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Research Article

Patterns of Onset of Serious Medical Illnesses: Implications for Physician Capitated Payments

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Abstract

In this study, the pattern of onset of major illness events (conditions associated with serious morbidity or mortality requiring acute intervention and/or chronic follow-up) is examined in each individual patient in a cohort followed over an extended period of time. Random as well as clustered patterns are discussed, as well as the possible effects of such patterns on physician payments in a capitated payment setting.

Keywords: *Patterns major illnesses random clustered capitation payments.*

Introduction

There have been no long-term studies of cohorts of patients followed over a period of many years looking at the patterns of onset of serious medical illnesses, specifically whether these occur as random events over time, or if they are clustered in non-random patterns. This would not only be of great interest in and of itself, but could have implications for physician payments, especially in a capitation setting.

In a capitation contract, a physician receives a yearly cash flow, either positive or negative, equal to a predetermined amount for each patient, minus the actual physician cost of caring for that patient (1). Over time the value of this series of cash flows can be computed by the standard net present value (NPV) method (2). This value represents the value of the capitation contract at its inception--the higher the NPV, the more economic value the contract has for the physician. Since physician costs relate directly to episodes of patient illness, the NPV depends not only on the cost of each illness event, but on their pattern of occurrence over time. As shown in Figure 1, a clustering of illness events early in the contract has a negative impact on the NPV compared to a random onset pattern over the course of time, even if the physician costs in real dollars are the same for these episodes. Thus, if patient illnesses tend to occur as clustered events over time, physicians would be at further economic risk by accepting such contracts. Although some studies have commented on the seasonal variation of illnesses (3.4), this study attempts to examine these patterns in a cohort of patients followed continuously for an extended period of time.

FIGURE 1

The effect of the onset pattern of major illness episodes (E) on the net present value (NPV) of capitated contracts. An early cluster pattern results in an economic loss to the physician as shown by the negative NPV. A late cluster pattern has the most economic gain for the physician as shown by the highest NPV. Yearly cash flows of +$150 represent the yearly capitated payment to the physician minus the average cost of medical care. Cash flow of -$250 represents the yearly capitated payment to the physician minus the average physician cost of medical care of a major illness event. These figures are for illustrative purposes only, and not based on actual economic data. A discount rate of 5.0% was used for all calculations.

RANDOM PATTERN (NPV=$+240)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Cash Flow		+150	+150	-250	+150	+150	-250	+150	+150	-250	+150	+150	-250
				E			E			E			E

EARLY CLUSTER PATTERN (NPV=$-89)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Cash Flow		-250	-250	-250	-250	+150	+150	+150	+150	+150	+150	+150	+150
		E	E	E	E								

MIDDLE CLUSTER PATTERN (NPV=$+163)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Cash Flow		+150	+150	+150	+150	-250	-250	-250	-250	+150	+150	+150	+150
						E	E	E	E				

LATE CLUSTER PATTERN (NPV=$+369)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Cash Flow		+150	+150	+150	+150	+150	+150	+150	+150	-250	-250	-250	-250
										E	E	E	E

Methods and Results

An extensive chart review was conducted of an eight physician large internal medicine fee-for-service private practice located in western Nassau County in Long Island, New York. Patients were selected for the study group if they were followed by this practice continuously for 15 years or more, and if they each had at least four major illness episodes during that time. A total of 87 patients were selected (35 females, 52 males).

All patients had traditional indemnity insurance including Medicare Parts A and B after age 65. At the end of the follow-up period, the patients had an average age of 75.9 years (range 51-93), each had an average of 73.6 office visits (range 33-245), and each patient was followed for an average of 22.9 years (range 15.0-32.5). Twenty-four patients expired during the study period.

For each patient, the time of onset of each major illness event was recorded. Broadly defined, a major illness event was the onset of any condition associated with serious morbidity or possible mortality requiring acute intervention and/or chronic follow-up, and incurring significant costs to the physician in rendering the needed care. As shown in Table 1, these included acute conditions (myocardial infarction, sepsis, pulmonary embolism, CVA), the onset of chronic conditions (hypertension, diabetes, CHF, angina), and major surgical procedures. Excluded were office visits for routine minor problems, minor exacerbations of chronic conditions requiring only minor interventions, and brief emergency room visits not requiring hospitalization. When it was unclear from the chart review if an incident was serious enough to be considered a major illness event, the patient's primary physician was interviewed before deciding if the episode should be included. The patients in the study group had an average of 6.6 major illness events per patient (range 4-18).

TABLE 1. Most frequent major illness events for the study group (574 events).

