Improving The Management Of Care For High-Cost Medicaid Patients

Evidence from New York City that it is possible to predict the future health care use of a costly population.

by John Billings and Tod Mijanovich

PROLOGUE: The fact that the majority of Americans are obese or overweight, although alarming, is hardly news, given the coverage of the trend in recent years. What should spark renewed concern among policymakers is recent evidence that despite a generalized awareness of the obesity epidemic and leaders' professed intentions to address it through policy, obesity rates have continued to rise in nearly every state. Remedial policy initiatives, it seems, have thus far proved too limited in scope and coherence to achieve much of an impact.

The persistence of this awareness-policy gap, with the full knowledge that obesity is a major precursor to cardiovascular disease, diabetes, and other, often preventable, high-cost chronic diseases, continues to perplex those in the public health and medical communities. Although seemingly counterintuitive, the failure to invest in comprehensive preventive policy interventions is merely reflective of a long-standing, although arguably shortsighted, societal calculus relying heavily on episodic care and the medical model, with far less attention paid to the many "upstream" determinants influencing overall population health.

Within the context of a medical model, exploding Medicaid budgets have prompted policymakers to redouble efforts to explore ways of boosting efficiency in care delivery, particularly for people with high-cost and chronic conditions. In this paper, John Billings and Tod Mijanovich further inform this conversation by examining the cost-effectiveness of care management for chronic disease patients treated in fee-for-service practice. The authors' empirical findings support the "business case" for such interventions by showing that even sizable investment in the improved health and welfare of potentially high-cost patients is offset by savings from reduced future hospitalizations. Equally important for implementation of such interventions, the authors also show that existing data resources may be used to predict with a reasonable degree of certainty the patients at greatest risk of future hospital admissions within twelve months.

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ABSTRACT: Increased policy attention is being focused on the management of high-cost cases in Medicaid. In this paper we present an algorithm that identifies patients at high risk of future hospitalizations and offer a business-case analysis with a range of assumptions about the rate of reduction in future hospitalization and the cost of the intervention. The characteristics of the patients identified by the algorithm are described, and the implications of these findings for policymakers, payers, and providers interested in responding more effectively to the needs of these patients are discussed, including the challenges likely to be encountered in implementing an intervention initiative. [*Health Affairs* 26, no. 6 (2007): 1643–1655; 10.1377/hlthaff.26.6.1643]

AMID ACCELERATING HEALTH CARE COSTS and continued pressure on state budgets, Medicaid policymakers are grappling with efforts to rein in Medicaid spending. Reductions in or freezes on payments to providers remains the most popular choice, and some states have cut coverage, trimmed eligibility, or raised patient copayments.[1] However, increasing attention has focused on high-cost cases and patients with chronic diseases. For example, 4 percent of Medicaid enrollees are responsible for nearly half of all Medicaid spending, and disabled and elderly patients account for 96 percent of cases where costs exceed $25,000 per patient per year.[2] Not surprisingly, these numbers have captured the attention of Medicaid policymakers, and many states are actively engaged in efforts to provide disease management or care management for fee-for-service patients with chronic diseases, often enrolling patients in programs offered by third-party vendors targeting patients with disease burdens that place them at "high risk of experiencing poor clinical and financial outcomes."[3]

There are two key elements to the success of these new efforts to target and improve care for high-cost Medicaid cases. First, it is essential to be able to identify in advance patients who are likely to have high costs in the future. Many high-cost occurrences (such as injury, acute illness, or cancer) might be episodic, and high spending in one year might not mean high spending in subsequent years. Second, and equally critical, is the ability to actually affect the care pathways and outcomes of these patients. Because of the circumstances that define their Medicaid eligibility (extremely low income and medical disability) and other factors that are likely to be associated with their social and personal environment (such as homelessness, substance use, or low educational achievement), these patients will undoubtedly present major challenges. Certainly this is the case if Medicaid agencies rely primarily on vendors experienced in coping with chronic disease management for commercial plans or the recent Medicare demonstrations. But even traditional Medicaid providers have little experience in actually managing these "frequent flyers," especially in a payment environment where repeat hospital admissions enter the balance sheet as revenue and efforts to manage the health and social needs of these patients are under- or unreimbursed. And although commercial disease management programs are somewhat more mature than those being

used in many Medicaid programs, these programs' capacity to achieve savings varies widely, with results often not published in peer-reviewed scientific journals.[4]

