ORIGINAL ARTICLE

Positive clinical and financial outcomes of patient-management accountable metrics contract among hospitalists

David Yi*[1], John M. Davidyock[2], Deborah Haywood[3]

[1] Department of Clinical and Operational Analytics, Advent Health Central Florida Division South, Orlando, FL, United States
[2] Hospital Medicine, Advent Health Central Florida Division South, Orlando, FL, United States
[3] Physician Operations, Advent Health Central Florida Division South, Orlando, FL, United States

Received: April 30, 2019 **Accepted:** June 5, 2019 **Online Published:** June 11, 2019
DOI: 10.5430/jha.v8n4p30 **URL:** https://doi.org/10.5430/jha.v8n4p30

ABSTRACT

Background: Studies have shown positive outcomes for patients treated by hospitalists, however, the impact of Patient-management Accountable Metrics (PAM) contract among hospitalists on financial and clinical outcomes is unclear. This study intends to determine the impact of PAM contract among hospitalists on these outcomes.
Methods: This retrospective cohort study conducted in a 7-hospital health system in southeast U.S. region included 93,037 adult inpatients treated by 264 hospitalists and discharged in 2018. It measures the impact of PAM contract among hospitalists on total cost, variable cost, contribution margin, length of stay (LOS), 30-day readmission and mortality per inpatient discharge. Univariate and multivariable regression analysis were used for measuring outcomes.
Results: When compared with non- PAM contracted hospitalists, PAM contracted hospitalists were estimated per case to have $437 ([95% CI: $326 to $548]) lower in total cost, $123 ([95% CI: $73 to $173]) lower in variable cost, $361 ([95% CI: $241 to $481]) higher in contribution margin, 0.37 days ([95% CI: 0.33 to 0.42]) shorter in LOS, and lower 30-day readmissions probability with an odds ratio of 0.82, ([95% CI: 0.79 to 0.86]). The impact of PAM contractual status was not significant on mortality rates. Study hospital system projected $17 million annual cost reduction, $14 million contribution margin and 14,000 patient days savings if all hospitalists were PAM contracted.
Conclusions: This study indicates that PAM contract had positive financial and clinical impact among hospitalists. These findings may help hospitals improve clinical outcomes while reducing costs and improve margin.

Key Words: Hospitalist, Clinical outcome, Financial outcome, Patient-management Accountable Metrics contract, Contribution margin

1. INTRODUCTION

Through the last two decades, hospital medicine has evolved and continued to be the fastest growing specialty in the era of modern medicine.[1–4] Numerous studies have compared care delivery in hospitals between hospitalists and non-hospitalists and showcased the advantages hospitalists have in acute inpatient care.[5–9] Ultimately, they have yielded to the success of the hospital medicine movement.[10–12] However, what separates high and low performing hospitalists has yet to be dissected. This article focused on the out-

*Correspondence: David Yi; Email: david.yi@adventhealth.com; Address: Department of Clinical and Operational Analytics, Advent Health Central Florida Division South, Orlando, FL, United States.

come differences between hospitalists that accepted a Patient-management Accountable Metrics contract (PAM contract; henceforth: "contracted hospitalist" and those without PAM contract "non-contracted hospitalists") with financial incentives and those who did not. The contracted hospitalists held a set of patient management requirements along with a potential financial reward for performance excellence. The outcomes between the contracted and non-contracted hospitalists were in two areas: clinical outcomes which include length of stay (LOS), 30-day readmission, and in-hospital mortality; and financial outcomes which include total cost, variable cost and contribution margin. These outcome measures have been increasingly used by U.S. hospitals to improve quality of care.[13–17] Our primary focus in this study was to show the efficacy of PAM contract and its potential benefits to both patients and hospitals.

2. METHODS

Local Institutional Review Board granted exemption status to this study. We conducted a retrospective review of outcomes both financially and clinically using administrative databases to investigate adult inpatients tended by hospitalists and discharged in 2018.

2.1 Study institution, PAM contract and hospitalists

The study hospital system comprising of non-profit community hospitals is in Southeast U.S. Seven out of its ten campuses provide acute inpatient care services which were the source of this study population; two freestanding emergency departments and one children's hospital were not included in this study. This hospital system has 2,675 beds and 2,230 staff physicians. Every year it has 602,500 ED visits and 131,000 inpatient admissions.

