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Accounting for differences in healthcare utilization and expenditures among US males with haemophilia by type of health insurance

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We previously published analyses of average health care expenditures during 2008 for US males with haemophilia. We reported that average annual health-care expenditures were $100 000 to $155 000 in 2008 US dollars [1,2]. In this research letter, we report further analyses from the MarketScan® research databases intended to help understand differences in expenditures for those covered by either Medicaid or employer-sponsored insurance (ESI).

Our primary measures of healthcare utilization are proportion of admission, proportion of treat-and-release ED visits (hereafter referred to as ED visits), length of hospital stays, frequency of ED visits and frequency of non-ED outpatient visits. Length of stay for hospitalizations is determined from admission and discharge dates. ED visits that resulted in hospital admission are recorded as hospitalizations. Outpatient visits are defined as visits based on outpatient claims data, except ED visits and claims filed by laboratories, imaging centres, radiologists, pathologists, pharmacists, supply centres, case managers and home health-care services.

Propensity score matching method

We use propensity score matching (PSM) technique, which controls for observable differences and assumes that unobservable factors are highly correlated with observable characteristics [3]. Using a logistic regression model, we estimated the propensity score of having Medicaid coverage for all individuals based on a set of observed covariates, without interactions or nonlinear terms. Matching covariates were age, risk score, haemophilia A vs. B, receipt of bypassing agents, and presence of any predefined comorbid conditions (infection with HIV or hepatitis C virus, injury, cardiovascular disease, hypertension, hypercholesterolaemia, chronic arthropathy, diabetes, renal disease, musculoskeletal and connective tissue issues, intracranial haemorrhage, depression, pulmonary disease,

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neurological disease or liver disease). All persons with Medicaid coverage were then matched to persons with ESI, using the nearest neighbour one-to-one matching technique within a calliper of 0.25 standard deviations of the propensity scores [4].

Multivariate model

We conducted multivariate analyses using the propensity score-matched sample. To better capture heterogeneous health-seeking behaviours between non-users and users or between less and more extensive users, we used mixture models. To assess the influence of covariates on outpatient visits and annual expenditures, we employed a semi-parametric, latent-class finite mixture model (FMM). Such a model uses observed data on healthcare use to distinguish two population subgroups with less vs. more extensive use of healthcare services [5,6]. FMM models assign observations into one of two latent classes and estimate both the distribution between classes and the 'effect' of each class on the amount of service used. The latent classes differ for each outcome measure; more extensive users of outpatient services are not necessarily more extensive users of annual healthcare expenditures.

To examine predictors of expenditures for clotting factor obtained through pharmacies and visits to EDs, we also used a two-part model [7,8], as well as a zero-inflated negative binomial model for hospitalization. Both models allow zero and positive values of factor expenses from pharmacies and acute care service use. The first part of each predicts factor purchasing activity through pharmacies or acute service use as a dichotomy (none vs. some); the second part predicts their factor expenditures as a continuous variable, or level of acute service use as a count variable conditioned on positive observations.

Results

The final study sample consisted of 419 males with Medicaid and 419 males with ESI who were successfully matched using PSM.

Approximately 54% of the sample had zero ED visits and 83% had no hospitalizations during 2008 (Table 1). In contrast, only 3% of the sample had no outpatient visits or zero annual expenditure recorded. Expenditures per ED visit, outpatient visit and inpatient admission among Medicaid enrolees were three-to six-fold lower than among ESI enrolees.

Expenditures per ED visit, outpatient visit and inpatient admission among Medicaid enrolees were three-to six-fold lower than among ESI enrolees (Table 1). Medicaid enrolees were less than one-half as likely to receive an infusion at home by a health service provider, and among those who did, average expenditure on clotting factor per infusion was 35% lower (Table 1). Expenditures per unit of clotting factor purchased from pharmacies, identified by NDC, were the same for Medicaid and ESI enrolees.

