Direct Medical Care Costs of Unstable Angina Pectoris in a Defined Population

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OBJECTIVE: To quantify the type and amount of resources used over two years in treating unstable angina pectoris.

DESIGN: A retrospective analysis of services used and costs to treat unstable angina pectoris, other coronary artery disease (CAD) and all other medical conditions over two years. Significance tests and cross correlations using Spearman and Pearson tests were performed among patient characteristics, services utilized, and costs. Patients were stratified by age, sex, time since original diagnosis, diagnostic procedure or operation, myocardial infarction (ICM-9 CM 410) and heart failure (ICM-9 CM 428).

SETTING: A managed care organization located in the Mid-Atlantic region.

PATIENTS: 492 patients given a diagnosis of unstable angina pectoris in the year prior to study enrollment. These patients were followed from July 1, 1993, through June 30, 1995.

MAIN OUTCOME MEASURES: Cost of treating unstable angina pectoris and other coronary artery disease.

RESULTS: More than \$1.6 million was spent on treatment of unstable angina pectoris over a two-year period. An additional \$5.8 million was spent on other CAD diagnoses. Cost per person per month was \$1,240. Mean annual cost of care for unstable angina pectoris was \$1,972, or \$164 per month. Mean expenditures for all CAD were \$760 per month.

CONCLUSION: Unstable angina pectoris is costly to treat and remains so over time. The main cost drivers are hospitalizations and procedures, often brought about by CAD complications, such as myocardial infarction and heart failure, as well as non-CAD care. The cost of any diagnosis must be examined in the broader context of all the patient's diseases. We conclude that cost containment efforts should focus first on preventing hospitalizations and procedures.

KEYWORDS: Unstable angina pectoris, Coronary artery disease, Myocardial infarction, Hospitalization

J Managed Care Pharm 1999; 39-44

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ACKNOWLEDGEMENT: Funded by an unrestricted research grant from Searle & Co.

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We estimated direct medical costs in caring for a defined population with a diagnosis of unstable angina pectoris (ICD-9 CM diagnosis 411.1). The objective of the study was to quantify the type and amount of resources used over two years in treating this disease. We chose unstable angina pectoris as an example of a variable and complex chronic disease that is part of the spectrum of coronary artery disease (CAD) defined, for the most part, by symptom severity and complexity.

Determining cost of illness in this population has two important uses. First, it examines in detail the cost of disease burden and distribution of costs across services—hospital, physician, pharmaceuticals—over time in a defined population. Second, it describes the distribution of expenditures across companion diagnoses in CAD and in noncoronary disease. Such information is basic for any decisions on resource allocation and cost/quality alternatives for tradeoffs among services, especially given the interrelatedness of care across diagnoses in the same person. Such data are especially useful for managed care organizations (MCOs) and others responsible for medical costs of defined populations.

There have been few long-term population studies of costs

of care for unstable angina pectoris; none are recent. Wittels, et al.,¹ used a decision analytic model based on opinions of a panel of cardiologists to estimate costs of unstable angina as part of a study of costs of all CAD. Five-year costs in 1986, including inpatient, surgical, medical, and all ambulatory care, were estimated at \$40,581 per person. Other studies²⁻⁴ have calculated and compared costs of specific procedures often used with patients having angina pectoris, such as angioplasty, coronary artery bypass graft, stent implant, and directional atherectomy.

METHODS

The population for this study was identified through an MCO in the mid-Atlantic United States. This not-for-profit health system is a full-service MCO that cares for about 175,000 persons; it is the largest provider organization in its primarily rural area. Due to the area's geographic isolation, patients obtain little care outside the system.

The MCO, which owns most of its facilities—hospitals, ambulatory clinics, and offices—had multiple forms of delivery and organization, including a staff-model health maintenance organization, provider networks, and independent practitioners. Physicians were paid by salary, capitation, and/or fee-for-service. Additionally, the MCO used multiple payment methods to all other providers and varied actual payments or reimbursements for services based on type of insurance policy held by the patient, contractual arrangements with providers, and MCO-specific cost accounting derivations.

