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Are Drugs Substitutes or Complements for Intensive (and Expensive) Medical Treatment

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The large geographic variation in Medicare spending has garnered a great deal of attention in the health reform debate, largely because it is viewed as evidence of expensive inefficiencies in spending on public insurance. Analysis of this variation, however, has mainly been based on only a subset of total Medicare spending, because information on pharmaceutical spending has not been available until recently (Yuting Zhang, Katherine Baicker and Joseph P. Newhouse, 2010a). This made it impossible to know whether the observed variation was overstated (because greater drug utilization substituted for other medical spending) or understated (because higher medical spending, reflecting a more intensive medical style, was associated with higher prescribing).

Using Medicare data on both drug and medical (non-drug) spending for traditional fee-for-service enrollees, we examine the relationships between spending on different types of health care across the 306 market areas, or Hospital Referral Regions (HRRs), as defined by the Dartmouth Atlas (The Dartmouth Atlas Project, 2010a). We examine both the *quantity* of spending on pharmaceutical and other medical spending and several measures of the *quality* and value of that spending. This allows us to gauge not only the total variation in spending but also the degree to which additional spending on drugs reflects potentially efficient substitution of inputs into health production versus inefficient practice style intensity that produces neither better health outcomes nor offsetting savings in other medical inputs. For example, do Medicare beneficiaries in areas with higher spending on pharmaceuticals designed to control chronic condition have fewer physician visits, reducing variation in total spending relative to medical spending, or do they have more physician visits where they are given more prescriptions, amplifying the variation in medical spending? In addition, we examine the extent to which patterns of enrollment in Medicare Advantage, the managed care alternative to traditional fee-for-service Medicare, are associated with differences in the quantity and quality of care received by enrollees in traditional Medicare – an indicator of potential spillover effects or selection into the Medicare Advantage program.

I. Data, Measures, and Methods

We focus on geographic variation in three sets of outcomes: 1) prescribing patterns, measured by both total pharmacy spending and the ratio of generic drug use to overall drug use; 2) non-drug medical spending, both in total and decomposed into spending on a group of services we term institutional care (inpatient hospital, hospice, skilled nursing home care, rehabilitation facilities, and home care since it often is used following a hospital admission) and non-institutional care (physician, including for convenience inpatient physician services, and other outpatient spending); and 3) the quality of care, including both the quality of prescribing patterns and the quality of primary care.

Our primary data source is individual-level Medicare claims data. More specifically, we use individual-level demographic, pharmacy, and medical claims data from a 5 percent random sample of Medicare beneficiaries who are enrolled in stand-alone prescription drug (Part D) plans in 2007. We restricted our study sample to beneficiaries who were between 65 and 99 years of age in 2007, alive on December 31 2007, and enrolled for a full year in Part A (institutional care as defined above), Part B (non-institutional care as defined above), and a stand-alone Part D (prescription drug) plan. This sample excludes individuals enrolled in Medicare Advantage (Part C) plans, as well as Medicare beneficiaries who have drug coverage through their prior or current employer because either medical or drug claims data for these beneficiaries are not available. In 2010, 38 percent of Medicare beneficiaries were enrolled in plans like those we excluded (Centers for Medicare & Medicaid Services, 2010a). We assigned the resulting sample of 533,170 individuals to an HRR on the basis of the beneficiary's ZIP Code of residence. The spending measures include payments made by drug plans, the patient, Medicare, and any supplementary insurance.

We deflated medical spending by the county-level wage index using the beneficiary's county of residence (we only deflated 72 percent of spending because not all of the spending is local labor). We did not similarly deflate drug spending because the geographic price variation was trivial; price indices for 34 prescription drug plan (PDP) regions (except for Alaska) were consistently within two percent of the national price index at the median (Thomas MaCurdy et al., 2009).

