HIDI HealthStats

Statistics and Analysis From the Hospital Industry Data Institute

NOVEMBER 2017 ■ Predicting Patients at Risk of Becoming Hospital Super-Utilizers

Key Findings

- Throughout 2018, HIDI will deploy a super-utilizer predictive risk model using near-real time ADT feeds to assist hospitals and other providers in care coordination efforts.
- More than 20,000 Missourians visited a hospital between 10 and 384 times during fiscal year 2016.
- The majority of these hospital super-utilizers were uninsured or covered by Medicaid — their utilization accounted for nearly $3 billion in associated hospital charges during the year.
- Based on these risk factors, a predictive model was developed using HIDI data to prospectively identify patients at high risk of becoming hospital super-utilizers.
- The model exhibited 96 percent discriminant ability and strong external validity on a randomly selected, independent sample of 655,000 hospital patients in fiscal year 2016.

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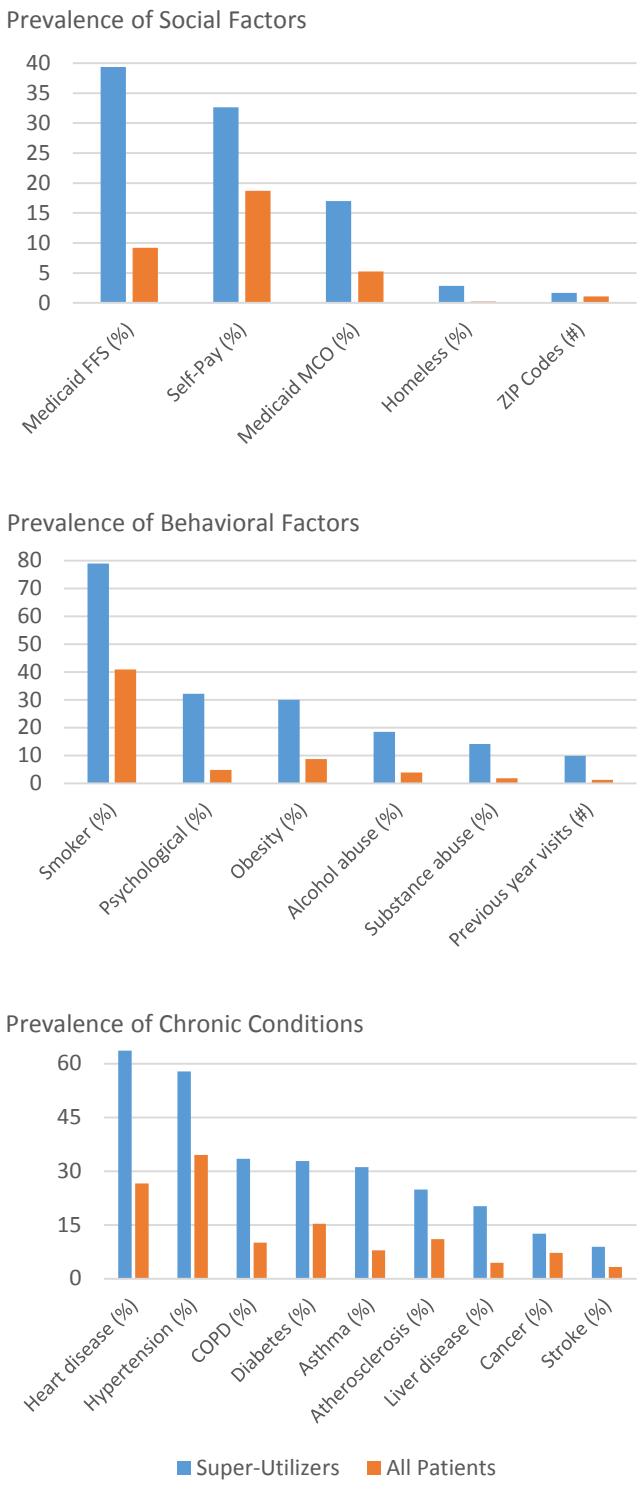
Background

Programs designed to intervene with hospital super-utilizers to reduce costs and improve outcomes commonly rely on predictive models to identify patients at highest risk of excess future hospital utilization, target scarce interventional resources and provide supplemental clinical and social decision support. For sustainability, super-utilizer intervention programs must exhibit more in direct cost savings than direct project investment.[i] Successful care coordination models designed to reduce unnecessary utilization among super-utilizers have found that programmatic costs were more than offset by reduced uncompensated inpatient days and emergency department visits.[ii] Robust risk prediction modeling increases the likelihood of positive programmatic ROI, particularly in accountable care settings when the intervening provider also bears part or all of the financial risk for avoidable health care utilization.

