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Preventable Acute Care Spending for High-Cost Patients Across Payer Types

Peter F. Graven
Assistant Professor, Ph.D, Oregon Health & Science University

Thomas H. A. Meath
Research Associate, MS, Oregon Health & Science University

Aaron Mendelson
Research Assistant, BS, Oregon Health & Science University

Benjamin K.S. Chan
Research Associate, MS, Oregon Health & Science University

David A. Dorr
Associate Professor, MD, MS, Oregon Health & Science University

K. John McConnell
Associate Professor, PhD, Oregon Health & Science University

Abstract

Background: Healthcare expenditures are shown to concentrate in a small percentage of individuals. Many of these expenditures are thought to be preventable. Programs have developed to target high-cost individuals with the goal of reducing cost. Two of the underlying assumptions of these programs, degree of persistence and share of preventability costs, have lacked rigorous empirical research to inform payers about the general prospects. The purpose of the study is to quantify preventable expenditures among high-cost individuals across three plan types (Medicaid, Medicare Advantage, and commercial insurance plans) in Oregon.

Methods: A retrospective longitudinal analysis of claims data was conducted. Shares of acute care expenditures considered preventable were calculated for non-high cost, episodically high cost, and persistently high cost patients. The results are shown for 74,717 Medicaid, 768,865 commercially insured, and 158,503 Medicare Advantage adults from Oregon using data from 2011 to 2013 data from the State of Oregon's All Payer All Claims (APAC) database and Medicaid data from the Oregon Health Authority.

Results: In 2012, high cost patients account for 61.8% of Medicaid, 69.1% of commercial, and 60.0% of Medicare Advantage inpatient expenditures. Preventable inpatient expenditures accounted for 11.8%, 4.6%, and 10.0% of inpatient spending for persistently high cost patients in Medicaid, commercial and Medicare Advantage programs. Rates of preventable ED spending for persistently high cost patients in the Medicaid, commercial, and Medicare Advantage programs were 44.7%, 38%, and 34.1% respectively. Mean reversion led to declines of 11%, 25.6%, and 30.6% in the third year of spending among persistently high cost patients in the Medicaid, commercial, and Medicare Advantage programs.

Conclusions: Potentially preventable health care spending for high cost patients accounted for less than 6% of total spending. More evidence is needed to support programs that target super-utilizers, as opposed to disease-conditions, as a way of reducing total health care spending.

Keywords: Preventable spending, persistent spending, hot-spotting, multi-payer, Medicaid

BACKGROUND

Many recent efforts to improve the value and efficiency of care have targeted the small group of high cost patients who make up a disproportionate share of the total spending [1]. For example, the Center for Medicare and Medicaid Innovations (CMMI) has funded demonstration projects designed to reduce avoidable hospitalizations for high cost patients [2], while the apparent success of a prominently featured "hotspotting" program in Camden, New Jersey, has inspired similar efforts throughout the country [3].

The rationale for "hotspotting" programs is based on two crucial, but often unexamined, assumptions. The first is that a significant portion of expenditures in high cost patients can be avoided through tailored case management, substituting lower cost outpatient care for high cost inpatient or emergency care. The second is that expenditures for high cost patients will increase or remain high absent an intervention.

Despite significant interest in these programs and some simulation models to support their premise [4], empirical evidence on their efficacy is lacking. For example, a recent study found that intensive case management did not reduce spending for high-cost disabled Medicaid enrollees [5]. Similarly, a study by Joynt and colleagues, which provides the framework for this study, found that only 9.6% of inpatient spending was preventable among the top 10% most expensive Medicare patients [6].

Nonetheless, enthusiasm for these programs may stem, in part, from self-reported successes. Media coverage of hotspotting programs often report cost savings of 50% or reductions in hospitalizations or emergency department utilization of a similar magnitude [7]. However, these reports lack rigorous evaluation. A particular concern is the potential that these large reductions

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[1] S.B. Cohen and W. Yu, "The Concentration and Persistence in the Level of Health Expenditures over Time: Estimates for the US Population, 2008-2009.," Statistics Brief 354, (2011); Teresa A. Coughlin and Sharon K. Long, "Health Care Spending and Service Use among High-Cost Medicaid Beneficiaries, 2002-2004," *Inquiry: A Journal of Medical Care Organization, Provision and Financing* 46, no. 4 (2010 Winter 2009): 405–17; Anna S. Sommers, "Medicaid's High Cost Enrollees: How Much Do They Drive Program Spending?" (Kaiser Family Foundation, 2006), http://kff.org/medicaid/issue-brief/medicaids-high-cost-enrollees-how-much-do/.

[2] Cindy Mann, "Targeting Medicaid Super-Utilizers to Decrease Costs and Improve Quality of Care.," 2013, www.medicaid.gov/federal-policy-guidance/downloads/CIB-07-24-2013.pdf.

[3] The Robert Wood Johnson Foundation, "Better Care for Super-Utilizers," accessed March 14, 2015, http://www.rwjf.org/en/about-rwjf/newsroom/series/super-utilizers.html.

[4] John Billings and Tod Mijanovich, "Improving The Management Of Care For High-Cost Medicaid Patients," *Health Affairs* 26, no. 6 (November 1, 2007): 1643–54, doi:10.1377/hlthaff.26.6.1643.

