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BENEFITS AND COSTS OF NEWER DRUGS: AN UPDATE

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ABSTRACT

We update and extend our previous study of the effect of drug age -- years since FDA approval -- on total medical expenditure, in several respects. The estimates indicate that, in the entire population, a reduction in the age of drugs utilized reduces non-drug expenditure 7.2 times as much as it increases drug expenditure. In the Medicare population, a reduction in the age of drugs utilized reduces non-drug expenditure by all payers 8.3 times as much as it increases drug expenditure; it reduces Medicare non-drug expenditure 6.0 times as much as it increases drug expenditure. About two-thirds of the non-drug Medicare cost reduction is due to reduced hospital costs. The remaining third is approximately evenly divided between reduced Medicare home health care cost and reduced Medicare office-visit cost. We also found that the mean age of drugs used by Medicare enrollees with private Rx insurance is about 9% lower than the mean age of drugs used by Medicare enrollees without either private or public Rx insurance.

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Benefits and Costs of Newer Drugs: An Update

Executive Summary

In previous work, we found strong evidence to support the hypothesis that the replacement of older drugs by new drugs resulted in reductions in total medical expenditures. In this study, we update and extend our previous study of the effect of drug age—years since FDA approval—on total medical expenditure, in several respects: (1) the unit of analysis is a medical condition, rather than a prescription; (2) the sample is much larger, including data for three years, rather than one year; (3) we obtain estimates for the Medicare population as well as for the entire population; and (4) within the Medicare population, we examine the effect of drug age on Medicare expenditure as well as on expenditure by all payers.

The estimates indicate that, in the entire population, a reduction in the age of drugs utilized reduces non-drug expenditure 7.2 times as much as it increases drug expenditure. For example, reducing the mean age of drugs used to treat a condition from 15 years to 5.5 years is estimated to increase prescription drug spending by $18 but reduce other medical spending by $129, yielding a $111 net reduction in total health spending. Most of the savings are due to reductions in hospital expenditure ($80) and in physician office-visit expenditures ($24).

In the Medicare population, a reduction in the age of drugs utilized reduces non-drug expenditure by all payers (i.e., Medicare and various forms of Medicare supplemental insurance, Medicare for dually eligible individuals and Medicare beneficiaries' out of pocket payments) 8.3 times as much as it increases drug expenditure; it reduces *Medicare* non-drug expenditure 6.0 times as much as it increases drug expenditure. About two-thirds of the non-drug Medicare cost reduction is due to reduced hospital costs. The remaining third is approximately evenly divided between reduced Medicare home health care cost and reduced Medicare office-visit cost.

We also show that Medicare enrollees with private prescription drug coverage tend to use newer drugs than those without such coverage: the mean age of drugs used by

Medicare enrollees with private Rx insurance is about 9% lower than the mean age of drugs used by Medicare enrollees without either private or public Rx insurance.

Introduction

In a previous paper[1], we used person-, condition-, and event-level data from the 1996 Medical Expenditure Panel Survey (MEPS) to examine the effect of drug age—years since FDA approval—on total medical expenditure and mortality. Since many individuals in the MEPS sample have multiple medical conditions, we were able to control for *all* individual characteristics—both observed and unobserved—by including "individual effects".

The results provided strong support for the hypothesis that the replacement of older by newer drugs generally results in reductions in total medical expenditure as well as mortality. The estimates indicated that reductions in drug age tend to reduce all types of non-drug medical expenditure, although the reduction in inpatient expenditure was by far the largest. The total estimated reduction in non-drug expenditure from reducing the age of the drug was almost four times as large as the increase in drug expenditure, so reducing the age of the drug results in a substantial net reduction in the total cost of treating the condition. Moreover, people consuming new drugs were significantly less likely to die by the end of the survey than people consuming older drugs.

In this paper we update and extend the previous study in three important ways. In the previous study, the unit of observation (level of aggregation) was the prescribed medicine event (prescription). We linked condition-level data (e.g., data on the number of hospital stays associated with the condition for which a drug was consumed) to data on each of the prescriptions associated with the condition. Hence if a person had five prescriptions for a given condition, there would be five observations in the sample corresponding to that condition.

[1] Lichtenberg, Frank, "Are the Benefits of Newer Drugs Worth Their Cost? Evidence from the 1996 MEPS," *Health Affairs* 20(5), September/October 2001, 241-51. A previous version of this paper, "The Benefits and Costs of Newer Drugs: Evidence from the 1996 Medical Expenditure Panel Survey," was issued as NBER Working Paper No.w8147, March 2001.

