Outpatient Complex Case Management: Health System-Tailored Risk Stratification Taxonomy to Identify High-Cost, High-Need Patients

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BACKGROUND: U.S. health systems, incentivized by financial penalties, are designing programs such as case management to reduce service utilization among high-cost, high-need populations. The major challenge is identifying patients for whom targeted programs are most effective for achieving desired outcomes.

OBJECTIVE: To evaluate a health system's outpatient complex case management (OPCM) for Medicare beneficiaries for patients overall and for high-risk patients using system-tailored taxonomy, and examine whether OPCM lowers service utilization and healthcare costs.

DESIGN: Retrospective case-control study using Medicare data collected between 2012 and 2016 for Ochsner Health System.

PARTICIPANTS: Super-utilizers defined as Medicare patients with at least two hospital/ED encounters within 180 days of the index date including the index event.

INTERVENTION: Outpatient complex case management.

MAIN MEASURES: Propensity score-adjusted multivariable logistic regression analysis was conducted for primary outcomes (90-day hospital readmission; 90-day ED re-visit). A difference-in-difference analysis was conducted to examine changes in per membership per month (PMPM) costs based on OPCM exposure.

KEY RESULTS: Among 18,882 patients, 1197 (6.3%) were identified as "high-risk" and 470 (2.5%) were OPCM participants with median enrollment of 49 days. High-risk OPCM cases compared to high-risk controls had lower odds of 90-day hospital readmissions (0.81 [0.40–1.61], non-significant) and lower odds of 90-day ED re-visits (0.50 [0.32–0.79]). Non-high-risk OPCM cases compared to non-high-risk controls had lower odds of 90-day hospital readmissions (0.20 [0.11–0.36]) and 90-day ED re-visits (0.66 [0.47–0.94]). Among OPCM cases, high-risk patients compared to non-high-risk patients had greater odds of 90-day hospital readmissions (4.44 [1.87–10.54]); however, there was no difference in 90-day ED re-visits (0.99 [0.58–1.68]). Overall, OPCM cases had lower total cost of care compared to controls (PMPM mean [SD]: −$1037.71 [188.18]).

CONCLUSIONS: Use of risk stratification taxonomy for super-utilizers can identify patients most likely to benefit from case management. Future studies must further examine which OPCM components drive improvements in select outcome for specific populations.

KEY WORDS: case management; Medicare; utilization; health services research.

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INTRODUCTION

With the advent of financial penalties for hospital readmissions, U.S. health systems are redesigning healthcare services for high-need, high-cost patients. Such individuals are frequently over 65 years of age, publicly insured with multiple chronic conditions and high rates of service utilization.[1–3] Several models of comprehensive care for older adults with chronic conditions have shown improvements in quality, efficiency, and/or health-related outcomes of care.[4, 5] Case management, for example, can improve patient satisfaction with care, quality of care, and quality of life.[5, 6] However, evidence regarding the impact of case management on health care utilization and cost of care is mixed.[5–8]

Ochsner Health System, the largest integrated delivery health system Louisiana, launched an outpatient complex case management (OPCM) pilot program in 2012 employing principles of interdisciplinary primary care and transitional care interventions to improve care coordination while reducing hospital readmissions and emergency department (ED) utilization among Medicare beneficiaries. During the 3-year pilot phase (2012–2015), OPCM employed a heterogeneous approach to pre-screening patients for program eligibility. The program used administrative data to run predictive risk models and review prior inpatient/emergency department (ED) use patterns. OPCM also accepted outpatient/ambulatory care team referrals.

A preliminary evaluation of OPCM pilot program impact on reduction of readmissions showed its effect was neutral. An in-depth review of program procedures revealed that case managers relied mostly on referrals from primary care physicians. Among the 8577 patients referred to OPCM, 6601 underwent full screening, 4333 were deemed program eligible, but only 2576 enrolled. Among patients who accepted enrollment, only 32% were originally screened because of prior hospital/ED utilization. Most program participants only had one-time social service needs that did not require intense case management and were not necessarily high service utilizers. Therefore, OPCM did not sufficiently capture the most relevant population to achieve the stated program objective.

