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Can Increases in CHIP Copayments Reduce Program Expenditures on Prescription Drugs?

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Objective: The primary aim is to explore whether prescription drug expenditures by enrollees changed in Alabama's CHIP program, ALL Kids, after copayment increases in fiscal year 2004. The subsidiary aim is to explore whether non-pharmaceutical expenditures also changed.

Data Sources: Data on ALL Kids enrollees between 1999–2007, obtained from claims files and the state's administrative database.

Study Design: We used data on children who were enrolled between one and three years both before and after the changes to the copayment schedule, and estimate regression models with individual-level fixed effects to control for time-invariant heterogeneity at the child level. This allows an accurate estimate of how program expenditures change for the same individual following copayment changes. Primary outcomes of interest are expenditures for prescription drugs by class and brand-name and generic versions. We estimate models for the likelihood of any use of prescription drugs and expenditure level conditional on use.

Principal Findings: Following the copayment increase, the probability of any expenditure decline by 5.8%, brand name drugs by 6.9%, generic drugs by 7.4%. Conditional on any use, program expenditures decline by 7.9% for all drugs, by 9.6% for brand name drugs, and 6.2% for generic drugs. The largest declines are for antihistamine drugs; the least declines are for Central Nervous System agents. Declines are smaller and statistically weaker for children with chronic health conditions. Concurrent declines are also seen for non-pharmaceutical medical expenditures.

Conclusions: Copayment increases appear to reduce program expenditures on prescription drugs per enrollee and may be a useful tool for controlling program costs.

Keywords: Children's Health Insurance Program (CHIP), cost-sharing, copayment, medications, econometrics, prescription drugs, chronic conditions

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Introduction

Over the past decade, concerns about budgetary shortfalls and "unnecessary" utilization have prompted several states to expand beneficiary cost-sharing via increased premiums and copayments in their Medicaid and Children's Health Insurance Programs (CHIP; Artiga & O'Malley, 2005; Coughlin & Zuckerman, 2005). In contrast to the extensive literature about the effects of cost-sharing on adult Medicaid recipients, very few studies have examined the effects of cost-sharing on health care utilization among publicly insured children. Moreover, though budgetary concerns are a primary motivation for increased cost-sharing, little research exists on whether increased cost-sharing meaningfully reduces program expenditure on various health services. In this study, we help fill that knowledge gap in the literature by exploring how increased copayments affect program expenditures in ALL Kids, the freestanding CHIP program in the state of Alabama. We primarily focus on program expenditures for prescription drugs, while also investigating changes in other medical expenditures (hereafter 'non-pharmaceutical expenditures'). This study builds upon earlier work by Morrisey *et al.* (2012) and Sen *et al.* (2012) that respectively explored how enrollment and general health service utilization in ALL Kids changed following increased cost-sharing.

Prescription drugs are used by more than a quarter of all children in the U.S. (Vernacchio, Kelly, Kaufman, & Mitchell, 2009; Gu, Dillon, & Burt, 2010). Access to newer and improved prescription drugs is associated with reductions in mortality, morbidity, and total medical spending (Goldman, Joyce, & Zheng, 2007; Lichtenberg, 2001). At the same time, the high rate of growth in prescription

drugs' costs have prompted both public and private health insurance programs to introduce cost-sharing and tiered copayments to rein in costs. Extensive research exists on the effects of such cost-sharing on seniors and non-elderly adults, both in public and private health insurance programs, but little research exists for children. For example, one comprehensive review of studies on prescription drugs and cost-sharing identified 132 studies over the period between 1985 and 2006 (Goldman *et al.*, 2007)—of which only four studies focused on child enrollees (Hong & Shepherd, 1996; Huskamp *et al.*, 2005; Kozyrskyj, Mustard, Cheang, & Simons, 2001 October; Kozyrskyj, Mustard, & Simons, 2001). Of these, two used data only on children with asthma from Manitoba, Canada, which limits generalizability of their results (Kozyrskyj *et al.*, 2001 October; Kozyrskyj *et al.*, 2001 November). Thus, the current study adds to the literature both by informing on the impact of cost-sharing on per enrollee program expenditures for prescription drugs and other health services in CHIP, and by informing on cost sharing and prescription drugs in context of children.

Background

Alabama's standalone CHIP program, ALL Kids, provides health insurance coverage to low-income children under age 19 who are legal residents, but are not eligible for Medicaid or dependant coverage under the state employees' health insurance plan. From the start, the program covered children with family incomes up to 200 percent of the Federal Poverty Level (FPL). After 2010 the income eligibility was expanded to 300 percent of the FPL.

