Care Fragmentation After Hospitalization for Acute Myocardial Infarction

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Care fragmentation (CF), or readmission at a nonindex hospital, has been linked to inferior clinical and financial outcomes for patients. However, its impact on patients with acute myocardial infarction (AMI) is unclear. This study investigated the prevalence and impact of CF on the outcomes of patients with AMI. All US adult (≥18 years) hospitalizations for AMI from January 2010 to November 2019 were identified using the Nationwide Readmissions Database. Patients were stratified by readmission at an index or nonindex center. Multivariable models were developed to evaluate factors associated with CF, and independent associations with mortality, complications, and resource utilization. A total of 413,819 patients with AMI requiring nonelective readmission within 30 days of discharge were included for analysis. Of these, 25.4% (n = 104,966) experienced CF. The incidence of CF increased from 2010 to 2019 (nptrend <0.001). After adjustment, patients insured by Medicaid faced higher odds of nonindex readmission. CF was associated with in-hospital mortality (adjusted odds ratio [AOR] 1.09, 95% confidence interval [CI] 1.01 to 1.18), and cardiac (AOR 1.12, 95% CI 1.03 to 1.22), respiratory (AOR 1.14, 95% CI 1.12 to 1.26), and infectious complications (AOR 1.14, 95% CI 1.07 to 1.22). Further, CF was linked to increased odds of nonhome discharge (AOR 1.18, 95% CI 1.11 to 1.24) and an additional ~$5,000 in per-patient hospitalization costs (95% CI 4,260 to 5,100). Approximately 25% of AMI patients experienced CF, which was independently associated with excess mortality, complications, and expenditures. Given the growing national burden of cardiovascular disease, new efforts are needed to mitigate the significant clinical and financial implications of nonindex readmissions and improve value-based healthcare. **(Am J Cardiol 2023;187:131−137)**

Introduction

Fragmentation of healthcare delivery across isolated hospital systems has been linked to inferior outcomes in surgical and medical settings.[1] Although readmission after an acute medical event might be because of the development of post-discharge complications, rehospitalization at a different center, or care fragmentation (CF), has been noted to be particularly detrimental.[2,3] In fact, CF after operative procedures across surgical specialties has been associated with a 25% to 48% relative increase in odds of mortality.[4,5] Although there is increasing focus on value-based care in the United States and the reduction of readmissions,[6] the impact of such efforts on CF remains largely unexplored. Acute myocardial infarction (AMI) contributes significantly to the burden of US hospitalizations, accounting for nearly 700,000 admissions annually.[7] Notably, these patients may suffer from conditions that predispose this population to excess rehospitalization, with Rymer and colleagues noting a 14% risk of readmission within 30 days.[6,8] However, the prevalence and impact of CF on outcomes of AMI hospitalizations remain uncharacterized at a large scale. The present study thus aimed to assess the association of CF with readmission outcomes after hospitalization for AMI. Furthermore, it sought to identify vulnerable populations at greater risk of experiencing fragmented care. We hypothesized that CF would be associated with greater readmission mortality, complications, and resource utilization.

Methods

All nonelective adult (18 years) hospitalizations with a primary diagnosis of AMI were tabulated using the 2010 to 2019 Nationwide Readmissions Database (NRD). Maintained as part of the Healthcare Cost and Utilization Project (HCUP), the NRD is the largest all-payer readmission database, providing accurate survey estimates for nearly 60% of all hospitalizations. The structure of the NRD allows readmissions to be tracked across participating institutions within a state for a single calendar year.[9]

International Classification of Diseases, Ninth and Tenth Revision diagnosis codes were used to ascertain the presence of AMI, which included both ST-elevation myocardial infarction (STEMI) and non−STEMI (NSTEMI).[10] Records with concurrent cardiac operations, diagnosis of myocarditis or endocarditis, index hospitalization in December of each year, or missing data for age, gender, in-hospital mortality, and costs were excluded from further