The PAM contract constructed by management in the study institution constitutes two parts: patient management requirements and performance metrics. Patient management requirements consist of daily hospital rounds, medical management, hospital discharge management, coordination with hospital administration and other provisions. This part mainly addresses process efficiency such as appropriate admission and consultation utilization, timely documentation, coordination with ED physicians, consults, primary care physicians (PCP) and specialists, and utilization of computerized order entry and order sets. The performance metrics consist of core performance measures, which a hospitalist needs to achieve to maintain contracted status; and bonus performance metrics tie to their bonus when met. Specific numeric goals are set for these metrics such as daily patient load less than 18 billable patients per hospitalist, patient perception of daily nurse-physician rounding from HCAHPS $\geq$ 80% (HCAHPS: Hospital Consumer Assessment of Healthcare Providers and Systems), 3-hour sepsis bundle compliance and respond to ED call within 30 minutes etc (see Appendix Tables s1-s2 for specific requirements and metrics).

The hospitalists identified in this study were attending physicians with a hospitalist specialty. They were grouped into two categories: contracted and non-contracted based on whether an effective PAM contract existed for a hospitalist during the study period. The attending physicians' specialty was identified using Morrisey Physician Database, an internal physician credentialing database that is updated daily. A hospitalist whose PAM contract ended prior to the beginning of the study period was identified as non-contracted. When a hospitalist with a PAM contract that either started or ended during the study period, only the time frames with effective contractual status would this physician be deemed as a contracted hospitalist. As the PAM contract were also campus-specific, a contracted hospitalist could see patients on more than one campus; under such circumstances, patients seen at contracted campus were identified as contracted and patients seen at non-contracted campuses by the same hospitalist were identified as non-contracted (see Table 1 & Appendix Figure 1 for details).

2.2 Study population

We extracted financial outcomes using claims data from the study hospitals' accounting and finance systems. Clinical outcomes were from the hospitals' electronic medical record (EHR) database. Morrisey Physician Database was used to extract attending physician specialty and contract time frame. Risk adjustment factor such as severity of illness from 3M® All Patient Refined Diagnosis Related Group (APR-DRG) was acquired from a vendor benchmark database. Study patients were inpatients with age $\geq$ 18 years and LOS $\geq$ 1 day; discharged between January 1st and December 31st in calendar year 2018. Among all 126,075 eligible patients, 93,037 were tended by an attending physician with hospitalist specialty which is the study population; those patients treated by non-hospitalist attending physicians were out of scope (see Appendix Figure 2 for exclusions).

For each patient in the study population, the following data were collected: age, gender, contracted vs. non-contracted hospitalist as attending physician, types of admission (emergency department [ED] or Non-ED), insurance payer (Medicare, Medicaid, managed care, other and self-pay), total cost, variable cost, contribution margin, case mix index, LOS, 3M® APR-DRG severity of illness, in-hospital mortalities, 30-day readmissions, and medical vs. surgical MSDRG category.

2.3 Study outcomes

Of the two types of study outcomes, financial outcome included total cost, variable cost and contribution margin; and clinical outcome included LOS, mortality and 30-day readmissions. Specifically, total cost was defined as all variable and fixed hospital expenditures combined to provide direct patient care and to manage and operate the facility. Fixed costs are all expenditures that do not change with business volumes. Examples include management salaries and benefits and depreciation of equipment and buildings. Variable costs were defined as all expenditures that vary based on changes in business volumes. Examples include nursing and other direct patient care salaries, benefits, supplies, and drugs. Each patient discharge was allocated a pro rata portion of the variable costs according to specific charges incurred. Contribution margin, an indicator of a hospital's profitability, was defined as total actual payments minus variable costs.[18] For clinical outcomes, patient's LOS was the gap between admission and discharge dates. Mortality rate captured patients expired during hospitalization. 30-day readmissions were derived using a patient's Medical Record Number (MRN, a unique perpetual patient ID) and tracked admissions to the study hospitals within 30 days after the patient was discharged from the indexed hospitalization.