In fiscal year 2004, the ALL Kids program increased cost-sharing for the first time since the onset of the program. Copayments for several non-preventive services, including prescription drugs, were raised in the first enrollment period initiated after the start of the 2004 fiscal year. Evidence indicates that health service utilization among enrollees fell across a broad range of services—including prescription drugs—after copayments were increased (Sen *et al.*, 2012). However, co-occurring premium increases resulted in decreased enrollment in ALL Kids at the same time, with greater decreases among children without chronic health conditions than those with such conditions (Morrisey *et al.*, 2012). Therefore, it is difficult to determine whether changes in service utilization (and hence in program expenditures) were driven by changes in the composition of enrollees after the increased cost-sharing or whether there were reductions in service utilization by *the same enrollees* who remained in the program before and after copayments increased. The current study looks at how increased cost-sharing is associated with per capita program expenditure on prescription drugs and uses an empirical approach that helps answer the question, "ceteris paribus, how do program expenditures for the same enrollee differ when copayments are higher compared to when they were lower?"

Previous studies of adults enrolled in Medicare, Medicaid, and private insurance plans have found that reducing program benefits for prescription drugs by increasing copayments or limiting the number of reimbursable medications leads to lower usage of prescription drugs (Cole, Norman, Weatherby, & Walker, 2006; Gaynor, Li, & Vogt, 2006; Goldman, Joyce & Karaca-Mandic, 2006; Hsu *et al.*, 2006; Soumerai, Ross-Degnan, Avorn, McLaughlin, & Choodnovskiy, 1991; Soumerai, McLaughlin, Ross-Degnan, Casteris, & Bollini, 1994). Recent work by Karaca-Mandic, Jena, Joyce, and Goldman (2012) found that, among children with asthma, higher out-of-pocket asthma drug costs led to small reductions in use of such drugs. However, both of those studies found

that the reduction in usage of prescription drugs were accompanied by increased usage of more cost-intensive inpatient or emergency services. Therefore, in the context of our study, we argue that it is useful to supplement the analysis of the impact of increased copayments on prescription drug expenditures with an analysis of the impact of increased copayments on non-pharmaceutical expenditures as well.

Methods

Data

We use longitudinal claims data from ALL Kids before and after the period of increased cost-sharing. The study was approved by the Institutional Review Board. In fiscal year 2004, ALL Kids increased copayments for several non-preventive health services, with the magnitudes of the increases varying across families with incomes between 101 and 150 percent of the FPL (referred to in the ALL Kids program as the "low-fee group") and families with incomes between 151 and 200 percent of the FPL (referred to as the "fee group"). For example, for the low-fee group, brand-name drug copays increased from $0 to $3 and generic drugs copays increased from $0 to $1. For the fee group, brand-name drug copays increased from $3 to $5 and generic drug copays increased from $1 to $2. Native American enrollees were not subject to any copayments for any health services, either before or after fiscal year 2004, due to federal guidelines. Hence, they are referred to as the "no fee group."

In ALL Kids, eligible children enroll by paying premiums, and receive 12 months of benefits per enrollment period. Given that we are particularly interested in determining how average prescription drugs expenditures for the *same enrollee* change when copayments increase, we restrict our sample to ALL Kids children from all three fee groups who were enrolled for *at least* one full enrollment period both before and after the copayment increases (that is, one complete enrollment period in the old and in the new copayment schedule). We include up to three enrollment periods per enrollee prior to and after the copayment changes. Thus, at the maximum, an enrollee could be seen for three enrollment periods prior to the copay increase and three enrollment periods after. Inclusion is based on enrollment, regardless of whether the child enrollee actually used prescription drugs in those years so, in principle, an enrollee could have zero prescription drug expenditures in each of the years they appear in the data.

We consider expenditure on all prescription drugs, expenditure on all brand-name prescription drugs, and expenditure on all generic prescription drugs as our main outcome variables of interest. We also consider expenditure on sub-categories of brand-name and generic drugs. We classify individual drugs into therapeutic classes using the American Hospital Formulary Service (AHFS) system—specifically, antihistamine, anti-infective, central nervous system (CNS), and other drugs. The CNS drugs were further sub-classified into analgesics and antipyretics, psychotherapeutic agents, respiratory and cerebral stimulants, and "other," which included anxiolytics, sedative hypnotics, and anticonvulsants. We examine total program expenditure—that is, the sum of pharmaceutical and non-pharmaceutical expenditures. Expenditures for different categories of prescription drugs were derived from the claims files provided by ALL Kids. Non-pharmaceutical expenditures include all non-pharmaceutical costs incurred by ALL Kids, which includes outpatient, inpatient, emergency department, physician's office, and laboratory tests. All expenditure figures were inflation-adjusted to 2008 dollars.