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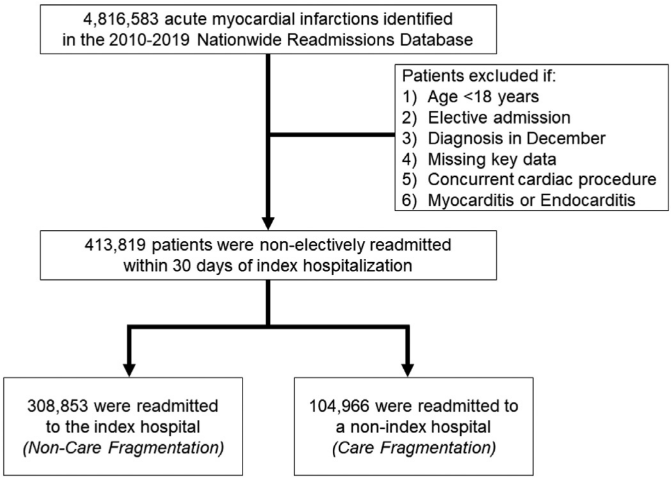

Figure 1. Flow Chart of the patient population selection process. Over 4 million patients hospitalized for an acute myocardial infarction were identified in the 2010 to 2019 Nationwide Readmissions Database. After application of exclusion criteria, 413,819 patients were considered who were non-electively readmitted within 30 d of index hospitalization. Of these, 25.4% (n = 104,966) experienced care fragmentation.

analysis (27.1%). While only patients requiring nonelective rehospitalization within 30 days of index discharge were considered, those readmitted to a nonindex facility comprised the CF cohort (others: non-CF; Figure 1).

Patient and hospital characteristics were defined according to the HCUP data dictionary and included age, gender, income quartile, primary payer, hospital bed size, and hospital teaching status.[11] Hospitals were categorized into low-, medium-, or high-volume tertiles based on their annual AMI caseload. Costs were calculated using HCUP hospital-specific cost-to-charge ratios and inflation-adjusted using the 2019 Bureau of Labor Statistics Personal Health Care Price Index.[12]

The previously validated Elixhauser Co-morbidity Index, a composite measure of 30 conditions, was used to quantify the burden of chronic illness.[13] Specific co-morbidities and complications were ascertained using previously reported an International Classification of Diseases, Ninth and Tenth Revision codes.[14] Complications were grouped into composite cardiac, infectious, respiratory, and cerebrovascular categories (Supplementary Table 1). Diagnosis Related Group codes as reported by Williamson et al[15] were used to tabulate the primary readmission diagnosis.

The primary outcome of this study was in-hospital mortality during readmission. Several secondary end points were considered and included complications, length of stay (LOS), nonhome discharge, and hospitalization costs at first readmission.

Nonnormally distributed variables are reported as medians with interquartile range (IQR). Categorical variables are represented as proportions (%). Given the large sample size, the effect size was further examined using standardized mean differences (SMDs), with significance defined as >0.1. The Adjusted Wald, chi-square, and Mann-Whitney *U* tests were used to compare patient and hospital characteristics where applicable. The significance of temporal trends was determined using Cuzick's nonparametric test (nptrend).[16]

For risk-adjusted analyses of readmission outcomes, a balanced patient cohort was generated using Mahalanobis 1: 1 propensity matching (nearest neighbor) based on age, gender, co-morbidity burden, socioeconomic status, complications at index admission, reasons for readmission, and key hospital characteristics.[17] Multivariable logistic and linear regression models were developed to evaluate independent associations between CF and key outcomes of interest. Covariates were selected using elastic net regularization, an automated method that reduces collinearity by way of a penalized least squares methodology.[18] Models were further optimized using the receiver operating characteristics and Akaike and Bayesian information criteria, as appropriate. Regression outputs are reported as AOR for logistics and as beta coefficients (β) for linear models, both with 95% confidence interval (CI). Statistical significance was considered as α <0.05. All analyses were performed using Stata 16.1 (StataCorp, College Station, Texas). This study was deemed exempt from full review by the Institutional Review Board of the University of California, Los Angeles.

Results

Of an estimated 4,816,583 admissions with a primary diagnosis of AMI, 3,511,413 were included for analysis because of exclusion criteria (72.9%). Among them, 11.8% (n = 413,819) required nonelective readmission within 30 days of index discharge, 25.4% of which (n = 104,966) were at a nonindex facility (CF). The proportion of CF patients increased significantly over the 10-year study period (24.8% in 2010 to 26.5% in 2019, nptrend p <0.001) (Figure 2).