[5] Janice F. Bell et al., "A Randomized Controlled Trial of Intensive Care Management for Disabled Medicaid Beneficiaries with High Health Care Costs," *Health Services Research*, November 1, 2014, n/a – n/a, doi:10.1111/1475-6773.12258.

[6] Joynt KE et al., "Contribution of Preventable Acute Care Spending to Total Spending for High-Cost Medicare Patients," *JAMA* 309, no. 24 (June 26, 2013): 2572–78.

[7] "A Revolutionary Approach to Improving Health Care Delivery," *RWJF*, accessed April 6, 2015, http://www.rwjf.org/en/library/articles-and-news/2014/02/improving-management-of-health-care-superutilizers.html; "Treating Super Utilizers in Rural Pennsylvania," *RWJF*, accessed April 8, 2015, http://www.rwjf.org/en/library/articles-and-news/2013/09/treating-superusers-in-rural-pennsylvania.html; "States Focus on 'Super-Utilizers' to Reduce Medicaid Costs" (The Pew Charitable Trust), accessed March 8, 2015, http://bit.ly/1tMg190.

in spending could be primarily attributable to mean reversion (regression to the mean). Recent studies have suggested less than half of those with high costs persist into future years [8]. Without a control group or proper adjustment for mean reversion, the effectiveness of hotspotting-type programs may be overstated, potentially drawing investment and resources with promised savings that never accrue.

In this study, we extend research by Joynt and colleagues on preventable spending in the Medicare fee-for-service population by providing analyses of the Medicaid, commercial, and Medicare Advantage populations [9]. Accordingly, we sought to quantify the contribution of preventable acute care spending to total health care spending for high cost patients using data from the State of Oregon's All Payer All Claims database, which allows for an almost comprehensive view of health care across a single region for multiple payers. The 3 objectives of this study were to: (1) determine the proportion of spending attributable to the 10% highest cost adults in three insurance programs (Medicaid, commercial, and Medicare Advantage); (2) determine the proportion of spending that is likely preventable using standard criteria; and (3) assess the extent to which health care spending for high cost individuals may subsequently decline in the absence of an intervention.

METHODS

Data

We focused on expenditures for acute care medical spending for adults ages 19 and over, enrolled in the Oregon Medicaid, commercial, or Medicare Advantage programs, in the years 2011-2013. We excluded individuals with any pregnancy- or birth-related claims from our study population. We used two sources of claims data for this analysis: data on commercially insured and Medicare Advantage enrollees are from the State of Oregon's All Payer All Claims (APAC) database; Medicaid data are from the Oregon Health Authority.

The Oregon APAC database includes medical and pharmacy claims as collected from health insurance payers for residents of the State of Oregon. This information encompasses individual plans, fully-insured group plans, and self-insured group plan claims [10]. The primary exceptions are individuals in "self-insured" plans whose insurance carrier has fewer than 5000 covered lives. Estimates from the Oregon's Department of Consumer and Business Services suggest that APAC data include approximately 87% of the commercially insured population in the state. Oregon's APAC database also includes data from the Medicare Advantage program (the Medicare program administered by private insurers). Approximately 43% of Oregon's Medicare beneficiaries are enrolled in Medicare Advantage, compared to 30% nationally [11]. The APAC

[8] Richard A. Hirth et al., "New Evidence on the Persistence of Health Spending," *Medical Care Research and Review* 72, no. 3 (June 1, 2015): 277–97, doi:10.1177/1077558715572387; Tracy L. Johnson et al., "For Many Patients Who Use Large Amounts Of Health Care Services, The Need Is Intense Yet Temporary," *Health Affairs* 34, no. 8 (August 1, 2015): 1312–19, doi:10.1377/hlthaff.2014.1186.

[9] Joynt KE et al., "Contribution of Preventable Acute Care Spending to Total Spending for High-Cost Medicare Patients."

[10] Oregon Health Authority, "All Payer All Claims Reporting Program," accessed February 3, 2015, http://www.oregon.gov/oha/ohpr/rsch/pages/apac.aspx.

[11] Kaiser Family Foundation, "Medicare Advantage Enrollees as a Percent of Total Medicare Population.," accessed March 17, 2015, http://kff.org/medicare/state-indicator/enrollees-as-a-of-total-medicare-population/.

database provides measures of the amount paid by the patient (out-of-pocket) and by the health plan.

Oregon's Medicaid program includes fee-for-service (FFS) claims as well as managed care (MCO) encounter claims data. For most services, FFS and MCO data contain identical data elements. The principal difference between MCO encounter and FFS data is that when providers are paid on a contracted or capitated basis in lieu of FFS payments, the "allowed" charge or payment field can is missing or equal to zero in the MCO data. Rather than place a "zero" value for these claims, we repriced claims for each service according to the median FFS reimbursement rate. In this process, a standardized price was defined for each Diagnosis Related Group (DRG) and Current Procedural Terminology code (CPT). Repriced spending reflects differences in utilization only (and not reimbursement or capitation rates). This approach allowed for the inclusion of MCO claims in our analysis and created a standardized set of values for each claim that is invariant to location and time.

