Article

Health Expenditure Concentration and Characteristics of High-Cost Enrollees in CHIP

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Abstract

Devising effective cost-containment strategies in public insurance programs requires understanding the distribution of health care spending and characteristics of high-cost enrollees. The aim was to characterize high-cost enrollees in a state's public insurance program and determine whether expenditure inequality changes over time, or with changes in cost-sharing policies or program eligibility. We use 1999-2011 claims and enrollment data from the Alabama Children's Health Insurance Program, ALL Kids. All children enrolled in ALL Kids were included in our study, including multiple years of enrollment (N = 1,031,600 enrollee-months). We examine the distribution of costs over time, whether this distribution changes after increases in cost sharing and expanded eligibility, patient characteristics that predict high-cost status, and examine health services used by high-cost children to identify what is preventable. The top 10% (1%) of enrollees account for about 65.5% (24.7%) of total program costs. Inpatient and outpatient costs are the largest components of costs incurred by high-cost utilizers. Non-urgent emergency department costs are a relatively small portion. Average expenditure increases over time, particularly after expanded eligibility, and the share of costs incurred by the top 10% and 1% increases slightly. Multivariable logistic regression results indicate that infants and older teens, Caucasian children, and those with chronic conditions are more likely to be high-cost utilizers. Increased cost sharing does not reduce cost concentration or average expenditure among high-cost utilizers. These findings suggest that identifying and targeting potentially preventable costs among high-cost utilizers are called for to help reduce costs in public insurance programs.

Keywords

CHIP, cost concentration, public insurance, children, high cost

Introduction

It is well established that overall health care expenditures in the United States are not uniformly distributed. One report from the Agency for Healthcare Research and Quality found that, among the US population, the top 5% of patients accounted for 49.5% of all spending, and the top 1% for almost 22% of all spending.[1] Concerns about continued growth in health care spending have generated discussions about "bending the curve" for health costs. However, standard approaches to cost containment aimed at all consumers, like premium increases, copayment increases, or higher deductibles, may not be effective if health care expenditures are concentrated among a small proportion of consumers.[2] A better understanding of the distribution of costs among publically insured children is necessary to develop more viable approaches to cost containment.

The extant literature in this field has largely focused on cross-sectional analysis of distribution of costs over relatively short periods. For example, using Medical Expenditure Panel Survey (MEPS) for 1996 to 1998, McCormick et al found that the top 10% of child enrollees accounted for 69% of total pediatric health spending,[3] and using MEPS data for 2000 to 2001, Liptak et al found that the top 10% accounted for 54% of all costs.[4] For Medicaid and CHIP child enrollees in 2002 to 2005, Kenney et al (2009) found that the highest 10% of enrollees accounted for 72% of all program expenditures, whereas 30%

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of enrollees used no services at all.[5] Similar cost concentrations have been found in studies focusing on children in public health programs in a single state, or special-needs children.[6,7] We are not aware of any studies that have explored whether programmatic changes such as increased cost-sharing or changes in eligibility to include less disadvantaged families influence cost concentration. Nor are we aware of studies that have explored whether child characteristics that predict being a high-cost user in one period also predict being a persistent high-cost user.

Regarding cost sharing and cost concentration, much of the medical care provided to children is preventive care that parents may regard as relatively discretionary. Hence, a modest increase in premiums may mostly deter take-up or re-enrollment by children in good health with minimal health expenses.[5,8-10] Furthermore, authors of one of the seminal RAND health insurance studies posited that many children's illnesses are "acute but self-limiting," and may be sensitive to cost-sharing in the form of higher copayments.[11] Their empirical results found that outpatient visits among children were sensitive to higher copayments, whereas inpatient visits were less so. Thus, increased cost sharing may increase inequality in health care spending if it reduces re-enrollment and health service utilization by low-cost users while having little impact on high-cost utilizers.

An expansion in eligibility that adds families that are less disadvantaged, both in terms of income and parental education, to the insurance pool should increase health care utilization and average enrollee costs across the board, as such families may be more conscious about acquiring preventive services for their children and willing to spend more in copayments on both low-acuity care and high-acuity care. It is not clear, a priori, how this would affect cost concentration. However, if less disadvantaged families disproportionately utilize preventive and low-acuity care, then this may reduce cost concentration.

In this study, we use detailed longitudinal claims data from the ALL Kids program and add to the literature in several ways. First, we examine the distribution of annual expenditures and cost concentration over a 12-year period, during which there were programmatic changes such as copayment and premium increases, as well as an expansion of eligibility to children from more affluent families. Second, we examine the individual characteristics that predict being a high-cost enrollee in 1 enrollment year, as well as a high-cost enrollee in several consecutive years. Finally, we use detailed claims data to assess what health services high-cost enrollees are most likely to utilize, and what percent of these are potentially preventable. This study complements previous work by this research team on changes in enrollment, health service utilization and average health expenditures following increased cost sharing and expansion in eligibility, and persistence of high costs for enrollees with specific chronic conditions.[10,12-16]