These findings prompted the health system to explore more practical solutions for identifying patients real-time who would benefit the most from OPCM. Physician leaders compiled a definition of high-risk patients based on a combination of clinical knowledge and population data review to capture "super-utilizers" with complex needs. Leadership determined that the factors indicating a "high-risk" Medicare patients were as follows: three or more chronic conditions; two or more hospital admissions or ED visits in the prior year; polypharmacy; and a history of depression, cognitive impairment, or falls. The main objectives of this 4-year retrospective observational study are to re-evaluate Ochsner's OPCM program using the revised risk stratification taxonomy for defining high risk, and to examine whether OPCM program participants had lower service utilization and cost of care compared to program non-participants.

METHODS

Study Design, Population, and Setting. This is a retrospective case-control study using Medicare insurance claims and clinical data within the Ochsner Health System. This study included patients who (1) were adults age 18 and older; (2) had received health care services between 2012 and 2015; (3) had insurance coverage through the system's largest Medicare plans (Medicare Advantage and Medicare Shared Savings Plan [MSSP]); (4) had an index event; and (5) had been enrolled in their health plan at least 180 days prior to the index event and a minimum of 1-day health plan enrollment after the index event. An index event was defined as (1) a hospitalization, (2) an ED visit resulting in a hospitalization, or (3) an ED visit. Patients included had at least two hospital/ED encounters—the index event and additional encounter(s) within 180 days after the index date. A minimum of 1-day health plan enrollment after the index event was chosen to simulate real-world identification of patients for the OPCM program and to allow for a subsequent event to occur as early as 1-day. The *primary exposure* was OPCM enrollment. *Cases* were defined as patients accepted into the OPCM program within 90 days of their index event. *Controls* were defined as having a similar history of hospital/ED encounters but did not have prior or subsequent exposure to OPCM. Approval for this study was obtained through the Ochsner Institutional Review Board.

Outpatient Complex Case Management. Table 1 provides details about the program. During the start-up years, OPCM initially employed a heterogeneous approach to identifying patients eligible for services. Case managers used Medicare Hierarchical Condition Category scores;[9] McKesson Risk Manager's prospective risk scores;[10] hospital discharge 3 M severity of illness score;[11] or prior hospital/ED use patterns to identify patients at risk for being high service utilizers. Since the aforementioned risk tools relied on administrative data that was often not available real-time, case managers heavily depended on care team referrals to proactively capture patients with complex medical conditions, high service utilization, care coordination, and complex psychosocial needs.

Case managers conducted chart reviews and patient/caregiver interviews to confirm program eligibility using a standardized checklist to assess complexity of health, service utilization in the last 6 months, disabilities, housing issues, and receipt of support services. If deemed eligible, a targeted assessment was conducted by an assigned case manager using additional checklists to further assess medical and/or psychosocial needs. Case complexity determined whether both registered nurses and social worker case managers were assigned. Services included medication reconciliation, patient education, care coordination, and conduct of complex psychosocial, or socioeconomic interventions. Follow-up assessments via clinic visits, home visits, or telephone occurred on a weekly to monthly basis depending on individual care plans.

Study Variables and Data Sources. The *main study outcomes are* 90-day hospital readmission and 90-day ED re-visit. The *main independent variable* is OPCM program enrollment. We selected 90-day readmission because the median length of time in OPCM was approximately 50 days. *Secondary outcome* was total cost of care. *Covariates* of interest included demographics (age, race, gender, insurance type, and zip code level income level), Charlson comorbidity index score,[12] and whether patients met the health system's definition of "high risk." For this analysis, "Ochsner high risk" was defined as patients having (1) ≥ 3 chronic diseases; *AND* (2) ≥ 2 hospital admissions *OR* ≥ 2 emergency department visits in the prior 12 months; *AND* (3) ≥ 10 active medications; *AND* (4) one of the following diagnoses—depression (ICD-9 codes: 296.xx, 311) *OR* "impaired cognition" (292.8×; 294; 298; 300.1×; 310.8×; 315; 331.8×; 348; 431; 437; 438; 780.9×; 799.5×; 854; 907; 909; v15.8×; v58.8×) *OR* fall (E880-E889) in the last 12 months. All data collected between 2012 and 2016 was