Information on other enrollee characteristics, such as age, gender, and race are collected from the ALL Kids enrollment files and other ALL Kids databases.

Empirical Model

We estimate regression models with individual-level fixed effects (Wooldridge, 2009). Because a substantial proportion of respondents report no expenditures on specific categories of drugs, we opt for a 'two part' model approach, where we separately model the probability of any expenditure (part 1) and level of expenditure conditional on any (part 2). This approach has been shown to yield a better fit than a single linear expenditure regression in the presence of a high mass of zero outcome values. (Duan, Manning, Morris, & Newhouse, 1983; Duan, Manning, Morris, & Newhouse, 1984; Mihaylova, Briggs, O'Hagan, & Thompson, 2011). It has the additional advantage of illustrating how cost-sharing changes prescription drug utilization at the "extensive margin" (that is, any utilization versus none) versus the "intensive margin" (amount of use, conditional on any).

Therefore, for each category of prescription drugs, we estimate linear probability models for any utilization (that is, any expenditure) and linear regressions of expenditure conditional upon utilization. The basic models may be written as follows

$$P(Y_{jt} > 0) = \alpha_1 + \beta_1 \text{ Copay\_Increase}_{jt} + X_{jt}\lambda_1 + T_t + \pi_j + u_{jt} \quad (1)$$

$$Y_{jt} = \alpha_2 + \beta_2 \text{ Copay\_Increase}_{jt} + X_{jt}\lambda_2 + T_t + \pi_j + u_{jt} \text{ if } Y_{jt} > 0 \quad (2)$$

Where Y_{jt} represents the ALL Kids expenditure for a specific category of prescription drugs for enrollees in enrollment year t. Because ALL Kids increased copayments for several health services simultaneously, we do not use dollar values of prescription drug copayments per se, since there may be cross-price effects of other copayments on prescription drug expenditure. Hence, we model $\text{Copay\_Increase}_{jt}$ as a binary variable that is one if the observation is from an enrollee subject to the increased copayments and an enrollment period after the increase in copayments, zero if before. Notably, this variable is always zero for Native Americans, since they are not subject to any higher copayments. X_{jt} includes time-variant enrollee characteristics, such as their age and whether their family income put them in the low-fee group or fee group in that contract year. T_t represents a general time trend, which can help capture effects of temporal changes in availability of new drugs, temporal changes in the likelihood that physicians will prescribe brand name versus generic drugs, or temporal changes in the price of drugs because of expiration of patents. Examples of factors that the time trend can help capture can be the effect of Claritin (loratadine) becoming available over-the counter in cases of antihistamine drugs. π_j incorporates individual-level characteristics that remain time-invariant (that is, the individual 'fixed effect'). This encompasses observable characteristics that remain time-invariant, such as the enrollee's gender and race. More importantly, it encompasses difficult-to-measure characteristics, such as (but not limited to) a child's past or family history for health problems or the parents' attitudes towards prescription drug usage. Such unmeasured characteristics may be correlated both with the enrollee's response to the copayment increase and with prescription drug usage (and therefore prescription drugs expenditures on that enrollee), and may thereby bias the estimated impact of the copayment increase. By accounting for, and partialing out the effects of such individual-level unobservable factors,

this regression technique essentially allows for minimally biased estimates of how program expenditures change for the average enrollee in the sample ('within-person change').

We also allow for the impact of the copay increase to vary across children who have a chronic health condition and those who do not, and children who are from the 'low fee' group versus the 'fee group,' by respectively interacting these characteristics with copay increases. Testing whether responsiveness to copayments vary for these groups is motivated by basic microeconomic theory of elasticity of demand. This theory suggests that, all other things equal, consumers will be *less responsive* to a price increase if they consider a commodity to be a necessity—hence, children suffering from chronic health conditions are likely to be less responsive to increases in copays. This theory also suggests that, all other things equal, consumers will be *more responsive* to a price increase if spending on that commodity uses up a larger share of their disposable income—and because copays may impose a bigger strain on budgets of families under 150 percent of FPL (i.e., low fee group) than those at 150–200 percent FPL (i.e., fee group), the former is likely to be more responsive to changes in copays. Regression coefficient estimates were considered meaningful if $p \leq 0.05$.