Patient and hospital characteristics are detailed in Table 1. The medians of age for the CF and non-CF cohorts were similar (70 years [IQR: 59 to 81] vs 72 years [IQR: 60 to 82]; SMD = 0.09). The groups were comparable in regards to the median Elixhauser Co-morbidity Index and frequency of congestive heart failure, hypertension, valvular heart disease, diabetes, nicotine use, or history of previous myocardial infarction (Table 1). Compared to non-CF, a similar proportion of CF patients was insured by Medicaid and initially treated at a metropolitan nonteaching hospital.

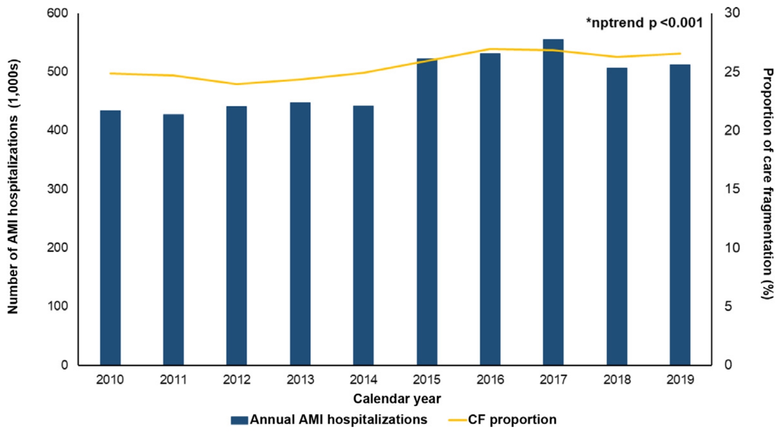

Figure 2. Temporal trends in annual AMI hospitalizations and care fragmentation. Both AMI hospitalizations and the respective proportion of CF patients experienced an overall upward trend since 2010. Analysis of trend is significant at nptrend <0.001.

However, CF patients were less frequently first admitted to institutions in the highest volume tertile (77.9 vs 87.1%; SMD = 0.25) or large bed size hospitals (58.4 vs 65.5%; SMD = 0.16), compared with non-CF patients (Table 1).

At index admission, patients in the CF cohort were equally likely to present with a NSTEMI as those in non-CF. The CF cohort also demonstrated a similar prevalence of cardiogenic shock, acute heart failure, and cardiac complications (Supplementary Table 2). Further, CF patients suffered from similar rates of infectious and cerebrovascular complications, and blood transfusions. While usage of intra-aortic balloon pump was similar among groups, the CF cohort was significantly less likely to receive percutaneous coronary intervention compared with the non-CF group (SMD = 0.17). Index LOS was similar for patients in the CF and non-CF cohorts, as were hospitalization costs. CF patients were significantly more likely to be discharged to nonhome settings, compared with non-CF patients (31.2 vs 20.6%; SMD = 0.26) (Figure 3).

After risk adjustment, several factors were associated with greater odds of CF upon readmission, including NSTEMI diagnosis at index admission (AOR 1.10, 95% CI 1.06 to 1.13), Medicaid insurance status (AOR 1.08, 95% CI 1.02 to 1.13) and treatment at a small bed size center (AOR 1.55, 95% CI 1.45 to 1.65). Other factors linked with CF included a previous coronary artery bypass graft, a history of myocardial infarction or diabetes, and the need for an intraaortic balloon pump and tracheostomy.

Several complications during index hospitalization were associated with CF, including cardiogenic shock (AOR 1.08, 95% CI 1.00 to 1.17) and cerebrovascular events (AOR 1.10, 95% CI 1.00 to 1.21). Finally, nonhome discharge was associated with a 79% greater relative odds of CF (AOR 1.79, 95% CI 1.73 to 1.85) (Figure 3).

Patients in both the CF and non-CF groups were most commonly readmitted for cardiovascular reasons, followed by infectious, respiratory, and vascular causes (Supplementary Figure 1). The distribution of time to readmission was similar in the two groups. Unadjusted rates of mortality and complications at readmission were similar between the CF and non-CF groups. However, CF patients experienced increased lengths of stay (4 days [IQR 2 to 7] vs 3 days [IQR 2 to 6]; SMD 0.13) and greater hospitalization costs ($9,907 [IQR 5,539 to 19,682] vs $8,048 [IQR 4,647 to 15,356]; SMD 0.20) (Table 2).