Medicare Advantage (MA) plan enrollment varies geographically, which could introduce variation attributable to selection into our measures. To explore this, we calculated penetration rates for MA plans for each HRR using tabulations of the CMS Enrollment File, 2007. We distinguished between two types of plans: private fee-for-service (PFFS) plans and coordinated care plans (MA managed care – mostly Health Maintenance Organizations). Both the PFFS and coordinated care plans are paid a fixed amount per enrollee by Medicare, but PFFS does not have a network and pays physicians per service – like traditional Medicare – so selection patterns could differ for the two types. Data on the overall utilization of the MA population are not yet available, so, like the Dartmouth Atlas of Healthcare data (The Dartmouth Atlas Project, 2010b), our spending and quality measures encompass only traditional Medicare enrollees.

We assessed how the quality of care varies in several ways. We obtained the number of discharges for ambulatory care-sensitive conditions (ACSCs) per 1000 Medicare beneficiaries for each HRR from the Dartmouth Atlas (The Dartmouth Atlas Project, 2010b). ACSCs are illnesses that should usually not result in hospitalizations if they have been well-managed through outpatient care – that is, they represent medical utilization that is potentially preventable. For example, with proper medication and management of care, most people should not require hospitalization for hypertension (high blood pressure). We capture the quality of prescription use through two measures from the Healthcare Effectiveness Data and Information Set (HEDIS): the percentage of beneficiaries using medications considered sufficiently high-risk for elderly patients that they should be avoided, and the percentage of beneficiaries with dementia, hip fracture, or chronic renal failure who are exposed to potentially harmful drug-disease interactions (National Committee for Quality Assurance, 2010) (Yuting Zhang, Katherine Baicker and Joseph P. Newhouse, 2010b). Spending on these drugs constitutes 2 percent of total drug spending (Yuting Zhang, et al., 2010b).

After adjusting for factor prices, we estimated regression models at the individual level for each outcome variable. We used linear regression for pharmacy, hospital, physician, and total non-drug medical spending and logistic regression to estimate the proportion of using high-risk drugs and potentially-harmful drug-disease interactions. In each model, we included 306 HRR indicators, demographic variables, including age (5-year age group indicators from 65-69 to 95-99), gender, and race; characteristics of Part D insurance coverage, including whether the individual received a low-income-subsidy (LIS) and the type of coverage, if any, in the Part D coverage gap; and the Centers for Medicare & Medicaid Services Hierarchical Condition Categories (CMS-HCCs) risk score in the medical spending regression and the analogous CMSRxHCC score for pharmaceutical spending in the drug spending regression (Centers for Medicare & Medicaid Services, 2010b). (The discharges for ACSCs are not adjusted for CMSHCCs, but the correlations we report below are not sensitive to our inclusion of these risk adjusters.) We used these estimates to calculate an adjusted value for each outcome variable for each HRR, turning on the relevant HRR fixed effect and setting the values of all covariates to their national average. This measure thus captures variation in outcomes at the HRR level that is purged of variation in population characteristics across HRRs.

We report several measures that illustrate the extent of geographic variation in each outcome across HRRs, including ratios of 90th percentile to the 10th percentile; ratios of the 75th percentile to the 25th percentile; and coefficients of variation. We also investigate the correlations between our outcome measures and report Pearson correlation coefficients.

II. Results

Table 1 demonstrates substantial geographic variation in each outcome. Variation in non-drug medical spending is larger than variation in pharmacy spending, and, not surprisingly, variation in institutional spending is larger than variation in physician and outpatient spending (Yuting Zhang, et al., 2010a). The quality of prescribing varies more than drug

spending, with 44% of seniors using high-risk drugs in the worst-performing HRR compared with 11% in the best.