Spending on prescription drugs was not included in our analysis. We excluded individuals who were "dually eligible" for both Medicaid and Medicare, as well as individuals who had "coordination of benefit" claims in the commercial or Medicare Advantage files. We also excluded individuals who had negative total spending for any quarter during the study period. Finally, we restricted the population to individuals with continuous enrollment from 2011 through the end of 2012 to allow for two years for assessing their cost profile. Claims data from 2013 were used to evaluate the effect of mean reversion among the subset of individuals with enrollment through 2013.

Measures

Identifying High Cost Patients

Costs were summed over the year and across settings for each patient. Following Joynt and colleagues, we defined patients in the top decile of total cost in 2012 as "high-cost" [12]. "Persistently high-cost" patients were defined as those in the top decile of spending in both 2011 and 2012. Individuals that were high cost in only 2012 were labelled "episodically high-cost." Individuals who were not in the top 10 percent in 2012 were labelled "Non-high cost."

Preventable Emergency Department Visits and Hospitalizations

We defined preventable emergency department (ED) visits using an algorithm developed by Billings and colleagues [13]. This algorithm, which has been validated and used in previous studies, prospectively estimates the probability that an ED visit is classified, based on the primary ICD-9 diagnosis code of the encounter, into four groups: non-emergent; emergent/primary care treatable; emergent/ED care needed; emergent, ED care needed/not preventable [14]. The first three categories were defined as preventable ED admissions for this

[12] Joynt KE et al., "Contribution of Preventable Acute Care Spending to Total Spending for High-Cost Medicare Patients."

[13] J. BIllings, N. Parikh, and T. Mijanovich, "Emergency Department Use in New York City: A Survey of Bronx Patients. Issue Brief." (Commonwealth Fund, 2000); Dustin W. Ballard et al., "Validation of an Algorithm for Categorizing the Severity of Hospital Emergency Department Visits:," *Medical Care* 48, no. 1 (January 2010): 58–63.

[14] Ballard et al., "Validation of an Algorithm for Categorizing the Severity of Hospital Emergency Department Visits"; P. B. Smulowitz et al., "Emergency Department Utilization After the Implementation of Massachusetts Health Reform," *Ann Emerg Med*, May 11, 2011, doi:10.1016/j.annemergmed.2011.02.020; Caroline S. Carlin, Bryan Dowd, and Roger

study. (Visits for alcohol and drug use, mental health, injuries, and some rarer conditions are excluded by this algorithm.) Spending for each claim was split into preventability categories based on the estimated probability of that claim falling into each category.

To identify preventable hospitalizations, we used the Agency for Healthcare Research and Quality's Prevention Quality Indicators (PQIs) [15]. These definitions use hospital discharge data for conditions that could likely have been prevented through good outpatient care. Preventable hospitalizations were broken down into acute and chronic diagnoses. Acute diagnoses include dehydration, bacterial pneumonia, urinary tract infection. Chronic diagnoses include diabetes short-term complications, diabetes long-term complications, chronic obstructive pulmonary disease (COPD), hypertension, heart failure, angina without procedure, uncontrolled diabetes, asthma in younger adults, and lower extremity amputation with diabetes. We list International Classification of Diseases, Ninth Revision (ICD-9) codes used for PQIs and avoidable ED visits in Appendix A.

Patient Comorbidities
Comorbidities were assigned according to the Centers for Medicare & Medicaid Services Hierarchical Condition Categories (HCCs). ICD-9 codes used to identify each major HCC comorbidity are provided in Appendix A.

Statistical Analysis

We conducted two analyses to yield: an estimate of preventable spending for each insurance group, and a measure of the mean reversion characteristics of each of the cost profiles for high cost patients in each insurance group.

Our analysis of potentially preventable expenditures included patients in Oregon in three payer categories, Medicaid, commercial and Medicare Advantage, continuously enrolled for two years between 2011-2012. Patients were further classified into three cost profile categories: non-high cost, episodically high cost, or persistently high cost based on utilization in 2011 and 2012. The payer categories and the cost profiles created nine mutually exclusive study populations. We used descriptive statistics of the patient characteristics (age, sex, and a set of medical conditions) to describe the differences in study populations across these nine populations.

We compared potentially preventable spending in the ED and inpatient settings for 2012. Preventable ED spending was categorized through the Billings algorithm and additional categories of visits were included: injury, mental health related, alcohol related, drug related and unclassified [16]. Spending for each claim was allocated to each category proportionate to the probability that the encounter would be classified into that category. Preventable inpatient spending was defined using the AHRQ PQI measures.

We quantified mean reversion as the percentage decrease in spending from 2012 to 2013, for the subset of patients who were continuously enrolled for all of 2011 to 2013, stratified into each of

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Feldman, "Changes in Quality of Health Care Delivery after Vertical Integration," *Health Services Research*, 2014, n/a – n/a, doi:10.1111/1475-6773.12274.

[15] "Prevention Quality Indicators Overview." (Agency for Healthcare Research and Quality.), accessed February 21, 2015, http://www .qualityindicators.ahrq.gov/modules/pqi_overview .aspx.