As Medicaid programs and managed care plans begin to target these high-cost/high-risk patients for intervention, these issues are likely to receive increased attention.[5] In this paper we apply logistic regression techniques to identify patients at high risk of future hospitalization. We examine utilization and diagnostic history to learn as much as possible about the characteristics of these patients. We make the assumption that there is no new money available for these patients and that any health and social care improvements or services for these patients must be supported by reductions in future hospital admissions. Although other reductions in use may be achieved (such as emergency department use), the relatively small size of these expenditures for each service use means that any savings associated with these reductions are likely to be too low to offset spending for any targeted intervention. We offer a business-case analysis with a range of assumptions about the rate of reduction in future hospitalizations and the cost of the intervention (including the cost of additional service use). We then discuss the implications of these findings for policymakers, payers, plans, and providers interested in responding more effectively to the needs of these patients.

Study Data And Methods

Our analysis is based on Medicaid fee-for-service (FFS) claims records for New York City residents from 2000–2004 for 70,000 adult disabled patients who would be eligible for mandatory enrollment in Medicaid managed care (which began in the fall of 2005). We also used data on an additional group of 28,000 Supplemental Security Income (SSI) disabled adult patients identified by the New York State Department of Health as "seriously and persistently mentally ill" scheduled for mandatory enrollment in a later phase.[6] The administrative data we analyzed included eligibility files and all paid FFS claims for these patients. Patients were given anonymized identifiers to allow linkage of claims over time and across providers.

The main method employed for case finding was to identify disabled adult patients eligible for mandatory managed care enrollment who had a hospital admission in 2003. We then examined all utilization for the three-year period prior to that "index" admission. We then constructed variables to capture prior utilization history, including frequency of and intervals between hospital admissions and emergency department (ED) visits, primary care and specialty care visits, and use of a broad range of other services (such as home care, personal care, rehab services, substance abuse services, prescription drugs, and so on). A variable was also created on the number of different specialty types consulted by the patient in the prior three years.

Prior diagnostic history was also examined, with variables created for a range of individual chronic diseases (such as diabetes, asthma, congestive heart failure,

coronary artery disease, chronic obstructive pulmonary disease, and so on), as well as a variable for the number of different chronic conditions for each patient. Separate variables were also created for mental illness categories and for history of alcohol or substance abuse. Additional variables for patient age, sex, and race/ethnicity were created from eligibility files, as well as variables for the sociodemographic characteristics of the patient's ZIP code of residence from census data.

These variables were included in a stepwise logistic regression model to create an algorithm to estimate the odds of hospital admission in the twelve months following discharge from the index admission. Predicted probabilities were multiplied by 100 to create a "risk score" for each patient in the data set ranging from 0 to 100, with patients with higher risk scores having a higher probability of an admission in the next twelve months.[7]

This "real time" approach of using a hospital admission as a triggering event was perceived as useful for two reasons. First, patients with a hospital admission are much more likely to have a subsequent admission in the next twelve months than patients without an admission, which improves the potential case-finding capacity of the algorithm. But, equally important, effective discharge planning is likely to be a critical component of any intervention strategy for high-cost, high-risk patients. However, because of limited resources and lag time in acquiring data, our experience in other environments has suggested that some providers and payers are interested in non–"real time," retrospective analyses.[8] Accordingly, we also examined patients with any claims in 2000–2003, to predict subsequent admissions in 2004 (regardless of whether they had a hospital admission in 2003 or any prior year). This "archival" approach to case finding is somewhat less robust (it finds fewer patients) than the "real time" method and only brief findings for this approach are presented for comparative purposes.[9]

The logistic regression model was developed using a randomly selected sample of half of eligible patients (Sample 1); regression coefficients were then applied to the remaining half of patients (Sample 2) in each group. Except as noted, all findings reported here are for Sample 2 patients using coefficients derived from Sample 1.

Study Findings

■ **Risk of hospital admission.** For the "real time" approach of case finding to identify patients at high risk of future admission, the algorithm based on the logistic regression produced a relatively high positive predictive value (PPV) for disabled adult SSI patients eligible for mandatory managed care enrollment: Two-thirds of patients with a risk score of 50 or more had an admission in the next twelve months. The stability between the first and second samples is also quite strong, with only minor differences in PPV, sensitivity, and specificity levels.[10] A comparable PPV value (0.668) was obtained for seriously and persistently mentally ill patients, with even higher levels of sensitivity. The "archival" approach had comparable PPV values

but identified fewer patients with future admissions. As expected, the PPV increases dramatically for patients with high risk scores: 83 percent of SSI mandatory Medicaid managed care patients with risk scores of 75 or more had future admissions, and 90 percent of patients with risk scores of 90 or more did so.[11]