We estimate equation (1) using linear probability models rather than more conventional approaches for binary outcomes like logistic models. The presence of individual fixed effects would necessitate using conditional logit models (Wooldridge, 2010). The primary limitation of the conditional logit model is that it can only include individuals who experienced a change in their binary outcome (any utilization versus no utilization), and therefore excludes individuals who either had zero utilization or non-zero utilization in all time periods. This can severely limit the generalizability of results. As well, there are the well-known limitations of meaningfully interpreting the magnitudes of effects from conditional logit models when interactions are involved (Ai & Norton, 2003; Buis, 2010).

Results

A total of 34,400 children were enrolled for at least one complete enrollment period before and one complete period after the change in copayment schedule. The final analytical dataset allowed for each child to contribute up to three periods before and three after, thus a possible total of six observations per child. The total number of observations was 132,012 person-years of enrollment, with the mean of 3.8 observations per child.

Exhibit 1 shows the descriptive information about children included in the cohort. The mean age of children was 10.4. Male and female children were represented at 51% and 49% respectively. The majority of the children (64%) were in the FPL range of 101–150% and were more likely to live in a more urban environment (64%). The racial composition of the cohort included 61.7% Caucasian, 34.7% African American, and 3.6% other racial groups. Chronic disease diagnosis was evident in 27% of the cohort. Descriptive information is also provided for the sub-set of children who were enrolled for the shortest period permitted in this study (2 years) and the longest period (6 years). The most notable difference between the two groups is chronic disease status, with the longest period enrollees having a higher proportion of children with chronic disease (38.3%) compared to the shortest period enrollees (17%).

Exhibit 1. Descriptive Statistics: Independent Variables

Variable	Full Sample N = 34,455		Enrolled 2 Periods N = 7298		Enrolled 6 Periods N = 4819	
Age at co-pay change, mean (SD)	10.4	4.1	10.2	4.6	11.1	3.5
Female, n (%)	16780	48.7	3532	48.4	2347	48.7
Fee group, n (%)						
No fee	379	1.1	51	0.7	68	1.4
Low fee	21948	63.7	5204	71.3	3142	65.2
Fee	12163	35.3	2043	28.0	1610	33.4
Rural/Urban Code						
RUCA 1, n (%)	22120	64.2	4664	63.9	3108	64.5
RUCA 2, n (%)	4204	12.2	898	12.3	579	12.0
RUCA 3, n (%)	4410	12.8	927	12.7	627	13.0
RUCA 4, n (%)	3480	10.1	774	10.6	472	9.8
Location unknown, n (%)	241	0.7	36	0.5	34	0.7
Race						
Caucasian, n (%)	21052	61.1	4204	57.6	2978	61.8
African American, n (%)	11818	34.3	2744	37.6	1629	33.8
Other, n (%)	1550	4.5	350	4.8	212	4.4
Chronic disease, n (%)	9303	27.0	1241	17.0	1846	38.3
Periods of enrollment, n (%)						
2	7298	21.1	7298	100.0	—	—
3	6306	18.4	—	—	—	—
4	10406	30.2	—	—	—	—
5	5620	16.5	—	—	—	—
6	4819	14.0	—	—	4819	100.0

NOTE: Descriptive statistics are presented for the full sample, as well as for those enrolled for the minimum number of periods permitted in this study (2 periods) and for the maximum number of periods permitted in this study (6 periods).
SOURCE: Authors' analysis of ALL Kids administrative and claims data, 2000–2006.

Exhibit 2 presents descriptive statistics for the outcome variables—program expenditures for different drug classes. Utilizing at least one drug was 78 percent of children, 59 percent utilized at least one brand-name drug, and 70 percent utilized at least one generic drug. The most commonly prescribed class of drugs was anti-infective agents (used by 59%), followed by antihistamine drugs (34%) and

Exhibit 2. Descriptive Statistics: Drug Expenditures

	Proportion of Children Utilizing	Expenditure Per Child Per Year	Expenditure Per Child Per Year Conditional on Any Use
Combined drug classes (all)	0.78	$336.66	434.67
Brand only	0.59	272.41	460.15
Generic only	0.70	64.25	93.03
Antihistamine drugs (all)	0.34	32.02	97.85
Brand only	0.21	23.87	113.67
Generic only	0.20	8.15	40.75
Anti-infective agents (all)	0.59	56.56	96.15
Brand only	0.32	37.36	117.08
Generic only	0.46	19.21	41.25
Central Nervous System (CNS) agents (all)	0.30	88.50	299.70
Brand only	0.10	77.93	746.31
Generic only	0.25	10.57	43.53
CNS brand subcategories			
CNS analgesics and antipyretics	0.02	1.20	80.30
CNS psychotherapeutic agents	0.03	20.48	682.87
CNS respiratory and cerebral stimulants	0.06	36.47	606.83
Other CNS agents	0.03	19.77	657.99
CNS generic subcategories			
CNS analgesics and antipyretics	0.20	2.67	13.56
CNS psychotherapeutic agents	0.02	2.22	111.10
CNS respiratory and cerebral stimulants	0.02	4.49	224.50
Other CNS agents	0.03	1.20	40.80
Other drug classes (all)	0.61	159.58	266.25
Brand only	0.39	133.26	342.89
Generic only	0.49	26.32	54.81
Medical services	0.95	$ 1,240.17	1302.80

