ORIGINAL RESEARCH

The Highest Utilizers of Care: Individualized Care Plans to Coordinate Care, Improve Healthcare Service Utilization, and Reduce Costs at an Academic Tertiary Care Center

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BACKGROUND: High utilizers are medically and psychosocially complex, have high rates of emergency department (ED) visits and hospital admissions, and contribute to rising healthcare costs.

OBJECTIVE: Develop individualized care plans to reduce unnecessary healthcare service utilization and hospital costs for complex, high utilizers of inpatient and ED care.

DESIGN: Quality-improvement intervention with a retrospective pre/post intervention analysis.

SETTING: Nine hundred twenty-four–bed tertiary academic medical center.

PATIENTS: Twenty-four medically and psychosocially complex patients with the highest rates of inpatient admissions and ED visits from August 1, 2012 to August 31, 2013.

INTERVENTION: A multidisciplinary team developed individualized care plans integrated into our electronic medical record (EMR) that summarize patient histories, utilization patterns, and management strategies.

MEASUREMENTS: Primary outcomes included inpatient admissions, ED visits, and corresponding variable direct costs 6 and 12 months after care-plan implementation. Secondary outcomes include inpatient length of stay (LOS) and 30-day readmissions.

RESULTS: Hospital admissions decreased by 56% ($P < 0.001$) and 50.5% ($P = 0.003$), 6 and 12 months after care-plan implementation. Thirty-day readmissions decreased by 66% ($P < 0.001$) and 51.5% ($P = 0.002$), 6 and 12 months after care-plan implementation. ED visits, ED costs, and inpatient LOS did not significantly change. Inpatient variable direct costs were reduced by 47.7% ($P = 0.001$) and 35.8% ($P = 0.052$), 6 and 12 months after care-plan implementation.

CONCLUSIONS: Individualized care plans developed by a multidisciplinary team and integrated with the existing healthcare workforce and EMR reduce hospital admissions, 30-day readmissions, and hospital costs for complex, high-utilizing patients. *Journal of Hospital Medicine* 2015;10:419–424. © 2015 Society of Hospital Medicine

High utilizers of hospital services are medically complex, psychosocially vulnerable, and at risk for adverse health outcomes.[1,2] They make up a fraction of the patient population but use a disproportionate amount of resources, with high rates of emergency department (ED) visits and hospital admissions.[1,3,4] Less than 1% of patients account for 21% of national healthcare spending, and hospital costs are the largest category of national healthcare expenditures.[2,5] Many patients who disproportionately contribute to high healthcare costs also have high hospital admission rates.[6]

Interventions targeting high utilizers have typically focused on the outpatient setting.[7–10] Interventions using individualized care plans in the ED reduced ED visits from 33% to 70%, but all have required an additional case management program or partnership with an outside nonprofit case management organization.[11–13] One study by a hospitalist group using individualized care plans reduced ED visits and admissions by 70%, 2 months after care-plan implementation; however, all of their care plans were focused explicitly on restricting intravenous opiate use for patients with chronic pain.[14]

Given the current focus on cost-conscious, high-quality care in the American healthcare system, we designed a quality-improvement (QI) intervention using individualized care plans to reduce unnecessary healthcare service utilization and hospital costs for the highest utilizers of ED and inpatient care. Our approach focuses on integrating care plans within our electronic medical record (EMR) and implementing them using the existing healthcare workforce. We analyzed pre- and postintervention data to determine its effect on service utilization and hospital costs across a regional health system.

