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ORIGINAL RESEARCH

What's Cost Got to Do With It? Association Between Hospital Costs and Frequency of Admissions Among "High Users" of Hospital Care

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BACKGROUND: Efforts to curb healthcare spending have included interventions that target frequently hospitalized individuals. It is unclear the extent to which the most frequently hospitalized individuals also represent the costliest individuals.

OBJECTIVE: To examine the relationship between 2 types of "high users" commonly targeted in cost-containment interventions—those incurring the highest hospital costs ("high cost") and those incurring the highest number of hospitalizations ("high admit").

DESIGN, SETTING, AND PATIENTS: Cross-sectional study of 2566 individuals with a primary care physician and at least 1 hospitalization within an academic health system from 2010 to 2011.

MEASUREMENTS: Overlap between the population constituting the top decile of hospital costs and the population constituting the top decile of hospitalizations; characteristics of the 3 resulting high user subgroups.

RESULTS: Only 48% of individuals who were high cost (>$65,000) were also high admit (≥3 hospitalizations). Compared to hospitalizations incurred by high cost–high admit individuals (n = 605), hospitalizations incurred by high cost–low admit individuals (n = 206) were more likely to be for surgical procedures (58 vs 22%, $P < 0.001$), had a higher cost ($68,000 vs $28,000, $P < 0.001$), longer length of stay (10 vs 5 days, $P < 0.001$), and were less likely to be a 30-day readmission (17 vs 47%, $P < 0.001$).

CONCLUSIONS: Stratifying high admit individuals by costs and high cost individuals by hospitalizations yields 3 distinct high user subgroups with important differences in clinical characteristics and utilization patterns. Consideration of these distinct subgroups may lead to better-tailored interventions and achieve greater cost savings. *Journal of Hospital Medicine* 2013;8:665–671. © 2013 Society of Hospital Medicine.

Despite signs of a slowing trend,[1–3] US healthcare costs continue to rise, and cost containment remains a major area of concern. Hospital costs are the largest single category of national healthcare expenditures,[4] and the burden of cost containment is increasingly being shifted to hospitals.[5] As such, hospitals are increasingly focusing on implementing interventions to reduce rates of hospitalizations and readmissions as a mechanism to reduce overall healthcare costs.[5–9]

Multiple factors potentially contribute to patients being "high cost," including acute care utilization,[10–12] pharmaceuticals,[13,14] procedures,[15] catastrophic illness,[16] and high-risk chronic conditions.[11,17,18] However, many hospitals are implementing interventions focused on a single subset of these high cost patients–high users of inpatient services. Care management interventions have received particular attention, due to their perceived potential to improve quality of care while reducing costs through the mechanism of reducing hospital admissions.[19–21] Despite their increasing prevalence, there is limited evidence demonstrating the effectiveness of these programs. Among interventions targeting high cost individuals, the Medicare Care Management for High Cost Beneficiaries showed no effect on hospital admissions.[19] Another high-profile intervention, the Citywide Care Management System led by the Camden Coalition, showed promising preliminary results, but data from a systematic evaluation are lacking.[22] Conversely, interventions targeting individuals with frequent hospitalizations have similarly shown mixed results in reducing costs.[6,7,9,23]

Taken together, these data suggest that the relationship between high costs and frequent hospital use is complicated, and the population of individuals with frequent hospitalizations may not represent the entire population of high cost individuals. Thus, focusing on reduction of hospitalizations alone may be inadequate to reduce costs. For these reasons, we sought to determine how many high cost individuals would be captured by focusing only on frequently hospitalized

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("high admit") individuals by examining the overlap between these populations. We also sought to describe the characteristics and distinctions between the resulting subgroups of "high users" to better inform the design of future interventions.

METHODS

We examined the cross-sectional relationship between high cost and high admit populations among adult patients ≥18 years of age hospitalized at the University of California, San Francisco (UCSF) Medical Center, a 660-bed urban academic medical center from July 1, 2010 to June 30, 2011.

This study was conducted as part of a quality improvement project to identify high user primary care patients for complex care management. Individuals were included in the study if: (1) they had an assigned UCSF primary care provider (PCP), and (2) they had at least 1 hospitalization at UCSF during the study period. PCP assignments were ascertained from panel lists maintained by clinics; lists included individuals with at least 1 visit at any of the 8 primary care clinics at UCSF in the 2 years prior to the end of the study period. Because individuals are dropped from PCP panels at death, we were unable to ascertain or include individuals who died during the study period.