NOTE: * Reported in constant 2008 dollars.

SOURCE: Authors' analysis of ALL Kids claims, 2000–2006

central nervous system (CNS) agents (30%). At least one drug from the 'other drug classes' category was utilized by 61 percent. Average drug expenditure per enrollee per year (calculated using all enrollees) was $336.66, average brand name prescription drug expenditure was $272.41 per year, and generic prescription drug expenditure was $64.25 per year. Corresponding numbers conditional on any use were $434.67, $460.15, and $93.03 per year.

Exhibit 3 presents the results of the covariate-adjusted individual fixed-effects regression models. In each case, 'Model 1' presents results from linear probability models for any utilization, and the estimate of β in these models is

interpretable as *average within-person percentage point change in the probability of any use* of that drug category following the copay increase. 'Model 2' gives results for enrollee-level program expenditure for each drug type conditional on any use, and β from each model is interpretable as the *average*

Exhibit 3. Results from Individual Fixed-Effects Regression Models.

	Model 1 β	Percent Change #	Model 2 β	Percent Change #
Combined drug classes (all)	–0.045***	–5.77	–34.57***	–7.95
Brand only	–0.041***	–6.95	–44.12***	–9.59
Generic only	–0.052***	–7.43	–5.72***	–6.15
Antihistamine drugs (all)	–0.062***	–18.24	–14.15***	–14.46
Brand only	–0.047***	–22.38	–25.63***	–22.55
Generic only	–0.037***	–18.50	4.4	10.80
Anti-infective agents (all)	–0.058***	–9.83	–10.19***	–10.60
Brand only	–0.011***	–3.44	–17.76***	–15.17
Generic only	–0.06***	–13.04	–3.41***	–8.27
Central Nervous System (CNS) agents (all)	–0.02***	–6.67	15.51	5.18
Brand only	–0.008***	–8.00	–0.74	–0.10
Generic only	–0.02***	–8.00	10.21***	23.46
CNS brand subcategories				
CNS analgesics and antipyretics	–0.002	–10.00	–2.7	–3.36
CNS psychotherapeutic agents	–0.002**	–6.67	87.95	12.88
CNS respiratory and cerebral stimulants	–0.006***	–10.00	–15.37	–2.53
Other CNS agents	–0.004***	–13.33	–6.87	–1.04
CNS generic subcategories				
CNS analgesics and antipyretics	–0.02***	–10.00	–1.8**	–13.27
CNS psychotherapeutic agents	–0.001	–5.00	7.11	6.40
CNS respiratory and cerebral stimulants	0.001	5.00	89.19***	39.73
Other CNS agents	–0.004**	–13.33	–16.92	–41.47
Other drug classes (all)	–0.037***	–6.07	–27.93**	–10.49
Brand only	–0.03***	–7.69	–38.99**	–11.37
Generic only	–0.038***	–7.76	–7.99***	–14.58
Medical services	–0.02***	–2.11	–79.3**	–6.09

NOTES: ** $p \leq 0.05$, *** $p \leq 0.01$.

Percentage changes are calculated based on the mean values (shown in Exhibit 2).

For all drug classes, Model 1 is a linear probability model estimating predictors of any use (or any expenditure), and Model 2 is a linear regression model estimating predictors of expenditure conditional on any use. Models also control for a full set of binary indicators for age-group, the FPL category for that family in that year. Time invariant characteristics like gender, race, and ever having a chronic disease diagnosis are accounted for by the fixed effects.

SOURCE: Authors' analysis of ALL Kids claims data, 2000–2006.

within-person change in program expenditures among users for that drug category following the copay increase. To further facilitate the interpretation of our results, we also present our estimates as percentage changes that they represent based on the proportion utilized and the average program expenditures for that drug class in fiscal year 2003.