Methods

We use pooled claims data from 1999 to 2011 from ALL Kids–Alabama's CHIP program. Alabama is one of 12 states with separate CHIP and Medicaid programs. At the start of our study period, ALL Kids coverage was available to Alabama residents under age 19 with family incomes between 100% and 200% of the federal poverty level (FPL). Enrollees face annual premiums and copayments that vary across 3 groups defined by family income and Native American status. Children in families with incomes 100% to 150% of the FPL (termed the *low-fee group*) face lower levels of cost sharing, whereas children in families with incomes 150% to 200% of the FPL (termed the *fee group*) face higher levels of cost sharing. The third group, comprising primarily Native American children ("no fee group"), is federally exempt from all cost sharing. There are no upfront annual deductibles in the ALL Kids program, and out-of-pocket costs per year may not exceed 5% of the family income.[17]

The ALL Kids program underwent 2 major changes over our study period. In October 2003, ALL Kids raised premiums and copayments for most non-preventive services. Thereafter, beginning in October 2009, the eligibility level was expanded to 300% of the FPL. These changes allow us to explore whether the distribution of costs changes following increased cost sharing and expanding eligibility to children from less disadvantaged families.

We investigated the share of expenditures incurred by the lower 90% of enrollees versus the 90th percentile and above (ie, top 10%) and 99th percentile and above (top 1%). This is done separately for 1999 to 2003 (ie, before the increase in cost sharing), 2004-2009 (ie, after the increased cost sharing but before expanded eligibility), and 2010-2011 (ie, after the eligibility expansion). Individual enrollees are classified based on their total claims-based expenditures, including those enrolled who had no claims. Observations for the top 1% are also included in overall observations for the top 10%. In addition to the share of expenditure of each type, we also present the average per member per month (PMPM) costs incurred overall, and for service category, adjusted to 2011 dollars.

We also compare socio-demographic characteristics of enrollees in the lower 90% versus the high-cost utilizers in the top 1% and 10% of the expenditure distribution. Children are considered high-cost utilizers during the fiscal year if they were among the top 1% or 10%, though the same child can be a high-cost utilizer in multiple fiscal years.

To characterize trends in the distribution of expenditures over time, we construct Gini coefficients for each fiscal year. The Gini coefficient is a measure of statistical dispersion conventionally used to measure inequality, and is independent of unit of measure or absolute size of group.[18-22] Appendix A gives details about how they are constructed.

Furthermore, we estimate multivariable logistic regressions to identify the characteristics associated with being a high-cost utilizer belonging in the top decile of the expenditure distribution, and in the top percentile of the expenditure distribution. For each outcome category (ie, 10%, 1%), we estimate logistic models with 2 alternative sets of covariates:

(1) patient socio-demographic characteristics, and (2) patient socio-demographic characteristics plus previous enrollment plus previous years of being a high-cost utilizer. Thereafter, we leverage the longitudinal nature of our data to investigate what characteristics are associated with being a "persistent high utilizer," namely, for 3 consecutive fiscal years or more. We present these latter results for the top 1% only. All results are presented in the form of "marginal effects"—that is, the percentage point change in the likelihood of being in the top 10% (1%) associated with a specific characteristic.

Finally, we briefly summarize the specific conditions that account for the most spending among the top 1%, and whether any of these appear to be potentially preventable (Appendix B). This can help provide information to program administrators about areas that can be targeted for cost savings.

This study was approved by the institutional review board for use of secondary data.

Results

As shown in Table 1, in fiscal years (FYs) 1999 to 2003, the top decile accounted for 63.6% of all health expenditures in the ALL Kids program; the top 1% accounted for nearly 20% of total expenditures. After the increase in cost sharing (FYs 2004-2009), the figures for the top 10% and top 1% were 64.2% and 21.1%, respectively. After the expansion in eligibility (FY 2010-2011), the corresponding figures were 65.5% and 24.7%. Figure 1 presents Gini coefficients calculated for each year from 1999 to 2011. The Gini coefficients range between 0.68 and 0.70, suggesting that the pattern of inequality in the distribution of health care expenditure does not change substantially over time.

For all 3 periods, inpatient and outpatient services are the 2 highest categories of expenditures among the top 10%. Inpatient services account for the highest share of expenditures for the top 1%. The share declines slightly following increased cost sharing, but increases again with expanded eligibility. In contrast, for non–high-cost utilizers (ie, those below the 90% percentile) the highest share of expenditures comes from outpatient claims, followed by dental claims and prescription drugs expenditure. Emergency department (ED) expenditures are a relatively small category for all groups, and its share is particularly small for the top 1%.

A more complete picture emerges when these numbers are taken in conjunction with the inflation-adjusted average PMPM expenditure in all categories. Overall, average PMPM expenditures increase for all groups of enrollees, but the increases are larger for the top 1%. For example, between FYs 1999 to 2003 and 2004 to 2009, average overall expenditures for the lower 90% increase by 18% ($489 to $577) whereas those for the top 1% increase by 28% ($22 619 to $28 918). Noticeably, there is no growth in PMPM for inpatient services for the lower 90%, and a 15% increase in PMPM for outpatient services. In contrast, for the top 1%,

PMPM for inpatient services increases by 18% and for outpatient services by 33%. From FYs 2004 to2009 to FY 2010 to 2011, the average overall expenditure for the lower 90% also increases by 18% ($577 to $683), but that for the top 1% increases by almost 43% ($28 918 to $41 436), leading to a further concentration in spending among the most expensive enrollees. The PMPM expenditures for all services increase over time, but the dollar increases from FYs 2004 to 2009 to FYs 2010 to 2011 are sizably larger than the changes from FYs 1999 to 2003 to FYs 2004 to 2009. For example, inpatient spending among the top 1% increases by 56.3% (from $16 748 to $26 182) across the 2 periods.

