number of visits are the same in both cases, but subspecialists prescribe more imaging tests and drugs. Although it may seem reasonable to presume that these increased expenditures are offset by decreases in hospitalization costs,⁷ this determination cannot be made until more precise data have been obtained.

Another finding unique to this study is that joint management did not improve outcome. The reasons are not clear. The most likely explanation is that, at least in our system, primary care providers and subspecialists coordinate care poorly, with each type of provider deferring decisions to the other. Communication problems, such as the failure to make charts available in a timely way, may be an additional contributory factor. These results suggest that a policy of mandatory cardiology consultation for patients will not improve outcome or lower costs, and that more innovative approaches incorporating the expertise of specialists with the comprehensiveness of generalists are necessary if performance is to improve.

This study is limited in two major ways. First, the retrospective design constrained data collection. Comparisons of baseline severity of illness among the groups was limited by lack of consistent information about parameters with known prognostic significance, such as functional capacity and ejection fraction. Therefore, we could not control for selection bias. It is thus quite possible that one of our major findings, differences in dosing of ACE inhibitors, were the result of such patient characteristics as renal function, rather than to provider behavior. Second, owing to the small sample size, the power to detect differences in outcome was low.

Another study limitation was our inability to measure care provided outside the Denver Health and Hospitals system. We therefore assumed that all groups sought care outside equally. The results of our study are not incompatible with the results of other studies comparing the performance of primary and

subspecialist care. The global, indirect arguments in the papers by Berenson and Holohan¹⁴ and by Franks et al¹⁵ tell us little about the specifics of treatment of patients with heart failure. As in both the Medical Outcomes Study¹⁶ and the study by Fleg et al,¹⁷ cardiologists in our system spent more on outpatient tests than did other providers. However, these higher subspecialty-care outpatient costs were associated with need for fewer total hospital days.

Other disease states present a clear precedent for an association between subspecialty care and lower costs and improved outcomes. Asthma is such a disease. Bucknall et al¹⁸ compared hospital treatment for asthma provided by pulmonary specialists and generalists. Patients who were treated by specialists had fewer symptoms at 2-week follow-up. Within 1 year, 20% of the patients treated by the generalists were readmitted, compared with only 2% of those initially treated by specialists.

Zeiger et al¹⁹ randomized HMO patients to either ongoing asthma care by an allergist or continued care by a generalist. The intervention group had fewer symptoms at the end of 6 months, and Kaplan-Meier analysis showed that patients in the intervention group had fewer emergency department visits. Finally, Mayo and colleagues²⁰ studied adults with asthma who were selected because of their repeated hospitalizations. These patients were randomized to outpatient care in either a specialized chest clinic or a general primary care clinic. Patients in the specialty clinic had fewer readmissions and fewer hospital days; patients crossed over to the specialty-clinic group had similar reductions.

In other cardiovascular diseases, there are data demonstrating that care provided by cardiologists may improve process-of-care; it is unclear whether outcomes are improved or costs are lowered. Schreiber et al²¹ compared care provided by internists and cardiologists to patients with unstable angina. Cardiologists were more likely to use heparin, aspirin, beta blockers, and cardiac catheterization, but neither the infarction rate nor the mortality rate between the two groups differed. Moreover, hospital charges were not significantly different. In another study,²² cardiologists were more likely than general internists or family physicians to prescribe treatments for myocardial infarction that have been demonstrated to decrease mortality and were less likely to prescribe treatments that have no proven benefit.

Mark et al²³ compared cohorts of Canadian and US patients at 1 year after myocardial infarction. Mortality rates did not differ, but greater improvements in quality-of-life indicators were observed in the US

patients. Although many reasons for this difference are possible, one reasonable interpretation is that Canadian patients were less likely to see a cardiologist.²⁴ A study of Canadian and US patients who were enrolled in a trial comparing coronary angioplasty with coronary bypass surgery produced strikingly similar results.²⁵

... IMPLICATIONS FOR POLICY AND CONCLUSIONS ...

Our data do not support outright abandonment of the gatekeeper model. More widespread access to and reliance on primary care may well improve overall health and decrease overall costs.²⁶ However, our data do support the notion that current practice patterns should be examined critically, with the goal of identifying specific diseases and specific settings in which specialist-controlled care improves outcomes. Our data also suggest that control of a patient's care by a single physician is a key element in improving quality and cost outcomes. Data obtained from our system may not be directly applicable to other systems, which have different provider mixes and patient populations.

In conclusion, in at least one integrated healthcare delivery system, care for outpatients with heart failure is of higher quality, as judged by better adherence to accepted guidelines for management of heart failure, when it is provided solely by cardiologists. Primary care providers may offer better care for non-heart failure conditions by adhering better to healthcare maintenance guidelines. Joint care did not improve the process of care. Although we are unable to make firm conclusions about costs and outcomes, the data support further investigation of the hypothesis that subspecialty care for heart failure, while having higher outpatient costs, may decrease overall costs by reducing the number of in-hospital days.

... REFERENCES ...