The copay increase is associated with statistically significant reductions in any utilization for all prescription drugs ($\beta = -0.045$, $p < 0.01$, percentage decline = 5.77%), brand-name drugs ($\beta = -0.041$, $p < 0.01$, percentage decline = 6.95%) and generic drugs ($\beta = -0.052$, $p < 0.01$, percentage decline = 7.43%). The copay increase is also associated with significant reductions in program expenditures conditional on any use for all prescription drugs ($\beta = -34.57$, $p < 0.01$, percentage decline = 7.95%), brand-name drugs ($\beta = -44.12$, $p < 0.01$, percentage decline = 9.59%) and generic drugs ($\beta = -5.72$, $p < 0.01$, percentage decline = 6.15%). However, there is substantial variation in responsiveness to higher copays across specific categories of drugs. For example, there is an overall decline of 18.24% in any utilization of antihistamine drugs and a 14.46% decline in expenditure conditional upon use, but while the decline in any utilization occurs for both brand name and generic antihistamine drugs (percentage declines of 22.38 and 18.50% respectively), only brand-name antihistamine drugs show significant decline in expenditure among users ($\beta = -25.63$, $p < 0.01$, percentage decline = –22.53%). For anti-infective drugs, the percentage decline in any usage is larger for generic (–13.04%) than brand-name drugs (–3.44%), but the decline in expenditures conditional on use is larger for brand-name drugs (–15.17%) than generic drugs (–8.27%). CNS agent drugs show lower responsiveness to copay changes, with declines in any usage, but in most cases with no statistically significant changes in expenditure conditional upon usage.

To further assess the appropriateness of using linear probability models for Model 1, we construct predicted values of the outcomes and inspect what proportions of these values were outside the logical range of 0 to 1. We find that these proportions are very small. For example, for all brand name drugs, no predicted values lay outside the 0–1 range, whereas for all generic drugs, only 0.7% of all predicted values lay outside this range. This assures that using linear probability models for these data is not inappropriate.

We also find a concurrent decline of about 2.1% in any non-pharmaceutical medical expenditures ($\beta = -0.02$, $p < 0.01$), as well as a decline of about 6.09% in expenditures conditional upon usage ($\beta = -79.3$, $p < 0.01$).

Exhibit 4 presents comparisons of results for children with and without chronic conditions and those in the low fee group versus the fee group. For children with no chronic conditions, the probability of use and expenditure conditional on use decrease significantly for all drugs, brand-name drugs and generic drugs, and percentage decline in expenditure is substantially larger for brand name (–24.7%) than generic drugs (–5.6%). In contrast, for children with chronic conditions, percentage declines in probability of any use are far smaller.

For example, for all drugs, the decline is 3.41% for the chronic condition group, and 6.85% for the no chronic condition group. Conditional on any utilization, there is actually an increase of 2.47% in expenditures on brand-name drugs for the chronic condition group. Additionally, there is a smaller decline in the likelihood of any non-pharmaceutical medical expenditures in the chronic condition group compared to the no chronic condition group (–2.04% versus –3.2%), and no statistical decline in expenditure conditional on use for the former, but a decline of 9.17% for the latter.

For children in the low-fee group, declines in probability of any utilization were larger

Exhibit 4. Main Results from Individual Fixed-Effects Regression Models, by Chronic Health Condition Status and Fee Group

	Proportion Utilizing	Expenditure Per Child Per Year Conditional on Any Use	Model 1 β	Percent Change	Model 2 β	Percent Change
No Chronic						
alldrug_amt	0.73	298.9	−0.05***	−6.85	−62.53***	−20.92
brand_amt	0.53	316.7	−0.05***	−9.43	−78.3***	−24.72
gener_amt	0.64	78.1	−0.06***	−9.38	−4.39	−5.62
med_amt	0.94	987.4	−0.03***	−3.19	−90.58***	−9.17
Chronic #						
alldrug_amt	0.88	704.2	−0.03***	−3.41	25.62***	3.64
brand_amt	0.74	707.6	−0.03***	−4.05	17.5***	2.47
gener_amt	0.81	121.3	−0.04***	−4.94	−8.2	−6.76
med_amt	0.98	2027.1	−0.02***	−2.04	−49.33	−2.43
Low Fee						
alldrug_amt	0.76	451.8	−0.05***	−6.58	−37.6***	−8.32
brand_amt	0.58	480.5	−0.05***	−8.62	−44.36***	−9.23
gener_amt	0.68	95.9	−0.06***	−8.82	−7.61***	−7.94
med_amt	0.95	1287.01	−0.03***	−3.16	−73.95**	−5.75
Fee #						
alldrug_amt	0.79	401.5	−0.03***	−3.80	−28.5	−7.10
brand_amt	0.61	422	−0.03***	−4.92	−43.6	−10.43
gener_amt	0.71	86.88	−0.04***	−5.63	−2.9***	−3.34
med_amt	0.96	1326.8	−0.02***	−2.08	−57.1	−4.30

NOTES: ** $p \leq 0.05$, *** $p \leq 0.01$. # P-values denote if difference with reference category (no chronic condition and low-fee group) are significant.