Variables associated with healthcare expenditures and utilization

Regression results are shown in Table 2. In order, dependent variables are (i) total healthcare expenditures; (ii) ratio of persons obtaining factor through pharmacies and these expenditures for factor if any; (iii) number of outpatient visits; (iv) ratio of persons who had at least one ED visit and number of ED visits if any and (v) ratio of persons hospitalized and annual length of stay, if any.

The coefficients of the first two rows of each model in Table 2 measure the associations of Medicaid coverage with healthcare expenditures and utilization, relative to employer-sponsored insurance (default), by Medicaid qualification criteria (poverty or disability). Total expenditures differed by Medicaid qualification criteria and level of healthcare use (less vs. more extensive users, see columns 2–3). The FMM identified 87% of the study sample as less extensive users and 13% as more extensive users of overall healthcare resources. Total expenditures of poverty-qualified Medicaid enrolees were lower than those of ESI enrolees, whereas disability-qualified Medicaid enrolees had significantly higher total expenditures.

Medicaid enrolees were more likely to obtain factor through pharmacies, regardless of Medicaid qualification criteria, than ESI enrolees ($P < 0.01$, see column 4). However, their expenditures for factor differed by Medicaid qualification criteria, compared to those of ESI enrolees (see column 5). The factor expenditures of poverty-qualified Medicaid enrolees among those who had positive pharmacy expenditures were significantly lower than those of ESI enrolees ($P < 0.01$), whereas those of disability-qualified Medicaid enrolees had a coefficient close to zero, i.e., essentially the same as the ESI group.

The difference in frequency of outpatient visits between Medicaid enrolees and ESI enrolees varied by level of healthcare use (columns 6–7). Among more extensive users, Medicaid enrolees had significantly more frequent outpatient visits than ESI enrolees. In contrast, among less extensive users, there was no significant difference in the frequency of outpatient visits between insurance types.

A higher proportion of poverty-qualified Medicaid enrolees than those with ESI had at least one ED visit (column 8). Among ED users, Medicaid enrolees had more frequent ED visits than those with ESI, regardless of Medicaid eligibility criteria (column 9). The proportion of Medicaid enrolees receiving inpatient care services was slightly lower, but the difference was not statistically significant (column 10). When disability-qualified Medicaid enrolees were admitted to hospitals, they were likely to stay significantly longer than those with ESI (column 11).

Comorbidities such as injury, hypertension, chronic arthropathy, intracranial haemorrhage and depression were significant cost drivers. Injury, intracranial haemorrhage and depression were also associated with increased healthcare utilization, especially more frequent outpatient visits and ED visits and longer hospitalizations. Although other comorbidities such as musculoskeletal, connective tissue and neurological disease were associated with the likelihood and frequency of ED visits and outpatient visits, especially among less extensive users, they were not statistically significant cost drivers. Also, these comorbidities were not associated with use of inpatient care.

Discussion

We found that Medicaid spends less on average than ESI plans for males with haemophilia on a health risk-adjusted basis, by an average of $17 277 per person per year, in 2008 dollars. A novel contribution of this study is the use of a latent-class regression model. Such a model can better capture heterogeneous behaviours between less and more extensive users. Lower expenditures associated with Medicaid coverage were concentrated among less extensive users, whose healthcare expenditures were relatively moderate. In contrast, predicted Medicaid spending was higher than ESI spending among extensive users of healthcare services (average expenditures of more than half a million dollars per year).

Slightly lower predicted spending through Medicaid than ESI reflects a combination of marginally higher utilization and much lower average expenditure per service. We found that Medicaid enrolees with haemophilia had (i) more frequent outpatient visits among more extensive users; (ii) higher likelihood of ED visits among poverty-qualified Medicaid enrolees; (iii) more frequent ED visits regardless of Medicaid qualification and (iv) more hospital days among disability-qualified Medicaid enrolees.

Differences in the severity of haemophilia symptoms can explain the observed differences in utilization between the two Medicaid eligibility groups, since the poverty-qualified enrolees showed lower demand for clotting factor and inpatient care. The positive association of poverty-qualified Medicaid coverage with ED use (relative to ESI) is consistent with reports of increases in ED visits among newly insured individuals with Medicaid [10,11].