From the initial study population, we defined the high cost group as those who were in the top decile of total hospital costs, and the high admit group as those who were in the top decile of total hospitalizations during the study period. We elected to use the top decile as a cutoff given that it is a common operational definition used to identify high users to target for intervention.[24]

To examine the relationship between high cost and high admits we defined 3 further subgroups: "high cost–low admits," "high cost–high admits," and "low cost–high admits" (Figure 1). To explore the face validity of these descriptors and classification scheme, we subsequently examined the proportion of total hospital costs and total hospitalizations each subgroup accounted for with respect to the study population.

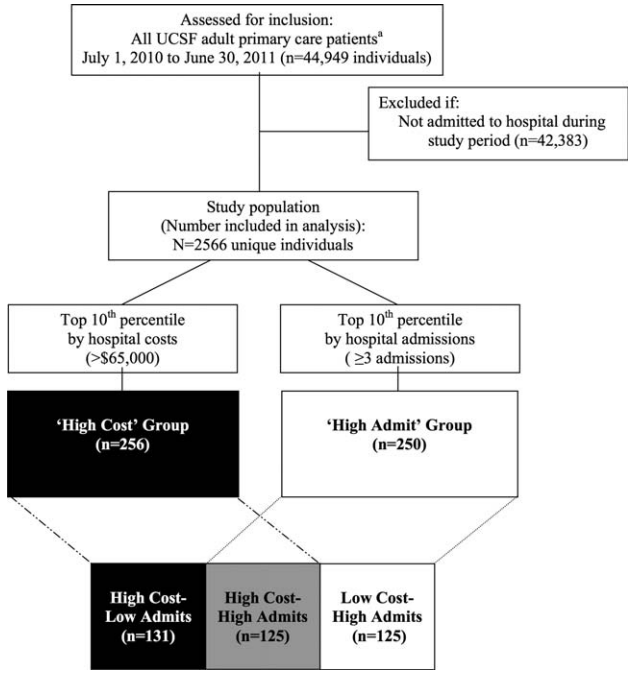

FIG. 1. Defining "high user" subgroups. [a]Individuals with a primary care provider (PCP) were defined as those with a PCP visit in the prior 2 years. Because individuals are dropped from PCP assignments at death, we were unable to ascertain or include individuals who died during the study period.

Data Sources

Hospital costs, demographic data, and encounter diagnoses were obtained from the hospital's Transition Systems Incorporated system (TSI, also known as Eclipsys or Allscripts), a commercially available automated cost accounting system that integrates multiple data sources to calculate total hospital costs on a per patient basis. Several studies have previously used the TSI system to estimate the costs of healthcare services at individual hospitals, and this approach is generally considered the most accurate method to estimate cost.[25,26] Hospital costs included the sum of actual total costs (not billed charges) for all hospital episodes including lab costs, drug costs, surgical supplies, nurse salaries and benefits, utilities, housekeeping, and allocated administrative overhead. This cost total does not capture the cost of physician labor (pro-fees), preadmission costs (e.g., outpatient care), or postadmission costs (e.g., home health, nursing home, or other postdischarge care). Preadmission lab, diagnostic tests, and imaging were included in hospital costs if these were ordered within 72 hours of hospital admission. Emergency department (ED) costs were included if an individual was admitted to the hospital via the ED. Hospitalizations were defined as inpatient admissions only to UCSF because we were unable to reliably ascertain hospitalizations outside of UCSF. PCP assignments were ascertained from administrative panel lists maintained by clinics.

Study Variables

We analyzed factors previously shown[13,27–29] to be associated with high healthcare cost and utilization. We examined demographic characteristics and hospitalization characteristics, including admission source, length of stay (LOS), cost per hospitalization, whether the episode was a 30-day readmission, days in the intensive care unit (ICU), and encounter diagnoses.

To ascertain whether a hospitalization was for a medical versus surgical condition, we used discharge diagnosis codes and designations as per the Medicare Severity Diagnosis-Related Groups (MS-DRG) versions 27 and 28 definitions manuals. We subsequently grouped medical and surgical conditions by Major Diagnostic Categories as per the MS-DRG definitions manuals.