For all drug classes, Model 1 is a linear probability model estimating predictors of any use (or any expenditure), and Model 2 is a linear regression model estimating predictors of expenditure conditional on any use. Models also control for a full set of binary indicators for age-group, the FPL category for that family in that year. Time invariant characteristics are accounted for by the fixed effects.

SOURCE: Authors' analysis of claims data, 2000–2006.

than for children in the fee group for all drugs (−6.6% versus −3.8%), brand-name drugs (−8.6% versus −4.9%) and generic drugs (−8.8% versus −5.6%), as well as non-pharmaceutical medical service use (−3.16% versus −2.08%). Conditional on any use, the difference between the two groups was statistically significant only in case of generic drugs, with a decline of 7.6% for the low-fee group and 2.9% for the fee group.

We also conducted other, detailed analyses for which we do not report the results here, but will make them available upon request. First, we analyzed the models for all sub-classes of drugs for children with and without chronic conditions, and in the low-fee versus fee group (not shown). The pattern of the fee group showing less responsiveness than the low-fee group in terms of change in any use to the copay changes holds for

most sub-classes, particularly antihistamines and anti-infective agents. For children with chronic conditions, the increase in drug expenditures following copay changes appears to be driven by a statistically significant and large increase in expenditures on brand name CNS agent drugs among users. For the remaining drug classes, children with chronic conditions mostly show smaller declines in any use compared to children with no chronic conditions, and no significant changes in expenditures conditional on use. These results are available on request.

Second, we examined the robustness of our main expenditure results to alternative specifications. In linear expenditure models that were inclusive of all the 0 values, our results were largely similar in terms of direction and statistical significance.

Finally, we also conducted the analyses using number of claims for each class of prescription drugs to better understand whether the changes we see in total expenditure might be an artifact of changes in drug prices rather than change in quantity utilized. ALL Kids claims data does not provide reliable information on day-supply per claim, so there is some concern about measurement error if enrollees tend to get different day-supply for certain drugs after the increase in copayments. However, we find qualitatively similar results, with statistically significant decreases in claims for both brand name and generic drugs, but with variations across the different classes of drugs. We also found evidence of smaller reductions in claims for children with chronic conditions. This strongly indicates that the decline in drug expenditures is driven by reduced drug utilization and is not an artifact of a coincidental change in prices occurring over the same period.

Conclusion

Previous research has found that health service utilization declines among CHIP enrollees following higher cost-sharing (Sen *et al*, 2012). In part, such changes in health service utilization may be because the composition of enrollees changes following changes in premiums (Morrisey *et al*, 2012; Kenney, Marton, Klein, Pelletier, & Talbert, 2011). Thus, this study complements the earlier paper by Sen *et al* (2012) by investigating if cost-sharing actually leads to within-person reductions in health care expenditures, by using only those enrollees who remain in the program both before and after copayment increases. Results indicate that increased copayments lead to reductions in program expenditures on overall prescription drugs, brand-name prescription drugs, and generic prescription drugs. Concurrent declines occurred in non-pharmaceutical service utilization and expenditures.

We also found variations in responsiveness across different classes of drugs, with particularly high declines in cases of antihistamine drugs—which are consistent with the findings of Goldman *et al*. (2004) for privately insured adult patients. We also found greater responsiveness and larger declines among children with no chronic conditions compared to children with chronic conditions, and some evidence of larger reductions for children between 101–150 percent of FPL compared to 150–200 percent of FPL. These results are generally consistent with the microeconomic theory of price responsive demand and predictions made by that theory about differential responsiveness to price increases based on the 'necessity' of a commodity to a consumer as well as the share of a consumer's disposable income used up by the higher copays.

We found mixed evidence of substitution from brand-name to generic drugs, even though the copayments on brand-name prescription drugs increased by larger amounts than copayments for generic prescription drugs. For the full sample, the percentage declines in any utilization were similar for brand-name and generic drugs, though expenditure conditional on utilization declined more for brand-name drugs. However, for anti-infective agents, the percentage declines in any utilization were higher for generic drugs compared to brand-name, whereas the decline expenditure conditional on use was larger for brand-names. For antihistamine drugs and for CNS agents, expenditure on generic drugs conditional on use either did not change statistically or appeared to increase. It should be noted that, given that brand name drugs are usually substantially more expensive than generic drugs (Lundy, 2010; Kaiser Family Foundation, 2012), a percentage decline in brand-name prescription drug expenditure typically leads to a percentage decline in overall prescription drug expenditure even if generic prescription drug expenditures increase (as seen in the case of antihistamines).