Table 1 Outpatient Complex Case Management Program for Health System Medicare Beneficiaries

Case identification (pilot phase procedures)	Hierarchical Condition Category scores Probability of Readmission scores (Medicare Advantage) McKesson Verisk DxCG prospective risk score Physician or care team referral Patient/family self-referral 3 M severity of illness score of hospitalized patients
Indications for referral	Complex diagnoses or catastrophic injury Coordination of multiple disciplines of care Complex psychosocial or socioeconomic intervention needed Increased utilization of inpatient or emergency room care
Screening checklist to confirm program eligibility	Health complexity Chronic health conditions Emotional status Number of medications Receipt of special treatments (e.g., tube feeds, dialysis) Inpatient/Emergency Department/ Ambulatory visits Disabilities Activities of daily living (and independent ADLs) History of falls Physical activity level Weight and nutrition status Living arrangements Receipt of support services (e.g., home health, transportation)
Initial assessment checklist	RN case manager addresses medical needs. Medications Cognitive status Hearing and vision status Health behaviors Caregiver issues Social worker caser manager addresses psychosocial needs. Mental health and coping skills Social network Housing/financial status Safety assessment Referral services
Scope of service includes clinic/home visits or telephone encounters weekly to monthly	Patient education regarding Illness/injury and treatment plan When to access emergency care When to contact their care team Coordinate complex discharge/home/ outpatient planning to Optimize care plan adherence Prevent duplication of services Remove barriers that may arise during care transitions Identify resources when complex interventions are needed Behavioral health issues Frail or non-existent support systems Inadequate coping skills Religious or ethnic beliefs Lack of transportation or financial support Limited education, health literacy, English proficiency Housing or place of residence.

extracted from Ochsner's Enterprise Data Warehouse. Medical service claims data was available for all study subjects. The 4-year period permitted analysis of data 1 year prior and 1 year after the OPCM program pilot years. Zip code level household median income data was retrieved from the Uniform Data System Mapper.[13]

Data Analysis. Since the stated primary outcomes are 90-day hospital/ED readmissions, the analysis was restricted to patients who had at least two events within 180 days of each other (e.g., super-utilizers).

Patient Characteristics. Descriptive statistics were performed for the entire sample. Bivariate analysis based on OPCM enrollment status was conducted with independent sample *t* tests or Wilcoxon rank sum tests for continuous variables as appropriate, and Pearson's chi-square tests for categorical variables.

Factors Associated with 90-Day Hospital Readmissions and ED Re-visits. Propensity score-adjusted multivariable logistic regression analysis was conducted for the primary endpoints (90-day hospital readmission and 90-day ED re-visit). The propensity score was constructed based on likelihood of receiving OPCM using clinically relevant patient characteristics (age, gender, race, insurance, income, Charlson comorbidity index score, and presence of any pre-index inpatient, ED, home health, or skilled nursing facility encounters).[14] In addition to the propensity score, the final logistic model employed to evaluate OPCM exposure incorporated covariates for patient demographics (age, gender, race, insurance, zip code level income), Charlson comorbidity index score, and Ochsner high-risk status.[14–16] Odds ratios were utilized to evaluate associations between outcomes and the model covariates. The propensity score was used solely to reduce bias and was not investigated in terms of relationship to readmission.

Multivariable Analysis of the Interaction Between OPCM Enrollment and High-risk Status. The analysis was repeated with a term added to the model to examine the interaction of "Ochsner high-risk" status with OPCM enrollment. The adjusted odds of readmission were calculated for each subgroup combination of risk status and OPCM status. Pairwise comparisons were carried out via odds ratios.

OPCM Enrollment and Change in Cost of Care. A difference-in-difference (DID) analysis was conducted for membership per month costs based on OPCM exposure (change in the difference between mean OPCM and control group costs following the index event) using a linear mixed model for repeated measures. For consistency of analyses across the study, all terms from the model used for the primary outcomes were included in the cost model with the addition of terms accounting for time. These additional terms were as follows: time (pre-/post-index), the two-way interactions of time with OPCM exposure and of time with Ochsner high-risk status, and the three-way interaction of time, OPCM exposure, and Ochsner high-risk status. Within-patient correlations over time were accounted for via a random patient effect modeled with an unstructured correlation matrix. The DID

statistic was constructed using adjusted means of healthcare costs from the model and evaluated via a *t* test.