Most of the limitations of this study are inherent in claims data: non-representativeness at the population level, lack of data on socioeconomic status, under-ascertainment of those with mild symptoms and understatement of expenditures for people with coverage by other insurance plans. We were not able to classify individuals as having severe, moderate or mild haemophilia due to lack of clinical data.

In conclusion, insurance type affected patients' source of factor; healthcare utilization varied by Medicaid qualification criteria and by extensiveness of service use. On average, because of lower reimbursements, Medicaid spent less per person with haemophilia than did ESI plans. However, Medicaid spent more on extensive users than did ESI plans.

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Table 1

Descriptive statistics of healthcare expenditures and utilization using the study sample selected after propensity score matching, 2008.

	ESI (N = 419)	Medicaid[†] (N = 419)
Annual healthcare expenditures ($)		
Annual expenditures[‡]	156 235	122 883*
Annual expenditures for clotting factor[‡]	132 346	115 151
Factor obtained through pharmacies (identified by NDC)		
Proportion of people (%)[§]	28	72***
Expenditures for factor ($) ≥ 0[‡]	38 160	90 495***
Healthcare utilization		
Proportion of people with ≥1 ED visits (%)[§]	41.3	50.8***
Number of ED visits with ≥1 visits[‡]	3.5	3.3
Proportion of people with ≥1 admissions (%)[§]	15.3	19.6*
Number of inpatient admission with ≥1 admissions[‡]	1.6	2.0
Annual length of stay with ≥1 admissions[‡]	8.0	9.1
Proportion of people with ≥1 outpatient visits (%)[§]	99.0	99.0
Number of outpatient visits with ≥1 visits[‡]	10.8	11.0
Proportion of people receiving factor at home (%)[$]	80.9	85.2
Infusion, identified by procedure codes	56.1	22.7***
Infusion, identified by NDCs	29.8	76.1***
Expenditure per service ($) > 0		
Expenditure for factor per infusion (identified by procedure code)[‡]	20 806	13 595***
Expenditure for factor per unit (identified by NDC)[¶,‡]	1.50	1.50
Expenditure per ED visit[‡]	782	213***
Expenditure per outpatient visit[‡]	1246	223***
Expenditure per hospital day[‡]	13 264	2442***
Expenditure per admission[‡]	73 764	25 686***

[†] Statistical tests examine the null hypothesis that employer-insured males have the same characteristics as Medicaid-insured males.

[‡] *t* test.

[§] Chi-square test.

[¶] Excluding Stimate nasal spray the symbols ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively, for a two-tailed test.

ESI, employer-sponsored insurance; ED, Emergency Department; NDC, National Drug Code.

Table 2

Regression for annual healthcare expenditures and utilization among persons with haemophilia in 2008