Alternatively, we could have aggregated the prescription level data up to the condition level. This approach would address any concern about correlation among disturbances relating to observations corresponding to the same condition. That is the level of aggregation we will use in this paper. In this approach, there is one observation per condition per person, rather than one observation per prescription. The drug vintage measure we use is the *mean* age of all of the person's prescriptions for that condition. Aggregation reduces the size of the sample by about half. In 1996, 76 thousand prescribed medicine events were linked to 36 thousand distinct conditions.

While estimation at the condition level is likely to reduce the measured precision of the estimates, another change we will make—increasing the sample period from one year to three years—is likely to *increase* the (true and measured) precision of the estimates. Since the original study, which was based solely on 1996 data, was performed, data for two additional years (1997 and 1998) have become available.[2] The number of medical conditions recorded during the entire 3-year period is 3.4 times as great as the number of conditions recorded in 1996 alone.[3]

In 1997, 39 percent of MEPS prescriptions were consumed by people who had Medicare coverage. The vast majority of these prescriptions were not paid for by Medicare, but Congress and the Administration are currently developing proposals for a Medicare prescription drug benefit. While there is no obvious reason why the effect of drug age on total medical expenditure should be different in the Medicare population than it is in the non-Medicare population, it may be useful to estimate the model in the Medicare population as well as in the total population. We will report both of these. We will also present estimates of the effect of drug age on *Medicare* (as well as total)

[2] *Different people* are in the 1996, 1997, and 1998 samples.

[3]

year	no. of conditions	no. of persons	conditions/person
1996	76,426	22,601	3.38
1997	109,859	34,551	3.18
1998	72,576	24,072	3.01

expenditure [4], and present some findings about differences in the age of drugs used by Medicare beneficiaries with private Rx coverage and those without either private or public Rx coverage.

Methodology

The basic model that we will estimate is similar to the model estimated in the earlier study:

$$Y_{ijt} = \eta_i + \theta_j + \delta_t + \beta \log(AGE\_DRUG_{ijt}) + \Sigma_y \lambda_y COND\_DUR_{ijty} + \varepsilon_{ijt} \qquad (1)$$

where:

Y_{ijt} = a measure of medical expenditure (e.g., hospital expenditure) associated with condition i borne by person j in year t (t = 1996, 1997, 1998)

η_i = a fixed condition effect

θ_j = a fixed person effect

δ_t = a fixed year effect (t = 1996, 1997, 1998)

$\log(AGE\_DRUG_{ijt})$ = the log of the average age (years since FDA approval) of the drugs consumed for condition i by person j in year t

$COND\_DUR_{ijty}$ = 1 if condition i borne by person j in year t began y years ago, otherwise zero

ε_{ijt} = the disturbance.

Inclusion of "individual effects" (θ_j 's) controls for *all* individual characteristics—both observed (e.g. age of the patient) and unobserved (e.g. age and practice style of his physician)—that determine Y and may be correlated with the age of the drug. Estimates of the parameter of interest (β) from eq. (1) are based entirely on the *within-individual*

[4] Medicare expenditures differs from total expenditure on the Medicare population because the latter includes various types of supplemental insurance, Medicaid for dually-eligible individuals, and Medicare beneficiaries' out-of-pocket payments.

correlation between Y and log(AGE_DRUG), not on the between-individual correlation.[5] Suppose a person has two conditions, asthma and hypertension, and is taking medications for both. He may have above-average numbers of hospital stays for both conditions, compared to other individuals with the same conditions. And he may be taking older-than-average drugs for both conditions. But due to the presence of individual effects in eq. (1), this would not make β positive. For β to be positive, it would have to be the case that the condition for which the age of the person's medications were *more* above average (relative to both individual and condition means) was the same as the condition for which his hospital stays were more above average.

Results

Estimates of the parameter β from equation (1) are presented in Table 1. Each estimate reported in the table is from a separate model. The estimates in panel A are based on the entire population, and on expenditures by all payers, by type of service (prescription drugs, hospital care, home health care, etc.)

The first dependent variable we consider is total prescription drug expenditure associated with the condition. Not surprisingly, a decrease in log(AGE_DRUG) is associated with a significant increase in total prescription drug expenditure. Reducing the mean age of drugs consumed for the condition from about 15 years to 5.5 years (which would cause log(AGE_DRUG) to decrease by 1) would increase total prescription drug expenditure by about $18.