2.4 Statistical analysis

We used univariate and multivariable regression analysis to measure outcome differences between contracted and non-contracted hospitalists. In the univariate analysis, we used Kruskal-Wallis rank tests and compared the mean differences for continuous variables that were non-normal.[19] Chi-square test was used to measure differences in categorical variables. For multivariable regression analysis, we used multiple linear regression and estimated continuous outcomes including total cost, variable cost, contribution margin and LOS. Results were reported in parameter estimates and p-values. We used multiple logistic models and estimated binary outcomes for 30-day readmissions and mortality and reported results in odds ratios (OR) and p-values.[20] In the models, covariates were included for adjustment of confounding factors; specific covariates included hospitalist's contract/non-contract status, patients' gender, age, admission type, insurance payor, case mix index, APR-DRG severity of illness, and medical/surgical MSDRG category. We coded discrete variables as either binary or categorical. For every coded variable, the sub-category with the highest percentage was defaulted as the referent. To adequately adjust risk, we included APR-DRG severity of illness. It is a powerful and widely used risk adjustment tool that is categorized based on all hospital-reported diagnoses, all re-abstracted diagnoses, diagnoses present on admission and all relevant diagnoses, regardless of timing.[21]

We applied a traditional health services research approach using multivariate regression models instead of transforming skewed outcome variables such as costs and LOS based on literature reviews.[22–27] To ensure result robustness, we used several model evaluation and refinements techniques. Tolerance and variance inflation factor (VIF) was used to check multicollinearity in all multivariate linear regressions. VIF reveals the degree of multicollinearity between one independent variable and other independent variables in the same model.[28] In our final models, we only included independent variables with a VIF value less than 10. We also examined outliers in continuous outcome variables according to outlier identification techniques.[29] Since hospitalists may contract with certain campuses but not all campuses in the study hospital system, campus specific characteristics may potentially influence the model results. For potential clustering effects, models were tested with clustering on discharge campus.[30] The results using clustering are found to have no significant change from the original model results in general (see Appendix Table s3 for details). Propensity score analysis was also used as it is an appropriate approach for treatment effects estimation with observational or nonexperimental data.[31] We found its results similar to the linear and logistic models (see Appendix Table s4). We consider p-values $\leq .05$ as statistically significant. Stata® 13.1 was used for all statistical analyses.

3. RESULTS

Table 1 shows the count of attending physicians by specialty, contractual status and patient volumes in each category. Of the 951 attending physicians, 687 or 72% were non-hospitalists and treated 33,038 or 26% of the patients. However, since the study focuses on the impact of contractual status among hospitalists, the non-hospitalist subgroup is out of scope. For hospitalists, 195 or 21% were contracted and treated 54,265 or 43% of the study population; 226 or 23% were non-contracted and tended 38,772 or 31% of study patients. Within 264 hospitalists, 157 treated patients under both contracted and non-contracted status due to different contractual time frame and effective campuses. However, as Appendix Figure 1 shows, the majority of the 157 hospitalists treated patients mainly in one status, making the delineation of contractual status rather clear. Monthly view of patient volumes for both groups were also steady, indicating month-to-month changes were not significant.

In Table 2, baseline characteristics by contracted and non-contracted hospitalists and non-risk-adjusted patient demographics are reported. Of the 93,037 study patients, 54,265 were tended by contracted hospitalists and 38,772 by non-

contracted hospitalists. Patients in the contracted group were 59 years old on average with 52% being female while in non-contracted group the average was 62.6 years with 52% being female. Therefore, patients' average age in non-contracted group was significantly higher. For the insurance category, 48% in contracted group were Medicare comparing to 58% in non-contracted group. Managed care for both groups are similar and Medicaid and self-pay for contracted group are higher. Therefore, contracted group's patients appeared to be "poorly" insured. In fact, contracted hospitalists were required by contract to take care of "unassigned patients" who do not have designated physician on hospital medical staff; and "indigent patients" who do not have the ability to pay for the medical and hospital services they receive. 87% of contracted group's patients were admitted via ED while 82% of non-contracted group's patients were ED admissions. Average total cost, variable cost, contribution margin and case mix index were higher for non-contracted patients. Non-contracted also showed higher average LOS, in-hospital mortality and 30-day readmission rates; their APR-DRG severity of illness were also higher. However, the percentage distribution of medical vs. surgical DRG and top 20 high volume DRG are very similar between these two groups (see Appendix Table s5 for details).