All odds ratios (ORs) with 95% confidence intervals (CIs) and means with standard errors (SEs) are reported as fully adjusted results. Statistical significance was set at p value < 0.05 and results were adjusted for multiple comparisons using the Tukey-Kramer method when appropriate. All analyses were conducted using SAS/STAT® software, Version 9.4 of the SAS System for Windows (Cary, NC, USA).

RESULTS

Patient Characteristics. A total of 18,882 patients were eligible for inclusion in the data analysis (Table 2). Most patients were female, White non-Hispanic with a median age of 75 years, and living in neighborhoods with low to medium levels of household income. Only 6% ($n = 1197$) of the population was identified as high risk by the health system's new definition. Under OPCM's original case identification procedures, the program only captured 16% ($n = 187$) of high-risk patients. More than one-third of patients had a 90-day hospital readmission. A similar rate was observed for repeat ED visits within 90 days of their index visit. Compared to OPCM non-participants (controls), a higher proportion of patients enrolled in OPCM were Black non-Hispanic, identified as high risk, had higher Charlson index scores, and higher overall cost of care. Eighty-three percent of controls had one of the top 40 primary discharge diagnoses seen among OPCM enrollees. Common primary discharge diagnoses among the study cohort ($N = 18,882$) included hypertension (56%), diabetes (23%), cardiac dysrhythmia (15%), respiratory disorder (13%), and coronary atherosclerosis (12%). The distributions of propensity scores between OPCM groups showed significant overlap, indicating good balance.

Table 2 Patient Characteristics by OPCM Enrollment Status ($N = 18,882$)

	OPCM*	
	No	Yes
	$n = 18,412$	$n = 470$
Demographics		
Age, median (IQR), years	75 (67–82)	77 (70–84)
Female, no. (%)	10,754 (58.4)	290 (61.7)
Race/ethnicity, no. (%)		
White, non-Hispanic	13,239 (71.9)	270 (57.5)
Black, non-Hispanic	4427 (24.0)	181 (38.5)
Hispanic	359 (2.0)	15 (3.2)
Other	387 (2.1)	4 (0.8)
Income level, no. (%)		
Low	6698 (36.4)	208 (44.3)
Medium	4890 (26.6)	110 (23.4)
High	6824 (37.1)	152 (32.3)
Insurance, no. (%)		
Medicare Shared Savings Plan	6188 (33.6)	124 (26.4)
Medicare Advantage	12,224 (66.4)	346 (73.6)
Intervention-OPCM days, median (IQR), days	NA	49 (31–76)
Morbidity indicators, no. (%)		
Charlson index, median (IQR)	1.0 (0.0–3.0)	4.0 (2.0–6.0)
Chronic disease total > 2	15,302 (83.1)	456 (97.0)
Ochsner high risk	1010 (5.5)	187 (39.8)
Depression†	570 (56.4)	98 (52.4)
History of fall†	342 (33.9)	78 (41.7)
Cognitive impairment†	394 (39.0)	68 (36.4)
Congestive heart failure	2013 (10.9)	162 (34.5)
Hypertension	10,661 (57.9)	371 (78.9)
Diabetes	4681 (25.4)	233 (49.6)
Chronic lung disease	2147 (11.7)	112 (23.8)
Opioid use	2815 (15.3)	108 (23.0)
Index events, no. (%)		
Hospital admit (not from ED)	5471 (29.7)	175 (37.2)
Hospital admit from ED	3095 (16.8)	78 (16.6)
ED visit	9846 (53.5)	217 (46.2)
90-day post-index events, no. (%)		
Admission to hospital	3211 (17.4)	59 (12.6)
ED visit	6451 (35.0)	154 (32.8)

**OPCM outpatient case management, IP inpatient, ED emergency department*
†Diagnoses involved in determination of Ochsner high-risk status; denominator in calculation of percentages is number of high-risk patients

Factors Associated with 90-Day Hospital Readmissions. Figure 1 displays the multivariable analysis of 90-day hospital readmission. OPCM program enrollment (case vs. control, O.R. [95% CI] 0.33 [0.23–0.47]) and insurance plan (Medicare Advantage vs. MSSP 0.13 [0.12–0.14]) were associated with *lower odds* of 90-day hospital readmission. Increasing age (1.01 [1.005–1.014]), Ochsner high-risk (yes vs. no 1.20 [0.99–1.50]) status, and increasing Charlson index scores (1.05 [1.03–1.07]) were associated with *higher odds* of 90-day hospital readmission.