METHODS

QI Intervention

We retrospectively analyzed data collected as part of an ongoing QI project at Duke University Hospital, a

924-bed academic tertiary care center with approximately 36,000 inpatient discharges per year. The Complex Care Plan Committee (CCPC) aims to improve the effectiveness, efficiency, and equity of care for medically, socially, and behaviorally complex adult patients who are the highest utilizers of care in the ED and inpatient medicine service. The CCPC is a volunteer, QI committee comprised of a multidisciplinary team from hospital medicine, emergency medicine, psychiatry, ambulatory care, social work, nursing, risk management, and performance services (system analysts). Individualized care plans are developed on a rolling basis as new patients are identified based on their hospital utilization rates (ED visits and admissions). To be eligible for a care plan, patients have to have at least 3 ED visits or admissions within 6 months and have some degree of medical, social, or behavioral complexity, for example, multiple medical comorbidities with care by several subspecialists, or concomitant psychiatric illness, substance abuse, and homelessness. Strict eligibility criteria are purposefully not imposed to allow flexibility and appropriate tailoring of this intervention to both high-utilizing and complex patients. Given their complexity, the CCPC felt that without individualized care plans these patients would be at increased risk for rehospitalization and increased morbidity or mortality. The patients included in this analysis are the 24 patients with the most ED visits and hospital admissions at Duke University Hospital, accounting for a total of 183 ED visits and 145 inpatient admissions in the 6 months before the care plans were rolled out.

Each individualized care plan summarizes the patient's medical, psychiatric, and social histories, documents any disruptive behaviors, reviews their hospital utilization patterns, and proposes a set of management strategies focused on providing high-quality care while limiting unnecessary admissions. They are written by 1 or 2 members of the CCPC who perform a thorough chart review and obtain collateral information from the ED, inpatient, and outpatient providers who have cared for that patient. Care plans are then reviewed and approved by the CCPC as a whole during monthly meetings. Care plans contain detailed information in the following domains: demographics; outpatient care team (primary care provider, specialists, psychiatrist/counselors, social worker, case manager, and home health agency); medical, psychiatric, and behavioral health history; social history; utilization patterns (dates of ED visits and hospitalizations with succinct narratives and outcomes of each admission); and finally ED, inpatient, and outpatient strategies for managing the patient, preventing unnecessary admissions, and connecting them to appropriate services. The CCPC chairperson reviews care plans quarterly to ensure they remain appropriate and relevant.

The care plan is a document uploaded into the EMR (EpicCare; Epic, Verona, WI), where it is available to any provider across the Duke health system. Within Epic, a colored banner visible across the top of the patient's chart notifies the provider of any patient with an individualized care plan. The care plan document is housed in a tab readily visible on the navigation pane. The care plan serves as a roadmap for ED providers and hospitalists, helping them navigate each patient's complex history and guiding them in their disposition decision making. We also developed an automated notification process such that when a high utilizer registers in the ED, a secure page is sent to the admitting hospitalist, who then notifies the ED provider. An automated email is also sent to the CCPC chairperson. These alerts also provide a mechanism for internal oversight and feedback by the CCPC to providers regarding care-plan adherence.

Outcome Variables and Data Analysis

Our analysis included the 24 patients with individualized care plans developed from August 1, 2012 to August 31, 2013. We analyzed utilization data 6 and 12 months before and 6 and 12 months after the individualized care-plan intervention was initiated (August 1, 2011 to August 31, 2014). Primary outcomes were the number of ED visits and hospital admissions, as well as ED and inpatient variable direct costs (VDCs). Secondary outcomes included inpatient length of stay (LOS) and 30-day readmissions. We analyzed outcome data across all 3 hospitals in the Duke University Health System. This includes the only 2 hospitals in Durham, North Carolina (population 245,475) and 1 hospital in Raleigh, North Carolina (population 431,746).

We also describe basic demographic data, payor status, and medical comorbidities for this cohort of patients. Payor status is defined as the most frequently reported payor type prior to care-plan implementation. Variable direct costs are directly related to patient care and fluctuate with patient volume. They include medications, supplies, laboratory tests, radiology studies, and nursing salaries. They are a proportion of total costs for an ED visit or hospitalization, excluding fixed and indirect costs, such as administrator or physician salaries, utilities, facilities, and equipment.

