Impact of a Scalable Care Transitions Program for Readmission Avoidance

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T he changing healthcare landscape has amplified the need to improve healthcare quality while also lowering healthcare spending, which reached $2.8 trillion in the United States in 2012.[1] A comparison of 12 countries showed the proportion of US gross domestic product spent on healthcare was more than 40% higher than in second-ranked France, yet measures of quality for US healthcare are often lower than in countries that spend far less. High rates of hospitalization for chronic conditions in the United States are one example; they have been attributed to low performance in care coordination and safety, and only average levels of care effectiveness and patient-centered care.[2] Although these observations could reflect a dysfunctional system, they are more likely the result of a healthcare system increasingly strained by a surging prevalence of complex conditions and concomitant care needs.

A focus on reducing hospital readmissions—which contribute to overall hospitalization rates—is recognized as an opportunity to improve care while also reducing avoidable costs. A study of nearly 12 million Medicare hospital discharges in 2004 found that approximately 20% resulted in 30-day readmissions, with only one-tenth of those readmissions likely planned. The total costs of these unplanned readmissions were over $17 billion.[3]

Diagnoses that are particularly readmission-sensitive include heart failure (HF), acute myocardial infarction (AMI), and pneumonia. In one study, 30-day readmission rates for these diagnoses were 24.8%, 19.9%, and 18.3%, respectively, in a Medicare population.[4] These conditions also account for a significant amount of hospitalization and cost in Medicaid, commercially insured, and uninsured US populations.[5] Readmission rates are concerning for these and other serious conditions across all age and payer groups.[6-9]

In 2012, the Affordable Care Act established strong financial incentives for hospitals and physicians to reduce readmissions. The law required CMS to establish the Hospital

ABSTRACT

Objectives: To evaluate the Care Transition Solution (CTS) as a means to improve quality through reduction of preventable hospital readmissions among patients with readmission-sensitive conditions subject to penalties imposed by the Affordable Care Act.

Study Design: A retrospective quasi-experimental evaluation of the impact of the CTS among admitted patients diagnosed with heart failure, acute myocardial infarction, chronic obstructive pulmonary disease, and/or pneumonia (CMS readmission-penalty diagnoses) in 14 acute care hospitals in Texas. The program, designed for scalable delivery, incorporated identification of high readmission–risk patients, assessment of individual needs, medication reconciliation, discharge planning, care coordination, and telephonic postdischarge follow-up.

Methods: The treatment group of program enrollees (N = 560) and the comparison group with no program contact (N = 3340) were matched on 8 coarsened demographic, diagnosis, and severity variables associated with readmission risk. Assessed outcomes included relative risk and odds of readmission within 30 days postdischarge and overall within the 6-month evaluation period. Zero-inflated Poisson multivariate models were used to estimate intervention effects controlling for matching-generated weights, age, disease status, and period of evaluation.

Results: Treatment group risk of readmission was 22% lower overall (incidence rate ratio [IRR], 0.78; *P* <.01) and 30-day readmission risk was 25% lower (IRR, 0.75; *P* = .01) relative to the comparison group. Odds of any or 30-day readmission were 0.47 (95% CI, 0.35-0.65) and 0.56 (95% CI, 0.41-0.77), respectively, for treatment relative to comparison.

Conclusions: Participation in the CTS resulted in significantly lower rates of readmissions among patients with readmission-sensitive conditions, offering a scalable and sustainable approach to reduce the number of preventable hospital readmissions.

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Readmissions Reduction Program, which penalizes, through reduced reimbursement, those hospitals whose risk-adjusted readmission rates for HF, pneumonia, and AMI exceed the national average. In 2015, the program expanded to include chronic obstructive pulmonary disease (COPD) and elective hip or knee replacement as readmission penalty conditions.[10,11] Commercial payers[12-14] and state Medicaid agencies will likely follow with similar programs to raise quality and reduce readmissions.[15,16]

Take-Away Points

There is increasing pressure to reduce hospital readmission rates by improving quality while maximizing efficiency. The evaluated collaborative care transitions program provides a scalable approach to reduce readmissions.