All participants were identified from the MCO patient service database, not billing records, with any diagnosis of unstable angina in the year prior to study enrollment. These patients were then followed from July 1, 1993, to June 30, 1995. Participants were originally diagnosed at any time from the year prior to enrollment to many years previously. The computerized database has been in use for about two decades, which facilitated this longitudinal study. Using a patient-unique identifier number, researchers collected data on all services used for all diagnoses, including inpatient hospital, other facilities, ambulatory services, and emergency room. These service data were available irrespective of method of payment to providers and were not based on billing information. Researchers also collected data on services such as psychiatric care, ambulance transport, coronary and noncoronary diagnostic procedures and surgical operations, rehabilitation, ambulatory surgery, home nursing care, and diagnostic tests by independent laboratories.

All services except outpatient pharmaceuticals dispensed were attributed to unstable angina, other CAD diagnoses, and all other diagnoses based on recorded diagnostic codes. When there was uncertainty about attribution of services to a specific diagnostic category, one of the study physicians chose the most likely category for the care. For ambulatory pharmaceuticals, however, only patient-unique number, medication dispensed, dosage, dispensing date, and cost as attributed by the

MCO were recorded as a separate file by the MCO. Diagnosis was not included, making it difficult to relate some medications dispensed to a specific diagnosis. Nearly all study participants had multiple diagnoses, particularly CAD diagnoses, for which the same medications were prescribed. A panel of physicians from the MCO estimated, based on their professional experience, that outpatient medications used for both unstable angina pectoris and other cardiac diagnoses would be generally attributable 25% to unstable angina and 75% to other CAD diagnoses.

Data collected included patient characteristics (age, sex, and date of original diagnosis of unstable angina), diagnostic and therapeutic procedures performed, ambulatory care (such as physician visits, ambulance transport, and X-ray tests), emergency room use, inpatient hospitalization, and ambulatory pharmaceuticals.

For consistency and generalizability, costs (actual national mean payments) by service for fiscal year 1995 were obtained from the Health Care Financing Administration (HCFA) and attributed to each service. Using HCFA payments allows one to generalize cost results across the country. However, HCFA payments are for the elderly and disabled and thus may overstate real payments by insurers. Further, actual payment variation by other payors may be importantly different from Medicare payment.

Payments during the two-year study period were aggregated for each patient and then added across all patients. Cost by diagnosis (i.e., unstable angina, other CAD diagnoses, and all other diagnoses) were then disaggregated for each of the three diagnostic subgroups. While we recognize that CAD, including unstable angina, is a continuum of disease, it is useful to categorize resource use into CAD and non-CAD (e.g., arthritis) subgroups.

All participants were eligible throughout the study period. However, we had no way of knowing if a family member with unstable angina died during the study period, as long as the primary insured person remained eligible. Those who died therefore used no services but remained in the study.

Significance tests and cross correlations (using Pearson and Spearman tests) were performed among patient characteristics, services utilized, and costs. Physician characteristics were not available. Patients were stratified by age, sex, time since original diagnosis of unstable angina, diagnostic procedure or operation, myocardial infarction (ICD-9 CM 410), and heart failure (ICD-9 CM 428). A multiple regression model was specified to test the effects of these variables on cost.

RESULTS

A total of 492 individuals were identified with a diagnosis of unstable angina pectoris, a prevalence rate of 4.7/1,000 for all men and women over age 30. Prevalence rates of angina in the United States have been estimated at 24/1,000 among

people over age 30.⁵ Thus, if our study population was representative of the country, about 20% of angina patients were further diagnosed with unstable angina during the history of their disease.

Mainly because of multiple identification numbers, 86 persons could not be accurately identified and categorized and were deleted from the study. By all measures, they were comparable to the rest of the population. Thus, 406 people were included in the study cohort. Because this was designed as a longitudinal, cross-sectional, cohort study, participants were at varying years post-original diagnosis of unstable angina; some were newly diagnosed and some were more than 15 years post-initial diagnosis.

Age

The study population was predominantly 45–64 years old (74.2%); 14.5% were age 65 and older (see Table 1). Mean (55.3 years, S.D. 9.6) and median (55 years) age and distributions for both women and men were similar.

Sex

More than two-thirds (68.2%) of the study population were male (see Table 1). Women generally predominated in the middle-age categories and men in younger and older age groups.