Using MS-DRG codes, we also classified whether hospitalizations were for pneumonia, acute myocardial infarction (AMI), and congestive heart failure (CHF), as these 3 conditions have specific payment penalties under the Centers for Medicare & Medicaid Services (CMS) reimbursement policies. For these CMS core conditions, we included hospitalizations with MS-DRG codes 193–195, 280–282, and 291–293 (codes 283–285 were not included for AMI because individuals who died during the study period were excluded.)

Analysis

We used descriptive statistics to compare patient and hospitalization characteristics between subgroups. Non-normally distributed variables including LOS and cost per hospitalization were log transformed. Because a single individual could account for multiple hospitalizations, we performed a companion analysis of hospitalization characteristics using generalized estimating equations with an independent correlation structure to account for clustering of hospitalizations within individuals. Our findings were robust using either approach. For ease of interpretation, *P* values from the former analysis are presented.

To determine whether the overall distribution and characteristics we observed for high user subgroups were a single-year anomaly or representative of temporally stable trends, we compared non-high users and high user subgroup characteristics over the 3 years preceding the study period using linear regression for trend.

The institutional review board at UCSF approved this study protocol.

RESULTS

Of the 2566 unique individuals included in the analysis (Figure 1), 256 individuals were identified as "high cost" (top decile, ≥$65,000). This group accounted for 45% of all costs and 22% of all hospitalizations (Figure 2). Two hundred fifty individuals were identified as "high admits" (top decile, ≥3 hospitalizations). This group accounted for 32% of all costs and 28% of all hospitalizations.

Only 48% of high cost individuals were also high admit (≥$65,000 and ≥3 hospitalizations; n = 125, Figure 1). Among high users, we subsequently defined 3 subgroups based on the relationship between cost and hospitalizations (high cost–low admits, high cost–high admits, and low cost–high admits). Each subgroup accounted for approximately 5% of the overall study population (Figure 2). The high cost–low admits subgroup incurred a proportionate share of hospitalizations (6%) but a disproportionate share of costs (20%). The high cost–high admits subgroup had a disproportionate share of both costs (25%) and hospitalizations (16%). The low cost–high admits subgroup had a proportionate share of costs (7%) but a disproportionate share of hospitalizations (12%).

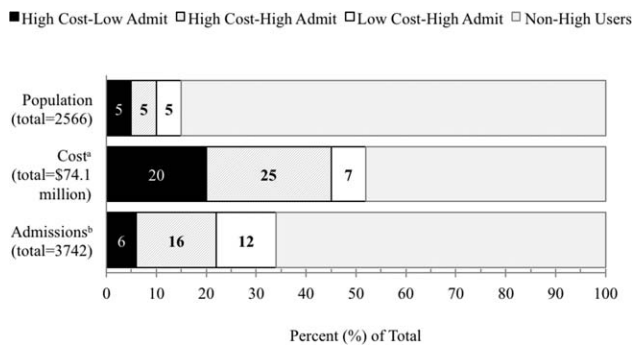

FIG. 2. "High users" account for a disproportionate share of costs and admissions. The top 10% of individuals by costs = high cost–low admit + high cost–high admit subgroups; the top 10% of individuals by admissions = high cost–high admit + low cost–high admit subgroups. [a]Total costs = sum of all hospital costs for study population. [b]Total admissions = sum of all hospital admissions for study population.

Patient and Hospitalization Characteristics

Compared to non-high users, all high user subgroups were more likely to have public insurance (Medicare or Medicaid) or have dual–eligible status, and the two high cost subgroups were more likely to be male and African American ($P < 0.05$ for all). Compared to each other, subgroups were similar with respect to race/ethnicity, payer, and age (Table 1).