1. Schocken DD, Arrieta MI, Leaverton PE, Ross EA. Prevalence and mortality rate of congestive heart failure in the United States. *J Am Coll Cardiol* 1992;20:301-306.
2. Stevenson WG, Stevenson LW, Middlekauf HR, et al. Improving survival for patients with advanced heart failure: A study of 737 consecutive patients. *J Am Coll Cardiol* 1995;26:1417-1423.
3. CONSENSUS Trial Study Group. Effects of enalapril on mortality in severe congestive heart failure: Results of the Cooperative North Scandinavian Enalapril Survival Study (CONSENSUS). *N Engl J Med* 1987;316:1429-1435.
4. SOLVD Investigators. Effect of enalapril on survival in patients with reduced left ventricular ejection fraction and congestive heart failure. *N Engl J Med* 1991;325:293-302.
5. Rajfer SI. Perspective of the pharmaceutical industry on the development of new drugs for heart failure. *J Am Coll Cardiol* 1993;22(suppl A):198A-200A.
6. Clarke KW, Gray D, Hampton JR. Evidence of inadequate investigation and treatment of patients with heart failure. *Br Heart J* 1994;71:584-587.
7. Paul SD, Kuntz KM, Eagle KA, Weinstein MC. Costs and effectiveness of angiotensin converting enzyme inhibition in patients with congestive heart failure. *Arch Intern Med* 1994;154:1143-1149.
8. Fonarow GC, Chelimsky-Fallick C, Warner Stevenson LW, et al. Effect of direct vasodilation with hydralazine versus angiotensin-converting enzyme inhibition with captopril on mortality in advanced heart failure: The Hy-C Trial. *J Am Coll Cardiol* 1992;19:842-850.
9. Davidson NC, Coutie WJ, Struthers AD. High-dose lisinopril is more effective than low-dose in suppressing aldosterone in patients with chronic heart failure. *Br Heart J* 1995;73(suppl 3):P13. Abstract.
10. Poole-Wilson PA and the NETWORK investigators. The NETWORK Study. The effect of dose of an ACE-inhibitor on outcome in patients with heart failure. *J Am Coll Cardiol* 1996;27(suppl A):141A. Abstract.
11. ACC/AHA Task Force. Guidelines for the evaluation and management of heart failure. Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Evaluation and Management of Heart Failure). *J Am Coll Cardiol* 1995;26:1376-1398.
12. McKee PA, Castelli WP, McNamara PM, Kannel WB. The natural history of congestive heart failure: The Framingham Study. *N Engl J Med* 1971;285:1441-1446.
13. Konstam M, Dracup K, Bortoff MB, et al. Heart failure: Evaluation and care of patients with left-ventricular systolic dysfunction. Clinical Practice Guideline No. 11. Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, US Department of Health and Human Services; 1994. AHCPR Publication 94-0612.
14. Berenson R, Holahan J. Sources of the growth in Medicare physician expenditures. *JAMA* 1992;267:687-691.
15. Franks P, Clancy CM, Nutting PA. Gatekeeping revisited—protecting patients from overtreatment. *N Engl J Med* 1992;327:424-428.
16. Greenfield S, Nelson EC, Zubkoff M, et al. Variations in resource utilization among medical specialties and systems of care: Results from the Medical Outcomes Study. *JAMA* 1992;267:1624-1630.
17. Fleg JL, Hinton PC, Lakatta EG, et al. Physician utilization of laboratory procedures to monitor outpatients with congestive heart failure. *Arch Intern Med* 1989;149:393-396.
18. Bucknall CE, Moran F, Robertson C, Stevenson RD. Differences in hospital asthma management. *Lancet* 1988;1: 748-750.
19. Zeiger RS, Heller S, Mellon MH, et al. Facilitated referral to asthma specialist reduces relapses in asthma emergency room visits. *J Allergy Clin Immunol* 1991;87:1160-1168.
20. Mayo PH, Richman J, Harris HW. Results of a program to reduce admissions for adult asthma. *Ann Intern Med* 1990;112:864-871.
21. Schreiber TL, Elkhatib A, Grines CL, O'Neill WW. Cardiologist versus internist management of patients with unstable angina: Treatment patterns and outcomes. *J Am Coll Cardiol* 1995;26:577-582.

22. Ayanian JZ, Hauptman PJ, Guadagnoli E, et al. Knowledge and practices of generalist and specialist physicians regarding drug therapy for acute myocardial infarction. *N Engl J Med* 1994;331:1136-1142.
23. Mark DB, Naylor CD, Hlatky MA, et al. Use of medical resources and quality of life after acute myocardial infarction in Canada and the United States. *N Engl J Med* 1994;331:1130-1135.
24. Kassirer JP. Access to specialty care. *N Engl J Med* 1994;331:1151-1153.
25. Pilote L, Bourassa MG, Bacon C, et al. Better functional status in American than Canadian patients with heart disease: An effect of medical care? *J Am Coll Cardiol* 1995;26:1115-1120.
26. Franks P, Nutting PA, Clancy CM. Health care reform, primary care, and the need for research. *JAMA* 1993;270:1449-1453.

*For editorial comment,
see page 925.*