Following risk adjustment, CF remained associated with in-hospital mortality (AOR 1.09, 95% CI 1.01 to 1.18), and development of cardiac complications (AOR 1.12, 95% CI 1.03 to 1.22) and cardiogenic shock (AOR 1.68, 95% CI 1.49 to 1.90). Moreover, CF was linked to greater odds of infectious (AOR 1.14, 95% CI 1.07 to 1.22) and respiratory complications (AOR 1.14, 95% CI 1.08 to 1.21), among others (Figure 4). Finally, CF was associated with a 17% increase in relative odds of nonhome discharge (95% CI 1.11 to 1.24), a 1.01-day incremental increase in LOS, and an additional $5,000 in hospitalization costs.

Discussion

CF at readmission has been linked to inferior clinical outcomes across several medical conditions.[2,3] However, such an association has yet to be described in patients admitted for AMI. We used a national cohort of AMI hospitalizations, with which several important observations were made. Overall, CF was independently associated with increased mortality, complications, and rehospitalization costs. Moreover, specific patient and hospital factors, including Medicaid coverage, were linked to increased odds of CF. Notably, our findings disagree with a previous study of CF after AMI performed by Rymer et al.[8] Their investigation relied on data from a limited registry of ~80,000 Medicare patients admitted for AMI among 504 hospitals from 2007 to 2010. In contrast, our study is not limited to the Medicare population and evaluates 4,816,583 MI admissions across 2010 to 2019, representing a significantly newer and more generalizable dataset. Thus, several of our findings warrant further discussion.

In agreement with previous work, the present study found CF to increase the odds of mortality at readmission. Moreover, CF was linked to excess complications at rehospitalization, including cardiac, infectious, and respiratory events. Though the reasons underlying such associations remain unclear, ineffective inter-provider communication likely plays a significant role. Primarily studied in the

Table 1
Demographic, clinical, and hospital characteristics at initial admission

	Non-CF (n = 308,853)	CF (n = 104,966)	SMD
Age (years [IQR])	72 [60-82]	70 [59-81]	0.09
Female (%)	45.6	43.6	0.04
Elixhauser Comorbidity Index	4 [2-5]	4 [2-5]	0.01
Smoking history	33.4	34.3	0.02
AMI type (%)			0.07
STEMI	26.1	22.9	
NSTEMI	73.9	77.1	
Income quartile (%)			0.03
>75%	17.4	18.1	
51-75%	23.1	22.0	
26-50%	27.1	26.7	
0-25%	32.4	33.2	
Insurance coverage (%)			0.06
Private	14.9	14.5	
Medicare	70.4	69.0	
Medicaid	8.4	9.9	
Self-Payer	3.4	3.7	
Other payer	2.9	2.9	
Co-morbidities (%)			
Congestive heart failure	36.5	34.9	0.04
Peripheral vascular disease	12.4	12.2	0.02
Pulmonary circulation disorders	6.3	6.0	0.01
Valvular heart disease	14.3	13.6	0.03
Hypertension	73.1	72.1	0.02
Cardiac arrhythmias	35.8	34.4	0.03
Chronic pulmonary disease	27.0	27.2	0.01
Diabetes	39.5	40.6	0.02
History of dialysis	3.2	3.6	0.03
Liver disease	3.1	3.4	0.02
Anemia	4.1	3.9	0.01
Neurological disorders	7.4	8.4	0.03
Cardiac history			
Previous MI	13.1	14.0	0.03
Previous PCI	15.7	16.7	0.03
Previous CABG	11.1	11.7	0.02
Hospital MI caseload volume (%)			0.25
Low volume	0.8	1.9	
Medium volume	12.1	20.3	
High volume	87.1	77.9	
Hospital teaching status (%)			0.03
Non-metropolitan	8.3	8.9	
Metropolitan nonteaching	35.6	36.9	
Metropolitan teaching	56.0	54.2	
Hospital bed size (%)			0.16
Large bed	65.5	58.4	
Medium bed	24.4	26.9	
Small bed	10.0	14.7	

Reported as proportions unless otherwise noted. Standardized mean differences (SMD) reported as decimals, with >0.10 considered to indicate a significant difference.