Table 2 shows the correlation coefficients across these key measures. Total prescription drug spending has small and mostly insignificant correlations with most utilization variables; there is no strong evidence from these area-level correlations that drugs are either net substitutes or net complements for medical spending (the correlations between drug spending and medical spending are $r=0.09$, $p=0.13$ for total non-drug medical spending, $r=0.07$, $p=0.22$ for institutional care; $r=0.06$, and $p=0.28$ for non-institutional care). Including drug spending thus modestly adds to the overall geographic variation in medical spending. Greater use of generic drugs is associated with lower non-institutional spending ($r=-0.14$, $p=0.01$), suggesting a pattern of higher value care where more generics are used. And greater use of generics relative to branded prescriptions is of course associated with lower drug spending ($r=-0.34$, $p<0.01$).

Interestingly, there is no evidence in these data of favorable selection into capitated Medicare Advantage health plans. In fact, there are negative and statistically significant correlations between co-ordinated care plan (non-PFFS) MA managed care penetration and spending in both Parts A ($r=-0.20$, $p=0.001$) and Part B ($r=-0.12$, $p=0.03$) – suggesting if anything either selection that is favorable to traditional fee-for-service Medicare or positive spillover effects of more efficient care delivery. (Spillovers could come from both MA and commercial HMO penetration, which tends to be higher in areas with higher HMO penetration in Medicare.) Areas with higher Medicare Advantage managed care penetration also have lower use of harmful or high-risk drugs among enrollees in traditional Medicare. There are no significant correlations between PFFS plan penetration and Parts A and B medical spending. This may not be surprising, since in many counties PFFS plans simply have better benefits than traditional Medicare without any care management and because many PFFS enrollees are enrolled in group PFFS plans not entirely by choice, having been subsidized to enroll in such plans by their former employers.

The correlations between medical spending and prescribing quality show that poorer-quality prescribing is associated with higher medical spending – and that correlation is considerably greater for Part A spending ($r=0.40$, $p<0.01$ for high-risk drugs, and $r=0.38$, $p<0.01$ for potentially-harmful drug-disease interactions) than for Part B spending ($r=0.12$, $p=0.04$ for both HEDIS measures), which is consistent with greater use of potentially dangerous drugs resulting in more hospitalizations. The correlations between the two measures of prescribing quality and drug spending, in contrast, are weak ($r=0.06$, $p=0.34$ for high-risk drugs; and $r=0.12$, $r=0.04$ for potentially-harmful drug-disease interactions). Poorer-quality prescribing is, however, associated with lower-quality outpatient care as measured by the rate of preventable hospital discharges (i.e., ACSCs, $r=0.49$, $p<0.01$ for high-risk drugs and $r=0.51$, $p<0.01$ for potentially-harmful drug-disease interactions).

III. Conclusion and Remarks

In sum, we find substantial variation across geographic areas in drug spending, but this variation is smaller than the variation in other types of medical spending (as seen, for

example, in the 90-10 ratio and the coefficient of variation) and is only weakly (positively) correlated with other types of medical spending. There is thus no evidence that areas with more intensive use of pharmaceuticals have offsetting reductions in medical care spending in either institutional or outpatient settings. We also find no evidence that greater penetration of Medicare Advantage managed care plans is associated with higher costs in traditional Medicare. Although that is consistent with there being no favorable selection into Medicare Advantage plans, it is also consistent with spillovers affecting traditional Medicare that are large enough to offset any selection. Additional analysis is needed to discriminate between these explanations.

Although geographic variation in drug spending is substantial, we find even more variation in the two measures of the quality of prescribing. Moreover, areas of lower-quality prescribing tend to be areas of lower quality ambulatory care and greater spending on medical care. This negative association between the quality of prescribing and spending is strongest for institutional care such as hospitalization. These findings are thus consistent with poorer quality prescribing patterns raising Medicare costs.