■ **Cost profiles.** The cost profiles of patients varied by risk score. For SSI MMC mandatory Medicaid managed care patients with a risk score of 50 or more, Medicaid spending in the prior twelve months was almost $24,000 (with an additional cost of the current admission of $10,209), and these patients had costs of almost $40,000 in the next twelve months following discharge (Exhibit 1). About half of these patients' costs were for inpatient care, although there was also sizable spending for personal care, home care, and medications. For patients with higher risk-score thresholds, costs were also higher, driven primarily by additional inpatient costs (hospital costs for patients with risk scores of 90 or more accounted for more than 70 percent of spending in both the previous and the next year). Comparable results were observed for SSI seriously and persistently mentally ill patients, although their costs were notably higher across all risk-score thresholds (Exhibit 1).

EXHIBIT 1
Past And Future Costs Of Identified Patients In New York City Medicaid Data, 2002

	Mandatory Medicaid managed care				Seriously and persistently mentally ill			
	Risk score			All patients	Risk score			All patients
	50+	75+	90+		50+	75+	90+	
Spending prior 12 months								
Inpatient	$11,460	$24,593	$38,419	$ 4,035	14,492	28,421	42,649	8,379
Emergency department	246	454	713	76	252	423	743	126
Professional services	1,378	1,539	1,382	967	2,373	2,370	2,192	3,875
Home health	2,426	3,031	3,788	600	1,037	1,262	1,310	597
Personal care	1,879	2,994	2,371	1,187	1,065	964	1,009	855
Long-term care	581	980	1,088	205	315	378	1,022	131
Rx drugs	3,460	4,105	4,014	2,355	3,993	4,201	4,116	4,801
Transportation	299	435	478	117	411	451	353	342
Other	2,196	2,488	2,115	1,294	6,186	6,741	6,036	4,329
Total prior 12 months	23,924	40,619	54,368	10,836	30,123	45,213	59,430	23,436
Current inpatient spending	10,209	9,507	8,523	–[a]	15,743	13,921	12,301	–[a]
Spending next 12 months								
Inpatient	23,687	34,781	44,385	4,264	27,361	38,309	46,626	7,194
Emergency department	274	483	686	98	290	428	699	149
Professional services	1,701	1,669	1,531	992	2,705	2,625	2,869	3,715
Home health	3,339	3,738	4,859	744	1,272	1,206	844	739
Personal care	2,536	3,927	3,321	1,370	1,433	1,412	1,395	982
Long-term care	813	787	599	527	458	494	344	403
Rx drugs	4,509	4,673	4,680	2,738	4,916	4,701	4,743	5,376
Transportation	408	502	452	155	523	568	450	366
Other	2,593	2,189	1,911	1,421	6,352	6,390	5,421	4,371
Total next 12 months	39,861	52,748	62,424	12,309	45,310	56,132	63,391	23,297

SOURCE: Values derived by the authors from analysis of Medicaid claims data.

[a] Not applicable.

The costs of patients with high risk scores represented a sizable proportion of all Medicaid spending for the patient populations we studied. SSI mandatory Medicaid managed care patients with risk scores of 50 or more accounted for more than $222 million of total spending in 2003 (when applied to combined Sample 1 and Sample 2)—almost 30 percent of the $775 million in total costs of all such patients that year. Seriously and persistently mentally ill patients with risk scores of 50 or more accounted for $263 million (40 percent) of the $656 million spent for all such patients in 2003.

■ **Business-case modeling.** It is also possible to perform business-case modeling using the algorithm to assess the financial impact of an intervention for patients flagged by the algorithm, using different assumptions about reductions in future admissions and the cost of the intervention. For example, for SSI mandatory Medicaid managed care patients with risk scores of 50 or more, with an assumption of a 10 percent reduction in future hospital admissions, an intervention with a cost of $3,000 per patient per year would not break even but in fact would add $1.6 million for Sample 2 patients (Exhibit 2). But if the assumption were a 15 percent or 20 percent reduction in future admissions, an intervention targeting patients with risk scores of 50 or more (with an intervention cost of $3,000 per patient per year) would yield savings of $1.8 million and $5.1 million, respectively. With a higher risk-score threshold for inclusion (risk scores of 75 or 90), an intervention would yield net savings even with an assumed 10 percent reduction in future admissions. If the assumption of a 10 percent reduction, the amount that can be spent on an intervention while still achieving break-even status varies from $2,433 for patients with a risk score of 50 to $4,866 for patients with risk scores of 90 or more. With the assumption of a 20 percent reduction in future admissions, an intervention costing almost $9,000 per year for patients with risk scores above 90 can, in effect, pay for itself from savings in hospital costs (Exhibit 3).