Table 1. Summary of attending physician and specialty and monthly patient volume

Variable	Hospitalist (Contracted)	Hospitalist (Non-Contracted)	Non-Hospitalist	Total
Attending Physician Specialty				
Physician, n (%)	195 (21)*	226 (23)*	687 (72)	951
Patient, n (%)	54,265 (43)	38,772 (31)	33,038 (26)	126,075
Patient Monthly Volume				
Jan, n (%)	4,820 (44)	3,421 (31)	2,799 (25)	11,040
Feb, n (%)	4,299 (43)	3,143 (32)	2,493 (25)	9,935
Mar, n (%)	4,757 (44)	3,325 (31)	2,812 (26)	10,894
Apr, n (%)	4,344 (42)	3,259 (32)	2,655 (26)	10,258
May, n (%)	4,339 (42)	3,272 (32)	2,711 (26)	10,322
Jun, n (%)	4,423 (42)	3,340 (32)	2,724 (26)	10,487
Jul, n (%)	4,475 (43)	3,287 (31)	2,701 (26)	10,463
Aug, n (%)	4,571 (42)	3,488 (32)	2,936 (27)	10,995
Sep, n (%)	4,381 (43)	3,150 (31)	2,705 (26)	10,236
Oct, n (%)	4,652 (44)	3,080 (29)	2,834 (27)	10,566
Nov, n (%)	4,535 (44)	2,951 (29)	2,718 (27)	10,204
Dec, n (%)	4,669 (44)	3,056 (29)	2,950 (28)	10,675

Note. * Among 264 hospitalists, 157 had patients under both contracted and non-contracted status, however, great majority of the 157 had either patients treated under contracted status predominately or vice versa

Table 3 summarizes the risk-adjusted model parameter estimates. Compared with patients in non-contracted group, patients in contracted group had statistically lower total cost and variable cost per case by $437 and $123 respectively and higher contribution margin by $361. LOS per patient was shorter by 0.37 days for contracted group. Contracted also shows a 0.82 odds ratio for 30-day readmission which was significantly lower than non-contracted. In-hospital mortality rate between two groups showed no significant difference.

Table 4 shows the detailed risk-adjusted model results. Besides showing the significant impact of contractual status on most outcome measures, the impact of other factors on outcomes are also shown in this table. When compared with Medicare, managed care, self-pay and other payers had lower costs, shorter LOS and lower 30-day readmission probabilities. ED admissions had significantly lower costs, longer LOS and lower in-hospital mortality probability than non-ED admissions. As non-ED admissions were normally direct admission for scheduled surgical procedures, these outcomes reflect the characteristics of surgical patients. This is also confirmed by having surgical DRGs with $2,921 higher in total cost than medical DRG per case. Campus with the highest patient volumes appeared to have higher costs, longer LOS than all other campuses in the study; it also had higher in-hospital mortality and 30-day readmission probabilities than some of the other campuses.

Table 2. Patient demographics and baseline characteristics

Demographic and characteristics	Attending Hospitalist		*p*-value
	Contracted (n = 54,265)	Non-Contracted (n = 38,772)	
Patient Demographics			
Age, y, mean (SD) *	59.0 (18.7)	62.6 (18.1)	< .001
Female, n (%) †	28,238 (52)	20,044 (52)	.306
Insurance, n (%) †			
Medicare	26,251 (48)	22,362 (58)	< .001
Medicaid	6,619 (12)	3,514 (9)	< .001
Managed Care	10,723 (20)	7,260 (19)	< .001
Self-pay	7,002 (13)	3,206 (8)	< .001
Other	3,670 (7)	2,430 (6)	< .001
Admission Type n (%) †			
ED	47,119 (87)	31,760 (82)	< .001
Non ED	7,146 (13)	7,012 (18)	< .001
Financial Outcomes, $, mean (*SD*) *			
Total Cost/Case	12,928 (21,694)	15,891 (32,399)	< .001
Variable Cost/Case	5,548 (9,899)	6,928 (15,950)	< .001
Contribution Margin/Case	5,499 (21,168)	6,409 (32,954)	< .001
Casemix/Case	1.62 (1.36)	1.82 (2.02)	< .001
Clinical Outcomes *			
LOS, day, mean (*SD*)	4.75 (5.70)	5.48 (6.66)	< .001
Mortality Rate % (N/D)	0.85 (463/54,265)	1.13 (440/38,772)	< .001
Readmission Rate % (N/D)	13.2 (6,706/50,763)	15.7 (5,652/36,061)	< .001
Discharge Disposition among Survivors, % (N/D) †			
Home & Home Health Service	81.4 (43,809/53,802)	81.1 (31,075/38,332)	< .001
Skilled Nursing/Long-term Care/Rehab Facility	11.0 (5,939/53,802)	12.0 (4,613/38,332)	< .001
Hospice	2.6 (1,404/53,802)	3.0 (1,149/38,332)	< .001
Acute Care Facility	2.4 (1,305/53,802)	2.0 (756/38,332)	< .001
Against Medical Advice	2.5 (1,345/53,802)	1.9 (739/38,332)	< .001
APR-DRG Severity of Illness Category, n (%) †			
Minor	10,984 (20)	6,757 (17)	< .001
Moderate	21,301 (39)	14,165 (37)	< .001
Major	16,988 (31)	13,454 (35)	< .001
Extreme	4,989 (9)	4,396 (11)	< .001
MS-DRG Type, n (%) †			
Medical DRG	40,077 (74)	28,488 (73)	.196
Surgical DRG	14,188 (26)	10,284 (27)	.196