Cost

Total cost of all medical care for this cohort was \$12,082,954 during the two years of the study (mean \$29,761 per person, S.D. \$32,985), or \$14,881 per person per annum (see Table 2). Cost per person per month averaged \$1,240 and varied from \$16 to \$10,346. Mean annual cost of care for unstable angina was \$1,972, or \$164 per month. This is but one part of caring for all coronary artery disease; mean expenditures for all CAD, including unstable angina, were \$760 per month. Patients with unstable angina have other diseases in addition to CAD that added approximately \$480 per month.

By Diagnosis Group

More than \$1.6 million (13.3% of total costs) was spent on care for unstable angina—a mean of \$1,972 per person per

Table 1. Population Distribution by Age and Gender

Age	Gender		Total	Percent
	Female	Male		
<35	—	04	04	1.0%
35-39	04	09	13	3.2%
40-44	05	24	29	7.1%
45-49	27	48	75	18.5%
50-54	28	48	76	18.7%
55-59	23	56	79	19.5%
60-64	24	47	71	17.5%
65-69	11	19	30	7.4%
70-74	03	12	15	3.7%
75+	04	10	14	3.4%
Total	129	277	406	—
Total %	31.8%	68.2%	—	100%

year. An additional \$5.8 million (48.1%) was spent on other CAD diagnoses (\$7,158 per person per year), and the remaining (38.6%) \$4.7 million was expended on all non-CAD care (\$5,751 per person per year). Thus, having unstable angina is associated with relatively high expenditures for both CAD and non-CAD diagnoses.

Large variation in costs was evident within all groups over time. Although there was a tendency for total medical care expenditures to rise with age, age was not a good predictor of cost. There was also little difference in cost between women and men, except in the youngest and oldest age groups. Small numbers of people in these latter age categories may bias the results. Irrespective of age and sex, care for unstable angina had the lowest overall mean cost during the two study years, while care for other CAD and/or non-CAD had substantially higher costs. These latter results should be

Table 2. Total Costs by Diagnosis Category (1995 U.S. Dollars)

	Unstable Angina		Other CAD		Non CAD		Total Costs	
	Hospital	Ambulance	Hospital	Ambulance	Hospital	Ambulance	Hospital	Ambulance
Mean	5,403	945	21,672	3,009	10,694	4,469	29,935	7,751
S.D.	9,028	3,793	23,026	5,429	21,278	4,961	30,179	8,221
Minimum	15	3	46	19	21	35	52	225
Maximum	77,890	44,759	151,019	71,363	210,289	38,149	220,633	76,844
Total	1,312,842	288,333	4,767,768	1,044,246	2,855,389	1,814,376	8,935,999	3,146,955

interpreted cautiously, as there was a large standard deviation (often twice the mean) for each age and gender group.

DISTRIBUTION OF COSTS

Hospitalization Costs

During the two study years 304 people (74.9%) were hospitalized at a total cost exceeding \$8.9 million (see Table 2). They were hospitalized a mean of 2.1 times and stayed an average of 6.6 days during each hospitalization. Inpatient costs (see Table 2) accounted for 74.0% of total expenditures. Patients hospitalized during the study period for CAD diagnoses other than unstable angina incurred the greatest cost (53.4% of total hospital costs). This was primarily due to inpatient diagnostic (mainly cardiac catheterization) and surgical (mostly coronary artery bypass graft [CABG] or angioplasty) procedures.

Ambulatory Costs

Ambulatory costs, including ambulatory prescription pharmaceuticals, accounted for more than \$3.1 million (see Table 2), or 26.0% of total expenditures. These costs included a wide variety of outpatient services: outpatient physician and clinic visits ($n=20,193$, \$2,081,806); emergency room visits ($n=1,328$, \$128,867); day surgery ($n=34$, \$27,097); and ambulance transport ($n=451$, \$94,076). Outpatient pharmaceuticals (12,964 prescriptions filled) were \$691,006 of the total.

Physician and clinic visits consumed 66.2% of ambulatory costs. Mean cost per visit was \$103, which may have included diagnostic tests and treatments not specifically recorded. Outpatient pharmaceuticals were 21.9% of ambulatory costs (mean=\$71); emergency room visits accounted for 4.1% (mean=\$97 per visit); and land, water, and air ambulance transport was 3.0% of total ambulatory costs (mean=\$209).