Primary and secondary outcomes were analyzed using descriptive statistics. Continuous outcomes are summarized with mean (standard deviation) and median (range), whereas categorical outcomes are summarized with N (%). LOS is calculated as the average number of days in the hospital per hospital admission per patient. The time periods of 12 months prior, 6 months prior, 6 months after, and 12 months after care-plan implementation were examined. Only patients with 6 or more months of post–care-plan data are included in the 6-month comparison, and only patients with 12 or more months of post–care-plan data are included in the 12-month comparison. One patient in the 6-month comparison group died very

TABLE 1. Patient Demographics and Comorbidities

	Patients With Care Plans, N = 24	Patients With 12 Months Post–Care Plan Follow-up, N = 12	Patients With 6 Months Post–Care Plan Follow-up, N = 23*
Age, y, mean (SD)	38.5 (11.7)	41.6 (9.2)	37.3 (10.5)
Median (range)	36 (25–65)	41 (28–58)	36 (25–58)
Gender, N (%)			
Male	11 (46%)	5 (42%)	11 (48%)
Female	13 (54%)	7 (58%)	12 (52%)
Payor, N (%)[†]			
Medicare	11 (46%)	6 (50%)	10 (43%)
Medicaid	9 (38%)	4 (33%)	9 (39%)
Medicare and Medicaid	0 (0%)	0 (0%)	0 (0%)
Private insurance	2 (8%)	1 (8%)	2 (9%)
None	1 (4%)	0 (0%)	1 (4%)
Other	1 (4%)	1 (8%)	1 (4%)
Comorbidities, N (%)[‡]			
Asthma	9 (38%)	5 (42%)	9 (39%)
Chronic obstructive pulmonary disease	2 (8%)	2 (17%)	2 (9%)
Chronic pain	20 (83%)	12 (100%)	20 (87%)
Coronary artery disease	5 (21%)	4 (33%)	5 (22%)
Diabetes mellitus	10 (42%)	6 (50%)	9 (39%)
End-stage renal disease	4 (17%)	4 (33%)	4 (17%)
Heart failure	5 (21%)	2 (17%)	4 (17%)
Hypertension	13 (54%)	6 (50%)	12 (52%)
Mental health/substance abuse	23 (96%)	12 (100%)	22 (96%)
Sickle cell	10 (42%)	5 (42%)	10 (43%)

NOTE: **Abbreviations:** SD, standard deviation. *One patient died soon after care-plan implementation; therefore N = 23. [†]Most frequently reported insurance type pre–care-plan start date. [‡]Patients can have more than 1 comorbidity; therefore, numbers do not add up to N = 24.

soon after care-plan implementation, so that patient is included in Table 1 (N = 24) but excluded from outcome analyses in Tables 2 and 3 (N = 23). Differences between 6 months pre– and 6 months post–care plan, and 12 months pre– and 12 months post–care plan were examined using the Wilcoxon signed rank test for nonparametric matched data. Mean change is calculated as ([Post-Pre]/Pre) for each patient, and then averaged across all patients. Mean percentage change is calculated as ([Post-Pre]/Pre)*100 for each patient, and then averaged across patients. It was done this way to emphasize the effect on the patient level. No adjustments were made for multiple comparisons. All statistical analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC). This study was granted exempt status by the Duke University Institutional Review Board.

RESULTS

Table 1 shows the demographics and comorbidities for the 24 patients with care plans included in this analysis. The average age of patients is 38.5 years (range, 25–65 years) and a nearly even split between males (11) and females (13). Chronic disease burden is high. Furthermore, 83% of patients have chronic pain and 96% have mental health problems or substance abuse.

Table 2 shows inpatient and ED utilization patterns before and after care-plan implementation. Inpatient admissions decreased by 56% for the 6 months after care-plan implementation ($P < 0.001$) and by 50.5% for the 12 months after care-plan implementation ($P = 0.003$). This translates to a decrease in the average number of admissions per patient from 6.3 to 2.4, 6 months post–care plan, and from 10.9 to 4.8, 12 months post–care plan.