■ Scalable delivery of the Care Transitions Solution (CTS) is achieved through predictive early identification of patients at high risk of readmission and telephonic follow-up.

■ Among program participants, the 30-day readmission risk was reduced by 25% and the odds of any readmission within 30 days were reduced by more than half, relative to matched nonparticipants.

■ The CTS can be efficiently implemented by hospitals and is an effective system to reduce the number of preventable readmissions.

High rates of unplanned readmissions are a reflection of the fact that the US healthcare system has traditionally functioned in a fragmented and poorly coordinated fashion, often leaving discharged patients and their family members uneducated, confused, and unprepared for the ongoing management of conditions to avoid future adverse events.[17-20] Inadequate hand-off of patient management among providers, poorly coordinated hospital discharge processes, discharge instructions for the patient that lack sufficient education and follow-up, and lack of medication reconciliation before and after hospitalization all amplify the likelihood that a patient will return to the hospital. Illustrating the consequences of these problems, the Medicare Payment Advisory Commission's 2007 report to Congress estimated that 76% of 30-day readmissions are potentially preventable.[21]

Although broad efforts to address gaps in the discharge and hand-off process can benefit all hospitalized patients, complex cases at higher risk for readmission often require additional resource-intensive planning and follow-up processes. Full implementation of comprehensive approaches established in the literature[22-24] for large populations or across multiple hospitals is a formidable initiative given resource constraints in the current healthcare environment. Thus, there is a need for scalable approaches delivering effective readmission prevention models that augment what hospitals, health plans, and providers are already doing to prevent unplanned readmissions.

Texas Health Resources (THR), a nonprofit, faith-based health system located in north Texas, is innovating through exploration and testing of scalable approaches to prevent readmissions. Specifically, THR—through partnership with Healthways, a global well-being improvement company—implemented the Healthways Care Transitions Solution (CTS) in 14 acute care hospitals. CTS uses predictive identification of admitted patients at high risk of readmission, then invokes a collaborative care model for discharge planning and follow-up that extends from the hospital to the home. The current study was conducted to assess the initial effectiveness of CTS participation in preventing readmissions among patients with readmission-sensitive conditions.

METHODS

Study Design and Data Overview

A quasi-experimental retrospective cohort study was conducted to test the hypothesis that CTS program participation among admitted patients with readmission-sensitive conditions was associated with reduced readmission risk relative to a matched nonparticipant group. Data originated from 14 acute care hospitals in the Texas Health Resources network; specifically, admission-discharge-transfer data documenting patient admissions during the initial 6-month intervention time period of January 1 to July 1, 2013, were used for this study. Because this study was a retrospective analysis of a quality improvement initiative conducted anonymously, it did not require informed consent from participants and was exempt from institutional review board approval based on exclusion criteria outlined in the US Code of Federal Regulations (45 CFR §46.101).

Intervention

Implementation of the CTS intervention was staggered over a 6-week period beginning in mid-January 2013; the program initiated at 2 to 3 hospitals each week. By March 2013, the CTS intervention program was fully functioning at all 14 sites. The CTS program was designed to deliver thorough and personalized patient education and discharge planning/preparation, provide regular individualized follow-up, and facilitate care coordination in order to avoid unnecessary visits/time spent in medical facilities or doctors' offices, while encouraging appropriate medical care to avoid additional exacerbations of the patient's condition.

Basic principles of the CTS program include the following: 1) Identification of patients at high risk of readmission

using a predictive model, and clinical assessment to ensure alignment of resources with need; 2) Early engagement of admitted patients by a nurse transition coach to establish a strong relationship with the patient; 3) Detailed collection of contact information to facilitate postdischarge patient interactions; 4) Assessment of medical, psychosocial, functional, literacy, adherence, and support needs, and of capabilities such as functioning and self-efficacy, to tailor interactions accordingly; 5) Reconciliation of medications before hospitalization to medications after hospital discharge; 6) Provision and review of a patient-oriented Care Transition Record, with documented discharge plan; 7) Coordination of medical providers and service agencies for postdischarge patient care; and 8) Postdischarge telephonic follow-up (4 calls over 4 weeks) to track and support the patient's recovery and ongoing self-management, and to encourage discharge plan adherence.