[16] BIllings, Parikh, and Mijanovich, "Emergency Department Use in New York City: A Survey of Bronx Patients. Issue Brief."

the nine patient categories defined by the payer type and cost profile type. Standard errors for all statistics are found in the appendix. Tests of statistical significance are indicated in the text by their p-value. The study was approved by the Institutional Review Board at Oregon Health & Science University.

RESULTS

Our analyses included 74,717 Medicaid, 768,865 commercially insured, and 158,503 Medicare Advantage beneficiaries, continuously enrolled from 2011 through 2012. Table 1 displays demographic characteristics for each insurance group and our three mutually exclusive categories of patients: Non-high cost (NHC), Episodically High Cost (EHC), and Persistently High Cost (PHC). In each payer category, PHC and EHC individuals tended to be older than NHC. For commercial payers, PHC and EHC individuals were more likely to be female, with only minor differences in gender for Medicaid and Medicare Advantage. Across all study populations, PHC patients had higher rates of comorbidities compared to EHC patients, and EHC patients had higher rates of comorbidities compared to NHC patients (P<0.01)

Table 1. Patient Characteristics

	Medicaid			Commercial			Medicare Advantage		
	NHC	EHC	PHC	NHC	EHC	PHC	NHC	EHC	PHC
Age, median	41.0	49.0	50.0	47.0	55.0	58.0	74.0	76.0	76.0
Male, %	39.3	35.3	37.8	50.8	43.6	38.3	41.1	40.3	39.0
Cancer, %	3.0	12.2	14.3	2.9	12.1	22.6	12.2	27.5	34.0
Congestive heart failure, %	4.1	17.0	26.7	1.0	4.9	11.4	9.2	29.1	42.0
Diabetes, %	13.6	29.3	38.7	7.1	15.6	23.9	19.9	30.7	39.8
Ischemic heart disease, %	3.8	14.1	20.0	1.0	5.7	9.4	5.4	18.5	24.1
Kidney disease, %	2.7	14.5	23.1	2.0	8.1	16.4	10.2	27.7	41.7
Liver disease, %	4.7	13.1	19.0	0.5	1.4	2.8	0.8	1.6	2.6
Lung disease, %	9.1	27.8	39.3	1.5	5.3	10.4	10.3	22.7	35.2
Stroke, %	1.3	5.7	8.1	0.4	2.5	4.2	3.9	12.4	18.3
Mental illness, %	22.1	38.0	54.6	5.0	10.2	17.6	4.7	7.6	10.7
N	67,245	3,962	3,510	691,978	48,638	28,249	142,652	10,678	5,173

Note:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.
PHC=Persistently High-Cost: patients in the top 10% in both years

Payer groups differed in the concentration of spending in the highest spending segment. In total, 61.8% of Medicaid spending in 2012 was attributable to the 10% highest spenders (the EHC and PHC cost profiles) as compared to 69.1% for commercial and 60.0% for Medicare Advantage (P<0.01).

Payer groups also differed in the persistence of high cost spending. In the Medicaid population, 47% of high cost patients in 2012 were also high cost in 2011; in the commercially insured group, 37% of high cost patients in 2012 were also high cost in 2011; and in the Medicare Advantage population, 33% of high cost patients in 2012 were also high cost in 2011 (P<0.01). These patterns suggest that Medicaid patients have greater persistence in high cost spending than commercial patients, and commercial patients have greater persistence in high cost spending than Medicare Advantage patients.

Table 2 displays preventable and non-preventable ED costs in 2012. Averaged across all three types of cost profiles, the Medicaid program had a greater share of preventable ED spending (48%) compared to individuals with commercial insurance (38%) or Medicare Advantage (36%) (P<0.01). Perhaps surprisingly, rates of preventable ED spending in the patients in Medicaid, Commercial, and Medicare Advantage programs was highest among NHC patients (50%, 43%, and 38%, respectively) compared to EHC (42%, 31%, and 30%) or PHC (45%, 38%, and 34%) in their payer types (P<0.01).

Table 2. Share of Preventable and Nonpreventable Emergency Department Expenditures, Oregon, 2012.

	Medicaid			Commercial			Medicare Advantage		
Visit Category (%)	NHC	EHC	PHC	NHC	EHC	PHC	NHC	EHC	PHC
Potentially Preventable	50.4	42.1	44.7	42.6	31.2	38.0	37.4	29.0	33.4
Emergent, primary care treatable	23.1	20.9	22.3	22.1	17.3	18.9	18.1	13.6	16.0
ED care needed, preventable	6.7	6.1	6.9	4.3	3.0	4.4	4.7	4.3	5.1
Non-emergent	20.7	15.1	15.4	16.2	10.9	14.6	14.6	11.0	12.4
Non-Preventable	12.9	14.7	14.7	19.9	21.7	19.2	17.9	14.2	14.7
Other	36.8	43.2	40.7	37.5	47.1	42.9	44.7	56.8	51.9
Total Cost ($1,000s)	17,852	4,941	6,827	38,160	30,307	22,057	12,706	5,029	3,511
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Note:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.
PHC=Persistently High-Cost: patients in the top 10% in both years

Table 3 displays estimates of spending attributable to preventable hospitalizations. Averaged across all cost profiles, preventable hospital spending accounted for 9.1% of all Medicaid hospital spending, 8.1% of all Medicare Advantage spending, and only 3.5% of all commercial hospital spending. PHC and NHC groups had a higher proportion of preventable spending than the EHC groups (P<0.01).

