Substitutability Among Different Types of Care Under Medicare

By Fred J. Hellinger

The question of whether Medicare coverage of outpatient services, nursing home care, and home health care reduced the use of short-term hospitals by Medicare beneficiaries, and whether reduced hospital use saved the Medicare program money, is reexamined by use of a simultaneous-equations model estimated by the two-stage least-squares method. It is argued that all alternative modes of care must be examined simultaneously for accurate results. The findings partly support and partly contradict results of previous studies: both outpatient care and nursing home care can substitute for hospital care, but a complementary relationship between outpatient and nursing home care indicates that the additional coverage resulted in greater, not less, expenditure by Medicare.

Previous studies have attempted to determine the cost impact, under Medicare, of substituting one type of care for another. Davis and Russell [1] analyzed the substitutability between short-term hospital (STH) inpatient care and outpatient care, using a single-equation model estimated by ordinary least squares. They included in their demand function price variables for inpatient and outpatient care, income, insurance coverage, occupancy rates, and physician availability measures. The coefficients for both inpatient and outpatient care price variables were positive and significant, demonstrating the existence of a substitution relationship between these modes of care. The authors concluded that an insurance program subsidizing outpatient care would induce substitution of outpatient for STH care and result in lower total costs.

In another study Russell [2] examined the influence of nursing home care (extended care facility, or ECF, care) on Medicare costs through the effect of ECF care on the mean length of stay of Medicare patients in short-term hospitals. Again a single-equation model was used, and a substitution effect was found between ECF care and mean length of stay, although Russell reported that she found no effect of

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ECF use on short-term hospital admissions. She assumed that ECF use had no effect on STH reimbursement per day and used this assumption and her findings to estimate that ECF use resulted in a net savings to Medicare of $99 million in 1967 and $219 million in 1968.

Both these studies, as mentioned, were based on single-equation models, and they each compared only two modes of care, ignoring the possible impact of other available modes. However, decisions regarding the site of a patient's care are influenced not only by patient needs and physician opinion, but also by the availability of alternative sites. The Medicare program in 1968 covered 60 days of short-term hospital care less a $40 deductible, 20 days of ECF care fully with a $4 per day copayment charge for an additional 80 days, and 100 percent of the charges for outpatient and home health care received after a hospital visit. Essentially, Medicare removed for the elderly any financial barriers that prevented them from receiving these types of care. It seems evident that the levels of utilization of outpatient, ECF, STH, and home care are interrelated and that accurate measurement of the substitutability pattern between any two types of care requires including all the other types in a simultaneous-equations model. The purpose of this article is to use such a model, with five equations, to investigate the mean length of stay and admission rate in short-term hospitals, along with utilization of outpatient, ECF, and home care and thereby to reexamine the cost to Medicare of covering ECF and outpatient care.

Variables and Data Sources

State aggregate data on utilization by Medicare beneficiaries during 1968 were taken from Social Security Administration publications [3–5]; demographic data were obtained from a U.S. Census Bureau publication [6]. The specific source of data for each variable is noted below. Five dependent variables were used for utilization of four modes of care:

ADM = short-term hospital admission notices per 100 Medicare (Part A) hospital insurance enrollees [3]

MLS = mean length of stay: covered days per claim for STH inpatient services provided to Medicare enrollees [3]

OP = number of claims for (Part A) outpatient hospital services [4] per 100 Medicare (Part A) hospital insurance enrollees [5]

ECF = number of extended care facility admission notices per 100 STH admission notices [3] (to be covered, an ECF admission must follow a stay of at least three days in a short-term hospital)

HH = number of home health care starts [4] per 100 (Part A) hospital insurance enrollees [5]

The *ADM* and *MLS* variables were chosen to describe the use of short-term hospital facilities because these two aspects of short-term hospital care may be affected differently by changes in an exogenous

variable. For example, if the number of teaching programs in a state increases, one would expect the mean length of stay to increase, because interns and residents use more time and resources to treat patients. Such an increase in teaching programs, however, may have no impact or possibly a negative impact on the admissions variable. (For example, large teaching hospitals often operate large outpatient clinics that lower the rate of hospitalization [1, 7].)