TABLE 2. Utilization Patterns Before and After Care-Plan Implementation Across Duke University Health System*

	6 Months Pre Care Plan	6 Months Post Care Plan	12 Months Pre Care Plan	12 Months Post Care Plan	6-Month Change[†]	6-Month P Value[‡]	12-Month Change[†]	12-Month P Value[‡]
Admissions						<0.001		0.003
N	23	23	12	12	23	23	12	12
Total	145	56	131	58	−56.0% (41.6%)		−50.5% (43.9%)	
Mean (SD)	6.3 (3.8)	2.4 (2.4)	10.9 (6.3)	4.8 (4.2)	−3.9 (3.76)		−6.1 (6.02)	
Median (range)	5 (1–14)	2 (0–8)	8 (3–20)	3 (0–11)				
30-day readmissions						<0.001		0.002
N	23	23	12	12	23	23	12	12
Total	130	44	106	45	−66.0% (32.4%)		−51.5% (32.0%)	
Mean (SD)	5.7 (4.1)	1.9 (2.4)	8.8 (7.0)	3.8 (2.7)	−3.7 (3.79)		−5.1 (5.71)	
Median (range)	4 (0–13)	1 (0–8)	6 (0–19)	3 (0–11)				
Inpatient LOS						0.506		0.910
N	23	23	12	12	23	23	12	12
Total	766	358	665	317	−50.8% (51.4%)		−37.8% (78.8%)	
Mean (SD)	5.0 (3.2)	4.7 (4.3)	4.7 (1.5)	4.4 (3.1)	−0.3 (4.3)		−0.3 (2.27)	
Median (range)	4.3 (1.5–15.8)	4 (0–16)	4.8 (2.2–6.9)	3.7 (0–9)				
ED visits						0.836		0.941
N	23	23	12	12	23	23	12	12
Total	183	198	185	307	+42.9% (148.4%)		+48.4% (145.1%)	
Mean (SD)	8.0 (11.5)	8.6 (19.8)	15.4 (14.7)	25.6 (54.4)	0.7 (11.92)		10.2 (43.19)	
Median (range)	5 (0–50)	3 (0–96)	12 (1–50)	7 (1–196)				

NOTE: **Abbreviations:** ED, emergency department; LOS, length of stay; SD, standard deviation. *Duke University Health System includes Duke University Hospital, Duke Regional Hospital, and Duke Raleigh Hospital. [†]Mean percent change is calculated as ([Post-Pre]/Pre)*100 for each patient, and then averaged across patients. Mean change is calculated as Post-Pre for each patient, and then averaged across patients. [‡]Wilcoxon signed rank test.

TABLE 3. Healthcare Costs Before and After Care-Plan Implementation Across Duke University Health System*

	6 Months Pre Care Plan	6 Months Post Care Plan	12 Months Pre Care Plan	12 Months Post Care Plan	6-Month Change[†]	6-Month P Value[‡]	12-Month Change[†]	12-Month P Value[‡]
Inpatient costs ($)						0.001		0.052
N	23	23	12	12	23	23	12	12
Total	686,612.43	358,520.42	538,579.90	299,501.03	−47.7% (52.3%)		−35.8% (76.1%)	
Mean (SD)	29,852.71 (21,808.22)	15,587.84 (21,141.79)	44,881.66 (30,132.26)	24,958.42 (27,248.41)	−14,264.9 (19,301.75)		−19,923.2 (31,891.69)	
Median (range)	30,203.43 (1,625.18–80,171.87)	7,041.28 (0–86,457.05)	39,936.05 (8,237.53–82,861.11)	13,321.56 (0–82,309.19)				
ED costs ($)						0.143		0.850
N	23	23	12	12	23	23	12	12
Total	80,105.34	60,500.38	82,473.86	98,298.84	+12.5% (147.5%)		+48.0% (161.8%)	
Mean (SD)	3,482.84 (4,423.57)	2,630.45 (4,782.56)	6,872.82 (5,633.70)	8,191.57 (13,974.75)	−852.4 (2,780.01)		1,318.7 (10,348.89)	
Median (range)	2,239.19 (0–19,492.03)	1,163.45 (0–22,449.84)	5,924.31 (277.30–19,492.03)	3,002.70 (553.72–50,955.56)				
Combined costs ($)						0.002		0.129
N	23	23	12	12	23	23	12	12
Total	766,717.77	419,020.80	621,053.76	397,799.87	−45.3% (48.3%)		−25.5% (76.9%)	
Mean (SD)	33,335.56 (22,427.77)	18,218.30 (21,398.27)	51,754.48 (32,248.94)	33,149.99 (31,769.40)	−15,117.3 (19,932.41)		−18,604.5 (35,513.56)	
Median (range)	32,000.42 (1,625.18–80,611.70)	9,088.88 (0–87,549.37)	45,716.08 (10,874.05–99,426.72)	23,971.85 (553.72–85,440.12)				