Table 2 presents descriptive statistics on socio-demographic characteristics. High-cost utilizers tend to be more concentrated among the youngest (0-1) and oldest (17-19) ALL Kids enrollees. High-cost enrollees are more likely to be Caucasian, have a chronic disease, have been previously enrolled in ALL Kids, and have previously been in the top percentile or decile of program expenditures.

Table 3 shows the adjusted marginal effects for high-cost utilizers from multivariable logistic models. Note that, when modeling the likelihood of being a persistent 1% user (3 years or more), covariates are measured at the first year of the spell. Chronic disease was a statistically significant predictor of being within the top 10% of expenditures. Although still positive and statistically significant, the magnitude of the effect for being in the top 1% was smaller, and for being a persistent top 1% was even smaller. Similarly, having previously been in the top 10% or top 1% of expenditures, as well as having previous ALL Kids enrollment were associated with being a high-cost utilizer, although again the magnitudes were higher in models examining the likelihood of being in the top 10% as opposed to top 1% or persistent top 1%. Age was also an important predictor, such that all age groups compared with the youngest children were less likely to be among the top 10% of utilizers, with the exception of older children aged 17 to 19 years. Notably, it is better to interpret effects of age from model 1—there are obvious collinearity issues in model 2 as the reference category of infants 0 to 1 years old can neither have previous ALL Kids enrollment nor have previously been in a high-expenditure category. The general pattern appears to be that all children in age groups from 2 to 12 years are less likely to be high-cost compared with infants. However, 17- to 19-year-olds appear to have a somewhat higher likelihood than infants of being in the top 10%, though they are less likely to be in the top 1%. When it comes to persistently being in the top 1%, there is no significant difference between infants and 17- to 19-year-olds (many of whom age out of ALL Kids over the 3 years), and 13- to 16-year-olds are actually more likely than infants to be in that category.

"Fee group" enrollees were less likely than "low-fee" group enrollees to belong to the top decile, and also slightly less likely to persistently be in the top percentile. No fee group enrollees were more likely to belong to both the top

Table 1. Comparison of the Health Expenditures by the Lower 90%, Top 10%, and Top 1% of ALL Kids Enrollees Over 3 Periods.

	FYs 1999-2003			FYs 2004-2009				FYs 2010-2011	
	90%	Top 10%	Top 1%	90%	Top 10%	Top 1%	90%	Top 10%	Top 1%
Total expenditures, %	36.4	63.6	19.8	35.8	64.2	21.1	34.5	65.5	24.7
Spending, %[a]									
Inpatient	0.4	30.3	62.5	0.3	29.5	57.9	0.4	32.4	63.2
ED[b]	9.7	6.9	2.8	9.2	7.3	3.3	8.1	6.7	2.6
Outpatient	47.5	37.3	20.8	46.4	34.8	21.7	46.9	32.9	20.1
Dental	23.1	8.3	1.1	23.2	6.7	0.9	25.0	5.8	0.7
Drugs	18.8	14.7	9.8	20.2	18.6	12.8	19.2	19.2	11.0
Other	0.5	2.5	3.0	0.6	3.1	3.5	0.4	3.0	2.5
$N_{\text{person-months}}$	222 590	39 281	2619	467 289	82 464	5500	178 359	31 476	2098
Expenditures, $ (% change from previous period)									
Overall PMPM expenditure	$489	$4832	$22 619	$577	$5867	$28 918	$683	$7328	$41 436
	—	—	—	(18.0)	(21.4)	(27.8)	(18.4)	(24.9)	(43.3)
Inpatient	$2	$1463	$14 127	$2	$1730	$16 748	$3	$2376	$26 182
				(0)	(18.2)	(18.5)	(50.0)	(37.3)	(56.3)
ED[b]	47	333	631	53	429	945	56	488	1057
				(12.8)	(28.8)	(49.7)	(5.6)	(13.7)	(11.8)
Outpatient	232	1800	4715	268	2042	6271	320	2410	8331
				(15.5)	(13.4)	(33.0)	(19.4)	(18.0)	(32.0)
Dental	113	403	253	134	393	252	170	427	281
				(18.6)	(−2.5)	(−0.4)	(26.8)	(8.6)	(11.5)
Drugs	92	712	2214	116	1090	3694	131	1410	4551
				(26.1)	(53.1)	(66.8)	(12.9)	(29.3)	(23.2)
Other	3	120	677	3	183	1008	3	217	1034
				(0)	(52.5)	(48.9)	(0)	(18.6)	(2.5)