Nine exogenous variables were used to help estimate the variation in the five utilization variables:

BEDS = short-term general and other special hospital beds per 1,000 state residents [3]

ECFB = extended care facility beds per 1,000 hospital insurance (Medicare Part A) enrollees [5]

DENS = state population divided by total state land area [6]

RACE = percentage of white Medicare hospital insurance enrollees [3]

SOUTH = a dummy variable set equal to one for 16 southern states and equal to zero for all other states

FEES = an index of state physician fees based on data for the period from July 1966 to December 1967: calculated as $\sum_i S_i P_i / \sum_i N_i P_i$, where $i = 1, \ldots, 6$ denotes six surgical procedures important to the aged, S_i = each state's average charge for procedure i, P_i = the percentage of total national charges accounted for by procedure i, and N_i = national average charge for procedure i [3]

INC = mean per capita personal income in each state [6]

MDS = number of primary care physicians (general practitioners, pediatricians, and internists) per 1,000 state residents [8]

NONT = percentage of total adult hospital beds that were in nonteaching hospitals (i.e., those not affiliated with a medical school and without an approved internship or residency program) [3]

The Model

The five simultaneous equations were structured as follows:

$$ECF = C_1 + aOP + bADM + cMLS + dHH + eBEDS + fECFB + gDENS + hRACE + iSOUTH + jFEES \quad (1)$$

$$OP = C_2 + aECF + bADM + cMLS + dHH + eINC + fBEDS + gMDS + hFEES + iRACE + jSOUTH + kDENS + lNONT \quad (2)$$

$$ADM = C_3 + aECF + bOP + cHH + dBEDS + eECFB + fMDS + gDENS + hRACE + iSOUTH + jFEES \quad (3)$$

$$MLS = C_4 + aECF + bOP + cHH + dBEDS + eNONT + fECFB + gMDS + hDENS + iRACE + jSOUTH + kFEES \quad (4)$$

$$HH = C_5 + aECF + bOP + cADM + dMLS + eINC + fBEDS + gDENS + hRACE + iSOUTH + jFEES \quad (5)$$

where the variables are as defined previously and all lower-case letters denote coefficients to be determined.

One would anticipate that an increase in the availability of hospital beds would be positively related to the utilization of hospital services. One therefore expects the *BEDS* variable to possess a positive coefficient in the *ADM* and *MLS* equations. Additionally, the assumption that home health, outpatient, and ECF care are substitute inputs for STH care in the health service process implies that the availability of beds in short-term hospitals is inversely related to the utilization of these services. Consequently one hypothesizes that the *BEDS* variable will enter into the *ECF*, *OP*, and *HH* equations (Eqs. 1, 2, and 5) with a negative coefficient.

If ECF care and STH care are substitute inputs in the health process as Russell asserts [2], then the availability of ECF beds should be negatively associated with the *ADM* and *MLS* variables. Thus *ECFB* is expected to enter Eqs. 3 and 4 with a negative coefficient. An increase in *ECFB* should be positively related to the use of extended care facilities; hence one expects the *ECFB* variable to have a positive coefficient in Eq. 1.

In less densely populated areas hospital admission rates are generally higher because it is easier for physicians to maintain observation of patients who are all in one location. Also, patients in rural areas may be hospitalized for longer periods of time because of travel distance and the difficulty of follow-up treatment. Fewer home health services may be available in rural areas because of a lack of health care professionals and because of the difficulty in treating patients in remote areas. In rural areas ECF services may be too far away to allow relatives to visit patients regularly, which may discourage elderly patients from leaving home to live in an extended care facility. Again, the utilization of outpatient services may be lower in rural areas because of the long distances to hospitals for many citizens. From these considerations the *DENS* variable would be expected to have a positive coefficient in Eq. 3 and a negative coefficient in Eqs. 1, 2, and 5.

The variables *RACE* and *SOUTH* are included in each equation to determine whether the utilization of health care services by Medicare enrollees varies systematically with the racial composition of the population or with the region of the nation. It is likely that black Medicare enrollees utilize health care services less intensively than the white population, as many nonwhite persons tend to view health care only as an emergency service. It is also expected that utilization of health care services may be lower in the South.