While various criteria are used to identify hospital super-utilizers, it is estimated that they collectively account for four to eight percent of all patients, and 21 to 28 percent of all ED utilization.[iii] [iv] Super-utilizers typically have a variety of clinical, social and behavioral complexities that add extreme difficulty in the design of interventions designed to reduce their ED utilization.[v] Successful interventions have focused on pain management, mental illness and substance abuse among patients by investing in integrated care delivery models that provide medical, social and mental health supports.[vi] [vii]

During fiscal year 2016 in Missouri, 20,655 patients with ten or more ED and inpatient visits accounted for 1.6 percent of patients, 12 percent of all inpatient and ED visits, and nearly $3 billion in hospital charges. With the exception of only 36 of these patients, all were identified as having at least one clinical, social or behavioral risk factor and 69 percent had all three risk factors. Nearly nine out of ten were diagnosed with a chronic disease during the year and 71 percent were diagnosed with multiple chronic conditions. Ninety percent were identified as having behavioral risk factors — more than half had more than one. And, 86 percent had a socioeconomic risk factor — nearly half had multiple social risk determinants. Super-utilizers with all three of the risk categories experienced 36 percent more hospital visits during fiscal year 2016 compared to super-utilizers with just one. Figure one contains the prevalence of clinical, social and behavioral risk factors for super-utilizers compared to all patients in Missouri during fiscal year 2016.

Figure 1: Rates of Social, Behavioral and Clinical Traits Among Super-Utilizers and All Patients in 2016



Source: Hospital Industry Data Institute

HIDI Advantage ADT Feeds

To enable near real-time notification of events, HIDI is developing an Admit, Discharge, Transfer feed and alerting solution within its HIDI Advantage platform. The transmission of the ADT feeds will trigger notification for patients identified on watch lists. There are two primary types of watch lists within the Advantage platform — hospital defined, and an analytic return to sender watch list. For hospital defined watch lists, a hospital will define a cohort of patients it wishes to receive alerts about based on their encounters with other participating hospitals. In the analytic return to sender watch list, HIDI creates the patient cohort based on its proprietary models, such as the super-utilizer model detailed below. When a patient in this cohort presents at a hospital, an alert is returned to that same hospital.

In both types of watch lists, there are four triggering events that may trigger a notification about a patient on a watch list. The four trigger events are inpatient admission, emergency department registration, transfer from outpatient to inpatient status and discharge. Once an alert is created based on the watch list, an email is sent to the individual(s) designated by the hospital. This email contains basic information that a notification exists and that they should log into the HIDI Advantage Alert portal to view the notification. When viewing the notification screens, hospital staff will be able to view a list of notifications received, as well as drill into a patient-specific view to see all alerts related to that individual patient.

This ADT data capture will also serve to increase the assets available for analysis and will serve to supplement the hospital discharge data. Recognizing that several hospitals actively participate in one or more health information exchanges, HIDI has initiated collaboration efforts with leadership of each of the active HIEs in Missouri. HIDI's goal is to connect hospitals to HIDI Advantage in the most efficient and cost effective manner possible, and to leverage work efforts where possible to eliminate unnecessary duplication and costs.

To realize the necessary data sharing and to fully enable alerts from ADT feeds, an updated Master Services Agreement between HIDI and member hospitals is required. HIDI will begin distribution of the updated Master Services Agreement later this fall. During the same time period, HIDI will solicit hospital participation in the project and collect the necessary information to begin the onboarding process throughout 2018.

Predictive Model Development

To demonstrate the value of using hospital discharge data to predict patients at risk of becoming super-utilizers, a retrospective study was conducted on Missouri residents who visited a hospital ED or were hospitalized as an inpatient during fiscal year 2016. The study cohort included all payers ages 18 and older, which resulted in a sample of 1,309,842 unique patients. Super-utilizers were defined as any patient with ten or more ED visits or inpatient hospitalizations during the 12-month study period. A total of 20,655 patients, or 1.6 percent of the full sample met this criteria, with a range of 10 to 384 visits during the year. The majority of super-utilizers in Missouri (71 percent) had between 10 and 15 hospital visits during the year, and only one percent (212 patients) had 60 or more visits.