Note. All expenditures are adjusted to 2011 dollars using the Consumer Price Index. CPI. ED = emergency department; PMPM = per member per month; FY = fiscal year. Percentage changes in PMPM changes represent changes from the previous period for the specific cost-category.
[a]Denotes how the expenditures for each group of enrollees (lower 90%, top 10%, and top 1%) are distributed across the categories of health services.
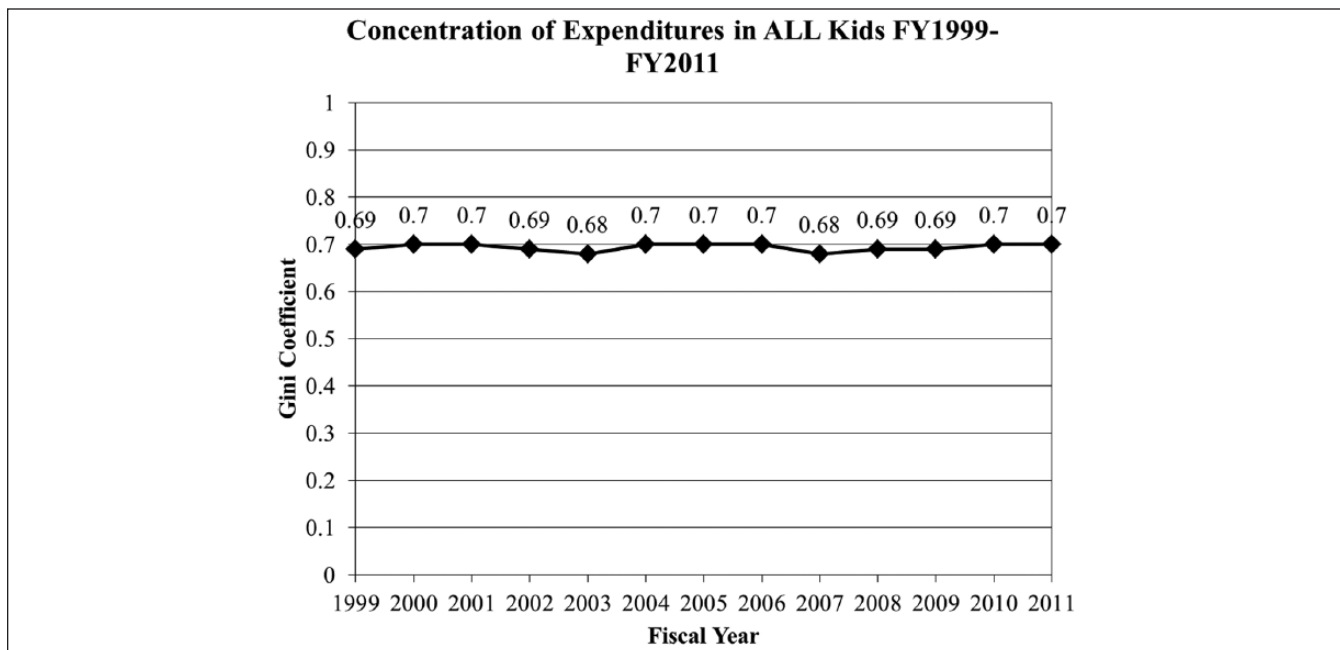[b]ED use that did not lead to an inpatient admission.

Figure 1. The concentration of expenditures is illustrated from FY 1999 to FY 2011 by the Gini coefficient, a measure of equality.

Table 2. Characteristics of ALL Kids Enrollee Months by "Non–High-Cost" and "High-Cost" Status.

	90%	Top 10%	Top 1%
	N = 868 166	N = 153 211	N = 10 213
Age, y			
0-1	0.7	1.2	4.5
2-4	8.5	7.3	8.2
5-8	17.9	13.6	9.3
9-12	27.3	22.3	15.7
13-16	26.4	25.6	23.5
17-19	19.2	30.0	38.8
Male	50.9	49.9	46.9
Race			
Caucasian	57.1	70.5	67.5
African American	35.7	24.1	26.5
Other/ unknown	7.2	5.5	6.0
Fee code			
Low fee	61.4	61.1	59.5
Fee	35.3	35.2	36.4
No fee	0.6	0.8	0.9
Expansion	2.7	2.9	3.3
Rural/urban			
Urban	64.5	63.0	67.1
Large rural town	12.3	13.4	12.4
Small rural town	12.5	12.7	10.8
Isolated rural	9.2	9.6	8.3
Unknown	1.4	1.2	1.3
Chronic disease	17.6	44.7	63.1
Previous enrollment	57.7	75.5	73.1
Previous top 10%	16.0	42.1	50.8
Previous top 1%	0.9	5.2	1.6

Note. Pooled data for 1999 to 2011 are used. "High-cost status" is based on expenditures in that fiscal year only. Enrollees may have high-cost status in multiple fiscal years.

decile, though their results for being in the top percentile are mixed. Expansion group enrollees were more likely to be in the top decile than low-fee group enrollees in model 1—again, there are collinearity issues with this group and model 2 as they only start in ALL Kids from 2010.

We also conducted several supplementary analyses (not shown) to explore persistence. For example, among infants initially in the top decile, 74.1% remained in the program the next year, but only 29.5% remained after 3 years. Of those who remained, 45.6% were still in the top decile the next year, but only 20% of those enrolled still remained in the top decile in later years.

In Appendix B, we present a summary of the inpatient diagnoses among the top 1% by year, and broadly categorize them into conditions that appear to be potentially preventable, conditions that may be preventable but are outside the scope of ALL Kids as they relate to maternal prenatal health and health behaviors, and conditions that are not preventable. We find that the majority of inpatient cases fall in the last category.