Table 3. Share of Preventable Inpatient Expenditures, Oregon, 2012.

	Medicaid			Commercial			Medicare Advantage		
Visit Category(%)	NHC	EHC	PHC	NHC	EHC	PHC	NHC	EHC	PHC
Total potentially preventable	11.5	6.5	11.8	8.8	2.6	4.6	16.2	5.8	10.0
Acute Diagnosis	4.1	2.3	3.0	4.3	0.9	1.2	9.3	2.5	4.0
Dehydration	0.5	0.3	0.4	0.5	0.2	0.2	1.0	0.2	0.2
Bacterial Pneumonia	2.1	1.5	1.8	2.7	0.5	0.7	5.0	1.6	2.5
Urinary Tract Infection	1.5	0.5	0.8	1.1	0.2	0.3	3.3	0.7	1.3
Chronic Diagnosis	7.4	4.2	8.8	4.5	1.7	3.4	6.9	3.4	6.0
Diabetes Short-Term Complications	2.3	0.7	2.1	0.5	0.2	0.2	0.1	0.1	0.1
Diabetes Long-Term Complications	0.3	1.1	2.1	0.2	0.3	1.0	0.3	0.4	0.8
Chronic Obstructive Pulmonary Disease (COPD)	3.0	1.4	2.7	0.9	0.2	0.5	1.7	0.5	1.1
Hypertension	0.5	0.1	0.2	0.4	0.1	0.1	0.5	0.1	0.1
Heart Failure	0.5	0.7	1.1	1.6	0.7	1.4	4.0	2.1	3.7
Angina without Procedure	0.2	0.0	0.1	0.7	0.1	0.1	0.4	0.1	0.1
Uncontrolled Diabetes	0.3	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0
Asthma in Younger Adults	0.4	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Lower Extremity Amputation (diabetes)	0.0	0.2	0.5	0.0	0.0	0.2	0.0	0.1	0.3
Total non-preventable (%)	88.5	93.5	88.2	91.2	97.4	95.4	83.8	94.2	90.0
Total ($1,000s)	11,435	55,467	45,979	7,927	376,402	259,477	31,835	179,120	77,259
N	67,245	3,962	3,510	691,978	48,638	28,249	142,652	10,678	5,173

Note:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.
PHC=Persistently High-Cost: patients in the top 10% in both years

Table 4 (see following page) shows spending for ED, inpatient, and other services. Approximately 5.3% of EHC and 5.9% of PHC Medicaid patients' costs were considered potentially preventable. These shares of preventable spending were similar to those estimated among NHC patients (6.6%). In the commercially insured populations, these shares were 1.8% for the EHC population, 2.2% of the PHC population, and 1.9% of the NHC population. In the Medicare Advantage population, these shares were 3.4% for the EHC population, 4.3% of the PHC population, and 2.7% of the NHC population.

Table 4. Share of Preventable Spending Summary Table Oregon, 2012.

	Medicaid			Commercial			Medicare Advantage		
Visit Category	NHC	EHC	PHC	NHC	EHC	PHC	NHC	EHC	PHC
Emergency department costs (%)	11.5	4.6	4.7	4.1	2.8	2.3	3.4	1.5	1.7
Preventable costs (%)	5.8	1.9	2.1	1.8	0.9	0.9	1.3	0.4	0.6
Nonpreventable costs (%)	5.7	2.7	2.6	2.4	1.9	1.4	2.1	1.0	1.1
Inpatient treatment costs (%)	7.3	51.7	31.8	0.9	34.3	27.0	8.6	51.8	36.8
Preventable costs (%)	0.8	3.3	3.8	0.1	0.9	1.3	1.4	3.0	3.7
Nonpreventable costs (%)	6.5	48.4	28.0	0.8	33.4	25.7	7.2	48.8	33.1
Total ($1,000s)	155,865	107,259	144,629	923,543	1,098,802	962,403	369,894	345,468	209,944
Preventable (%)	6.6	5.3	5.9	1.8	1.8	2.1	2.7	3.5	4.3
Nonpreventable (%)	12.2	51.0	30.6	3.2	35.3	27.1	9.3	49.8	34.2
Non - ED or IP Costs (%)	81.2	43.7	63.5	95.0	63.0	70.7	88.0	46.7	61.5
Inpatient & ED Costs (% of Payer)	20.6	42.4	37.1	6.3	55.4	38.3	14.4	59.5	26.1
Preventable (% of Payer)	42.2	23.2	34.7	29.9	34.0	36.1	32.4	38.7	28.9
Nonpreventable (% of Payer)	16.1	46.4	37.6	4.3	57.2	38.5	12.4	61.8	25.8
Non - ED or IP Costs (% of Payer)	47.7	17.7	34.6	39.0	30.8	30.3	52.8	26.2	21.0
N	67,245	3,962	3,510	691,978	48,638	28,249	142,652	10,678	5,173

Note:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
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Table 5 displays the extent to which mean reversion is observed in PHC and EHC patients. Among Medicaid patients, PHC patients had spending in their third year that was 88.9% of spending in their second year; thus they experienced spending declines of only 11% in the third year, suggesting relatively little mean reversion. However, mean reversion was higher in other payer groups, demonstrating declines of 26% and 31% for PHC patients in the commercial and Medicare Advantage plans (P<0.01). Mean reversion was even larger for EHC patients: demonstrating declines of 49%, 54%, and 57% in the year after assignment for Medicaid, commercial patients, and Medicare Advantage patients, respectively (P<0.01).