Study Population

The study-eligible population included all patients admitted to 1 of the 14 evaluated hospitals during the study period who were documented to have at least 1 of the following readmission-sensitive conditions that are also CMS readmission-penalty diagnoses: AMI, HF, pneumonia, or COPD. In accordance with intention-to-treat research design, all CTS enrollees were eligible for the treatment group, regardless of their level of participation or completion of the CTS program, to provide a realistic assessment of program effectiveness. The eligible population had an average age of 59.3 years (range = 18-96 years). Eligible comparison group members did not have any documented interaction with the CTS program. The staggered implementation across hospital sites provided a population of program-eligible patients admitted to sites where the program was not yet available, and although the comparison group was not constrained to patients admitted pre-implementation, the availability of these patients in the matching process diminished the potential for selection bias and availed a more equivalent group for comparison.

Drawing from this eligible population, comparable study groups were created using coarsened exact matching (CEM), which exactly matches individuals within a nonparametric framework into strata based on a set of shared characteristics (coarsened variables) chosen to explain selection bias and variance in the outcome. CEM typically requires removal of fewer cases for a given level of bias removal and thus is comparatively a more effective and efficient method for yielding an unbiased estimate of treatment effect.[25,26] Matching variables included age group; gender; dichotomous indication of whether or not initial admission resulted from AMI, pneumonia, HF, or COPD; initial admission length-of-stay group; depression status[27]; stroke status[28,29]; hip fracture status[30]; and disease count (range = 0-5, counting discrete indications of COPD, HF, coronary artery disease, diabetes, and chronic kidney disease). After strata assignment, matched comparison members were assigned a weight specific to their stratum and representative of the relative proportion of members in that stratum; treatment group members were assigned a weight of 1.[25] CEM weights were used as a covariate to adjust estimates in multivariate statistical modeling.

Outcomes Assessment

Study groups were compared on 2 metrics: readmissions within 30 days of prior admission and all readmissions occurring within the 6-month study time period. The initial (index) admission for each CTS group member was defined as the admission from which the member was enrolled in the CTS program. For each comparison group member, the index admission was the first admission record during the study period. A readmission was defined as a hospital admission occurring subsequent to the discharge date, documented for a previous admission during the study period, allowing for more than 1 readmission in the study period. Same-day readmissions, in which a discharge and subsequent admission occurred within 24 hours, were excluded as these cases generally denote transfers as opposed to readmissions. For each study member, hospital admission records were assessed from their index admission to the July 1, 2013, study end point.

Statistical Methods

The quantitative measure to evaluate the extent of imbalance and heterogeneity between the study groups was the L1 metric, a nonparametric measure generated in the CEM process that quantifies imbalance by comparing relative frequencies of the 2 groups across each of the strata.[31] Values of L1 close to 0 indicate a higher quality match with minimal imbalance, whereas an L1 value of 1 indicates complete dissimilarity or disproportionality between the groups (no overlap between groups in the strata assignment). Matching variables are optimized with respect to providing a low L1 with high retention of treatment group members. For additional confirmation of intergroup comparability, a Wald test was estimated to determine if the independent variables in multivariate modeling provided similar explanatory contribution to the dependent variable (readmissions) for both study groups. A small Wald statistic and a large *P* value indicate sufficient similarity between groups to obtain a reliable estimate of intervention effect.