Discussion

We analyzed the distribution of individual health expenditures in Alabama's ALL Kids between 1999 to 2011, a period during which the program underwent changes in cost sharing as well as program eligibility. We found the top 10% of enrollees accounted for 64% to 66% of program expenditures, and the top 1% for 20% to 24.7%, throughout this period. These findings are broadly consistent with previous studies examining the distribution of health expenditures among children. Consistent with previous literature, we find that non-Hispanic whites and those with chronic diseases are more likely to be high utilizers,[4,5] and that infants and older adolescents are the age groups most likely to have the highest expenditures.[4,23] We additionally find that older adolescents may be most likely to persist in the highest percentile for 3 or more years.

Our results generally support arguments of Kenney et al that policies like nominal increases in cost sharing are likely to have minimal effectiveness in terms of cost containment.[5] Our previous work has suggested cost sharing discouraged re-enrollment[10] and modestly reduced or slowed growth in the utilization of some health services,[12,16] but results here suggest that they did little to slow utilization among high utilizers. Our results also support earlier work indicating that average expenditures increased following the expansion in eligibility,[13] but we additionally found that increases among the top 1% were disproportionately higher in the post-expansion period, leading to further cost concentration.

Although we agree that cost-containment approaches should focus on "strategies that target Medicaid/CHIP spending among children in the upper spending decile,"[5] these strategies must be carefully selected. For example, targeting popular "wasteful" services like non-emergent ED use may not play a major role in reducing costs, as ED use that did not result in an inpatient admission accounts for only a small share of spending by high-cost utilizers. Better management of chronic diseases may be useful in limiting costs among the top decile, but is unlikely to help with reducing costs among the top percentile, given its small association with being in, or persisting in, the top 1%.

Finally, we identify the most common reasons for inpatient stays among the top 1%, and broadly categorize them as potentially preventable versus not as a way of providing some guidance to policy makers as to where attempts at cost containment could start. This is presented in Table 4. The large majority of inpatient stays appear to be due to "non-preventable" acute health events. A small fraction of

Table 3. Multivariable Logistic Regression for Characteristics Associated With Being a High-Cost Utilizer.

	Top 10%		Top 1%		Top 1% persistent	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Age, years						
0-1	Reference		Reference		Reference	
2-4	−7.9	−13.6	−3.1	−4.0	−0.5	−1
	[−8.8, −7.0]	[−14.7, −12.5]	[−3.5, −2.7]	[−4.4, −3.5]	[−0.7, −0.3]	[−1.4, −0.8]
5-8	−9.1	−16.0	−3.4	−4.3	−0.01	−0.8
	[−10.0, −8.2]	[−17.1, −14.9]	[−3.8, −3.1]	[−4.7, −3.8]	[−0.03, −0.004]	[−1.0, −0.5]
9-12	−8.3	−16.3	−3.4	−4.2	0.01	−0.7
	[−9.2, −7.4]	[−17.4, −15.1]	[−3.8, −3.0]	[−4.7, −3.8]	[−0.005, 0.03]	[−1, −0.4]
13-16	−6.4	−15.0	−3.1	−4.1	0.4	−0.7
	[−7.3, −5.4]	[−16.1, −13.9]	[−3.6, −2.8]	[−4.5, −3.6]	[0.2, 0.6]	[−0.9, −0.4]
17-19	1.1	−9.6	−2.5	−3.6	−0.07	−1.3
	[0.1, 2.0]	[−10.7, −8.4]	[−2.8, −2.1]	[−4.0, −3.1]	[−0.2, 0.1]	[−1.6, −1]
Male	−0.9	−0.9	−0.1	−0.1	−0.06	−0.01
	[−1.1, −0.7]	[−1.1, −0.8]	[−0.1, −0.1]	[−0.1, −0.1]	[−0.1, −0.01]	[−0.01, −0.07]
Race						
Caucasian	Reference		Reference		Reference	
African American	−7.0	−5.9	−0.2	−0.2	−1	−0.6
	[−7.2, −6.8]	[−6.0, −5.7]	[−0.2, −0.2]	[−0.2, −0.1]	[−1, −0.9]	[−0.6, −0.6]
Other/unknown	−5.3	−4.4	−0.1	−0.1	−0.8	−0.5
	[−5.6, −5.0]	[−4.7, −4.1]	[−0.2, −0.1]	[−0.2, −0.1]	[−0.9, −0.7]	[−0.6, −0.4]
Fee code						
Low fee	Reference		Reference		Reference	
Fee	−0.3	−0.8	0.1	−0.1	−0.07	−0.15
	[−0.5, −0.2]	[−1.0, −0.7]	[−0.1, 0.1]	[−0.1, 0.1]	[−0.1, −0.03]	[−0.18, −0.12]
No fee	6.3	3.5	0.2	0.1	1.1	0.2
	[4.8, 7.7]	[2.3, 4.6]	[−0.1, 0.5]	[−0.1, 0.3]	[0.5, 1.5]	[−0.01, 0.5]
Expansion	0.7	−0.2	0.1	0.1	—	—
	[0.2, 1.1]	[−0.6, 0.2]	[−0.1, 0.2]	[−0.1, 0.1]	—	—
Rural/urban						
Urban	Reference		Reference		Reference	
Large rural town	0.2	0.3	−0.1	−0.1	0.002	0.002
	[−0.1, 0.5]	[0.7, 0.5]	[−0.1, −0.1]	[−0.1, −0.1]	[−0.07, 0.08]	[−0.03, 0.06]
Small rural town	−0.4	−0.4	−0.1	−0.1	−0.1	−0.06
	[−0.7, −0.2]	[−0.6, −0.1]	[−0.2, −0.1]	[−0.1, −0.1]	[−0.1, −0.02]	[−0.01, −0.003]
Isolated rural	0.1	0.1	−0.1	−0.1	−0.005	−0.03
	[−0.3, 0.3]	[−0.2, 0.3]	[−0.2, −0.1]	[−0.1, −0.1]	[−0.01, 0.003]	[−0.09, 0.01]
Unknown	−0.7	−0.5	0.1	0.1	−0.02	−0.01
	[−1.5, −0.1]	[−1.1, 0.1]	[−0.1, 0.2]	[−0.1, 0.1]	[−0.3, 0.02]	[−0.06, 0.04]
Chronic disease	15.2	11.9	1.1	0.9	0.2	1.5
	[15.0, 15.4]	[11.7, 12.1]	[1.1, 1.1]	[0.9, 0.9]	[0.2, 0.2]	[1.4, 1.5]
Previous enrollment	—	3.7	—	0.1		0.2
		[3.4, 3.8]		[0.1, 0.1]		[0.1, 0.2]
Previous top 10%	—	8.9	—	—		
		[8.7, 9.1]				
Previous top 1%	—	—	—	1.2		
				[1.1, 1.2]		
Previous top % count						0.5
						[0.5, 0.53]