Table 5. Mean Reversion Among Persistent & Episodically High Cost Patients

			Average Spending per person per year ($)			2013/
Payer/Patient Group	**Spend Type**	N	2011	2012	2013	2012
Medicaid						
PHC	**Total**	2,613	38,707	38,652	34,358	-11.1%
	Preventable	2,613	2,377	2,313	1,939	-16.2%
EHC	**Total**	2,537	4,549	25,704	13,088	-49.1%
	Preventable	2,537	2,377	1,353	853	-37.0%
Commercial						
PHC	**Total**	24,131	29,627	31,967	23,765	25.7%
	Preventable	24,131	668	639	481	24.8%
EHC	**Total**	42,549	2,336	21,895	10,119	53.8%
	Preventable	42,549	40	363	167	-54.0%
Medicare Advantage						
PHC	**Total**	4,744	36,614	36,798	25,533	-30.6%
	Preventable	4,744	1,478	1,386	1,110	-19.9%
EHC	**Total**	10,063	4,064	29,799	12,854	-56.9%
	Preventable	10,063	1,478	902	453	-49.7%

Notes:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.
PHC=Persistently High-Cost: patients in the top 10% in both year

CONCLUSIONS

Most health care spending is concentrated in a small group of individuals. In this study, the top 10% of highest cost enrollees accounted for approximately 61.8% of acute spending in Medicaid, 69.1% in commercial, and 60.0% in Medicare Advantage spending in Oregon. Among the top decile of high cost patients, 5.6%, 1.9%, and 3.8% was attributable to spending on preventable services for Medicaid, commercial, and Medicare Advantage patients, respectively. As a comparison, in a national study of enrollees in the traditional Medicare Fee-for-service population, Joynt and colleagues found that 70% of spending was attributable to the 10% of high

cost patients, and approximately 10% of their spending was for preventable services [17]. The rate of preventable spending in our sample was lower for the commercial population (1.9%) than for either Medicaid (6.0%) or Medicare Advantage (3.3%).

We also found substantial mean reversion among high cost patients, with spending decreasing in subsequent year in the range of 19% to 60%, depending on the population studied. These findings suggest that, absent a control group, evaluations of programs that target high-cost patients may report cost and utilization reductions that could be primarily attributable to mean reversion.

There are several implications of this work. First, programs that attempt to stratify patients based on future costs should carefully consider the timeliness and scope of the stratification. Timeliness of risk assessment greatly matters: only 33-47% of patients in the top spending decile were in the top decile of the previous year. Programs that use tiered payments based on previous year's risk, a strategy used in CMS's Multi-payer Advanced Primary Care Practice and Comprehensive Primary Care initiatives, could be improved if these temporal patterns were taken into account. Similarly, with only 2-6% of costs potentially preventable by current algorithms, goals for bundled or population payments, such as those found in Accountable Care Organization or capitation agreements, the scope for further reductions may be small, even with ideal prevention. For some utilization events, such as ED visits, risk stratification may not be useful, as non-high cost groups have the largest proportion of preventable spending.

Our study has several limitations. First, the algorithms create binary indications for claim items with imperfect sensitivity and specificity. In particular, the services identified as "preventable" are relatively narrow. As a comparison, a number of recent studies have identified the high variability in admitting practices through the emergency department, suggesting that it is possible to avoid hospital admissions even when the diagnostic conditions do not fall into the categories specified by the AHRQ PQI resulting in a measure that is potentially too conservative [18]. Similarly, emergency department indicators provide a measure of specificity by giving probabilities of being preventable for each condition. These conditions could perhaps be prevented through better outpatient care or public health efforts. On the other hand, recent work has suggested that these ED-based algorithms may be too generous and the visit may actually be appropriate for emergency department care based on the presenting complaint [19].

Our study is also limited by its focus on Oregon, a state that has generally been considered to utilize fewer health services than other regions and one whose Medicaid Managed Care programs have had a strong role [20]. However, the focus on Oregon allows for the use of multi-

[17] Joynt KE et al., "Contribution of Preventable Acute Care Spending to Total Spending for High-Cost Medicare Patients."

[18] Jesse M. Pines, Ryan L. Mutter, and Mark S. Zocchi, "Variation in Emergency Department Admission Rates Across the United States," *Medical Care Research and Review* 70, no. 2 (April 1, 2013): 218–31, doi:10.1177/1077558712470565; Jeremiah D. Schuur and Arjun K. Venkatesh, "The Growing Role of Emergency Departments in Hospital Admissions," *New England Journal of Medicine* 367, no. 5 (July 11, 2012): 391–93, doi:10.1056/NEJMp1204431; Amber K. Sabbatini, Brahmajee K. Nallamothu, and Keith E. Kocher, "Reducing Variation In Hospital Admissions From The Emergency Department For Low-Mortality Conditions May Produce Savings," *Health Affairs* 33, no. 9 (September 1, 2014): 1655–63, doi:10.1377/hlthaff.2013.1318.