The second dependent variable is total non-drug expenditure (the sum of expenditure on hospital care, office visits, home health care, outpatient visits, and emergency room visits). A decrease in log(AGE_DRUG) is associated with a significant *decrease* in total non-drug expenditure. Moreover, the estimated reduction in total non-drug expenditure is 7.2 times as large as the estimated increase in drug expenditure. This implies that a unit decrease in log(DRUG_AGE)—which would occur, for example, if

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[5] The θ_j's capture all attributes of the individual that do not vary across prescriptions and conditions, including sex, age, education, race, income, insurance status, and the number of medical conditions reported by the person.

one switched from 15 year-old drugs to 5.5 year old drugs —would yield a $111 net reduction in the total medical cost of the condition. The next five columns show estimates of the effects on each of the five components of non-drug medical costs. All of the estimated effects are positive and highly statistically significant. Reduced hospital expenditure accounts for 62% of the total non-drug medical cost reduction. A unit decrease in log(DRUG_AGE) is estimated to reduce hospital expenditure by $80, or 21% of mean hospital expenditure per condition (which includes expenditures for those with and without hospitalizations). The second-largest cost reduction--$24--comes from reduced office-visit expenditure. Home health care and outpatient expenditure are reduced by about $12 and $10, respectively. These figures are summarized in the second column of the following table.

Effect of a unit decrease in log(DRUG_AGE)--e.g., a switch from 15 year-old drugs to 5.5 year old drugs--on expenditures per condition, by expenditure type, population, and payer			
Expenditure type	**Entire population, expenditure by all payers**	**Medicare population, expenditure by all payers**	**Medicare population, Medicare expenditure**
total	-$111	-$155	
prescription drugs	$18	$21	
total non-drug	-$129	-$176	-$127
hospital	-$80	-$102	-$82
home health care	-$12	-$37	-$21
office visits	-$24	-$34	-$20
outpatient	-$10	-$2	-$4
emergency room	-$3	$1	-$1

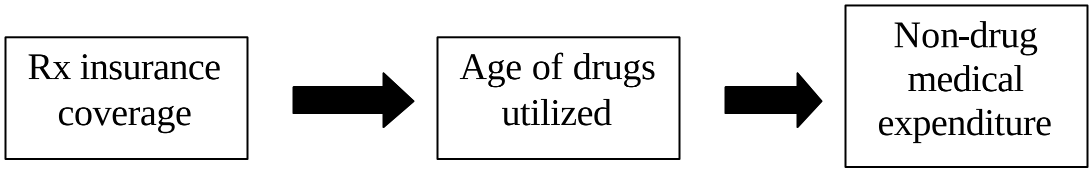
The estimates in panel B of Table 1 are based on the Medicare population, and again examine expenditures by all payers on Medicare beneficiaries (e.g. Medicare, private supplemental insurance, Medicaid for dually eligible individuals and out of pocket). Average medical expenditure per condition is 57% higher ($1286 vs. $817) in the Medicare population than it is in the entire population: Medicare recipients have more expensive conditions, as well as more conditions per person. In the Medicare population, a unit reduction in log(DRUG_AGE) would increase total prescription drug expenditure per condition by about $21, and reduce total non-drug expenditure per condition by $176, yielding a $155 net reduction in expenditure per condition. Hospital cost reduction accounts for 58% ($102) of the latter. Home health care yields the next largest cost reduction ($37); office visits ($34) account for most of the remaining cost reduction. These figures are summarized in the third column of the table above.

The estimates in panel C of Table 1 are based only on Medicare expenditure and the Medicare population. Medicare pays about two-thirds of the total non-drug medical costs of the Medicare population. The estimates indicate that a unit reduction in log(DRUG_AGE) would reduce Medicare expenditure per "Medicare condition"[6] by $127. (This just happens to be very close to the effect of a unit reduction in log(DRUG_AGE) on expenditure by all payers per condition in the entire population.) About two-thirds of the non-drug Medicare cost reduction is due to reduced hospital costs. The remaining third is approximately evenly divided between reduced Medicare home health care cost and reduced Medicare office-visit cost. These figures are summarized in the last column of the table above.

Effect of Rx insurance coverage on age of drugs consumed

The preceding evidence indicates that the age or vintage of drugs has important effects on non-drug medical expenditure. Now we will argue that the age or vintage of drugs is likely to depend on the extent of prescription drug coverage[7,8]:

[6] A "Medicare condition" refers to a condition borne by a Medicare recipient.
[7] Prescription drug coverage may also affect the *quantity* of drugs consumed.
[8] A recent HHS study alluded to this effect: "People with coverage not only fill more prescriptions than those without coverage; they are likely to have access to a broader array of therapies, including more costly therapies." (Department of Health & Human Services, "Report to the President: Prescription Drug Coverage, Spending, Utilization, and Prices," April 2000.)