Note. The 95% confidence intervals are given in brackets. Pooled data for 1999 to 2011 are used, N = 1 021 377 enrollee-months. Top 10% of 1% is based on expenditures in that fiscal year only. Enrollees may have high-cost status in multiple fiscal years. Persistent 1% is based on being in the category for at least 3 subsequent years. Standard errors are clustered to account for repeat observations for the same child.

Table 4. Most Common Reasons for Inpatient Stays Among Top Percentile.

Fiscal year	Most common inpatient primary diagnoses (upcoded via Clinical Classifications Software) in each year among top 1%				
1999	Intracranial injury (7.2%)	Pneumonia (7.1%)	Mood disorders (3.3%)	Appendicitis (3.2%)	Epilepsy/convulsions (2.8%)
2000	Pneumonia (4.1%)	Cystic fibrosis (3.8%)	Urinary tract infection (2.5%)	Congestive heart failure (2.4%)	Other injury (2.4%)
2001	Mood disorders (4.5%)	Pneumonia (4.1%)	Other lower respiratory (3.3%)	Low birth weight (3.1%)	Epilepsy/convulsions (3.0%)
2002	Pneumonia (5.0%)	Mood disorders (4.0%)	Low birth weight (3.9%)	Leukemias (3.9%)	Pleurisy (3.5%)
2003	Low birth weight (7.8%)	Mood disorders (6.4%)	Pneumonia (4.3%)	Diabetes mellitus With coma (3.7%)	Schizophrenia (3.1%)
2004	Mood disorders (12.7%)	Attention-deficit (5.2%)	Diabetes mellitus with coma (4.6%)	Pneumonia (2.6%)	Epilepsy/convulsions (2.5%)
2005	Mood disorders (6.0%)	Low birth weight (3.8%)	Pneumonia (3.7%)	Asthma (2.6%)	Schizophrenia (2.4%)
2006	Low birth weight (6.8%)	Asthma (3.5%)	Pneumonia (3.4%)	Leukemias (3.0%)	Intracranial injury (2.6%)
2007	Low birth weight (6.3%)	Asthma (5.4%)	Epilepsy/convulsions (3.8%)	Skin infection (3.6%)	Pneumonia (3.5%)
2008	Low birth weight (9.5%)	Mood disorders (5.9%)	Leukemias (4.0%)	Skin infection (3.4%)	Other perinatal dx (3.3%)
2009	Mood disorders (9.4%)	Low birth weight (8.4%)	Asthma (3.3%)	Pneumonia (3.2%)	Pleurisy (3.1%)
2010	Mood disorders (13.2%)	Low birth weight (11.2%)	Other perinatal dx (6.5%)	Leukemias (4.0%)	Attention-deficit (2.6%)
2011	Low birth weight (12.5%)	Mood disorders (11.6%)	Other perinatal dx (6.9%)	Impulse control disorder (2.8%)	Attention-deficit (2.6%)

Note. Data are based on a single primary diagnosis per child per day or per stay.

potentially preventable cases are outside the scope of ALL Kids to address—for example, as the program does not cover non-minor pregnant women, the program cannot seek to improve prenatal care in an effort to reduce the risk of low birth weight. However, approximately 14% to 15% of inpatient stays that stem from causes like asthma, chronic disease complications, nutrition deficiency, or mood/anxiety disorders might be prevented with better access to preventive services, outpatient services, or better case management.

The study has several limitations. Because it is based on a free-standing CHIP program, distinct from the state's Medicaid program, results may not be generalized to all publicly insured children. It focuses on claims-based expenditures from the program's point of view, and does not inform on out-of-pocket expenditures for children. We have little information on "high-expenditure" status of enrollees who leave ALL Kids for Medicaid or private insurance. We also have no information on prenatal health behaviors of mothers whose infants fall in the high-expenditure category. We present a broad generalization of the categories of inpatient use that may be considered "preventable," but cannot do an in-depth clinical review of individual records to further verify this. Finally, we cannot comment on the extent to which high-cost utilizers experience improvements in health and quality of life as a result of consuming higher levels of health services.