■ **Diagnostic profiles.** To help provide information for consideration in design of interventions, we also examined the diagnostic profile of SSI mandatory Medicaid managed care and seriously and persistently mentally ill patients identified by the algorithm. For both groups, the underlying levels of chronic disease were quite high: 58 percent of the former and 66 percent of the latter had some chronic disease history recorded in their Medicaid claims, and more than one-third of both groups had more than one chronic condition. SSI mandatory Medicaid managed care patients with high risk scores had even higher levels of chronic disease (80 percent of patients with risk scores of 50 or more and almost 90 percent of those with risk scores of 90 or more), although the level of chronic disease was comparable across most risk-score categories for seriously and persistently mentally ill patients (Exhibit 4). Hypertension was the most common chronic condition (80 percent of SSI mandatory Medicaid managed are patients with risk scores of 50 or more), but there were also high levels of diabetes (38 percent), asthma (35 percent), coronary artery disease (35 percent), and congestive heart disease (25 percent) among this group

EXHIBIT 2
Business-Case Modeling: Using The Algorithm To Assess The Financial Impact Of An Intervention For Patients Flagged By The Algorithm

Future admission reduction assumption/risk score threshold	Number of patients identified	Percent identified correctly (with future admissions)	Total intervention cost ($3,000 per patient)	Savings from reduction in admissions[a]	Net savings or loss
Mandatory MMC					
10 percent					
50	2,748	65.9	$8,244,000	$ 6,686,279	−$1,557,721
75	789	83.3	2,367,000	2,823,018	456,018
90	256	89.8	768,000	1,148,170	380,170
15 percent					
50	2,748	65.9	8,244,000	10,029,419	1,785,419
75	789	83.3	2,367,000	4,234,527	1,867,527
90	256	89.8	768,000	1,722,255	954,255
20 percent					
50	2,748	65.9	8,244,000	13,372,558	5,128,558
75	789	83.3	2,367,000	5,646,036	3,279,036
90	256	89.8	768,000	2,296,340	1,528,340
SPMI					
10 percent					
50	2,717	66.8	8,151,000	7,671,839	−479,161
75	832	80.2	2,496,000	3,297,089	801,089
90	163	90.8	489,000	771,434	282,434
15 percent					
50	2,717	66.8	8,151,000	11,507,759	3,356,759
75	832	80.2	2,496,000	4,945,634	2,449,634
90	163	90.8	489,000	1,157,152	668,152
20 percent					
50	2,717	66.8	8,151,000	15,343,679	7,192,679
75	832	80.2	2,496,000	6,594,179	4,098,179
90	163	90.8	489,000	1,542,869	1,053,869

SOURCE: Values derived by the authors from analysis of Medicaid claims data.

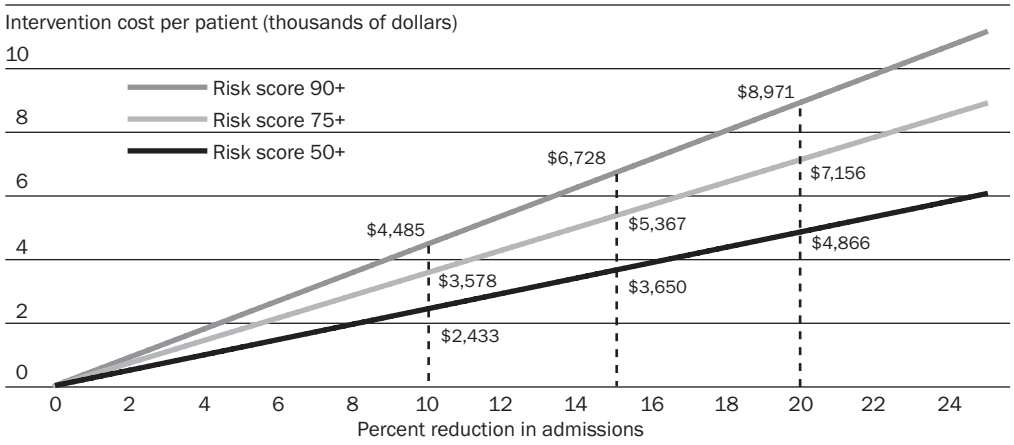
NOTES: Costs reflect mean costs for patients in five-point increment in risk score within risk score threshold group. MMC is Medicaid managed care. SPMI is seriously and persistently mentally ill.