Finally, we found no evidence of increases in non-pharmaceutical medical expenses. Thus, there is no evidence that the reduction in drug claims is counterweighed by higher costs resulting from increases in utilization of other forms of medical services. This finding is somewhat in contrast to findings in some studies on adults (Gaynor *et al*., 2006; Soumerai *et al*., 1991; Soumerai *et al*., 1994), but in keeping with other studies, such as Johnson *et al*. (1997), Smith and Kirking (1992), Motheral and Fairman (2001), Fairman, Motheral, and Henderson (2003), which found that higher prescription drug copayments in adult or elderly patients led to lower drug use and expenses with no increases in other medical care utilization, such as outpatient visits, hospitalizations, or emergency department visits. Of course, our study differs in an important way from some of the above ones because of the simultaneous increase in other copayments as well. Therefore, it is within the realm of possibility that higher copayments led to lower utilization of prescription drugs, but also led to lower use of inpatient or emergency services even though inadequate prescription drug usage led to adverse health conditions that would have, in other circumstances, led to using those services. On the other hand, it could be speculated that the copayment increases in ALL Kids were not so prohibitive as to lead to reduced prescription drug utilization among the child enrollees who need prescription drugs the most (such as children with chronic health conditions); therefore, there were not many instances of lack of drugs leading to development of medical conditions that would have concurrently driven up non-pharmaceutical expenditures.

The study has some limitations. Simultaneous increases in copayments for many health services essentially imply that changes in program expenditures must be interpreted as a combination of the own-price effects of copayments of that health service, and cross-price effects of other health services that are potential complements or substitutes. Our research is focused on one state, and the results may not be generalizable to all CHIP programs. We do not have information on provider re-imbursement changes in this period, which may be a factor affecting access and utilization (Kenney *et al*, 2011). We used data on children who remained enrolled in the program for at least one year prior to and one year after the change in copayments—while this is required to permit individual fixed effects modeling techniques, it does limit the generalizability of our results, given that approximately 42% of enrollees ever entering ALL Kids only remain in the program for one year.

In conclusion, higher cost-sharing appears to reduce program expenditures on prescription drugs for enrollees. At the same time, policy-makers

should be aware that higher cost-sharing may place a greater burden on households with children for whom prescription drugs are more of a necessity, thus making their demand less responsive to price increases. Children with chronic health conditions and children using CNS agents may be especially vulnerable to this, thus making them less able to reduce their utilization in response to higher prices. Finally, even though we do not see any concurrent increases in non-pharmaceutical expenditures—which include inpatient or ED expenditures, it is possible that less prescription drug utilization leads to small, but nonetheless adverse, effects on the health of children in the short run and may lead to severe adverse health consequences and increased health expenditures in the long run. Useful directions of future research include analyzing potential long-term consequences of changes in copayments of prescription drugs and other health services, as well as collecting information from parents/guardians of child enrollees on their perceptions about any adverse health effects due to reduced health service utilization.

Disclaimer

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Appendix

Exhibit A1. Proportion of drug classes observed.

American Hospital Formulary Service (AHFS) Drug Class	Percent
Anti-infective Agents	22.9
Central Nervous System Agents	20.7
Respiratory and Cerebral Stimulants	34.5†
Analgesics and Antipyretics	30.8†
Psychotherapeutic Agents	18.4†
Other CNS Agents	16.4†
Antihistamine Drugs	12.3
Hormones and Synthetic Substitutes	8.8
Autonomic Drugs	6.8
Skin and Mucous Membrane Agents	6.8
Respiratory Tract Agents	6.1
EENT Preparations	5.4
Miscellaneous Therapeutic Agents	3.3
Gastrointestinal Drugs	2.2
Cardiovascular Drugs	1.3
Vitamins	0.4
Pharmaceutical Aids	0.4
Devices	0.4
Diagnostic Agents	0.4
Electrolytic, Caloric and Water Balance	0.2
Antineoplastic Agents	0.1
Dental Agents	0.1
Smooth Muscle Relaxants	0.1
Other	0.1
Unclassified	1.3

†Percent of CNS agents.

SOURCE: Authors' analysis of ALL Kids claims data, 2000–2006.