Note. * Examined by using Kruskal-Wallis rank test; † Examined by using chi-square test

4. DISCUSSION

We examined impact of PAM contract, a financial incentive contract rewarding performance excellence, among hospitalists on patient financial and clinical outcomes and concluded that contracted hospitalists had lower total and variable cost, higher contribution margin, shorter LOS and lower probabilities of 30-day readmissions than non-contracted hospitalists. In-hospital mortality rates were found not statistically different between these two groups. Despite small differences in coefficients with other statistical models such as propensity score matching and regression with clustering, the findings derived from multiple regressions in this study population are overall consistent.

Table 3. Summary of adjusted model parameter estimate results with 95% CI

Outcome Measures	Contracted vs. Non-Contracted	*p*-value
	Mean Estimate	
Total Cost, $ (95% CI)	-437 (-548 to -326)	< .001
Variable Cost, $ (95% CI)	-123 (-173 to -73)	< .001
Contribution Margin, $ (95% CI)	361 (241 to 481)	< .001
LOS, day (95% CI)	-0.37 (-0.42 to -0.33)	< .001
In-Hospital Mortality, odds ratio (95% CI)	1.02 (0.88 to 1.18)	.793
30-day Readmission, odds ratio (95% CI)	0.82 (0.79 to 0.86)	< .001

Table 4. Detailed adjusted model parameter estimate results at sub-category level*

Independent Variable	Dependent Variable, Mean Estimation (*p*-value)											
	Total Cost ($)		Variable Cost ($)		Contribution Margin ($)		LOS (day)		In-Hospital Mortality (OR)		30-day Readmission (OR)	
Contracted Hospitalist												
Contracted	-437	< .001	-123	< .001	361	< .001	-0.37	< .001	1.02	.793	0.82	< .001
Insurance Category						< .001						
Medicaid	169	.083	39	.369	-4,032	< .001	0.21	< .001	1.19	.261	1.12	.001
Managed Care	-377	< .001	-78	.031	18,264	< .001	-0.23	< .001	1.16	.279	0.65	< .001
Self-pay	-907	< .001	-328	< .001	-6,773	< .001	-0.23	< .001	1.26	.268	0.59	< .001
Other	-929	< .001	-325	< .001	4,034	< .001	-0.39	< .001	3.70	< .001	0.67	< .001
Admission Category												
ED	-1,213	< .001	-1,164	< .001	-43	.613	0.29	< .001	0.60	< .001	1.12	< .001
Other Category												
Severity of Illness	2,837	< .001	930	< .001	-651	< .001	1.97	< .001	8.70	< .001	1.66	< .001
Age	-8	< .001	-1	.502	9	< .001	0.00	.352	1.04	< .001	0.99	< .001
Female	307	< .001	113	< .001	-158	.004	0.13	< .001	0.99	.861	0.96	.053
Case Mix	4,438	< .001	2,068	< .001	545	< .001	0.73	.000	1.03	.014	0.99	.292
Surgical DRG	2,921	< .001	1,667	< .001	2,226	< .001	1.77	< .001	0.57	< .001	0.59	< .001
Race												
Black or African American	372	< .001	47	< .001	-349	< .001	0.35	< .001	0.90	.335	1.13	< .001
Other	-4	.954	-55	< .001	-299	< .001	0.15	< .001	1.01	.905	0.93	.023
Asian	-28	.904	-54	.602	779	< .001	0.10	.304	1.19	.517	0.85	.095
American Indian or Alaska Native	-201	.696	-162	.486	-275	.618	0.01	.950	0.95	.948	1.26	.225
Hispanic	754	< .001	203	.557	-2,786	.001	0.61	.055	0.81	.838	0.51	.069
Discharge Campus												
Campus 1	-2,823	< .001	-1,520	< .001	1,226	< .001	-0.79	< .001	0.61	< .001	1.05	.117
Campus 2	-461	< .001	-761	< .001	-520	< .001	-0.85	< .001	0.45	.001	0.72	< .001
Campus 3	-1,258	< .001	-1,278	< .001	732	< .001	-0.64	< .001	0.60	.001	0.80	< .001
Campus 4	-2,558	< .001	-1,239	< .001	1,225	< .001	-0.54	< .001	0.74	.010	0.97	.290
Campus 5	-2,177	< .001	-1,193	< .001	783	< .001	-0.52	< .001	1.57	< .001	0.76	< .001
Campus 6	-1,926	< .001	-1,213	< .001	796	< .001	-0.56	< .001	0.89	.388	0.98	.635
Model Measures												
Adjusted R^2	0.52		0.52		0.49		0.28					
Pseudo R^2 *(C-statistics)*									0.27 (0.91)		0.05 (0.66)	