NOTE: **Abbreviations:** ED, emergency department; SD, standard deviation. *Duke University Health System includes Duke University Hospital, Duke Regional Hospital, and Duke Raleigh Hospital. [†]Mean percent change is calculated as
([Post-Pre]/Pre)*100 for each patient, and then averaged across patients. Mean change is calculated as Post-Pre for each patient, and then averaged across patients. [‡]Wilcoxon signed rank test.

Thirty-day readmissions also significantly decreased after care-plan implementation. Among the 23 patients with data 6 months pre– and post–care plan, there were 130 readmissions before and 44 readmissions after care-plan implementation, a 66% reduction (P < 0.001). Among the 12 patients with data 12 months pre– and post–care plan, there were 106 readmissions before and 45 readmissions after care-plan implementation, a 51.5% reduction (P = 0.002). Inpatient LOS did not show a statistically significant change after care-plan implementation.

ED visits were similar for the 6 months pre– compared to 6 months post–care plan. ED visits at 12 months post–care plan increased from an average of 15.4 visits pre– to 25.6 visits per patient post–care plan. This was driven by a single homeless patient with dialysis-dependent end-stage renal disease, who had 134 ED visits in the 12 months after care–plan implementation. Analysis of the data with this outlier removed showed a reduction in ED visits from an average of 12.3 visits per patient to 10.1 visits per patient in the 12 months post–care plan; however, this was not statistically significant (P = 0.66, data not shown).

Table 3 shows inpatient and ED VDCs before and after care-plan implementation. The average VDCs per patient per admission decreased from $29,852.71 to $15,587.84, 6 months after care-plan implementation, a 47.7% reduction (P = 0.001). The average

VDCs per patient per admission decreased from $44,881.66 to $24,958.42, 12 months after care-plan implementation, a 35.8% reduction (P = 0.052). ED costs did not show a statistically significant decrease. However, with the outlier removed as above, costs did decrease by 12.3%, 6 months after care-plan implementation, approaching statistical significance (P = 0.073, data not shown). Combined inpatient and ED variable direct costs decreased by an average of $15,117.30, 6 months after care-plan implementation, a 45.3% reduction (P = 0.002), and by an average of $18,604.50, 12 months after care-plan implementation, a 25.5% reduction, although this did not reach statistical significance (P = 0.129).

DISCUSSION

A multidisciplinary team at our academic medical center developed individualized care plans tailored to the specific medical and psychosocial complexities of high utilizers to reduce unnecessary service utilization and hospital costs. Postintervention analysis shows reduced inpatient admissions and 30-day readmissions among this population by 50%. Furthermore, inpatient variable direct costs decreased by 47% for the 6 months following care-plan implementation and by 35% for the 12 months following care-plan implementation. This translates into a $347,696.97 cost savings for the 23 patients 6 months after care-plan implementation, and a $223,253.89 cost savings for

the 12 patients 12 months after care-plan implementation. This reduction in utilization and cost was seen across all 3 hospitals in the Duke University Health System, including the only 2 hospitals in Durham, North Carolina. Unlike other urban areas, public transportation in our region is scarce, and the options for hospital shopping in central North Carolina are relatively limited. Although this study does not measure utilization in surrounding counties, we do not feel this occurred as we did not see a rise in requests for medical records nor attempts to contact Duke providers for questions on these patients as a result of our intervention. This, along with our regional health system outcome analysis, provides support that our intervention did not cause patients to seek care elsewhere and result in cost-shifting to other facilities.