Regarding hospitalization characteristics, each high user subgroup was distinct and significantly different from each of the other subgroups with respect to admission source, proportion of 30-day readmissions, LOS, and cost per hospitalization (Table 2, $P < 0.001$ for all). The low cost–high admit subgroup had the highest proportion of admissions from the ED (73%), a moderate proportion of 30-day readmissions (32%), the shortest LOS (median, 3 days; interquartile range [IQR], 2–4 days) and the lowest cost per hospitalization (median, $12,000; IQR, $8,000–$15,000). In contrast, the high cost–low admit subgroup had the highest proportion of admissions from clinic or physician referrals (45%), lowest proportion of 30-day readmissions (17%), the longest LOS (median, 10; IQR, 4–17), the most ICU days per hospitalization (median, 1; range, 0–49) and the highest cost per hospitalization (median, $68,000; IQR, $43,000–$95,000). High cost–high admit individuals had the highest proportion of 30-day readmissions (47%) and a moderate cost per hospitalization (median, $28,000; IQR, $23,000–$38,000), but the highest median cost per individual over 1 year ($113,000; IQR, $85,000–$174,000, Table 1). Hospitalizations classified as 30-day readmissions accounted for 42% of costs incurred by this subgroup; 30-day readmissions specifically associated with CMS core conditions accounted for <1% of costs.

Encounter diagnoses associated with hospitalizations were also significantly different between each of the high user subgroups (Table 2, $P < 0.001$ for all). The high cost–low admit subgroup was predominantly

TABLE 1. Patient Characteristics Among High User Subgroups

		High User Subgroups					
		1	2	3	*P* Value for Comparison		
	Non-High Users, n = 2145	High Cost–Low Admit, n = 131	High Cost–High Admit, n = 125	Low Cost–High Admit, n = 125	1 vs 2	2 vs 3	1 vs 3
Male, %	34	57	42	38	0.02	0.52	0.003
Race/ethnicity, %					0.15	0.76	0.18
White	45	46	36	38			
Black	14	21	26	19			
Hispanic	9	5	10	10			
Asian	22	18	22	26			
Other	10	10	6	6			
Primary payer, %					0.23	0.44	0.51
Commercial	42	24	20	17			
Medicare	42	58	55	61			
Medicaid	15	17	25	21			
Other	<1	2	—	2			
Dual eligible, %*	18	27	26	31	0.85	0.38	0.48
Age, mean years ± SD	57 ± 20	60 ± 17	58 ± 17	63 ± 20	0.40	0.04	0.19
No. of hospitalizations per individual, median (interquartile range)	1 (1–1)	2 (1–2)	4 (3–6)	3 (3–4)	<0.001	<0.001	<0.001
Hospital costs per individual, median $1000 (interquartile range)	12 (7–22)	93 (75–122)	113 (85–174)	37 (30–51)	<0.001	<0.001	<0.001

NOTE: **Abbreviations:** SD, standard deviation. *Dual eligible = Medicare and Medicaid as primary and secondary payers, respectively.

TABLE 2. Hospitalization Characteristics and Encounter Diagnoses

		High User Subgroups					
		1	2	3	*P* Value for Comparison		
	Non-High Users	High Cost–Low Admit	High Cost–High Admit	Low Cost–High Admit	1 vs 2	2 vs 3	1 vs 3
No. of admissions	2500	206	605	431	—	—	—
Admission source, %					<0.001	<0.001	<0.001
Emergency department	53	50	65	73			
Clinic or physician referral	44	45	30	20			
Transfer from outside facility	2	5	4	4			
Self-referral	1	<1	1	3			
Other	<1	—	—	—			
30-day readmission, %	5	17	47	32	<0.001	<0.001	<0.001
LOS, median days (IQR)	3 (2–4)	10 (4–17)	5 (3–10)	3 (2–4)	<0.001	<0.001	<0.001
ICU days, median (range)*	0 (0–8)	1 (0–49)	0 (0–21)	0 (0–3)	<0.001	<0.001	<0.001
Cost per hospitalization, median $1,000 (IQR)	11 (7–19)	68 (43–95)	28 (23–38)	12 (8–15)	<0.001	<0.001	<0.001
Encounter diagnoses†					<0.001	0.002	<0.001
Surgical MS-DRGs, %	30	58	22	13			
Most common MDCs							
Cardiovascular	4	15	8	6			
Orthopedic	10	13	6	4			
Transplant	<1	7	1	1			
Medical MS-DRGs, %	70	42	78	87			
Most common MDCs							
Pregnancy related	17	2	2	2			
Cardiovascular	10	10	7	13			
Respiratory	9	4	14	17			
Gastrointestinal	7	3	10	14			
Hematologic	1	2	9	6			
Myeloproliferative	<1	4	9	6			
CMS core condition‡	7	3	6	12	0.174	0.01	0.004