■ **Table 1.** Study Population Descriptive Characteristics

Variable	Full Admitted Population With Penalty Diagnosis[a]	Matched Study Population[a]	Treatment Group[b]	Comparison Group[b]
N	4638	3900	560	3340
Age, years: mean (SD)	70.8 (14.5)	71.9 (13.2)	69.1 (13.1)	69.5 (13.3)
Gender, female	57.0%	57.6%	54.5%	54.5%
COPD	37.4%	38.6%	37.5%	45.5%
Heart failure	26.2%	26.4%	37.9%	28.3%
Pneumonia	37.4%	37.3%	31.8%	28.9%
Acute myocardial infarction	8.4%	8.9%	7.9%	10.2%
Coronary artery disease	12.2%	12.2%	12.0%	14.4%
Diabetes	1.1%	0.8%	1.4%	2.3%
Depression	0.2%	0.0%	0.0%	0.0%
Chronic kidney disease	2.8%	2.4%	4.5%	2.7%
Stroke	1.4%	0.3%	0.5%	0.5%
Hip fracture	1.2%	0.05%	0.2%	0.2%
Chronic disease count,[c] mean (SD)	0.80 (0.6)	0.80 (0.6)	0.93 (0.6)	0.93 (0.6)
0	30.6%	27.9%	19.5%	19.5%
1	59.8%	63.9%	68.6%	68.6%
2	9.1%	8.0%	11.3%	11.3%
3	0.6%	0.2%	0.7%	0.7%
Length of stay in days, initial admission: mean (SD)	5.3 (4.8)	5.0 (3.8)	5.6 (5.2)	5.6 (4.3)

COPD indicates chronic obstructive pulmonary disease.
[a]Unadjusted.
[b]Adjusted for weights generated in coarsened exact matching. No adjustment for additional covariates used in statistical models.
[c]Count of following diagnoses: chronic obstructive pulmonary disease, heart failure, coronary artery disease, diabetes, chronic kidney disease.

Zero-inflated Poisson multivariate models were used to estimate intervention effects on all readmissions and on 30-day readmissions while accounting for potential confounders. These control variables included age (continuous), evaluation window (time from index admission to end of study period), CEM-generated weights, and disease status for COPD, HF, pneumonia, AMI, diabetes, chronic kidney disease, and coronary artery disease, as well as the status for each of these conditions, as documented during the index admission. Adjusted incidence rate ratios (IRRs; relative risk) were produced from the 0-inflated Poisson model by taking the exponential of the intervention variable coefficient, using the comparison study group as the reference. Poisson multivariate count regression models with least squares means statements were used to calculate adjusted daily readmission rates for each study group. Adjusted daily readmission rates were then converted to annualized readmission rates per 1000. Multivariate logistic regression was used to estimate adjusted odds ratios (ORs) and 95% CIs of intervention effects on the likelihood of having versus not having at least 1 readmission using the same control variables. Data manipulation and analysis were performed using SAS version 9.2 (SAS Institute, Cary, North Carolina).

RESULTS

Descriptive characteristics of the full population of admitted patients meeting study eligibility requirements and the matched treatment and comparison study groups are displayed in Table 1. CEM matching resulted in the pruning of 12 (2.1%) treatment members and 726 (17.9%) comparison members from the initially eligible populations. Although some improvement in balance was achieved through this pruning, adjustment using CEM weights resulted in near equivalence between the groups across all matching variables. The mean evaluation window (days from index admission to end of the 6-month study period) was also similar for the treatment and comparison groups at 88.9 and 81.8 days, respectively. Remaining differences, including evaluation window, were controlled for using additional covariates in statistical modeling of outcomes.

Further verification of comparability between the study groups was provided by L1 and Wald statistics. Table 2

■ **Table 2.** Final Study Group Sample Sizes and Balance Metrics After Matching Using Coarsened Exact Matching

	Study Group	Treatment	Comparison	CEM L1 Metric[a]
Before CEM match	4638	572	4066	0.229
After CEM match	3900	560	3340	4.09 E^{-16}
Members lost due to match	738	12	726	

CEM indicates coarsened exact matching.
[a]The L1 metric is an indicator of balance/equivalence between study groups. A value of 1 indicates complete dissimilarity (no overlap) and a value of 0 indicates that groups are perfectly equivalent or balanced.

displays an L1 postmatch statistic of 4.09 E^{-16} indicating minimal imbalance between study groups and a dramatic improvement in balance from the pre-match L1. The summary Wald test statistic and large associated P value (Wald = 0.0026; P = 1.0) provided confirmation of intergroup comparability with respect to all modeled covariates.