Dependent variable	Total expenditures (in $1000)[†]		Likelihood of obtaining factor via pharmacy	Expenses for factor via pharmacy[‡]	Outpatient visits		Likelihood of ED visit	Number of ED visits[‡]	Likelihood of admission	Annual length of stay[‡]
	Less	More			Less	More				
	extensive users				extensive users					
Model	Finite mixture model (FMM)		Two-part model		FMM		Two-part model		Zero-inflated negative binomial model	
			Probit	Generalized linear model[§]			Logit	Negative binomial model		
Independent variables										
Poverty Medicaid eligibility (=1)	−9.71 (9.48)	−127.59* (69.03)	0.779*** (6.25)	−0.837*** (−4.38)	−0.003 (0.08)	0.533** (0.23)	0.760*** (0.22)	0.379** (0.19)	−0.150 (0.38)	−0.068 (0.32)
Disability Medicaid eligibility (=1)	16.80** (7.73)	14.08 (77.26)	1.652*** (12.97)	0.070 (0.47)	−0.008 (0.09)	0.428** (0.19)	0.325 (0.21)	0.288* (0.18)	−0.141 (0.33)	0.427* (0.23)
Age 0–6 (=1)	18.81 (15.67)	−190.86 (226.48)	0.740*** (3.18)	−0.005 (−0.01)	0.308* (0.16)	−0.059 (1.16)	0.912** (0.42)	0.246 (0.34)	−0.097 (0.81)	−0.077 (0.51)
Age 7–11 (=1)	42.73*** (15.16)	−129.09 (220.17)	0.867*** (3.83)	0.247 (0.55)	−0.066 (0.16)	0.609 (0.99)	−0.199 (0.42)	−0.372 (0.36)	0.734 (0.84)	−0.899 (0.60)
Age 12–18 (=1)	68.10*** (14.98)	−12.36 (223.33)	0.740*** (3.30)	0.853* (1.84)	−0.192 (0.16)	0.926 (0.97)	0.015 (0.41)	−1.088*** (0.35)	0.315 (0.82)	−0.556 (0.66)
Age 19–38 (=1)	77.64*** (13.93)	90.00 (203.49)	0.703*** (3.33)	0.858** (1.98)	−0.368*** (0.14)	0.377 (0.89)	−0.177 (0.36)	0.189 (0.28)	−0.968 (0.72)	−0.206 (0.45)
Risk score	2.02*** (0.37)	0.46 (3.13)	−0.007 (−1.36)	0.018** (2.29)	0.003 (0.00)	0.015 (0.01)	0.0001 (0.01)	0.020*** (0.01)	−0.117*** (0.03)	0.036*** (0.01)
Receiving bypassing agents (=1)	79.56*** (22.50)	429.06*** (109.05)	−0.381* (−1.70)	0.392 (1.08)	0.245 (0.23)	0.847** (0.39)	0.155 (0.48)	0.270 (0.26)	−2.107*** (0.69)	0.289 (0.42)
Haemophilia A (=1)	−5.72 (9.06)	67.88 (96.69)	0.244* (1.82)	0.196 (1.02)	0.064 (0.08)	0.201 (0.26)	0.106 (0.27)	0.069 (0.24)	0.249 (0.38)	0.013 (0.30)
HIV positive (=1)	−24.51* (14.65)	117.48 (203.66)	−0.236 (−1.05)	0.198 (0.50)	0.408** (0.18)	−0.639 (0.44)			−0.195 (0.71)	−0.861*** (0.27)
HCV positive (= 1)							0.146 (0.32)	−0.790*** (0.23)		
Injury (=1)	1.52 (9.05)	309.78*** (93.13)	−0.081 (−0.73)	−0.153 (−0.91)	0.237** (0.09)	0.126 (0.16)	2.670*** (0.22)	1.027*** (0.17)	−0.572* (0.32)	0.036 (0.23)
Cardiovascular disease (=1)	15.16 (13.78)	−42.16 (126.07)			0.126 (0.16)	0.887 (0.55)	−0.102 (0.37)	0.276 (0.25)	−1.365 (0.90)	0.321 (0.45)
Hypertension (=1)	84.27** (36.59)	1026.44*** (214.00)	1.058* (1.63)	0.519 (0.66)	0.741 (0.71)	−0.820** (0.41)	1.240 (1.10)	1.255** (0.63)	−1.752* (1.06)	1.310*** (0.33)
Hypercholesterolaemia (= 1)	17.16 (18.02)	−169.86 (139.16)	0.508* (1.92)	0.295 (0.65)	0.152 (0.17)	0.126 (1.12)	−0.852* (0.47)	0.039 (0.40)	−0.307 (0.76)	0.012 (0.28)
Chronic arthropathy (=1)	15.32 (13.77)	123.29 (143.95)	−0.328* (−1.65)	−0.055 (−0.18)	0.176 (0.17)	0.667 (0.44)	−0.037 (0.33)	0.079 (0.27)	−1.906*** (0.61)	−0.734*** (0.26)
Diabetes (=1)	−14.91 (18.98)	301.16* (166.70)	0.310 (1.10)	−1.120*** (−2.52)	0.003 (0.33)	0.808 (0.87)	0.960* (0.21)	0.365 (0.42)	−1.305* (0.79)	−0.996*** (0.27)
Renal disease (=1)	12.22 (16.85)	−585.28*** (158.63)			0.129 (0.20)	−0.140 (0.68)	0.464 (0.48)	0.047 (0.30)	−0.177 (0.54)	−0.340 (0.35)
Musculoskeletal, connective tissue (=1)	9.42 (8.02)	41.75 (69.16)	0.098 (0.89)	0.109 (0.68)	0.386*** (0.10)	−0.203 (0.24)	0.940*** (0.21)	0.783*** (0.22)	−0.321 (0.33)	0.108 (0.27)
Intracranial haemorrhage (=1)	30.49 (13.19)	395.02** (188.98)	−0.008 (−0.04)	0.474 (1.44)	0.434*** (0.15)	1.205 (0.74)	0.868*** (0.35)	0.997*** (0.22)	−1.517** (0.69)	0.548** (0.26)