Overall, this study suggests that to effectively control public insurance program costs, more in-depth attention should be given to health services utilized by high-cost enrollees. Using information on socio-demographic characteristics, health service access and patterns of utilization, targeted interventions should be developed to reduce the use of avoidable care by the highest cost utilizers.

Appendix A

The Gini coefficient (G) is a unit-independent measure of statistical dispersion. It is frequently used in the analysis of inequality of income or expenditures. Mathematically, G is the ratio of the area between the expenditure distribution curve (Lorenz curve) and the line of equal distribution (45° straight line)—denoted as "A" in diagram below—to the area under the equal distribution curve—denoted as (A + B). Each (*x, y*) point on the curve means that the bottom *x*% of enrollees account for *y*% of the wealth. The 45° straight line represents all points where *x* = *y* (such that lowest 10% of enrollees account for 10% of expenditure, lowest 20% account for 20% of expenditure, and so forth). G can hypothetically range from 0 to 1; 0 represents the "most equal" situation—each person accounts for an equal share of expenditure and the Lorenz curve is identical to the 45° line, and 1 represents the most unequal distribution, where just one person accounts for all expenditure.
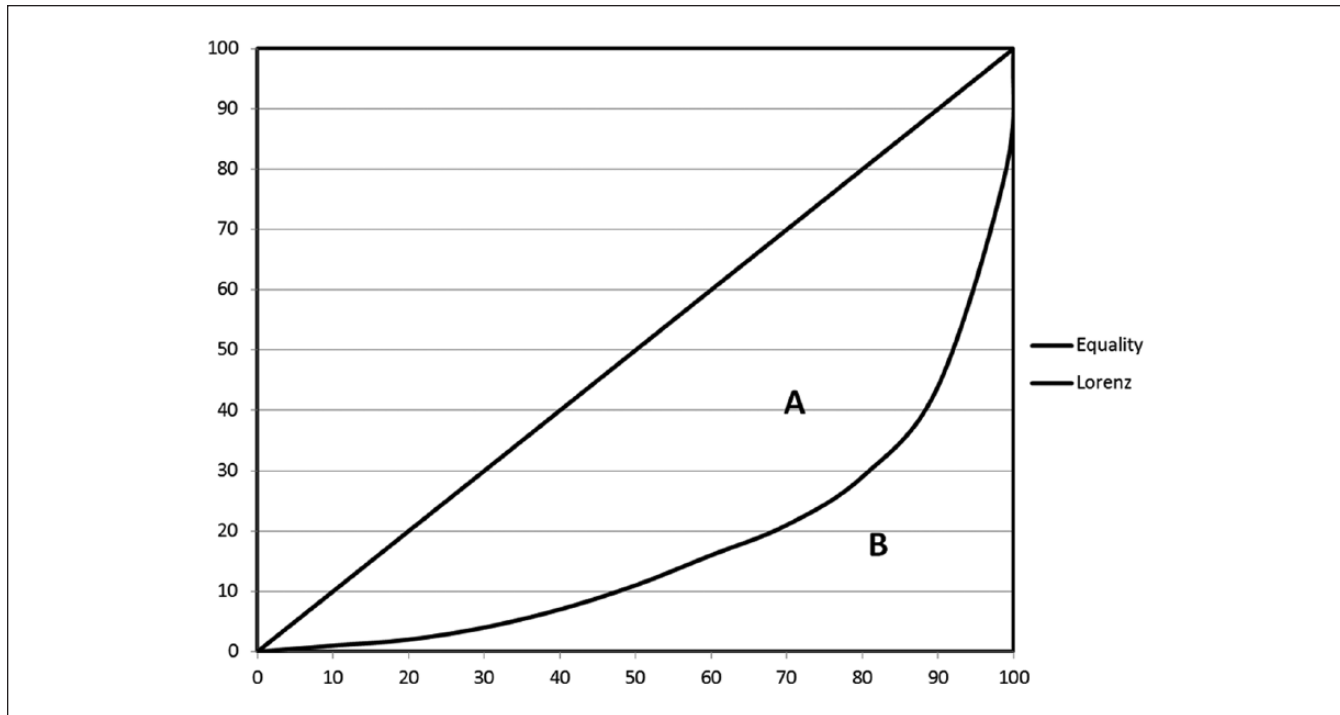
Figure A1. Gini coefficients for health expenditure distribution.

Appendix B

Percentage of Diagnosis for Inpatient Stays Among Highest 1% of Enrollees Due to "Preventable" and "Not Preventable Conditions," 1999-2011.