[19] Raven MC et al., "COmparison of Presenting Complaint vs Discharge Diagnosis for Identifying ' Nonemergency' Emergency Department Visits," *JAMA* 309, no. 11 (March 20, 2013): 1145–53, doi:10.1001/jama.2013.1948.

[20] Dartmouth Atlas of Health Care, "Total Medicare Reimbursements per Enrollee, by Adjustment Type, 2012," 2012, http://www.dartmouthatlas.org/.

payer data, which have not seen widespread use in the health services literature. The populations we studied are limited to those with continuous enrollment for two years. If these individuals have a different set of experiences than other patients, the results may not reflect the full population enrolled at any given point in time. However, our study population may better represent the patients that a program tries to target for intervention since some history would be needed for identification.

This study casts some doubt on the potential cost savings from programs that rely on blunt criteria for high cost patients as a target for intervention. These patients may nonetheless provide a lever that can help slow spending. Successful interventions might benefit from advanced risk stratification algorithms or additional information about health status, that could more reliably identify patients who were likely to have high (or avoidable) costs in the absence of an intervention [21]. Tailoring models of care for conditions that are prevalent among high cost patients in these populations may help to reduce costs. For example, in Oregon, almost 55% of PHC Medicaid patients have mental illness, and 42% of PHC Medicare Advantage patients have CHF. Targeting spending on programs for relevant conditions may be a way to improve the value of care. This research provides important data to help inform these potential interventions.

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Contact information for corresponding author (and reprint requests):
Peter Graven
Mail Code: MDYCHSE
3181 Sam Jackson Park Rd.
Portland, OR 97239
Tel: 503.494.7488
Fax: 503 494-4997

email: graven@ohsu.edu

[21] Christy K. Boscardin et al., "Predicting Cost of Care Using Self-Reported Health Status Data," *BMC Health Services Research* 15, no. 1 (September 23, 2015): 406, doi:10.1186/s12913-015-1063-1.

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APPENDICES

Table A-1. Patient Characteristics, Standard Errors

	Medicaid			Commercial			Medicare Advantage		
	NHC	EHC	PHC	NHC	EHC	PHC	NHC	EHC	PHC
Age, median	0.02	0.09	0.09	0.01	0.03	0.04	0.01	0.05	0.07
Male, %	0.09	0.38	0.41	0.03	0.11	0.14	0.07	0.24	0.34
Cancer, %	0.03	0.26	0.30	0.01	0.07	0.12	0.04	0.22	0.33
Congestive heart failure, %	0.04	0.30	0.37	0.01	0.05	0.09	0.04	0.22	0.34
Diabetes, %	0.07	0.36	0.41	0.02	0.08	0.13	0.05	0.22	0.34
Ischemic heart disease, %	0.04	0.28	0.34	0.01	0.05	0.09	0.03	0.19	0.30
Kidney disease, %	0.03	0.28	0.36	0.01	0.06	0.11	0.04	0.22	0.34
Liver disease, %	0.04	0.27	0.33	0.00	0.03	0.05	0.01	0.06	0.11
Lung disease, %	0.06	0.36	0.41	0.01	0.05	0.09	0.04	0.20	0.33
Stroke, %	0.02	0.18	0.23	0.00	0.04	0.06	0.03	0.16	0.27
Mental illness, %	0.08	0.39	0.42	0.01	0.07	0.11	0.03	0.13	0.21

Note:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.
PHC=Persistently High-Cost: patients in the top 10% in both years

Table A-2. Share of Preventable and Nonpreventable Emergency Department Expenditures, Standard Errors

Visit Category (%)	Medicaid			Commercial			Medicare Advantage		
	NHC	EHC	PHC	NHC	EHC	PHC	NHC	EHC	PHC
Potentially Preventable	0.19	0.78	0.84	0.06	0.22	0.32	0.13	0.44	0.70
Emergent, primary care treatable	0.16	0.57	0.61	0.04	0.14	0.21	0.09	0.31	0.46
ED care needed, preventable	0.16	0.65	0.70	0.05	0.17	0.23	0.10	0.34	0.52
Non-emergent	0.10	0.38	0.43	0.02	0.08	0.12	0.06	0.20	0.31
Non-Preventable	0.13	0.56	0.60	0.05	0.19	0.23	0.10	0.34	0.50
Other	0.19	0.79	0.83	0.06	0.23	0.29	0.13	0.48	0.70
Total Cost ($1,000s)	143.8	106.3	213.0	242.9	317.5	359.6	115.2	88.1	88.6

Note:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.
PHC=Persistently High-Cost: patients in the top 10% in both years