Adjusted IRRs showed significantly lower rates of all readmissions (P = .0060) and 30-day readmissions (P = .0107) in the treatment group relative to the comparison group (Table 3). The treatment group displayed 22% fewer overall readmissions and 25% fewer 30-day readmissions in contrast to the comparison group. As a reference point for the relative rates, the adjusted annualized readmission rate per 1000 patients was 603.0 for the treatment group and 771.4 for the comparison group.

Logistic analysis results indicated that treatment group members were significantly less likely to have had any readmission or a 30-day readmission during the study period, with adjusted odds being 0.47 and 0.56, respectively, relative to comparison group members (Table 4). Changing the reference group, the adjusted odds of having 1 or more readmissions during the study period was 2.1 times higher in the comparison group relative to the treatment group (adjusted OR, 2.1; 95% CI, 1.5-2.9). Results for 30-day readmissions were of similar magnitude (adjusted OR, 1.8; 95% CI, 1.3-2.5).

DISCUSSION

Across the board, results indicate that the CTS intervention significantly reduced hospital readmissions for THR patients with readmission-sensitive conditions. Participation in the CTS program was significantly associated with lower readmission incidence, both for 30-day readmissions and all readmissions occurring over the 6-month study period. Additionally, admitted patients who did not participate in CTS had approximately twice the odds of having a 30-day readmission or any readmission during the study period relative to the treatment group.

The estimated reduction in readmissions for the entire 6-month period demonstrates the sustained intervention

impact, extending beyond the 30-day window that is often the bar for efforts aimed at preventing the immediate ramifications of failures to provide effective discharge instructions and planning. The measured impact of CTS is beyond that of more global hospital initiatives to reduce readmissions from which all patients benefit. The CTS model also intends to maximize cost efficiency and scalability through sophisticated prediction of high-risk cases for selective supplemental support and by outsourcing program operations, data management, predictive modeling, and post-discharge telephonic follow-up.

The CTS program builds on a remote telephonic intervention, also delivered by Healthways, that one study found was associated with a 23% lower likelihood of readmission within 30 days relative to the comparison group.[32] CTS represents an enhancement of this telephonic model, one that allows for early intervention and a direct connection to providers. For example, in the prior study, Harrison et al highlighted the delayed delivery of patient discharge information and, consequently, delayed initiation of telephonic follow-up—problems that were due to claims-based identification without any direct data feed from the hospital or communication with providers. Initiating the intervention within a hospital environment with access to timely patient information ensures continuity of patient support across different settings, allows a relationship to be established with the patient prior to discharge, and permits rapid follow-up after discharge. Congruent with Kripalani et al, who concluded that single-component interventions are less impactful,[33] the effect of CTS exceeded what was reported for the described patient-centric telephonic-only model while also using a cost-efficient approach.[32]

In addition to prior research supporting the benefit of telephonic follow-up, there is foundational evidence for

■ **Table 3.** Treatment Effect on Incidence of Readmission

	IRR[a]	P	95% CI
All readmissions	0.78	.0060	0.66-0.93
Readmissions within 30 days	0.75	.0107	0.61-0.94

IRR indicates incidence rate ratio.
[a]Ratios reflect readmission incidence for the treatment group relative to the comparison group (reference group) from 0-inflated Poisson multivariate models. Results are adjusted for coarsened exact matching weight, age, gender, evaluation window, first admission length of stay, disease status, and index admission diagnosis status.