AMI = acute myocardial infarction; CABG = coronary artery bypass grafting; IQR = interquartile range; MI = myocardial infarction; PCI = percutaneous coronary intervention; STEMI = ST-elevation myocardial infarction.

transition from inpatient to outpatient care, communication breakdown among medical providers has been estimated to account for a majority of sentinel events occurring in the immediate post-discharge period.[19] Patients discharged after AMI are especially vulnerable given their complex health profiles and polypharmacy.[20] In fact, a study of medication reconciliation found that discrepancies in type or dosage of cardiovascular and anticoagulation drugs accounted for approximately 30% of all unintentional errors.[21] Not only contributing to post-discharge adverse events and rehospitalizations, ineffective communication among isolated medical centers may also lead to worse readmission outcomes in patients experiencing CF.

Importantly, our study noted excess resource utilization in this population, with CF leading to an additional ~\$5,000 in hospitalization costs per patient. Given the large and growing AMI patient population, this investigation posits approximately \$250 million in total annual healthcare costs at the national level attributable to CF. This finding is especially significant given that initial management of AMI already represents a significant burden to US healthcare expenditures, accounting for \$14 billion or 3.3% of aggregate annual hospitalization costs each year.[7] Fragmented healthcare is thought to increase costs through several different pathways, including lack of seamless information exchange among various systems resulting in redundant testing and imaging.[22] Considering the increased national emphasis on value-based care,[23] innovative solutions that improve information sharing and reduce unnecessary procedures could improve both patient outcomes and hospitalization costs, and thus deserve further exploration and development.

Critically, the identification of populations at-risk for CF may serve to mitigate its negative impact. Previous work by Juo et al. considered the role of socioeconomic factors in experiencing CF.[24] Similarly , the present work identified Medicaid insurance as a significant risk factor for experiencing fragmented rehospitalization. Although recent expansions in government-funded insurance programs have allowed improved access to healthcare, Medicaid beneficiaries are still largely limited in choice of treatment location because of multiple factors, including coverage, debt remaining from previous admissions and transportation access.[22,25] Although patients insured by Medicaid are primarily located in metropolitan areas with high-volume tertiary care centers, a recent study reported that a disproportionately low percentage of these patients are actually treated by these hospitals.[26] Given that our study investigated outcomes after nonelective admissions for AMI, it is likely that a subset of Medicaid beneficiaries encountered similar barriers to receiving care at their initial institution. Moreover, Medicare insurance coverage was also linked with greater odds of CF. Previous studies have reported Medicare beneficiaries experience extensive health CF, with the median beneficiary seen by a minimum of 7 to 8 different clinicians each year.[27,28] Historically, Medicare law does not provide payments for care coordination or reward efficiency, and thus effectively discourages overall care management.[1,29] Policy change could therefore continue to address this gap and incentivize higher-quality, coordinated care by reimbursing care organization and management.

In addition, patients experiencing NSTEMI were significantly more likely to experience CF, as compared with those with STEMI. STEMI patients require early intervention, whether percutaneous coronary intervention within 90