Table A-3. Share of Preventable Inpatient Expenditures, Standard Errors

Visit Category	Medicaid			Commercial			Medicare Advantage		
(%)	NHC	EHC	PHC	NHC	EHC	PHC	NHC	EHC	PHC
Total potentially preventable	0.12	0.39	0.54	0.03	0.07	0.13	0.10	0.23	0.42
Acute Diagnosis	0.08	0.24	0.29	0.02	0.04	0.07	0.08	0.15	0.27
Dehydration	0.03	0.08	0.10	0.01	0.02	0.03	0.03	0.04	0.07
Bacterial Pneumonia	0.06	0.20	0.22	0.02	0.03	0.05	0.06	0.12	0.22
Urinary Tract Infection	0.05	0.11	0.1	0.01	0.02	0.03	0.05	0.08	0.15
Chronic Diagnosis	0.10	0.32	0.48	0.02	0.06	0.11	0.07	0.17	0.33
Diabetes Short-Term									
Complications	0.06	0.13	0.24	0.01	0.02	0.03	0.01	0.03	0.04
Diabetes Long-Term									
Complications	0.02	0.16	0.24	0.01	0.03	0.06	0.01	0.06	0.13
Chronic Obstructive Pulmonary									
Disease (COPD)	0.07	0.19	0.27	0.01	0.02	0.04	0.03	0.07	0.14
Hypertension	0.03	0.05	0.08	0.01	0.02	0.02	0.02	0.03	0.05
Heart Failure	0.03	0.13	0.18	0.02	0.04	0.07	0.05	0.14	0.26
Angina without Procedure	0.02	0.04	0.05	0.01	0.02	0.02	0.02	0.03	0.04
Uncontrolled Diabetes	0.02	0.03	0.05	0.00	0.01	0.01	0.01	0.02	0.03
Asthma in Younger Adults	0.03	0.05	0.08	0.00	0.01	0.00	0.00	0.00	0.00
Lower Extremity Amputation									
(diabetes)	0.00	0.08	0.12	0.00	0.01	0.03	0.00	0.02	0.07
Total non-preventable (%)	0.12	0.39	0.54	0.03	0.07	0.13	0.10	0.23	0.42
Total ($1,000s)	337.66	1427.89	1927.42	165.39	6706.33	6130.47	580.15	2559.44	1986.52

Note: NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.

PHC=Persistently High-Cost: patients in the top 10% in both years

Table A-4. Share of Preventable Spending Summary Table Oregon, Standard Errors

	Medicaid			Commercial			Medicare Advantage		
Visit Category	NHC	EHC	PHC	NHC	EHC	PHC	NHC	EHC	PHC
Emergency department costs (%)	0.12	0.33	0.36	0.02	0.07	0.09	0.05	0.12	0.18
Preventable costs (%)	0.09	0.22	0.24	0.02	0.04	0.06	0.03	0.06	0.10
Nonpreventable costs (%)	0.09	0.26	0.27	0.02	0.06	0.07	0.04	0.10	0.15
Inpatient treatment costs (%)	0.10	0.79	0.79	0.01	0.22	0.26	0.07	0.48	0.67
Preventable costs (%)	0.04	0.29	0.32	0.00	0.04	0.07	0.03	0.17	0.26
Nonpreventable costs (%)	0.10	0.79	0.76	0.01	0.21	0.26	0.07	0.48	0.65
Total ($1,000s)	731.33	1382.89	3002.42	1337.02	7330.74	9289.67	1155.40	2541.21	2627.11
Inpatient & ED Costs									
(%)	0.15	0.79	0.81	0.03	0.22	0.27	0.09	0.48	0.68
Preventable (%)	0.10	0.36	0.40	0.02	0.06	0.09	0.04	0.18	0.28
Nonpreventable (%)	0.13	0.79	0.78	0.02	0.22	0.26	0.08	0.48	0.66
Non - ED or IP Costs (%)	0.15	0.79	0.81	0.03	0.22	0.27	0.09	0.48	0.68
Inpatient & ED Costs									
(% of Payer)	0.15	0.18	0.18	0.03	0.06	0.06	0.09	0.12	0.11
Preventable (% of Payer)	0.18	0.15	0.17	0.05	0.05	0.05	0.12	0.12	0.11
Nonpreventable									
(% of Payer)	0.13	0.18	0.18	0.02	0.06	0.06	0.08	0.12	0.11
Non - ED or IP Costs									
(% of Payer)	0.18	0.14	0.17	0.06	0.05	0.05	0.13	0.11	0.10

Note:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.
PHC=Persistently High-Cost: patients in the top 10% in both years

Table A-5. Mean Reversion Among Persistent & Episodically High Cost Patients, Standard Errors

Patient Group		N	Average Spending per person per year ($) 2011	2012	2013	2013/ 2012
Medicaid						
PHC	**Total**	2764	882.52	975.00	1219.40	3.87
	Preventable					
EHC	**Total**	3120	62.48	368.28	402.34	1.91
	Preventable					
Commercial						
PHC	**Total**	24096	303.51	334.28	327.72	1.28
	Preventable					
EHC	**Total**	42448	8.91	147.98	127.25	0.66
	Preventable					
Medicare Advantage						
PHC	**Total**	4730	490.48	475.95	510.57	1.65
	Preventable					
EHC	**Total**	10021	32.60	227.41	202.74	0.75
	Preventable					

Notes:
NHC=Non-High Cost: patients who were not in the top 10% in either year.
EHC=Episodically High-Cost: patients in the top 10% in either year but not both.
PHC=Persistently High-Cost: patients in the top 10% in both years