Factors Associated with 90-Day ED Re-visits. Figure 1 also displays the multivariable analysis of 90-day ED utilization. OPCM status (case vs. control 0.59 [0.48–0.74]) and insurance plan (Medicare Advantage vs. MSSP: 0.90 [0.84–0.96]) were associated with *lower odds* of a repeat ED visit within 90 days of the index visit. Race (Black vs. White non-Hispanic 1.14 [1.03–1.26]), Ochsner high-risk status (yes vs. no 1.27 [1.12–1.44]), and increasing Charlson index scores (1.02 [1.01–1.04]) were associated with *higher odds* of 90-day ED repeat visit.

Multivariable Analysis of the Interaction Between OPCM Enrollment and High-risk Status. Table 3 shows the unadjusted and adjusted odds of 90-day hospital readmission and ED re-visits based on interactions between OPCM enrollment and Ochsner high-risk status. In the multivariable analysis of *high-risk patients*, OPCM program participants compared to controls had lower odds of 90-day hospital readmissions but this difference was not significant (0.81 [0.40–1.61]). Also among high-risk patients, OPCM participants had significantly lower odds of 90-day ED re-visits (0.50 [0.32–0.79]). In the multivariable analysis of *patients who were not high-risk*, OPCM program participants compared to controls had significantly lower odds of 90-day hospital readmissions (0.20 [0.11–0.36]) and 90-day

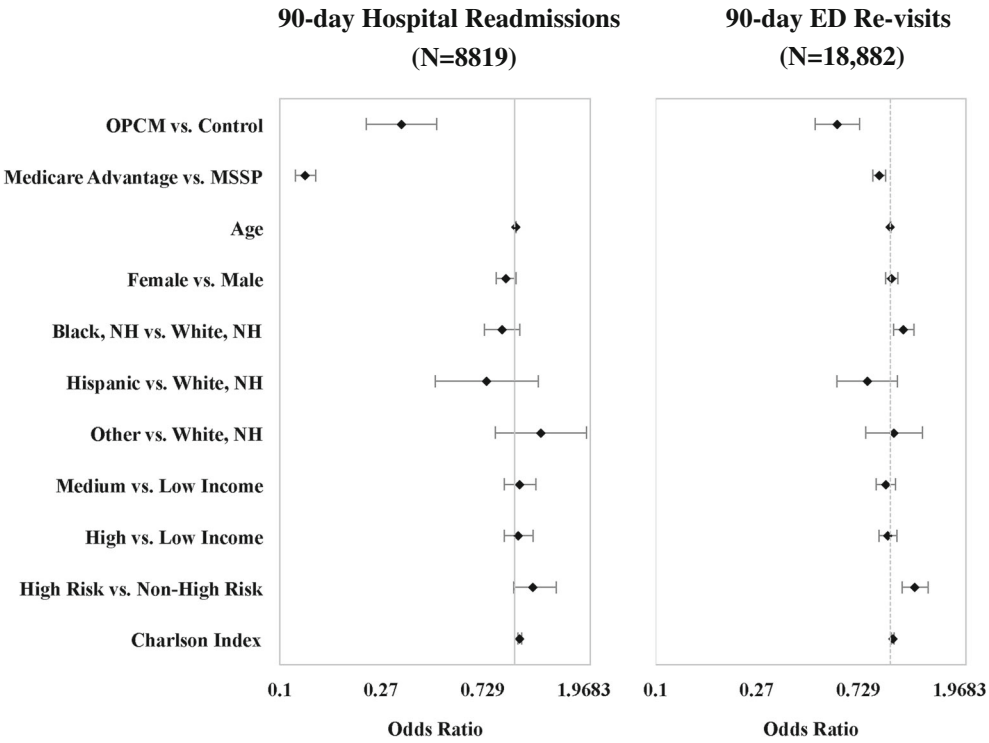

Fig. 1 Factors associated with 90-day hospital readmissions and 90-day emergency department re-visits.