[a] Cost of future admissions varies somewhat by risk score (lower costs, shorter length-of-stay for patients with higher risk scores).

(data not shown).

A substantial percentage of patients in both groups had a history of substance abuse in the prior three years. Although the underlying rate of prior substance abuse for SSI mandatory Medicaid managed care patients overall was only 14.5 percent, the level was almost 40 percent for patients with risk scores of 50 or more 57 percent for those with risk scores of 90 or more. For seriously and persistently mentally ill patients, the underlying rate for all patients was higher (26.9 percent), with rates of 51.5 percent for patients with risk scores of 50 or more and an extraordinary 84 percent for patients with risk scores of 90 or more. By definition, seriously and persistently mentally ill patients also had a history of mental illness, but the level of mental illness among mandatory Medicaid managed care patients was also quite high (33.7 percent had a history of mental illness in their claims records). For patients with risk scores of 50 or more, the level was comparable, but

EXHIBIT 3
Maximum Intervention Cost For Break-Even



SOURCE: Values derived by the authors from analysis of Medicaid claims data.

for patients with risk scores of 90 or more, the rate was even higher (50.8 percent).

■ **Characteristics of "future" hospital admissions.** Critical in assessing the "business case" for any intervention is the assumption about reductions in future hospital admissions. To help frame this analysis, we examined the characteristics of "future" admissions (admissions in the twelve months following the index admission) for patients identified by the algorithm with high risk scores. For SSI mandatory Medicaid managed care patients with risk scores of 50 or more, 30.8 percent of future admissions had a primary diagnosis involving a chronic condition, and 40.7

EXHIBIT 4
Percentage Of Identified Patients With Various Diagnoses Before The Index Admission, New York City Medicaid Data, 2002

	Mandatory Medicaid managed care				Seriously and persistently mentally ill			
	Risk score			All	Risk score			All
Diagnosis	50+	75+	90+	patients	50+	75+	90+	patients
Any chronic disease	80.7	89.9	89.5	58.4	60.2	69.5	76.1	66.4
Multiple chronic diseases	63.7	76.9	77.3	34.6	35.9	44.6	53.4	36.6
Stroke	12.7	16.5	15.6	6.6	5.1	7.5	13.5	4.6
Cancer	27.3	25.9	23.4	18.8	16.3	19.1	25.2	22.8
Any mental illness	36.4	47.4	50.8	33.7	100.0	100.0	100.0	100.0
Schizophrenia	4.0	5.2	5.5	4.5	73.9	82.1	80.4	52.7
Psychoses	3.4	4.8	7.0	2.4	45.1	60.5	66.3	22.9
Bipolar/major depression	16.2	22.8	28.9	11.8	44.2	60.2	75.5	39.6
Substance abuse	39.1	52.1	57.0	14.5	51.5	75.5	84.0	26.9
Mental illness or substance abuse	56.6	72.2	76.2	40.4	100.0	100.0	100.0	100.0

SOURCE: Values derived by the authors from analysis of Medicaid claims data.

percent were for either chronic or potentially preventable/avoidable conditions (ambulatory care–sensitive, or ACS, conditions).[12] Another 13.1 percent involved substance abuse, and less than 1 percent were for mental illness. At a risk score threshold of 90, 51.7 percent involved admissions for chronic conditions, and 58.4 percent were for either chronic or ACS conditions. For seriously and persistently mentally ill patients, more than half of future admissions of patients with risk scores of 50 or more involved a primary diagnosis of mental illness (Exhibit 5). For such patients with risk scores of 90 or more, the proportion of admissions with mental illness was lower, with somewhat higher levels of chronic disease admissions and chronic/ACS conditions than for those with risk scores of 50 or more (Exhibit 5).[13]

Discussion

This analysis provides some encouragement to policymakers, health plans, and providers interested in initiatives to target high-cost Medicaid patients. With existing data, it is possible to identify with reasonable accuracy patients at risk of admission in the next twelve months. There is a lot of money on the table, with spending of $222 million and $263 million representing 30–40 percent of all Medicaid expenditures for adult SSI mandatory Medicaid managed care and seriously and persistently mentally ill patients, respectively, with risk scores of 50 or more, even though these high-cost patients represented only 8 percent of all mandatory Medicaid managed care and 19 percent of all seriously and persistently mentally ill patients.