other aspects of the CTS program reducing readmissions. A randomized study of nurse and pharmacist support to reinforce the discharge plan and review medications found a 0.695 IRR for 30-day readmissions compared with controls.[23] A randomized trial of an intensive transitional care model delivered by advanced practice nurses to patients 65 years and older reported a significantly lower 24-week readmission rate for treatment relative to controls (20.3% vs 37.1%).[34] Coleman et al reported positive results from the Care Transitions Intervention using both a quasi-experimental approach[35] and a randomized trial.[24] The trial, on admitted patients 65 years and older, showed significant reductions in treatment group readmission rates, with 30- and 90-day readmission adjusted ORs of 0.59 and 0.64, respectively. Similar findings have been published more recently on the real-world effectiveness of the Care Transitions Intervention using a quasi-experimental design.[36]

Comparison of the present study with published randomized trial results indicates the CTS program has performed comparably in readmission avoidance. The 30-day readmission incidence rate ratio of 0.75 for the CTS program was comparable with the 0.695 IRR reported by Jack et al,[23] as was the CTS 30-day readmission OR of 0.56 compared with the Coleman et al[24] trial result of 0.59. This is especially significant when taking into account that the CTS program was evaluated under "real-world effectiveness" conditions, whereas randomized trials are conducted in a more controlled setting.

The need for real-world effectiveness studies on readmissions has been acknowledged in the literature. Voss et al write, "Patients who agree to participate in randomized controlled trials are a select subset of that population, limiting the generalizability of these observations."[36] Although Coleman's Care Transition Intervention has been tested extensively, both in randomized trials[24,37] and effectiveness studies,[35,36] there is value to testing alternative approaches to improve quality of healthcare solutions. A given solution is not necessarily applicable or practical in all environments. The use of a predictive model to selectively deliver this program to patients at higher risk, then outsourcing telephonic follow-up, makes this evaluated program potentially more operationally appealing than programs that are delivered less selectively and that require greater hospital staff time in order to intervene with a larger number of people and to follow up after discharge.

The retrospective design presents a limitation to the study, as it necessitated the creation of a comparison group from a convenience sample as opposed to prospective selection and randomization. Further, generalizability of study results is unknown, but the multisite design

■ **Table 4.** Treatment Effect on Odds of Readmission

	OR[a]	95% CI
All readmissions	0.47	0.35-0.65
Readmissions within 30 days	0.56	0.41-0.77

OR indicates odds ratio.
[a]Ratios reflect odds of readmission for the treatment group relative to the comparison group (reference group) from multivariate logistic regression. Results are adjusted for coarsened exact matching weight, age, gender, evaluation window, first admission length of stay, disease status, and index admission diagnosis status.

strengthens the likelihood that results would translate to other hospitals. Future work should evaluate additional diseases and conditions beyond the penalty diagnoses evaluated here, as well as program effectiveness over a longer duration and in different institutions, demographic groups, and geographic regions.

The changing architecture of healthcare reimbursement is requiring hospitals to quickly find solutions to improve quality metrics. In the first year of the Hospital Readmissions Reduction Program, 2200 hospitals received cumulative penalties of $280 million.[10] Given that reported readmission outcomes are publicly available on the CMS Hospital Compare website, the revenue impact of negative press may be as detrimental as the reimbursement penalties. These changes in the healthcare market highlight the importance of the current study results, which indicate that CTS offers an efficient and effective solution for health systems, hospitals, and large provider groups that are seeking support in reducing readmissions among high-risk patients.

CONCLUSIONS

Implementation of the CTS program by THR succeeded in significantly reducing readmissions for enrolled patients diagnosed with COPD, HF, AMI, or pneumonia meeting the recognized need to improve care and associated outcomes among a growing number of higher-complexity cases. An innovative approach to improving patient support and care coordination, the CTS program is a collaborative model designed as a scalable and sustainable approach that maximizes efficient resource use while improving quality of care and continuity in the transition from hospital to home. The implications may extend beyond the evaluated diagnoses given that CTS is applicable to additional conditions that may be included within future expansion of the readmission avoidance directive. Overall, CTS is a viable option for institutions wishing to efficiently implement an effective approach to reducing avoidable readmissions.