Procedure Costs

Having any diagnostic and/or surgical procedure had an important effect on cost. The 164 patients (40.4% of the study population) who had any procedure accounted for \$8.3 million or 68.8% of total expenditures during the study period. Those with any CAD or non-CAD procedure (e.g., cholecys-

tectomy), on average, had similar 3.3-fold greater costs than those who did not (see Table 3). Patients who had both CAD and non-CAD procedures averaged costs about one-third greater than those who had only one or the other.

Cost Since Initial Diagnosis of Unstable Angina

Year of original diagnosis of unstable angina was available for 185 patients (45.6%). Except for the first one to two years following diagnosis, time since first diagnosis had little effect on cost during the two-year study period (see Figure 1). Increased costs in the first two years following diagnosis of unstable angina were due to inpatient treatment, mainly for diagnostic and surgical procedures. There was another sharp cost rise between the 10th and 12th year after diagnosis, but the small number (only five patients) makes generalizing from these results difficult. Ambulatory costs were stable over time.

Myocardial Infarction and/or Heart Failure

Those who had a myocardial infarction during the study period ($n=145$, 35.7% of study participants) incurred 2.9-fold higher mean costs than those who did not (\$51,202 vs. \$17,869). Those with heart failure ($n=60$, 14.8%) had two-fold greater costs than those without (\$52,725 vs. \$25,779). Here, too, hospitalizations and procedures were powerful cost drivers.

Regression Analysis

Results of the multiple regression model showed that having any diagnostic or surgical procedure, having myocardial infarction, and/or having heart failure related significantly to cost ($R^2=53.7\%$, $p<0.0001$). This means that more than half the cost variation was explained by these three variables.

DISCUSSION

People with unstable angina pectoris are expensive to treat for the rest of their lives, especially within the broader context of all comorbid conditions—both CAD and non-CAD. Complications of underlying ischemic heart disease (e.g., myocardial infarction, heart failure), of which unstable angina pectoris is but one part, accounted for nearly half of all expenditures. Moreover, non-CAD diagnoses consumed more than one-third of total costs. Thus, a serious chronic illness has an important effect on all diseases afflicting the individual. Any cost of illness study must include all costs of care in addition to costs for the index disease.

Mean costs of unstable angina pectoris, \$14,881 per annum, varied little between study years or by age and sex. High costs throughout the long-term episode of care were due to intensive diagnostic workup and surgical procedures, especially evident in the first two years after initial diagnosis. But much of the high annual cost was due to the substantial numbers of patients who continued to have procedures, mainly CAD-related, years after initial diagnosis of unstable angina. One explanation may be that once a person has a diagnosis of

Table 3. Cost by Procedure (1995 U.S. Dollars)

Procedure	n=	Hospitalization	Ambulatory	Total
No procedure	242	9,116	6,116	15,232
CAD only	106	38,052	9,263	47,315
Non-CAD only	12	32,230	11,250	43,480
Both CAD & non-CAD	46	50,210	11,956	62,166
Total	406	22,010	7,751	29,761

unstable angina, he or she needs treatment indefinitely.

Patients having any procedure incurred from threefold to sevenfold greater costs than those with no procedure. The 40% of patients who had a procedure accounted for about 69% of total study costs. Additionally, having myocardial infarction and/or heart failure led to nearly threefold greater costs. If our cohort is representative, we can expect within any two-year period about 75% of people with unstable angina to be hospitalized and about 40% to have a diagnostic or therapeutic procedure. The financial effects of hospital care (74% of total study costs, including most procedure costs) cannot be over-emphasized. Costs of ambulatory services such as physician visits, emergency room use, ambulance transport, and others, were approximately 20% of the total.

Outpatient pharmaceuticals were less than 6% of total annual cost. This last amount is interesting, given the close scrutiny of outpatient pharmaceuticals by payors. Even the best efforts aimed at reducing ambulatory pharmaceutical expenditures can have only a small effect on cost, and the effort needed to achieve it may cost more than the savings obtained. Large cost savings can be realized with even small reductions in hospitalizations and procedures. There are increasing numbers of examples from other expensive chronic illnesses, such as diabetes and asthma, in which investments in intensive ambulatory care lead to important reductions of in-hospital services, improved health outcomes, and lower overall disease and per-patient costs.