The business-case analysis also suggests that sizable net savings can be achieved with relatively modest assumptions about the ability to affect future hospitalizations. For example, for SSI mandatory Medicaid managed care patients

EXHIBIT 5
Percentage Of Identified Patients Having Various Diagnoses in "Future Admissions," New York City Medicaid, 2002

	Mandatory Medicaid managed care				Seriously and persistently mentally ill			
	Risk score			All	Risk score			All
Diagnosis	50+	75+	90+	patients	50+	75+	90+	patients
Medical admission	59.8	69.9	76.7	56.1	19.5	19.5	26.1	25.5
Mental illness	0.5	0.4	0.3	2.0	55.7	51.4	42.6	46.7
Substance abuse	13.1	11.7	9.3	8.7	17.9	23.4	25.4	14.8
Cancer	4.7	1.9	0.9	5.6	0.7	0.2	0.3	1.8
Injury	3.1	2.1	1.4	4.8	2.1	2.5	2.6	2.3
Surgery/procedure	13.4	10.8	8.8	17.0	3.1	2.3	2.4	6.5
Other	5.4	3.3	2.7	5.8	1.1	0.6	0.6	2.3
Chronic disease	30.8	41.2	51.7	24.6	6.5	7.0	8.7	8.1
Chronic disease or ACS[a]	40.7	51.6	58.4	34.3	10.7	11.0	15.7	13.7

SOURCE: Values derived by the authors from analysis of Medicaid claims data.

[a] Ambulatory care–sensitive or preventable/avoidable conditions; see Note 14 in text.

"Whatever is on the shelf from disease management vendors for commercial plans will require overhaul for these populations."

with risk scores of 50 or more, spending of almost $2,500 per patient per year on an intervention will still enable break-even with only a 10 percent reduction in future admissions. For such patients with risk scores of 90 or more and future reductions of 20 percent, a cost of almost $9,000 per patient per year will still achieve break-even (Exhibit 3). With a cost of $3,000 per patient per year, total net savings citywide with a 20 percent reduction in admissions in the next twelve months for patients with risk scores of 50 or more would be $10.2 million for SSI mandatory Medicaid managed care patients and $24.6 million for seriously and persistently mentally ill patients after deducting costs of the intervention (figures in Exhibit 2 projected to combined Samples 1 and 2).

Accordingly, these data indicate that with careful case finding, sizable amounts can be invested to help improve the health and social care of patients at high risk of future hospital admission and high health costs, with the reasonable expectation that the cost of the intervention could be offset by savings from reduced hospitalizations. The data also provide some information about the characteristics of these patients that might be critical in intervention design. First, as noted above, 30 percent of subsequent admissions occur within ninety days of discharge, which confirms that improved discharge planning—preferably with an intervention that begins while the patient is still hospitalized—is likely to be critical to achieving future reductions in hospital admissions. In contrast, an initiative that depends on initial contact with postdischarge follow-up or on periodic analysis of archival data (with outreach to patients identified as being at high risk) could miss important opportunities to intervene in a timely manner. Moreover, many of these patients are likely to live in difficult social circumstances, and locating them after discharge to initiate an intervention would undoubtedly present challenges.

■ **Designing interventions.** The data on diagnostic history and characteristics of subsequent admissions may also provide some help in conceptualizing intervention design. The relatively high rates of chronic disease suggest the importance of a comprehensive, multidisciplinary approach to any intervention, using what we already know about improving chronic disease management (such as the chronic care model).[14] But the extraordinarily high levels of substance abuse among high-risk patients and the history of mental illness even among the population without serious and persistent mental illness make clear that any intervention will have to take these factors into account. Whatever is on the shelf from chronic disease management vendors for commercial plans and Medicare will require a serious overhaul for adaptation to these populations.