The variable representing physicians' fees attempts to measure the costliness of physician services. The implicit assumption is that the fees for the six surgical procedures chosen are representative of physician fees for a broad spectrum of services. Since physician services are covered under Part B of Medicare and require a 20-percent copayment by the enrollee, the utilization of health care modes that involve large amounts of physician time should be inversely related

Two-stage Least-squares Coefficients (and *t*-scores) of Simultaneous-equations Model of Medical Service Utilization by Medicare Beneficiaries

Independent variable	Dependent variable				
	ECF (Eq. 1)	*OP* (Eq. 2)	*ADM* (Eq. 3)	*MLS* (Eq. 4)	*HH* (Eq. 5)
ECF	...	1.458*	0.433	-0.108*	0.178
		(2.368)	(1.284)	(2.669)	(0.934)
OP	0.019*	...	-0.051*	-0.026	0.084
	(2.292)		(2.932)	(1.023)	(1.162)
ADM	0.034	-0.775*	...	...	0.004*
	(0.156)	(2.718)			(2.458)
MLS	-0.096	0.124	...	...	0.019
	(0.047)	(0.015)			(1.807)
HH	0.016	0.085	0.167	0.068	...
	(0.364)	(0.062)	(0.724)	(0.641)	
BEDS	-0.078*	-0.083	0.093	0.068*	-0.004
	(3.613)	(0.771)	(1.415)	(2.764)	(0.050)
ECFB	0.070*	...	0.110	-0.025*	...
	(2.618)		(1.173)	(1.942)	
DENS	1.047	-0.004	0.036	0.556	-0.091
	(0.282)	(0.061)	(0.708)	(0.009)	(1.841)
RACE	0.018	0.036*	-0.097	0.081	-0.008
	(1.27)	(2.061)	(0.724)	(0.141)	(0.029)
SOUTH	-1.542*	-0.464	-0.103	-0.215	-0.230
	(2.022)	(0.861)	(1.415)	(0.058)	(1.446)
FEES	0.037*	0.060	0.116	0.136	0.670
	(2.068)	(1.588)	(1.173)	(0.672)	(0.255)
INC	...	-0.010	...	...	-0.006
		(0.935)			(0.912)
MDS	...	-0.014	-0.065*	0.019	...
		(1.762)	(2.071)	(1.371)	
NONT	...	-0.742	...	-0.376	...
		(1.232)		(1.12)	
Constant	-0.023	2.708	-4.360	1.026	0.592
R^2	0.734	0.672	0.784	0.621	0.337

* Significant with $p \leq 0.05$.

to *FEES*. Consequently *FEES* should have a negative coefficient in the *OP*, *ADM*, and *MLS* equations. The converse hypothesis is that the *FEES* variable should enter the *ECF* and *HH* equations with a positive coefficient.

The income variable *INC* is defined as the mean per capita personal income of a state's residents. This variable was included in Eqs. 2 and 5, which explain, respectively, variations in *OP* and *HH*—the utilization of outpatient and home health services—because the Medicare program under Part B requires a 20-percent copayment for covered outpatient and home health services. However, the first 60 days of inpatient hospital care and the first 20 days of ECF care are covered completely under Part A of the Medicare program. Therefore the income variable is omitted from the equations for *ECF* (Eq. 1), *ADM* (Eq. 3), and *MLS* (Eq. 4).

The physician is often the primary factor in the determination of where a patient receives care. M. Feldstein has shown [7] that the utilization of STH services by Medicare enrollees is negatively related to the supply of primary care physicians, which leads one to expect the *MDS* variable to enter the *ADM* and *MLS* equations with a negative coefficient. In areas with a relative scarcity of primary care physicians more individuals are expected to seek care from outpatient departments. Hence one expects *MDS* to have a negative coefficient in the *OP* equation.

Patients in teaching hospitals are often treated by interns and residents under the supervision of staff physicians. It is likely that interns and residents use more resources, including time, to treat their patients than are needed to treat comparable patients in nonteaching hospitals. Further, many teaching hospitals maintain large outpatient departments for the benefit of their students and the community. Hence the variable *NONT* is expected to enter the *OP* and *MLS* equations with a negative sign.

Using the data mentioned previously, the coefficients of the five equations were estimated by the two-stage least-squares method. This method was necessary because at least three of the five dependent variables also appear in the equations as independent variables. The coefficients calculated are shown in the accompanying table (p. 15).

Results

Those variables entering the model with significant coefficients displayed the expected signs, as the table shows. However, the coefficients of the *FEES* variable were unexpectedly positive in the *OP*, *ADM*, and *MLS* equations, which suggests that patients in areas with high physician fees use more services in all health care settings and that increasing physician fees will not lower the rate of hospitalization. The model explained more than 60 percent of the variation in all equations except Eq. 5: only about 34 percent of the variation in the utilization of home care was explained.