NOTE: **Abbreviations:** LOS, length of stay; IQR, interquartile range; MS-DRG, Medicare Severity Diagnosis-Related Group; MDC, Major Diagnostic Category; CMS, Centers for Medicare & Medicaid Services. *Interquartile ranges for non-high users and each high user subgroup were 0–0, 0–4, 0–0, and 0–0, respectively. †Comparisons were done for proportion of hospitalizations for surgical versus medical MS-DRGs (not for MDCs). ‡CMS core conditions defined using MS-DRG codes for pneumonia, acute myocardial infarction, and congestive heart failure.

hospitalized for surgical conditions (58% vs 42% for medical MS-DRGs) and had the lowest proportion of hospitalizations for CMS core conditions (3%). The most common types of surgical hospitalizations in this subgroup were for cardiovascular procedures (15%; including coronary artery bypass grafting and cardiac

TABLE 3. Temporal Stability in High User Subgroup Distribution and Discharge Diagnoses

	2008	2009	2010	2011	P Value (For Linear Trend)
Study population	2408	2518	2647	2566	—
Characteristics, n					
Cutoff for "high cost" (top decile), nearest $1000	>47	>51	>54	>65	<0.001
Proportion of total hospital costs incurred by high cost group, %	46	47	47	48	—
Cutoff for "high admit" (top decile), no. of admissions	≥3	≥3	≥3	≥3	—
High cost who are also high admit, %	42	48	48	48	—
Discharge diagnoses by subgroup*					
Non-high user population					
Surgical MS-DRG	32 (751)	33 (842)	36 (932)	30 (751)	0.51
Medical MS-DRG	68 (1598)	67 (1676)	64 (1673)	70 (1749)	
High cost–low admit					
Surgical MS-DRG	67 (138)	68 (132)	61 (120)	58 (119)	0.09
Medical MS-DRG	33(67)	32 (63)	39 (78)	42 (87)	
High cost–high admit					
Surgical MS-DRG	23 (104)	25 (133)	24 (150)	22 (134)	0.60
Medical MS-DRG	77 (341)	75 (392)	76 (464)	78 (471)	
Low cost–high admit					
Surgical MS-DRG	11 (35)	17 (44)	13 (40)	13 (54)	0.90
Medical MS-DRG	89 (277)	83 (219)	87 (269)	87 (377)	

NOTE: **Abbreviations:** MS-DRG, Medicare Severity Diagnosis-Related Group.*Values are given as percentage and (number) of admissions for each subgroup.

valve replacement) and orthopedic procedures (13%; including hip, knee, and other joint replacements). Most surgical hospitalizations were from referrals (67%) rather than admissions through the ED. In contrast, the low cost–high admit group was predominantly hospitalized for medical conditions (87% vs 13% for surgical MS-DRGs) and had the highest proportion of hospitalizations for CMS core conditions (12%). The most common types of medical hospitalizations in this subgroup were for respiratory conditions (17%; including chronic obstructive pulmonary disease and pneumonia), gastrointestinal conditions (14%), and cardiovascular conditions (13%; including CHF, AMI, arrhythmia, and chest pain). High cost–high admit individuals were also hospitalized primarily for medical rather than surgical conditions (78% vs 22% medical vs surgical MS-DRGs). Only 6% of hospitalizations in this subgroup were for CMS core conditions, and only 2% of hospitalizations were 30-day readmissions for CMS core conditions.

The overlap between the high cost and high admit groups was persistently 48% or less for the 3 years prior to the study period (Table 3). Although the extent of overlap was similar across years, the absolute dollar value for the cutoff to define the top decile by hospital costs gradually increased over time from $47,000 in 2008 to $65,000 in 2011 ($P < 0.001$ for trend). Among the high cost–low admit subgroup, there was a trend toward a decrease in the proportion of surgical hospitalizations from 67% in 2008 to 58% in 2011 ($P = 0.09$).

DISCUSSION

In this study, we found that only half of high cost individuals were also high admit. Further categorizing high users into high cost–low admit versus high cost–high admit versus low cost–high admit identified distinct patterns between each group. High cost–high admit individuals were more likely to be hospitalized for medical conditions, whereas high cost–low admit individuals were more likely to be hospitalized for surgical conditions. CMS core conditions accounted for a low proportion of overall hospitalizations across all groups.