We hypothesize that our care plans may be responsible for decreased admissions and 30-day readmissions through several mechanisms. By raising awareness of these patients' excessive hospital utilization patterns and making this information readily available through our EMR, providers in the ED may be more conscientious about their admission decisions. Problems that at face value seem acute, are often more chronic and can be better managed in the outpatient setting. Several care plans also explicitly recommend limiting unnecessary intravenous opiate use for chronic pain patients. Other patients who have frequent admissions actually have end-stage disease, and care plans for these patients help facilitate referrals to hospice programs.

Care plans provide a consistent message of patient histories, utilization patterns, and management strategies, and also serve as a communication tool between hospitalists and ED providers. A systematic review of all ED-based interventions for high utilizers revealed that most studies did show a reduction in ED visits, but all incorporated case management programs to do so.[15] We did not reduce ED visits, possibly because we lacked the resources and care coordination a community-based case management program provides. However, care plans did serve as a platform with which hospitalists and ED providers can help coordinate care among multiple outpatient providers. This has potentially limited admissions by providing a referral destination or outpatient point of contact for ED providers. For example, as a result of our intervention, referral mechanisms to our comprehensive pain clinic and outpatient psychiatry clinic have both been strengthened and streamlined. The fact that care plans decreased admissions and readmissions, but not ED visits, suggests that our intervention may not have actually changed patient behavior, but instead changed provider practices in relation to disposition decisions in the ED.

Our QI intervention has several strengths. First, it is fully integrated within our existing healthcare workforce, without the need for an extra case management system. Second, it is seamlessly incorporated into our EMR and represents another potential use of an EMR that has not been previously touted. Third, the multidisciplinary nature of the CCPC ensures that all stakeholders involved in the care of high utilizers are represented. Fourth, the outcome analysis across all 3 hospitals in our health system provides a balancing metric against the notion that our intervention simply caused patients to seek care elsewhere in the region. Last, the QI design and lack of strict inclusion and exclusion criteria adds practicality and shows effectiveness, not just efficacy, of the intervention.

Because this was developed as a QI intervention without strict inclusion and exclusion criteria, generalizability is lacking. In the future, one could use the EMR to more systematically identify high-utilizing, complex patients. One study showed the ability to use the EMR with a standardized framework to identify hot spotting (high utilizers) and contextual anomaly detection (ie, anomalous utilization cases where patient-incurred levels of utilization are unexpected given their clinical characteristics).[16] The nonrandomized, retrospective pre/post-intervention analysis without a control group diminishes the external validity of the results and does introduce the potential for bias.

One of the primary study limitations includes the small sample size of only 24 patients. Admittedly, these first 24 patients are the absolute highest utilizers of care at our hospital, possibly making their utilization patterns more amenable to our intervention. The 96% prevalence rate of mental health and substance abuse in our cohort is significantly higher than other published data among high utilizers.[4,17,18] We are continuing to develop care plans for additional high-utilizing, complex patients, and expect to enroll more patients with end-stage disease, and relatively fewer with substance abuse or psychiatric illness as time goes on. It is possible this new cohort of patients has proportionally less "unnecessary" utilization, thus limiting our intervention effect. One final limitation of our study is the lack of care quality and patient safety outcomes. In future studies, health outcomes, adverse events, and outpatient care utilization will be important balancing measures to include.

In conclusion, we showed that a QI intervention using individualized care plans reduces hospital admissions, 30-day readmissions, and hospital costs across a regional health system for a group of complex, high-utilizing patients. This intervention can, and should, be developed by a multidisciplinary team and fully integrated into the existing healthcare workforce and EMR to ensure appropriateness, effectiveness, and longevity. Going forward, it will be imperative to evaluate this intervention prospectively, at multiple sites, in coordination with outpatient providers, and including quality and safety outcomes to determine if this hospital-based

intervention impacts care coordination, utilization rates, cost, and health outcomes across the broader healthcare system.

Disclosure

Disclosure: Nothing to report.

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