ED re-visits (0.66 [0.47–0.94]). Notably among OPCM participants, high-risk patients compared to non-high-risk patients still had significantly greater odds of 90-day hospital readmissions (4.44 [1.87–10.54]); however, there was no significant difference in 90-day ED re-visits (0.99 [0.58–1.68]).

Table 3 Propensity Score-Adjusted Multivariable Logistic Regression Analysis Of 90-Day Hospital ($N = 8819$) and Emergency Department ($N = 18,884$) Readmissions Based on Ochsner High-risk Status Interaction with OPCM*

	90-day hospital re-admit		90-day ED re-visit	
	OR (95% CI)	AOR (95% CI)	OR (95% CI)	AOR (95% CI)
Comparison of case vs control within each Ochsner risk group				
High-risk OPCM vs. high-risk control	0.86 (0.50, 1.48)	0.81 (0.40, 1.61)	0.69 (0.45, 1.06)	0.50 (0.32, 0.79)‡
Non-high-risk OPCM vs. non-high-risk control	0.50 (0.30, 0.85)‡	0.20 (0.11, 0.36)†	0.88 (0.63, 1.23)	0.66 (0.47, 0.94)§
Comparison of Ochsner risk groups within each study group				
High-risk OPCM vs. non-high-risk OPCM	1.96 (0.95, 4.02)	4.44 (1.87, 10.54)†	1.12 (0.67, 1.87)	0.99 (0.58, 1.68)
High-risk control vs. non-high-risk control	1.14 (0.92, 1.41)	1.08 (0.83, 1.40)	1.43 (1.21, 1.69)†	1.31 (1.10, 1.55)‡

OPCM outpatient case management, OR odds ratio, CI confidence interval, AOR adjusted odds ratio

**The logistic model incorporated a main effect for OPCM group; covariates for age, sex, race, income level, insurance, Ochsner high-risk status, Charlson comorbidity index, and probability of receiving OPCM; and a two-way interaction term between OPCM group and Ochsner high-risk status*

†$P \leq 0.001$

‡$P \leq 0.01$

§$P < 0.05$

OPCM Enrollment and Change in Cost of Care. Table 4 shows the unadjusted and adjusted difference-in-difference (DID) analysis of member per month costs. In the adjusted model, OPCM-enrolled patients had higher average costs (mean [SE] $1687.27 [111.58]) compared to OPCM program non-participants ($1628.14 [48.74]) prior to the index events. Following the index events, there was a much larger reduction in costs for OPCM-enrolled patients, resulting in lower average total cost of care ($596.99 [165.94]) versus the non-enrolled patients ($1575.56 [64.46]).The DID analysis showed a post- versus pre-index event group difference of − $1037.71 [188.18]).

DISCUSSION

Since Ochsner's OPCM program objective was to reduce cost of care by reducing hospital/ED utilization, it was imperative to target patients likely to receive the most benefit (e.g., super-utilizers). The original approach to case identification incorporated administrative data-driven risk models—the utility of which was limited by delays in data availability. Subsequent reliance on care team referrals hampered the program's ability to capture the most relevant population to achieve the stated objective. Accordingly, Ochsner revised its risk stratification taxonomy. This retrospective data analysis found that the health system's new definition of high risk identifies patients with

Table 4 Multivariable Difference-in-Difference Analysis of Change in Member Per Month Costs Following Index Event (N = 18,882)

	Control		OPCM			
MPM total cost mean (SE)	**Pre-index**	**Post-index**	**Pre-index**	**Post-index**	**Difference-in-difference**	***p* value**
Unadjusted	$1170.04 (17.03)	$1387.04 (25.48)	$3265.52 (201.95)	$2220.42 (205.15)	−$1262.10 (176.50)	< 0.001
Adjusted	$1628.14 (48.74)	$1575.56 (64.46)	$1687.27 (111.58)	$596.99 (165.94)	−$1037.71 (188.18)	< 0.001