Our findings suggest several distinct types of high users with different clinical characteristics, utilization, and cost patterns. From a hospital perspective, one implication is that a multifaceted approach to cost containment, rather than the one-size-fits-all strategy of reducing hospitalizations, may be more effective in reducing costs. For example, our findings show that high cost–low admit individuals have a disproportionate number of hospitalizations for surgical conditions, longer LOS, and more ICU days. Costs incurred by this subgroup may be more responsive to in-hospital interventions aimed at reducing procedural costs, LOS, unnecessary use of the ICU, and minimizing postoperative infections and complications rather than to a care management approach.

In contrast, care management strategies such as improving postdischarge care and chronic disease management, which aim to achieve cost savings through reducing hospitalizations, may be more effective in reducing costs among high cost–high admit individuals, who have a high proportion of hospitalizations for medical conditions and the highest proportion of 30-day readmissions. Such strategies may also be important in optimizing the quality of care for low cost–high admit individuals, who have the highest proportion of medical hospitalizations among all high users, though the potential for cost savings may be more limited in this subgroup.

Our results suggest that current hospital-based approaches—driven by readmissions penalties for CMS core conditions—may have less than the expected impact on costs. For example, although high cost–high admit individuals had the highest proportion of 30-day readmissions, readmissions specifically for CMS core conditions accounted for <1% of costs in this subgroup. Thus, the potential return on an expensive investment in a care management intervention is unclear, given the small number of readmissions for these select conditions. From a broader perspective, the focus on readmissions for CMS core conditions, which overall contribute relatively little to high hospital costs, may not be a comprehensive enough strategy for cost containment. To date, there have been limited policies targeting factors contributing to high hospital costs outside of frequent medical hospitalizations. Medicare's nonpayment policy for treatment of preventable hospital conditions, including surgical site infections, translates prevention of these conditions into cost savings for hospitals.[30] However, this rule has been criticized for not going far enough to drive substantial savings.[31] A new CMS rule authorizes states to identify other provider-preventable conditions for which Medicaid payment will be prohibited.[32] Future policy efforts should further emphasize a comprehensive, multipronged approach beyond readmissions penalties for select conditions if healthcare cost containment remains a policy priority.

Our results should be interpreted in light of several limitations. First, this was a single-site study at an academic medical center; the generalizability of our results to other settings is unclear. Our cost data likely reflect local market factors, including the highest wage rates for skilled healthcare labor in the United States.[33] Although the explicit distribution of high user subgroups may be institution-specific due to variations in our cost structure, we anticipate that the general classification paradigm will be similar in other health systems. Second, we captured utilization and costs only at a single hospital. However, our study population includes only individuals with PCPs at UCSF, and internal data from both Medicare and UCSF's largest private payer show that over 85% of hospitalizations among this population are to UCSF Medical Center. Third, we were able to capture only hospital costs rather than overall healthcare costs. Given that hospital costs account for the single largest category of total national health costs,[4] we expect that future studies examining total health costs will show similar findings. Fourth, our data did not include measures of health status, socioeconomic status, housing, or mental health comorbidities to permit an analysis of these factors, which have been previously related to frequent hospitalizations and high costs.[34–39] Fifth, due to resource constraints, we were unable to conduct a longitudinal analysis to examine the extent to which individuals are consistently high users over time. Previous studies have described that 20% to 30% of individuals are consistently high users; the remainder have discrete periods of high utilization.[34,40] This may be an important consideration in the design of future interventions.

Finally, our analysis was limited to individuals with a PCP to allow identification of an accessible cohort for care management. Thus, we did not capture individuals without a PCP and individuals who died during the study period, because these individuals no longer had an assigned PCP following death. Although this approach is consistent with that of many care management programs,[19] these populations are likely to incur higher than average utilization and healthcare costs, and represent important areas for future investigation.

In summary, our study identifies three types of high-user populations that differ in the proportion of costs attributable to frequent hospitalizations, clinical conditions associated with hospital use, and frequency of 30-day readmissions. Stratifying high users by both costs and hospitalizations may help identify tailored strategies to more effectively reduce costs and utilization.

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