Effect of Outpatient Care Coverage

The negative coefficients of *ADM* in Eq. 2 and of *OP* in Eq. 3 support the finding by Davis and Russell that short-term hospital admissions and outpatient care are substitutes in the production of health care. If this relationship were the only one considered, this study would also support Davis and Russell's conclusion [1] that coverage of outpatient care had lowered Medicare costs. However, the coefficient of *OP* is positive in Eq. 1 and that of *ECF* is positive in Eq. 2, which indicates that outpatient care and ECF care are complementary inputs to health care. The whole effect on costs, therefore, is a function of this complementary relationship as well as the substitution relationship.

The negative coefficient of –0.051 for *OP* in Eq. 3 indicates that each 1,000 outpatient visits by Medicare enrollees was associated with a decrease of 51 short-term hospital admissions of Medicare enrollees.

Since an average inpatient stay cost Medicare $593 in 1968 [4], this implies that each OP visit decreased expenditures for STH care by $0.051 \times \$593 = \$30.24$. The average amount paid for an outpatient claim in 1968 was $12 [4], so the substitution effect led to a saving of $18.24 per outpatient visit.

The effect of the complementarity of outpatient and ECF care must be calculated differently. Because *OP* represents outpatient visits per 100 Medicare enrollees and *ECF* represents ECF admissions per 100 Medicare STH admissions, the coefficient of *OP* must be multiplied by the ratio of enrollees [5] to STH admissions in 1968 [4], which is equal to 3.496. Thus the average OP visit increased ECF admissions by $3.496 \times 0.019 = 0.0664$. Since the average ECF admission cost Medicare $340 in 1968 [4], each OP visit added $0.0664 \times \$340 = \$22.58$ in ECF admission costs. With the $18.24 saving on STH admissions due to outpatient care, each outpatient visit resulted in a net cost of $4.34. There were 369,771 OP visits by Medicare enrollees in 1968 [4], which means that outpatient coverage cost the Medicare program about $1.6 million.

Effect of Extended Care Facility Coverage

Equation 4 indicates that each ECF admission per 100 STH admissions reduced the mean length of stay for Medicare patients in short-term hospitals by 0.108 days (to be covered, an ECF admission must follow an STH stay of at least three days). In 1968 there were 8.2 ECF admissions per 100 STH admissions [4], which reduced the mean length of STH stay of Medicare patients by $0.108 \times 8.2 = 0.886$ days. The average cost to Medicare per day of STH care in 1968 was $46 [4], so the average saving per stay attributable to the substitution of ECF for STH care was $\$46 \times 0.886 = \$40.76$. Multiplied by the 5,519,906 STH admissions paid for in 1968 by Medicare [4], this figure yields a total saving on STH admissions of somewhat more than $224 million. However, Medicare paid more than $304 million [4] to extended care facilities for care rendered to beneficiaries in 1968, which exceeds the calculated saving by about $80 million.

The complementarity between ECF and outpatient care is estimated to have added about $3.5 million more to this increased cost, so that coverage of ECF care increased Medicare costs by more than $83 million in 1968.

Discussion

It is evident that the utilization of each type of health care facility depends partially on the availability of alternative sources of care. The simultaneous-equations model that has been used in this article, taking into account five variables that relate to four modes of care, yields a result quite different from the findings of the single-equation model used by Russell [2] and by Davis and Russell [1]. The present study supports their finding that a substitutability relation holds between outpatient care and short-term hospital care and between extended care facility care and length of stay in short-term hospitals.

However, the present study indicates that there is in addition a complementary relation between outpatient care and extended care facility care, which considerably changes the conclusions that can be drawn about the effect on total Medicare costs of covering OP and ECF care. It appears that coverage of these alternative modes of care did not result in savings, but rather increased Medicare costs in 1968.

The home health care variable *HH* was not significant in any equation in this study, which may be a result of the heterogeneity of home health care visits. In order to measure the impact of HH coverage accurately it may be necessary to weight each visit according to the type of service and/or the type of personnel (e.g., nurse, occupational therapist, inhalation therapist) performing the service.

As the eventual adoption of national health insurance grows more likely, it is important that estimates of probable cost be based on the most accurate analysis possible, taking sufficient detail into account that national experience with the Medicare program is not misinterpreted but can be used as a guide to what may be expected from the addition of various types of coverage.

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