A logistic regression model was fit to the data to estimate the risk each patient had of visiting a hospital ten or more times during the study period using information on patients' socio-demographic status, behavioral traits and presence of multiple chronic conditions. To test for internal validity, the full sample was partitioned into two randomly-selected, equal-sized cohorts, each consisting of 654,921 unique patients. The two random samples were used in identical models to test for differences in performance between the randomly generated development and validation model cohorts.

Table 1 contains summary statistics for the development and validation model cohorts, as well as for the full sample and patients meeting the super-utilizer criteria during the study period. No statistically significant differences were observed between the frequency of model variables for the development and validation models.

Table 1: Variable Frequency for Super-Utilizer Development, Validation and Full Models and Super-Utilizer Cohort

Parameter		Development Model	Validation Model	Full Model	Super-Utilizers
Observations		654,921	654,921	1,309,842	*20,655*
Super-utilizers		1.6%	1.6%	1.6%	*100.0%*
Socio-Demographic	Age	48.8	48.8	48.8	*43.8*
	Male	43.5%	43.5%	43.5%	*42.4%*
	Number of ZIP codes during year	1.07	1.07	1.07	*1.65*
	Primary payer Medicaid managed care during year	5.2%	5.3%	5.3%	*17.0%*
	Primary payer Medicaid fee for service during year	9.2%	9.2%	9.2%	*39.4%*
	Primary payer self-pay during year	18.7%	18.7%	18.7%	*32.6%*
	Homeless during year	0.2%	0.2%	0.2%	*2.8%*
Behavioral	Psychological diagnosis during year	4.8%	4.7%	4.8%	*32.2%*
	Alcohol abuse diagnosis during year	3.9%	3.8%	3.8%	*18.4%*
	Substance abuse diagnosis during year	1.8%	1.8%	1.8%	*14.2%*
	Smoker diagnosis during year	40.9%	40.8%	40.8%	*79.0%*
	Obesity diagnosis during year	8.6%	8.7%	8.7%	*30.0%*
	Previous year visits	1.27	1.26	1.26	*9.89*
Chronic Conditions	COPD diagnosis during year	10.0%	10.1%	10.1%	*33.5%*
	Stroke diagnosis during year	3.3%	3.3%	3.3%	*8.9%*
	Diabetes diagnosis during year	15.4%	15.3%	15.4%	*32.8%*
	Hypertension diagnosis during year	34.6%	34.5%	34.5%	*57.8%*
	Heart disease diagnosis during year	26.6%	26.6%	26.6%	*63.7%*
	Liver disease diagnosis during year	4.4%	4.4%	4.4%	*20.2%*
	Asthma diagnosis during year	7.9%	8.0%	7.9%	*31.2%*
	Cancer diagnosis during year	7.2%	7.2%	7.2%	*12.6%*
	Atherosclerosis diagnosis during year	11.0%	11.0%	11.0%	*24.8%*

Source: Hospital Industry Data Institute

Results for the development, validation and full models are contained in table 2. The coefficients for each of the included explanatory variables were statistically significant in each model. The strongest predictor of excess hospital utilization was psychological disorders, followed by heart and liver disease, patients with Medicaid Managed Care as a primary insurer at any time during the year, and the number of residential ZIP codes reported during the year — an indicator of housing stability. No statistically-significant differences in the discriminant ability of any of the three models were observed (as measured by C-statistics).

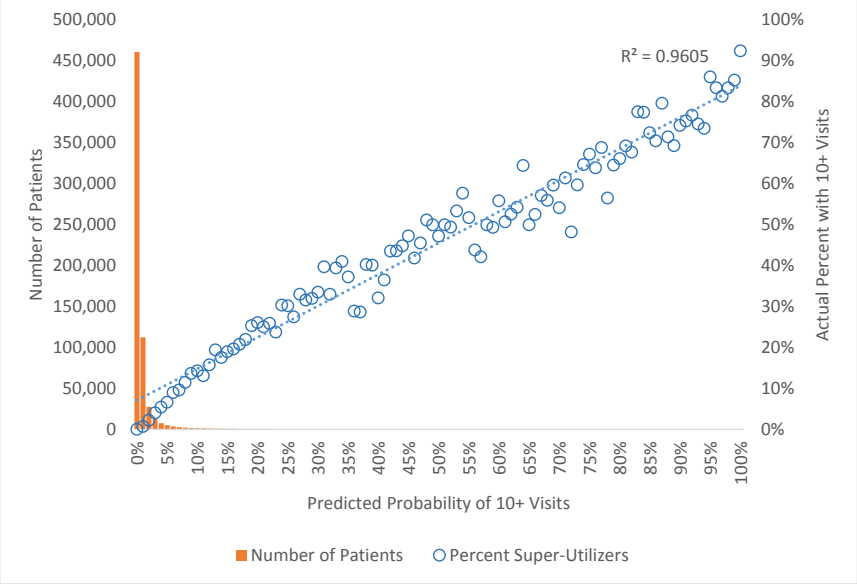
Table 2: Super-Utilizer Predictive Model Odds Ratios for Development, Validation and Full Sample Cohorts