Major surgery	61	CVA	9
Hypertension	45	Renal	9
Angina	44	Colon CA	8
Hyperlipidemia	42	COPD	7
Arrhythmias	32	Embolism	5
Expirations	24		
Myocardial Infarct	23		
CHF	22		
Hematologic	22		
Diabetes	16		
Thyroid	13		
Gastrointestinal	12		
Pneumonia	12		
Heart Valve	10		

For each patient, the time intervals in months between each consecutive pair of major illness events (interevent intervals) were plotted against the cumulative frequency of interevent intervals during the follow-up period. Also, for each patient, a model distribution of the same number of interevent intervals as occurred during the patient's follow-up period was generated. This model assumed that each major illness event had an equal likelihood of occurring at any time during follow-up. Statistically, this model of independent and random event occurrence would be described by an exponential distribution of the interevent intervals. For each patient, the cumulative frequency for this random model of events over the follow-up duration is given by F(t)=1-e _(t/B) where F(t) is the cumulative frequency of events with interevent intervals <t, and B is the estimated mean time between episodes for the patient (duration of follow-up in months divided by the patient's total number of events). The model of random distribution for each patient was also plotted against the predicted cumulative frequency of interevent intervals during follow-up. The Kolmogorov-Smirnov goodness-of-fit test (5) was used to compare each patient's observed (sample) distribution with his or her own model of random distribution.

The null hypothesis assumed that the interevent intervals were independent and randomly distributed throughout the follow-up for each patient. The null hypothesis was rejected if the patient's sample distribution differed significantly from his or her model of random distribution. Comparisons between continuous and categorical data were made with Student's t test and chi-squared tests respectively.

The level of statistical significance was set at P<0.05. Of the 87 patients in the study group, 73 (84%) had a random pattern of onset of major illness episodes, while 14 (16%) had a non-random or clustered pattern. As shown in Table 2, there were no differences between the two groups in average age, average number of events per patient, average number of office visits per patient, and average length of follow-up. There were also no differences in the most common major illness events such as major surgery, hypertension, angina, hyperlipidemia, congestive heart failure, hematologic disease, pneumonia, and expiration. However, the random group did have a higher incidence of diabetes and arrhythmias, while the non-random group had a higher incidence of myocardial infarction.

TABLE 2. Comparisons of Random Pattern and Non-Random Pattern Patients

	Random	Non-Random	P Value
Number of Patients	73	14	P<0.001
Major Illness Events	480	94	NS
Average Events/Patient	6.58	6.71	NS
Average Age (years)	76.05	75.24	NS
Average Office Visits/Patient	74.85	67.29	NS
Average Follow-up (months)	278.5	262.0	NS
Major Surgery	52	9	NS
Hypertension	37	8	NS
Angina	36	8	NS
Hyperlipidemia	34	8	NS
Arrhythmia	30	2	P<0.01
CHF	19	3	NS
Hematology	18	4	NS
Diabetes	16	0	P<0.02
Myocardial Infarction	16	7	P<0.01
Pneumonia	10	2	NS
Expirations	21	3	NS

In the non-random group, the follow-up period for each patient was divided into thirds (early, middle, late) in order to see for each patient where 40% or greater of the major illness episodes were clustered. Three patients had an early clustering pattern, three had middle clustering, and eight had late clustering. Thus, for the entire group only 3.4% of patients had early clustering, while 9.2% had late clustering. Also in the non-random group, 8 periods were noted in which 3 or more major illness events occurred within 3 months of each other. In 7 of these periods a cardiovascular event occurred, in 4 anemia was present, and in 3 an expiration took place.

DISCUSSION

Despite its small size, this study supports the idea that in elderly patients followed over an extended period of time, major illnesses occur in a random pattern in the majority of patients. It is not clear from this study the reasons for this finding, and it is also not clear why a small percentage of patients were found to have a non-random pattern. The two groups appear to be clinically similar, but because of the small number in the non-random group, it may take a larger study to determine what patient attributes are associated with a non-random disease pattern. It is also not clear if the results of this study can be applied to the general population, especially younger people who often have captitation type health plans.

The high incidence of a random pattern may lend support to the concept of random screening for certain diseases, and may have some application to clinical guidelines regarding the content of routine annual examinations. In the non-random group, the significance of the higher incidence of cardiac and hematologic seen in the small clusters is also unknown, and larger studies may be needed to confirm this finding. Some late clustering as seen in this study of elderly patients may be anticipated as many of these patients approach the end of their lives. However, the study appears to support the idea that in accepting capitation contracts over the long term, physicians do not appear to be at increased economic risk resulting from the clustering of illness episodes. Indeed, an early clustering pattern, which has the greatest negative impact on the net present value of a capitated contract, was only seen in 3.4% of the entire study group. The late clustering pattern (best NPV) seen in 9.2% may more than negate the losses incurred from the early clustering group, and further lessen the economic risk for physicians.

Conclusions

In the majority of elderly patients in this small study, the onset of serious medical illnesses appears to occur in a random pattern when followed over a long period of time. Clustered patterns in the non-random group do not appear to put physicians at significant economic risk when accepting capitation contracts over the long term.

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