Myocardial infarction occurs in 3%–7% of patients within one month of diagnosis of unstable angina.^{6,7} There are many possible explanations for observed myocardial infarction over two years in 35.7% of our study population. The results could be due to patient selection, underreporting of unstable angina, or inadequate coding of records.

Although we have no direct evidence regarding appropriateness of care for individuals in this study's population, we do show clearly the enormous variability of resource consumption and cost. While we could not tie this variation consistently to individual physicians, the large percentage of patients with similar experience (e.g., catheterization and CABG within two years of initial diagnosis of unstable angina) may be related to the emphasis on symptom-based treatment; expensive interventions occur with serious acute events such as myocardial infarction and heart failure. However, we do not know if these high-risk and expensive events could have been prevented by more aggressive prophylactic medical treatment.⁸ It may well be that initial hospitalization for unstable angina can lead to lower subsequent costs if symptoms are resolved or controlled, even though our results showed substantial numbers of people hospitalized every year, with or without procedures, and irrespective of date of first diagnosis. But aggressive hospital treatments for unstable angina such as thrombolytic therapy, CABG, and angioplasty have not proved useful in preventing myocardial infarction.⁷⁻⁹ Treatment variation also may indicate the distribution of this study population's needs⁹ or low effec-

Figure 1. Mean Costs Since First Diagnosis

tiveness of current interventions. Recent studies of costs and benefits of initial treatment based on symptoms have shown it to be a preferred strategy in circumstances as diverse as peptic ulcer treatment, community-acquired pneumonia, and acute bronchitis.^{10,11}

Longitudinal data on defined populations also can serve future evaluations. Effects of new interventions such as pharmaceuticals can be evaluated using these data as inputs into decision analytic models. These results also show clearly each sector's contribution to total costs, especially that small percentage of costs attributable to ambulatory pharmaceuticals

Study Limitations

Unstable angina pectoris is a clinical diagnosis, one based not entirely on objective testing. Both under- and over-diagnosis are possible. Unstable angina can progress to myocardial infarction or regress to stable angina. For this study, we were most interested in what physicians actually did when the diagnosis was made, what resources were used, and what costs were incurred—in essence, a two-year history of service utilization and costs of care.

Issues of data validity and reliability exist. As the study was done without reference to individual patients and physicians, computerized data were not compared to patient records.

The distribution of ambulatory prescriptions was estimated between unstable angina and all other CAD diagnosis categories, introducing the possibility of attribution bias. Date of first diagnosis of unstable angina was not available for 54.4% of study patients, reducing statistical power. For example, more patients without a known date were likely to have been diagnosed further in the past than those whose date of initial diagnosis was known.

Costs reported here underestimate total direct medical care expenses. We could not estimate, for example, inpatient

short-term skilled nursing facility care, long-term nursing home care, or hospice care. Such costs were borne mainly by Medi-care, Medicaid, other insurers, and patients and families, and these data were not available in study files. Ambulatory pharmaceutical costs are also underestimated, as an unknown percentage of study participants had no outpatient pharmaceutical insurance coverage and thus no medication records in the study data base. Indirect costs borne by patients, families, and employers, undoubtedly substantial, also were not estimated.

The criteria for diagnosis of unstable angina and their application by practitioners, as well as diagnostic strategies and therapeutic regimens, have undoubtedly changed over time. ICD 9CM 411.1 is not specific only to unstable angina but includes a variety of related conditions. Coding variability could mean that rates of diagnosis, service use, and costs of care of unstable angina could be either underestimated or overestimated. The limited usefulness of most existing computerized data systems developed for administrative needs is also apparent in this study. For example, variable differentiation of services used between unstable angina and other CAD care could influence study results.

CONCLUSION

Unstable angina pectoris is costly to treat and remains so over time. The main cost drivers are hospitalizations and procedures, often brought about by CAD complications as well as non-CAD care. Thus, cost of any diagnosis must be examined within the broader context of all the patient's diseases. The large annual cost resulting from this synergy of multiple chronic diseases is obvious.

From our broad analysis of resource use in these patients with unstable angina, we conclude that cost-containment

efforts should focus first on preventing hospitalizations and procedures. Economic savings across the population could be substantial if alternatives are less costly in aggregate.

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