Note. * Default reference subcategory for Insurance is Medicare; Admission Type is ER Admission; Race is white and Discharge Campus is the one with highest volume

Ever since the Affordable Care and its key program—value-based purchasing (VBP) were passed in 2010, U.S. hospitals have experienced a payments redistribution from Medicare. Approximately $1.9 billion of bonuses and penalties under VBP is projected to be redistributed in fiscal year 2019.[32] Quality improvement and cost reduction have become imperative factors for hospitals to stay viable. Providers, employers, and patients are increasingly attentive to healthcare quality and value. Our study outcomes are important because they measure care quality and hospital performance. These findings can be implemented to improve the management of hospitalist programs. First, this study demonstrated the im-

pact of PAM contract among hospitalists. Studies have found the efficacy of hospitalist programs and concluded that when compared with non-hospitalists, hospitalists were able to achieve lower costs and shorter LOS, while inconclusive on quality outcomes such as mortality and readmissions.[7, 10, 33] Studies comparing contracted and non-contracted hospitalists are yet to be done and this study may fill this void. Next, with over 93 thousand patients treated by almost 300 hospitalists, this study has a large population both in terms of patients and hospitalists, which is a strength that other study may lack due to small physician population.[34] Also, in the study hospital system, the unified method to manage contract, active daily update of physician credentialing database, and the standardized cost accounting systems and EMR systems ensure data accuracy and analysis reliability while reducing bias that may derive from different hospital systems used in other study.[35] Third, focused in 2018, the timeliness of this study will also make the findings more relevant for hospitals to achieve better outcomes. Last, the findings can potentially assist hospital systems to achieve better quality and lower costs by implementing contract programs. Hypothetically if all non-contracted hospitalists were contracted in this study hospital system, the total annual cost savings would be approximately $17 million, hospital margin which is a direct indicator of profitability, would increase by $14 million, and LOS saving 14,000 days; the 30-day readmissions would also be lower and no impact on in-hospital mortality rates. In reality, the logistics of having all hospitalists contracted may be a daunting task that can't be achieved overnight. The fact that a high percentage of hospitalists in this study hospital system were contracted may render this conversion less challenging, however, for hospitals with majority of their hospitalist not contracted, it will probably take greater effort to contract.

This study has several limitations: we were only able to track the study hospitals' readmissions, patients readmitted to other hospitals were not included. This prevented us from fully assessing the readmission impact. Coding accuracy can be a potential issue with administrative data and this study was not free from such characteristics of coded data. Hospitalists' gender, age, training school and years of experience were not available and hindered us from risk-adjusting using these factors.

All stakeholders in healthcare currently demand more value, which equates to lower cost and better quality than what the healthcare industry has provided in the past. Hospitals need to embrace quality improvement and create high value service as patients rightfully deserve. Our study suggests that contracted hospitalists can achieve better outcomes than non-contracted hospitalists. From a business profitability perspective, implementation of PAM contract has also proven to increase contribution margin in this study. To hospital management, this indicates that by delivering better outcome in patient care, hospitals will also be more profitable. This shows that quality improvement effort will pay back and foster business growth. Therefore, the existence of PAM contract among hospitalists may be a significant contributor for quality improvement in hospitals.

FUNDING/SUPPORT

This study was supported by Advent Health Central Florida Division South.

ROLE OF THE SPONSORS

Coauthors from the supporting organization were involved in the design and conduct of the study; collection, management, and interpretation of the data; and drafting and review of the manuscript.