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– Variation in Adjusted Pharmacy and Medical Spending and the Quality of Prescribing

Table 1

	Adjusted Pharmacy Spending and Use		Adjusted Non-drug Medical Spending		Adjusted HEDIS Quality Measures		
	Adjusted Annual Gross Drug Spending	Percent Prescriptions Generic	Total Medical Spending	Institutional Spending *	Physician and Other Outpatient Spending	Use of High Risk Drugs	Potentially Harmful Drug Disease Interactions
	2007 \$	percent	2007 \$	2007 \$	2007 \$	percent	Percent
Lowest	1,851	0.47	7,182	2,990	3,060	11.4	9.5
25 th percentile	2,274	0.58	8,785	4,205	4,098	20.6	17.3
Median	2,413	0.60	9,534	4,769	4,350	24.9	19.7
75 th percentile	2,537	0.63	10,178	5,313	4,583	30.6	22.8
Highest	3,026	0.73	15,542	9,135	6,412	44.0	30.6
Mean	2,410	0.60	9,588	4,821	4,358	25.8	20.2
Standard deviation	204	0.04	1,161	861	426	6.9	4.2
Ratio of 90 th to 10 th percentiles	1.25	1.20	1.34	1.55	1.27	2.02	1.71
Ratio of 75 th to 25 th percentiles	1.12	1.09	1.16	1.26	1.12	1.49	1.31
Coefficient of variation	0.08	0.07	0.12	0.18	0.10	0.27	0.21

* Notes: Institutional spending includes spending for inpatient hospital, hospice, skilled nursing home care, rehabilitation facilities, and home care services.

Table 2

Correlations Across Pharmacy, Medical Spending and Quality Measures

Variable	Spending and Use			Quality			Enrollment Patterns		
	Non-Drug			Drug					
	Institutional (Inpatient Related*)	Non-institutional (Physician and Outpatient)	Spending	Ratio of Generic Drug Counts	High-Risk Drug Use	Potentially-Harmful Drug-Disease Interaction	Ambulatory Care Sensitive Discharges	Medicare Advantage Managed Care Penetration	Private Fee-For-Service Penetration
Total Non-Drug Spending	0.93	0.68	0.09	0.03	0.40	0.37	0.38	-0.21	0.06
<i>p-value</i>	<0.001	<0.001	0.13	0.56	<0.001	<0.001	<0.001	<0.001	0.28
Institutional Spending		0.39	0.07	0.09	0.40	0.38	0.45	-0.20	0.03
<i>p-value</i>		<0.001	0.22	0.13	<0.001	<0.001	<0.001	0.001	0.65
Non-institutional Spending			0.06	-0.14	0.12	0.12	0.04	-0.12	0.06
<i>p-value</i>			0.27	0.01	0.04	0.04	0.45	0.03	0.32
Drug Spending			-0.34	0.06	0.12	0.12	0.07	0.07	-0.12
<i>p-value</i>			<0.001	0.34	0.04	0.04	0.22	0.25	0.03
Ratio of Generic Counts				0.00	-0.15	-0.06	-0.06	-0.24	0.48
<i>p-value</i>				0.94	0.01	0.30	0.30	<0.001	<0.001
High-Risk Drug Use					0.75	0.49	0.49	-0.30	0.11
<i>p-value</i>					<0.001	<0.001	<0.001	<0.001	0.05
Potentially-Harmful Drug-Disease Interaction							0.51	-0.21	-0.01
<i>p-value</i>							<0.001	<0.001	0.89

Variable	Spending and Use		Quality		Enrollment Patterns			
	Non-Drug		Drug					
	Institutional (Inpatient Related*)	Non-institutional (Physician and Outpatient)	Spending	Ratio of Generic Drug Counts	Potentially-Harmful Drug-Disease Interaction	Ambulatory Care Sensitive Condition Discharges	Medicare Advantage Managed Care Penetration	Private Fee-For-Service Penetration
Ambulatory Care Sensitive Conditions							-0.27	-0.12
<i>p-value</i>							<0.001	0.03
Medicare Advantage Managed Care Penetration								-0.38
<i>p-value</i>								<0.001

* Notes: Institutional spending includes spending for inpatient hospital, hospice, skilled nursing home care, rehabilitation facilities, and home care services.