REFERENCES

1. Martin AB, Hartman M, Whittle L, Catlin A; National Health Expenditure Accounts Team. National health spending in 2012: rate of health spending growth remained low for the fourth consecutive year. *Health Aff (Millwood)*. 2014;33(1):67-77.

2. Squires DA. The U.S. health system in perspective: a comparison of twelve industrialized nations. *Issue Brief (Commonw Fund)*. 2011;16:1-14.

3. Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med*. 2009;360(14):1418-1428.

4. Dharmarajan K, Hsieh AF, Lin Z, et al. Diagnoses and timing of 30-day readmissions after hospitalization for heart failure, acute myocardial infarction, or pneumonia. *JAMA*. 2013;309(4):355-363.

5. Torio CM, Andrews RM. National inpatient hospital costs: the most expensive conditions by payer, 2011 [statistical brief #160]. Healthcare Cost and Utilization Project website. http://www.hcup-us.ahrq.gov/reports/statbriefs/sb160.pdf. Published August 2013. Accessed May 28, 2014.

6. Allen LA, Smoyer Tomic KE, Smith DM, Wilson KL, Agodoa I. Rates and predictors of 30-day readmission among commercially insured and Medicaid-enrolled patients hospitalized with systolic heart failure. *Circ Heart Fail*. 2012;5(6):672-679.

7. Dalal AA, Liu F, Riedel AA. Cost trends among commercially insured and Medicare Advantage-insured patients with chronic obstructive pulmonary disease: 2006 through 2009. *Int J Chron Obstruct Pulmon Dis*. 2011;6:533-542.

8. Wier LM, Barrett M, Steiner C, Jiang HJ. All-cause readmissions by payer and age, 2008 [statistical brief #115]. Healthcare Cost and Utilization Project website. http://www.hcup-us.ahrq.gov/reports/statbriefs/sb115.pdf. Published June 2011. Accessed May 28, 2014.

9. Coffey RM, Misra A, Barrett M, Andrews RM, Mutter R, Moy E. Congestive heart failure: who is likely to be readmitted? *Med Care Res Rev*. 2012;69(5):602-616.

10. James J. Medicare Hospital Readmissions Reduction Program [health policy brief]. *Health Affairs* website. https://www.healthaffairs.org/healthpolicybriefs/brief.php?brief_id=102. Published November 12, 2013. Accessed November 12, 2013.

11. Readmission Reduction Program. CMS website. http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html. Accessed May 7, 2014.

12. UnitedHealthcare, Dovetail Health launch innovative program to reduce unnecessary hospital readmissions in New Jersey [press release]. Minnetonka, MN: Business Wire; March 21, 2012. http://www.businesswire.com/news/home/20120321005032/en/UnitedHealthcare-Dovetail-Health-Launch-Innovative-Program-Reduce#.U2p61Id_U5Q. Accessed May 7, 2014.

13. Aetna, Genesis HealthCare take aim at preventing hospital readmissions [press release]. Hartford, CT: Aetna; August 10, 2011. https://www1.aetna.com/news/newsReleases/2011/0810_Aetna-Genesis_HospitalReadmissions.html. Accessed December 2015.

14. Adamy J. WellPoint shakes up hospital payments. *Wall Street Journal*. http://www.wsj.com/articles/SB10001424052748704281504576325163218629124. Updated May 16, 2011. Accessed May 7, 2014.

15. Include all diagnoses, payers in readmission projects. *Hosp Case Manag*. 2012;20(7):97-99.

16. Readmission reduction has begun and the penalties will escalate. *Hosp Case Manag*. 2013;21(4):45-47.

17. Coleman EA, Berenson RA. Lost in transition: challenges and opportunities for improving the quality of transitional care. *Ann Intern Med*. 2004;141(7):533-536.