	% Preventable by ALL kids[a]	% Preventable, outside scope of ALL kids[b]	% Not preventable[c]
1999 n = 118	16	2	82
2000 n = 152	14	1	85
2001 n = 163	15	1	83
2002 n = 168	14	1	85
2003 n = 180	14	1	84
2004 n = 189	14	1	85
2005 n = 184	14	1	85
2006 n = 176	9	1	90
2007 n = 171	10	1	89
2008 n = 186	13	1	86
2009 n = 185	13	1	86

Appendix B (continued)

	% Preventable by ALL kids[a]	% Preventable, outside scope of ALL kids[b]	% Not preventable[c]
2010 n = 197	13	1	86
2011 n = 194	15	1	84

Note. This categorization is based on over 200 types of claims that were the primary reason of inpatient stays among the top 1%. The rows may not add up to 100% due to rounding.
[a]Includes conditions such as mood disorders, anxiety disorders, attention-deficit, chronic disease complications, nutrition deficit, anemia, asthma, influenza, upper respiratory infection, otitis media, tonsillitis.
[b]Includes hypertension during pregnancy, low birth weight.
[c]Includes conditions such as malignancy, organ anomaly/disorder, organ failure, acute medical conditions (acute cardiovascular disease, appendicitis, injury, fractures, etc), infection.

Authors' Note

The study team had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. The design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, and approval of the manuscript were the sole responsibility of the authors listed and were not influenced by the research's sponsor.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

1. Stanton MW, Rutherford M. *The High Concentration of US Health Care Expenditures*. Washington, DC: Agency for Healthcare Research and Quality; 2006.
2. Berk ML, Monheit AC. The concentration of health care expenditures, revisited. *Health Aff*. 2001;20(2):9-18.
3. McCormick MC, Weinick RM, Elixhauser A, Stagnitti MN, Thompson J, Simpson L. Annual report on access to and utilization of health care for children and youth in the United States—2000. *Ambul Pediatr*. 2001;1(1):3-15.
4. Liptak GS, Shone LP, Auinger P, Dick AW, Ryan SA, Szilagyi PG. Short-term persistence of high health care costs in a nationally representative sample of children. *Pediatrics*. 2006;118(4):e1001-1009.
5. Kenney GM, Ruhter J, Selden TM. Containing costs and improving care for children in Medicaid and CHIP. *Health Aff (Millwood)*. 2009;28(6):w1025-w1036.
6. Ireys HT, Anderson GF, Shaffer TJ, Neff JM. Expenditures for care of children with chronic illnesses enrolled in the Washington State Medicaid program, fiscal year 1993. *Pediatrics*. 1997;100(2, pt 1):197-204.
7. Kuhlthau K, Perrin JM, Ettner SL, McLaughlin TJ, Gortmaker SL. High-expenditure children with supplemental security income. *Pediatrics*. 1998;102(3, pt 1):610-615.
8. Kenney G, Hadley J, Blavin F. Effects of public premiums on children's health insurance coverage: evidence from 1999 to 2003. *Inquiry*. 2006;43(4):345-361.
9. Herndon JB, Vogel WB, Bucciarelli RL, Shenkman EA. The effect of premium changes on SCHIP enrollment duration. *Health Serv Res*. 2008;43(2):458-477.
10. Morrisey M, Blackburn J, Sen B, et al. The effects of premium changes on ALL kids, Alabama's CHIP program. *Medicare Medicaid Res Rev*. 2012;2(3):E1-E17.
11. Leibowitz A, Manning WG, Keeler EB, Duan N, Lohr KN, Newhouse JP. Effect of cost-sharing on the use of medical services by children: interim results from a randomized controlled trial. *Pediatrics*. 1985;75(5):942-951.
12. Becker DJ, Blackburn J, Morrisey MA, et al. Co-payments and the use of emergency department services in the children's health insurance program. *Med Care Res Rev*. 2013;70(5):514-530.
13. Becker DJ, Blackburn J, Morrisey MA, et al. Enrollment, expenditures, and utilization after CHIP expansion: evidence from Alabama. *Acad Pediatr*. 2015;15(3):258-266.
14. Menachemi N, Blackburn J, Sen B, et al. The impact of CHIP coverage on children with asthma in Alabama. *Clin Pediatr (Phila)*. 2012;51(3):247-253.
15. Sen B, Blackburn J, Morrisey M, et al. Can increases in CHIP copayments reduce program expenditures on prescription drugs? *Medicare Medicaid Res Rev*. 2014;4(2):E1-E18.
16. Sen B, Blackburn J, Morrisey MA, et al. Did copayment changes reduce health service utilization among CHIP enrollees? evidence from Alabama. *Health Serv Res*. 2012;47(4):1603-1620.
17. All Kids Children's Health Insurance Program. http://www.adph.org/allkids/assets/spd.pdf. Published October 1, 2012. Accessed April 1, 2016.
18. Moore S, Daniel M, Kestens Y. Is educational inequality protective? *Am J Public Health*. 2007;97(1):8-9; author reply 9.
19. Garner TI. Consumer expenditures and inequality: an analysis based on decomposition of the Gini coefficient. *Rev Econ Stat*. 1993;75:134-138.
20. Measuring Inequality. Poverty Analysis: Measuring Inequality. http://go.worldbank.org/3SLYUTVY00. Published 2013. Accessed April 1, 2016.
21. CIA. *The World Factbook*. https://www.cia.gov/library/publications/the-world-factbook/fields/2172.html. Published 2013. Accessed April 1, 2016.
22. Meschi E, Scervini F. A new dataset on educational inequality. *Empir Econ*. 2014;47(2):695-716.
23. Children's Health Care Spending Report: 2007-2010. Washington, DC: Health Care Cost Institute; 2012.