MPM member per month, OPCM outpatient complex case management)
All results presented as mean (SE). Model included main effects for OPCM status, Ochsner high-risk status, and time along with all interactions among these effects. Covariates for insurance, age, sex, race, income, Charlson comorbidity index, and propensity score were also included in the model. The means in the table are adjusted for all model terms

higher odds of hospital/ED readmission within the study population. Additionally, OPCM in this population reduced 90-day hospital/ED readmissions and cost of care for high service utilizers. The relationship between each subgroup combination of risk group-OPCM exposure status and service utilization appears to suggest differential impact of complex case management depending on the risk status. Nonetheless, even though the impact of OPCM on hospital readmission was not statistically significant for high-risk patients, the *direction* of the association was similar to that of non-high-risk patients. Both risk groups when exposed to OPCM had lower odds of ED re-visits.

In this retrospective analysis, unlike the initial program evaluation, we restricted our analysis to patients who appeared to be hospital/ED super-utilizers because of the specific program objectives. Given the large volume of patients who met our initial criteria of super-utilizer, we further risk stratified the study population using the health system's new definition. However, under OPCM's original case identification procedures, the pilot program only captured 16% of the newly defined high-risk patients; therefore, the full impact of OCPM on reducing service utilization among high-utilizers requires further analysis. Notwithstanding, at a minimum, this study demonstrates that targeting the program to the most relevant population can yield positive outcomes.

Ochsner's revised definition of high-risk incorporates factors (multiple chronic conditions, prior high use service utilization, poly-pharmacy, mental health conditions, and/or evidence of frailty) that have already been well documented in the literature as associated with high service utilization and cost of care. Adverse clinical consequences of poly-pharmacy include adverse drug events, drug interactions, functional decline, cognitive impairment, falls, and greater healthcare costs.[17] Individuals with mental/behavioral health conditions have higher rates of using ED and home care services as well as higher healthcare expenditures.[3, 18] Impaired cognition is similarly associated with higher rates of hospitalization, use of nursing and home care services, and healthcare costs.[19–22] Fall-related injuries are also very costly due to ED visits and hospitalization for fractures and head injuries.[23] Most of the aforementioned clinical factors are easily captured in electronic medical records and reduce the need to rely on risk models that use time-delayed administrative data.

This retrospective observational study has several limitations. The study reflects experience of one organization and may have limited external generalizability. The OPCM program only targeted patients enrolled in the Medicare Advantage and MSSP health plans for which the health system had shared savings and value-based contracts. The health system did not have a shared risk for pharmaceutical expenses under the MSSP contract; so, this information was not available for analysis. The medical service claims data was otherwise complete. Changes in cost of care for super-users could reflect population regression to the mean. To minimize this effect, we conducted a case-control study, employed propensity score-adjusted multivariable regression analysis, and report all results in terms of differences between the case and control groups. We acknowledge however that the OPCM program included a heterogenous group of patients. Our analyses may not have fully adjusted for inherent differences between the OPCM participants and non-participants. Finally, it is not clear which component of OPCM services explains the observed outcomes. Given the patient-centered approach to case management interventions, the scope of service provided to each patient may differ according to individual needs identified. Next steps in this research will include an in-depth examination of case management services rendered to this study's program participants including intensity, modes of contact, and types of case management (medical, social, or combination). This additional information will help further clarify which intervention components are associated with better outcomes.

An important lesson learned from this study is that programs targeting high-need, high-cost patients must critically assess alignment of program objectives with identification of the population at risk. Ochsner Health System's revised risk stratification taxonomy incorporates evidence-based measures of vulnerability/frailty to tailor case management as a cost-saving intervention to reduce service utilization for a specific population. We demonstrated that complex outpatient case management can reduce hospital/ED readmission and cost of care when the most relevant patient population is targeted. Given the current mixed evidence regarding the impact of case management on outcomes of care, future studies must further examine which intervention components drive improvements in outcomes among specific populations.

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Authors' Contributions *The authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the interpretation.*

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Compliance with Ethical Standards:

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