18. Cebul RD, Rebitzer JB, Taylor LJ, Votruba ME. Organizational fragmentation and care quality in the U.S. healthcare system. *J Econ Perspect*. 2008;22(4):93-113.

19. Elhauge E. *The Fragmentation of U.S. Health Care: Causes and Solutions*. New York, NY: Oxford University Press; 2010.

20. Stange KC. The problem of fragmentation and the need for integrative solutions. *Ann Fam Med*. 2009;7(2):100-103.

21. Report to the Congress: promoting greater efficiency in Medicare. Medicare Payment Advisory Commission website. http://www.medpac.gov/documents/reports/Jun07_EntireReport.pdf. Published June 2007. Accessed May 7, 2014.

22. Sánchez Ulayar A, Gallardo López S, Pons Llobet N, Murgadella Sancho A, Campins Bernadàs L, Merino Méndez R. Pharmaceutical intervention upon hospital discharge to strengthen understanding and adherence to pharmacological treatment. *Farm Hosp*. 2012;36(3):118-123.

23. Jack BW, Chetty VK, Anthony D, et al. A reengineered hospital discharge program to decrease rehospitalization: a randomized trial. *Ann Intern Med*. 2009;150(3):178-187.

24. Coleman EA, Parry C, Chalmers S, Min SJ. The care transitions intervention: results of a randomized controlled trial. *Arch Intern Med*. 2006;166(17):1822-1828.

25. Wells AR, Hamar B, Bradley C, et al. Exploring robust methods for evaluating treatment and comparison groups in chronic care management programs. *Popul Health Manag*. 2013;16(1):35-45.

26. Blackwell M, Iacus S, King G, Porro G. CEM: coarsened exact matching in Stata. *Stata J*. 2009;9(4):524-546.

27. Mitchell SE, Paasche-Orlow MK, Forsythe SR, et al. Post-discharge hospital utilization among adult medical inpatients with depressive symptoms. *J Hosp Med*. 2010;5(7):378-384.

28. Lakshminarayan K, Schissel C, Anderson DC, et al. Five-year rehospitalization outcomes in a cohort of patients with acute ischemic stroke: Medicare linkage study. *Stroke*. 2011;42(6):1556-1562.

29. Nahab F, Takesaka J, Mailyan E, et al. Avoidable 30-day readmissions among patients with stroke and other cerebrovascular disease. *Neurohospitalist*. 2012;2(1):7-11.

30. Hahnel J, Burdekin H, Anand S. Re-admissions following hip fracture surgery. *Ann R Coll Surg Engl*. 2009;91(7):591-595.

31. Iacus SM, King G, Porro G. CEM: software for coarsened exact matching. *J Statistical Software*. 2009;30(9):1-27.

32. Harrison PL, Hara PA, Pope JE, Young MC, Rula EY. The impact of postdischarge telephonic follow-up on hospital readmissions. *Popul Health Manag*. 2011;14(1):27-32.

33. Kripalani S, Theobald CN, Anctil B, Vasilevskis EE. Reducing hospital readmission rates: current strategies and future directions. *Annu Rev Med*. 2014;65:471-485.

34. Naylor MD, Brooten D, Campbell R, et al. Comprehensive discharge planning and home follow-up of hospitalized elders: a randomized clinical trial. *JAMA*. 1999;281(7):613-620.

35. Coleman EA, Smith JD, Frank JC, Min SJ, Parry C, Kramer AM. Preparing patients and caregivers to participate in care delivered across settings: the Care Transitions Intervention. *J Am Geriatr Soc*. 2004;52(11):1817-1825.

36. Voss R, Gardner R, Baier R, Butterfield K, Lehrman S, Gravenstein S. The care transitions intervention: translating from efficacy to effectiveness. *Arch Intern Med*. 2011;171(14):1232-1237.

37. Parry C, Min SJ, Chugh A, Chalmers S, Coleman EA. Further application of the care transitions intervention: results of a randomized controlled trial conducted in a fee-for-service setting. *Home Health Care Serv Q*. 2009;28(2-3):84-99. ∎

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