■ **Study limitations.** There are also significant limitations to this work. We have modeled various assumptions for expected reductions in future admissions (to off-

set intervention costs), but for this population it is extraordinarily difficult to assess in advance what level is reasonable. Is it 10 percent? 15 percent? 20 percent? Or is it closer to 0 percent? On the one hand, high levels of chronic disease and preventable/avoidable conditions among future admissions suggest opportunities for impact, but these are also patients with high levels of mental illness and substance abuse. Motivation and willingness to engage (core elements of many chronic disease management approaches) will present a huge barrier for many. The presence of mental illness in this population also is intimidating.[15]

There are also other important questions that remain unanswered. From claims records we can say little about the social and personal characteristics of these patients. This is a population living in extreme poverty, and a broad range of factors (educational, behavioral, and coping capacity) likely complicate their lives. We have documented their mental illness and substance abuse problems, and there are also potentially high levels of homelessness and housing instability. Getting more and better information about these issues will require further work, but it is clearly critical to any intervention design. However, the potential impact of solving these problems may also be large, even for the most apparently daunting problems such as the high number of mental illness admissions. For some high-risk patients, an effective, supportive housing environment might be enough to tip the balance, allowing sufficient life stabilization to address previously intractable health and mental health problems. An emerging body of research indicates that these "social service" interventions can have a major impact on the use of health services.[16]

An effective intervention will also generate additional costs. Some of these costs are likely those associated with more-effective discharge planning by a multidisciplinary team or those associated with management and care coordination by case workers with very small panel sizes. But costs are also likely to be associated with more use of primary care, specialty care, or prescription drugs (or greater adherence to medication regimens). We have modeled various cost levels for program intervention and identified some rough parameters for maximum spending that would allow break-even. But implementation in at least a quasi-experimental mode will be required to get a fuller understanding of the costs/savings trade-off.

We conducted this analysis using data from New York City, an environment with a relatively rich Medicaid program and a unique social/demographic population mix. Although analysis of Medicare data in the *Dartmouth Atlas of Health Care* suggests that admission rates in New York City are comparable to national averages, payment levels are clearly higher.[17] (Also, our approach focused on utilization and diagnostic history and did not include expenditure levels in the regression.) We have outlined an approach to case finding, but when it is applied in different areas for different populations, different variables will likely prove important in predicting future admissions, and the costs/savings trade-offs will likely differ as

well (see, for example, the application of a similar approach in the United Kingdom).[18]

Finally, it is critical to recognize the limitations of any approach to improved management and coordination in a health care system characterized by its fragmentation and competing interests. In a payment environment where admissions and visits remain revenue and there is only nominal coordination among hospitals, primary care providers, specialists, and other providers (even virtually, with electronic health records), the challenges are large. Of course, managed care holds some potential, especially with global capitation payments to organized care systems where admissions and visits are considered expenses and where there is likely to be some level of provider engagement that can help enable integration of intervention strategies directly into the practice environment. But for other managed care patients, there will continue to be serious, inherent limits to efforts at making meaningful changes in care pathways, provider decision making, or patient behavior remotely, either from plan headquarters or through a third-party vender not directly engaged with the care of the patient.

Moreover, while more than 60 percent of Medicaid patients nationally are in some form of "managed care," the majority of Medicaid spending remains in the FFS sector. Accordingly, even if savings are achieved from reduced hospital admissions with interventions targeted at high-cost/high-risk patients, the Medicaid program itself might not realize these savings if the emptied beds are "back-filled" with other FFS Medicaid patients. With an available bed, sending the patient upstairs is often the easiest option for the ED physician weighing treatment choices for a Medicaid patient who is perceived to be not well connected to the health care delivery system and likely to lack social support to help in self-management.

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NOTES

1. See V. Smith et al., "Low Medicaid Spending Growth amid Rebounding State Revenues" (Menlo Park, Calif.: Henry J. Kaiser Family Foundation, October 2006).
2. A. Sommers and M. Cohen, "Medicaid's High Cost Enrollees: How Much Do They Drive Program Spending?" (Menlo Park, Calif.: Kaiser Family Foundation, March 2006).
3. J.L. Gillespie and L.F. Rossiter, "Medicaid Disease Management Programs: Findings from Three Leading U.S. State Programs," *Disease Management and Health Outcomes* 11, no. 6 (2003): 345–361. See also the Indiana Chronic Disease Management Program home page, http://www.indianacdmprogram.com; Washington State Department of Social and Health Services, "Medicaid Disease Management Program Winds Down as DSHS Prepares New Approach for 2007," Press Release, 9 June 2006, http://www1.dshs.wa.gov/mediareleases/2006/pr06088.shtml (accessed 2 August 2007); and OMPRO, "An Evaluation of the Management of Chronic Disease by Oregon Health Plan Managed Care Plans, 2003–2004," 19 August 2005, http://www.oregon.gov/DHS/healthplan/data_pubs/reports/diseasemgt0304.pdf (accessed 2 August 2007).
4. R.Z. Goetzel et al., "Return on Investment in Disease Management: A Review," *Health Care Financing Review* 26, no. 4 (2005): 1–19.
5. J. Billings et al., "Case Finding for Patients at Risk of Readmission to Hospital: Development of an Algorithm to Identify High Risk Patients," *British Medical Journal* 333, no. 7563 (2006): 327; R.T. Meenan et al.,