Suppose that a patient has a choice between a new drug and an old drug to treat a given medical condition. Let B_N represent the gross benefit (or value) to the patient of the new drug, and B_0 represent the gross benefit to the patient of the old drug. Then $(B_N - B_0)$ is the difference between the benefit of the new drug and the benefit of the old drug. Suppose that this difference in benefit is normally distributed across patients. This is depicted in Figure 1. (Although the mean difference in benefit is presumably positive, for some patients $B_N < B_0$.) Let $(C_N - C_0)$ represent the difference between the cost to the patient of the new drug and the cost to the patient of the old drug. Suppose that physicians/patients choose the new drug if and only if the benefit difference exceeds the cost difference: $(B_N - B_0) > (C_N - C_0)$. Hence, the fraction of patients who choose the new drug is equal to the area under the normal curve to the right of $(C_N - C_0)$.

We hypothesize that prescription drug coverage often reduces $(C_N - C_0)$, because it reduces the cost to the individual of new drugs more than it reduces the cost of old drugs. This is illustrated by the following example:

Cost to individual	**New drug**	**Old drug**	**Difference**
Without insurance	$50	$20	$30
With insurance (copayment)	$15	$5	$10

If prescription drug coverage reduces $(C_N - C_0)$—it shifts the $(C_N - C_0)$ line to the left in Figure 1—it will increase the fraction of patients utilizing the new drug.

The data are consistent with the hypothesis that Medicare enrollees with private Rx insurance use newer drugs than Medicare enrollees without either private or public Rx insurance. The mean age of drugs used by Medicare enrollees with private Rx insurance is about 8.6% lower than the mean age of drugs used by Medicare enrollees without private or public Rx insurance.[9]

[9] 56.3% of the drugs utilized in 1997 by Medicare enrollees with private Rx insurance were approved by the FDA after 1970. 52.1% of the drugs utilized in 1997 by Medicare enrollees without private or public Rx insurance were approved by the FDA after 1970.

Summary and Conclusion

In this paper we updated and extended our previous study of the effect of drug age—years since FDA approval—on total medical expenditure, in several respects. The estimates indicate that, in the entire population, a reduction in the age of drugs utilized reduces non-drug expenditure 7.2 times as much as it increases drug expenditure. In the Medicare population, a reduction in the age of drugs utilized reduces non-drug expenditure by all payers (e.g. Medicare, private supplemental insurance, Medicaid for dually eligible individuals and out of pocket) 8.3 times as much as it increases drug expenditure; it reduces *Medicare* non-drug expenditure 6.0 times as much as it increases drug expenditure. About two-thirds of the non-drug Medicare cost reduction is due to reduced hospital costs. The remaining third is approximately evenly divided between reduced Medicare home health care cost and reduced Medicare office-visit cost.

We also found that Medicare enrollees with private prescription drug coverage tend to use newer drugs than those without such coverage: the mean age of drugs used by Medicare enrollees with private Rx insurance is about 9 % lower than the mean age of drugs used by Medicare enrollees without either private or public Rx insurance.

Table 1
Estimates of β in Equation 1

Expenditure type	prescription drugs	total non-drug	hospital	home health care	office visits	outpatient	emergency room
	A. Entire population, expenditure by all payers						
mean expenditure per condition	$74	$742	$388	$112	$164	$58	$19
β	-18.04	129.37	79.93	12.32	24.43	9.74	2.54
std. err.	0.55	19.10	17.04	5.65	2.93	2.91	1.07
t-statistic	-32.76	6.77	4.69	2.18	8.34	3.34	2.37
p-value	<.0001	<.0001	<.0001	0.0292	<.0001	0.0008	0.0177
% of nondrug cost reduction		100%	62%	10%	19%	8%	2%
	B. Medicare population, expenditure by all payers						
mean expenditure per condition	$95	$1,191	$592	$330	$192	$61	$15
β	-21.12	175.62	101.96	37.25	33.87	2.33	-0.96
std. err.	1.04	36.09	29.75	16.03	5.68	4.48	2.29
t-statistic	-20.36	4.87	3.43	2.32	5.96	0.52	-0.42
p-value	<.0001	<.0001	0.0006	0.0202	<.0001	0.6022	0.6739
% of nondrug cost reduction		100%	58%	21%	19%	1%	-1%
	C. Medicare population, Medicare expenditure						
mean expenditure per condition		$822	$452	$201	$108	$50	$11
β		127.02	82.09	20.53	19.77	3.78	0.84
std. err.		28.57	24.35	11.80	3.83	3.41	1.05
t-statistic		4.45	3.37	1.74	5.16	1.11	0.80
p-value		<.0001	0.0008	0.0818	<.0001	0.2669	0.4257
% of nondrug cost reduction		100%	65%	16%	16%	3%	1%

Figure 1

New-vs.-old drug differences in benefits and costs to patient