Parameter		Development Model (95% CI)	Validation Model (95% CI)	Full Model (95% CI)
Socio-Demographic	Age	0.976-0.976*	0.974-0.974*	0.975-0.975*
	Male	0.957-0.952~	0.900-0.890*	0.927-0.922*
	Number of ZIP codes during year	2.051-2.166*	2.029-2.140*	2.056-2.136*
	Primary payer Medicaid managed care during year	2.287-2.603*	2.252-2.555*	2.314-2.533*
	Primary payer Medicaid fee for service during year	1.911-2.060*	1.806-1.934*	1.878-1.976*
	Primary payer self-pay during year	1.588-1.681*	1.621-1.721*	1.617-1.686*
	Homeless during year	1.162-1.260~	1.242-1.396^	1.219-1.307^
Behavioral	Psychological diagnosis during year	3.045-3.514*	3.138-3.636*	3.156-3.497*
	Alcohol abuse diagnosis during year	1.169-1.203*	1.168-1.202*	1.173-1.197*
	Substance abuse diagnosis during year	1.943-2.243*	1.801-2.049*	1.911-2.105*
	Smoker diagnosis during year	1.670-1.779*	1.683-1.796*	1.693-1.771*
	Obesity diagnosis during year	1.687-1.804*	1.651-1.761*	1.687-1.767*
	Previous year visits	1.271-1.274*	1.278-1.281*	1.275-1.277*
Chronic Conditions	COPD diagnosis during year	1.716-1.844*	1.763-1.902*	1.758-1.852*
	Stroke diagnosis during year	1.852-2.099*	1.800-2.035*	1.860-2.031*
	Diabetes diagnosis during year	1.355-1.410*	1.328-1.379*	1.348-1.386*
	Hypertension diagnosis during year	1.503-1.590*	1.503-1.591*	1.516-1.578*
	Heart disease diagnosis during year	2.751-3.118*	2.776-3.151*	2.816-3.078*
	Liver disease diagnosis during year	2.355-2.671*	2.537-2.903*	2.492-2.732*
	Asthma diagnosis during year	1.703-1.818*	1.712-1.827*	1.724-1.805*
	Cancer diagnosis during year	1.620-1.760*	1.702-1.863*	1.681-1.787*
	Atherosclerosis diagnosis during year	1.176-1.207*	1.229-1.270*	1.207-1.232*
				** P<0.0001, ^ P<0.05, ~ P<0.10*
	Observations	654,921	654,921	1,309,842
	Super-utilizers	10,297	10,358	20,655
	C-statistic	0.956	0.958	0.957

Source: Hospital Industry Data Institute

To test for external validity, and evaluate the predictive ability of the model, the coefficients generated by the development model were applied to the patient characteristics of the validation model cohort. The probability each randomly-selected validation model patient had of having ten or more hospital visits during the study period was calculated with a logarithmic transformation of the coefficients derived with the development model. The results were grouped into probabilities rounded to the nearest integer between one and 100 and compared to the actual observed percentage of those patients who were super-utilizers. Univariate analysis suggests that the predicted probability of super-utilization derived with the development model cohort explained 96 percent of the variation in the actual probability of super-utilization in the independent validation model patient cohort (Figure 2). These results signal the model's strong ability to prospectively identify patients who will consume excess health care resources.

Figure 2: Super-Utilizer Predictive Model External Validity Test Results



Source: Hospital Industry Data Institute

"Our hospital leaders have voluntarily invested new resources in HIDI to marry our analytic expertise with enabling technologies, which will create actionable insights to identify opportunities to improve care."

– Theresa Roark, MHA's Senior Vice President of Research, Data and Information Services

Suggested Citation

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