AUTHORS' CONTRIBUTION

David Yi had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Yi, Davidyock and Haywood.

Acquisition of data: Yi.

Analysis and interpretation of data: Yi.

Statistical analysis: Yi.

Drafting and revision of the manuscript: Yi and Davidyock.

CONFLICTS OF INTEREST DISCLOSURE

None of the authors reported financial interest or material support disclosures.

REFERENCES

[1] Lurie JD, Miller DP, Lindenauer PK, et al. The potential size of the hospitalist workforce in the United States. Am J Med. 1999; 106: 441-5. https://doi.org/10.1016/S0002-9343(99)00045-5

[2] Wachter RM. An introduction to the hospitalist model. Ann Intern Med. 1999; 130: 338-42. PMid: 10068402. https://doi.org/10.7326/0003-4819-130-4-199902161-00002

[3] Kralovec PD, Miller JA, Wellikson L, et al. The status of hospital medicine groups in the United States. J Hosp Med. 2006; 1: 75-80. PMid: 17219476. https://doi.org/10.1002/jhm.82

[4] Palabindala V, Salim S. Era of Hospitalists. Journal of Community Hospital Internal Medicine Perspectives. 2018; 8(1): 16-20. PMid: 29441160. https://doi.org/10.1080/20009666.2017.1415102

[5] Epane JP, Weech-Maldonado R, Hearld L, et al. Hospitals' use of hospitalists implications for financial performance. Health Care Management Review. January/March 2019; 44(1): 10-18. PMid: 28700508. https://doi.org/10.1097/HMR.0000000000000170

[6] Stephens JR, Chang JW, Liles EA, et al. Impact of hospitalist vs. non-hospitalist services on length of stay and 30-day readmission rate in hip fracture patients. Hosp Pract (1995). 2019 Feb; 47(1): 24-27. PMid: 30328742. https://doi.org/10.1080/21548331.2019.1537850

[7] Auerbach AD, Wachter RM, Katz P, et al. Implementation of a voluntary hospitalist service at a community teaching hospital: improved clinical efficiency and patient outcomes. Ann Intern Med. 2002; 137: 859-65. PMid: 12458985. https://doi.org/10.7326/0003-4819-137-11-200212030-00006

[8] Li J, Williams M. Hospitalist value in an ACO world. J Hosp Med. 2018 April; 13(4): 272-276. PMid: 29624190. https://doi.org/10.12788/jhm.2965

[9] Wachter RM. The benefits of using hospitalists. Health Forum J. 2001 Jul-Aug; 44(4): 34-6, 1.

[10] Applebaum G. Advantages and limitations of the hospitalist movement. JAMA. 2002; 287(16): 2073-2076.

[11] Watcher RM. The state of hospital medicine in 2008. Med Clin North Am. 2008; 92(2): 265-273. PMid: 18298978. https://doi.org/10.1016/j.mcna.2007.10.008

[12] Wachter RM, Goldman L. The hospitalist movement 5 years later. JAMA. 2002; 287: 487-94. https://doi.org/10.1001/jama.287.4.487

[13] Hinami K, Smith J, Deamant CD, et al. When do patient-reported outcome measures inform readmission risk? J Hosp Med. 2015; 10(5): 294-300. PMid: 25914304. https://doi.org/10.1002/jhm.2366

[14] Yi D, Monson JRT, Stankiewicz C, et al. Impact of colorectal surgeon case volume on outcomes and applications to quality improvement. Int J Colorectal Dis. 2018 May; 33(5): 635-644. PMid: 29569073. https://doi.org/10.1007/s00384-018-3018-6

[15] Jungerwirth R, Wheeler S, Paul J. Association of Hospitalist Presence and Hospital-Level Outcome Measures Among Medicare Patients. Journal of Hospital Medicine. 2014; 9: 1-6. PMid: 24282042. https://doi.org/10.1002/jhm.2118

[16] Tarchichi TR, Garrison J, Jeong K, et al. Comparison of Patient Outcome Measures between a Traditional Teaching Hospitalist Service and a Non-Teaching Hospitalist Service at an Academic Children's Hospital. Pediatr Ther. 2017 Dec; 7(4): pii: 336. PMid: 29354324. https://doi.org/10.4172/2161-0665.1000336

[17] Peterson M. A Systematic Review of Outcomes and Quality Measures in Adult Patients Cared for by Hospitalists vs Nonhospitalists. Mayo Clin Proc. 2009 Mar; 84(3): 248-254. PMid: 19252112. https://doi.org/10.4065/84.3.248

[18] Adler L, Yi D, Li M, et al. Impact of inpatient harms on hospital finances and patient clinical outcomes. J Patient Saf. 2015.