"The Sensitivity and Specificity of Forecasting High-Cost Users of Medical Care," *Medical Care* 37, no. 8 (1999): 815–823; D.M. Smith et al., "Predicting Non-Elective Hospital Readmissions: A Multi-Site Study," *Journal of Clinical Epidemiology* 53, no. 11 (2000): 1113–1118; Y. Zhao et al., "Identifying Future High-Cost Cases through Predictive Modeling," *Disease Management and Health Outcomes* 11, no. 6 (2000): 389–397; and A.K. Rosen et al., "Identifying Future High-Healthcare Users: Exploring the Value of Diagnostic and Prior Utilization Information," *Disease Management and Health Outcomes* 13, no. 1 (2005): 117–127.

6. SSI disabled adults are low-income people who are unable to engage in substantial gainful activity, whose condition can be expected to result in death or has lasted or can be expected to last for a continuous period of not less than twelve months. For a more detailed description, see Social Security Administration, *Understanding Supplemental Security Income: SSI Eligibility Requirements, 2007 Edition,* http://www.socialsecurity.gov/ssi/text-eligibility-ussi.htm (accessed 2 August 2007). Patients with serious and persistent mental illness (as identified by the New York State Department of Health), those with dual eligibility, HIV/AIDS patients, patients with end-stage renal disease (ESRD), residents of intermediate care facilities for the mentally retarded (ICF/MR), and others were "exempted" from mandatory enrollment (but allowed to enroll voluntarily). Disabled "spend-down" patients, certain patients in long-term care, "restricted recipient" patients, and others were "excluded" for enrollment. For a full listing of exclusions and exemptions, see New York City Department of Health and Mental Hygiene, "New York City List of Exemption Categories," 2007, http:// www.nyc.gov/html/doh/html/hca/hca5.shtml (accessed 2 August 2007). About 8 percent of SSI disabled patients voluntarily enroll in managed care, and these patients were excluded from the analysis because claims data for these patients were not available.
7. For variables included in the model, see Appendix 1, online at http://content.healthaffairs.org/cgi/content/full/26/6/1643/DC1.
8. See J. Billings et al., *Case Finding Algorithms for Patients at Risk of Re-Hospitalisation, PARR1 and PARR2,* 22 February 2006, http://www.kingsfund.org.uk/document.rm?id=6209 (accessed 25 September 2007).
9. For information on the "archival" approach, as well as specific variable definitions and regression coefficients, see New York University, Center for Health and Public Service Research, "Variables Included in Stepwise Regression," http://www.nyu.edu/wagner/chpsr/CaseFindingAlgorithm.xls (accessed 25 September 2007).
10. See Appendix 2 online, as in Note 7.
11. See Appendix 3 online; ibid.
12. J. Billings et al., "Impact of Socioeconomic Status on Hospital Use in New York City," *Health Affairs* 12, no. 1 (1993): 162–173; and J. Billings, J. Anderson, and L. Newman, "Recent Findings on Preventable Hospitalizations," *Health Affairs* 15, no. 3 (1996): 239–249.
13. For a listing of the top twenty-five *International Classification of Diseases,* Ninth Revision (ICD-9), codes for future admissions, see Appendix 4 online, as in Note 7.
14. E.H. Wagner, B.T. Austin, and M. von Korff, "Organizing Care for Patients with Chronic Illness," *Millbank Quarterly* 74, no. 4 (1996): 511–544.
15. For a list of ICD-9 codes for future admissions, see Appendix 4 online, as in Note 7.
16. D.P. Culhane, S. Metreaux, and T. Hadley, "Public Service Reductions Associated with Placement of Homeless Persons with Severe Mental Illness in Supportive Housing," *Housing Policy Debate* 13, no. 1 (2002): 107–163; and T.E. Martinez and M.R. Burt, "Impact of Permanent Supportive Housing on the Use of Acute Care Health Services by Homeless Adults," *Psychiatric Services* 57, no. 7 (2006): 992–999.
17. See *Dartmouth Atlas of Health Care* Data Tables, http://cecsweb.dartmouth.edu/release1.1/datatools/datatb_s1.php (accessed 6 September 2007).
18. Billings et al., *Case Finding Algorithms.*