Dependent variable	Total expenditures (in $1000)† Less extensive users	Total expenditures (in $1000)† More extensive users	Likelihood of obtaining factor via pharmacy	Expenses for factor via pharmacy‡	Outpatient visits Less extensive users	Outpatient visits More extensive users	Likelihood of ED visit	Number of ED visits‡	Likelihood of admission	Annual length of stay‡
Model	Finite mixture model (FMM)		Two-part model		FMM		Two-part model		Zero-inflated negative binomial model	
			Probit	Generalized linear model§			Logit	Negative binomial model		
Depression (=1)	18.53* (11.28)	2958.29*** (363.88)	0.174 (0.97)	−0.391* (−1.77)	0.674*** (0.11)	0.433 (0.30)	0.661* (0.35)	−0.017 (0.23)	0.941 (0.58)	0.397** (0.34)
Pulmonary disease (=1)	5.35 (8.90)	14.25 (79.68)	0.412*** (3.33)	−0.021 (−0.12)	0.356*** (0.09)	−0.149 (0.43)	0.072 (0.28)	0.368** (0.17)	−0.968** (0.44)	−0.349* (0.20)
Neurological disease (=1)	1.80 (10.32)	−81.01 (110.64)			0.420*** (0.09)	0.348 (0.28)	0.913*** (0.29)	0.413** (0.17)	−1.427*** (0.53)	−0.087 (0.24)
Constant	−53.25 (16.24)	351.50 (237.90)	−1.354*** (−5.30)	10.671*** (20.77)	0.324 (0.20)	0.755 (0.65)	−2.353*** (0.46)	−1.838*** (0.52)	5.706*** (0.94)	0.575 (0.57)
Number of observations	786		838	444	790		838	386	838	146
Proportion of each part (%)	87	13	100	53	85	15	100	46	100	17
Log-likelihood	−10 300.36		−455.84	−5566.20	−2423.84			−1042.56		−663.49
Wald χ^2	962.99		192.80	–	535.65			223.27		167.72
Pseudo R^2	–		0.21	–	–			–		–
Alpha¶	–		–		–			0.33 (0.04)***		1.08 (0.22)***††

†This regression includes ED visit, rate of readmission ≤30 days, number of infusion, identified by procedure code and expenditures for factor per unit, identified by NDC, though they were not presented here.

‡Restricted to individuals with positive expenditures for factors via pharmacy, or users of ED or inpatient facilities.

§More specifically, generalized linear model with log link and gamma distribution.

¶Alpha is the overdispersion parameter of the negative binomial model. When $\alpha = 0$, there is no overdispersion in the data and the Poisson model is sufficient. When a $\alpha \neq 0$, then the negative binomial is the appropriate model.

††The Vuong test compares the zero-inflated model with an ordinary negative binomial model [9]. A significant z-test indicates that the zero-inflated model is better at a 1% level of significance ($z = 6.14$).

The symbols ***, ** and * indicate a significance level of 1%, 5% and 10%, respectively, for a two-tailed test. Robust standard errors are given in parentheses.