[19] Kruskal WH, Wallis WA. Use of ranks in one-criterion variance analysis. Journal of the American Statistical Association. 1952; 47: 583-621. https://doi.org/10.1080/01621459.1952.10483441

[20] Klein-Geltink JE, Rochon PA, Dyer S, et al. Readers should systematically assess methods used to identify, measure and analyze confounding in observational cohort studies. J Clin Epidemiol. 2007; 60. PMid: 17606171. https://doi.org/10.1016/j.jclinepi.2006.11.008

[21] Romano P, Chan B. Risk-adjusting acute myocardial infarction mortality: are APR-DRGs the right tool? HSR: Health Services Research. 2000; 34: 7.

[22] Basu A, Manning WG. Issues for the next generation of health care cost analyses. Med Care. 2009; 47: S109-S114. PMid: 19536022. https://doi.org/10.1097/MLR.0b013e31819c94a1

[23] Jones AM. Models for health care. In: MP Clements Hendry DF, eds. Oxford Handbook of Economic Forecasting. New York: Oxford University Press; 2011.

[24] Mihaylova B, Briggs A, O'Hagan A, et al. Review of statistical methods for analyzing healthcare resources and costs. Health Econ. 2011; 20: 897-916. PMid: 20799344. https://doi.org/10.1002/hec.1653

[25] Deb P, Burgess JA. Quasi-experimental Comparison of Econometric Models for Health Care Expenditures, New York, NY: Department of Economics Working Papers, Hunter College; 2003.

[26] Hill SC, Miller GE. Health expenditure estimation and functional form: applications of the generalized gamma and extended estimating equations models. Health Econ. 2010; 19: 608-627. PMid: 19434646. https://doi.org/10.1002/hec.1498

[27] Jones AM, Lomas J, Moore P, et al. A Quasi-Monte Carlo Comparison of Developments in Parametric and Semi-parametric Regression Methods for Heavy Tailed and Non-normal Data: With an Application to Healthcare Costs. Health, Econometrics and Data Group (HEDG) Working Papers. Heslington, England: University of York; 2013.

[28] Sonnberger H. Regression diagnostics: Identifying influential data and sources of collinearity, by D. A. Belsley, K. Kuh and R. E. Welsch. John Wiley & Sons, New York, 1980, pp. xv + 292, ISBN 0-471-05856-4. J Appl Econ. 1989; 4: 97-99. PMid: 23238200. https://doi.org/10.1002/jae.3950040108

[29] Grubbs F. Procedures for Detecting Outlying Observations in Samples. Technometrics. 1969; 11(1): 1-21. https://doi.org/10.1080/00401706.1969.10490657

[30] Cameron AC, Trivedi PK. Microeconometrics Using Stata; Chp 8. Rev. ed. College Station, TX: Stata Press; 2010.

[31] Guo S, Fraser MW. Propensity score analysis: Statistical methods and applications. 2nd ed. Thousand Oaks, CA: Sage; 2015.

[32] Centers for Medicare and Medicaid Services. Hospital value-based purchasing. Baltimore (MD): CMS; 2018 Dec 3rd [cited 2018 Dec 26]. Available from: https://www.cms.gov/newsroom/fact-sheets/cms-hospital-value-based-purchasing-program-results-fiscal-year-2019

[33] Coffman J, Rundall TG. The impact of hospitalists on the cost and quality of inpatient care in the United States: a research synthesis. Med Care Res Rev. 2005; 62: 379-406. PMid: 16049131. https://doi.org/10.1177/1077558705277379

[34] Meltzer D, Manning WG, Morrison J, et al. Effects of physician experience on costs and outcomes on an academic general medicine service: results of a trial of hospitalists. Ann Intern Med. 2002; 137: 866-74. PMid: 12458986. https://doi.org/10.7326/0003-4819-137-11-200212030-00007

[35] Lindenauer P, Rothbery M, Pekow P, et al. Outcomes of care by hospitalists, general internists, and family physicians. N Engl J Med. 2007; 357: 25. PMid: 18094379. https://doi.org/10.1056/NEJMsa067735