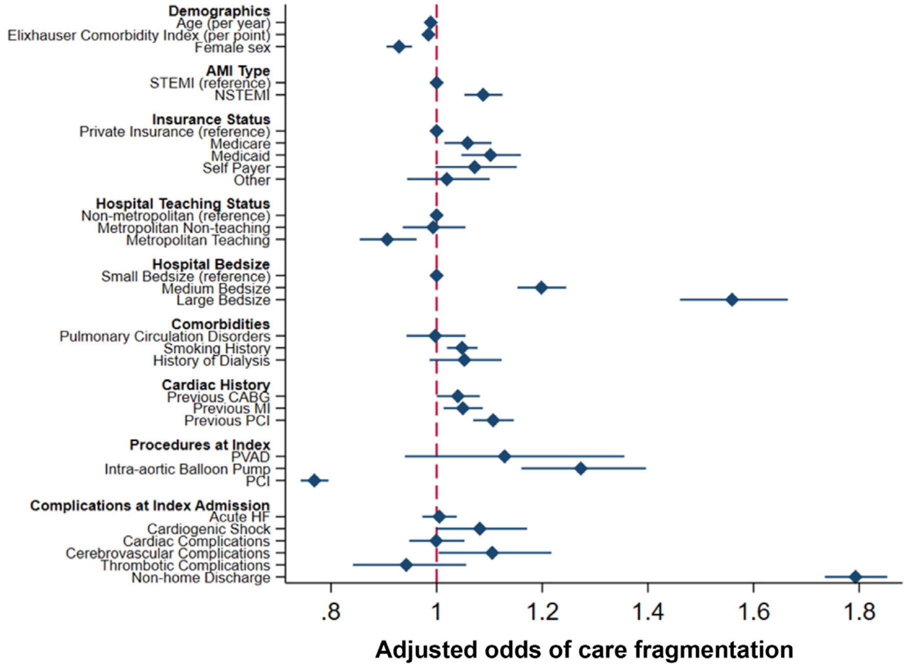

Figure 3. Independent association of demographic factors, co-morbidities, procedures, and complicates at index hospitalization with care fragmentation. After risk adjustment, NSTEMI diagnosis at index admission, Medicaid insurance status, and treatment at a large bed size center were associated with greater odds of care fragmentation. Further, a history of CABG, MI, or diabetes was linked to higher CF odds. CABG = coronary artery bypass grafting; ECMO = extracorporeal membrane oxygenation; MI =, myocardial infarction; PVAD = percutaneous ventricular assist device.

Table 2
Unadjusted and adjusted outcomes during readmission hospitalization

	Unadjusted*		Adjusted†		
	Non-CF	*CF*	*SMD*	*CF*	95%CI
Clinical outcomes					
In-hospital mortality	5.6	6.1	0.02	1.15	1.10-1.20
Cardiac complications	5.2	5.6	0.02	1.10	1.00-1.20
Cardiogenic shock	2.1	3.2	0.07	1.81	1.60-2.06
Infectious complications	14.7	15.9	0.03	1.13	1.06-1.20
Respiratory complications	16.9	18.1	0.03	1.17	1.11-1.24
Thrombotic complications	2.3	2.3	0.01	1.01	0.88-1.15
Blood transfusion	10.9	12.7	0.05	1.23	1.15-1.32
Acute kidney injury complications	18.3	18.2	0.05	1.02	0.97-1.07
Nonhome discharge	23.4	25.7	0.05	1.18	1.12-1.24
Resource utilization					
Length of stay (days) [IQR]	3 [2-6]	4 [2-7]	0.13	+0.92	0.80-1.05
Cost (USD $1,000) [IQR]	8.0 [4.6-15.4]	9.9 [5.5-19.7]	0.20	+4.68	4.26-5.10

Outcomes reported as proportions (%) or as adjusted odds ratio (AOR) with 95% confidence intervals (95%CI). Standardized mean differences (SMD) reported as decimals, with >0.10 considered to indicate a significant difference.

IQR = interquartile range; USD = United States dollar.

minutes or fibrinolysis and subsequent cardiac catheterization. Meanwhile, NSTEMI patients may be initially managed medically, and thus may only require reperfusion therapy or catheterization if ischemia continues. NSTEMI patients have also been linked with greater resource use and hospitalization expenditures.[30] Considering that we report NSTEMI patients are more likely to experience CF, and CF is associated with greater costs, interventions that seek to improve discharge planning and ensure continuity of care could both improve outcomes and reduce resource use among these patients.

Ultimately, the significant impact of rehospitalization and CF on both patient outcomes and resource utilization prompts further efforts to provide value-based healthcare. Implementation of more effective predischarge care coordination has previously been demonstrated to lower readmission rates[31] and might prove to reduce CF. Previous studies have explored the role of "patient navigators" in assisting underserved individuals access quality healthcare while also addressing noncompliance.[32] Such models have further proved useful in patients with rehabilitation needs after acute hospitalizations.[33] Furthermore, given that nonhome discharge was found to be linked to increased odds of CF, early identification of individuals at high risk for discharge to a postacute care facility could present another important

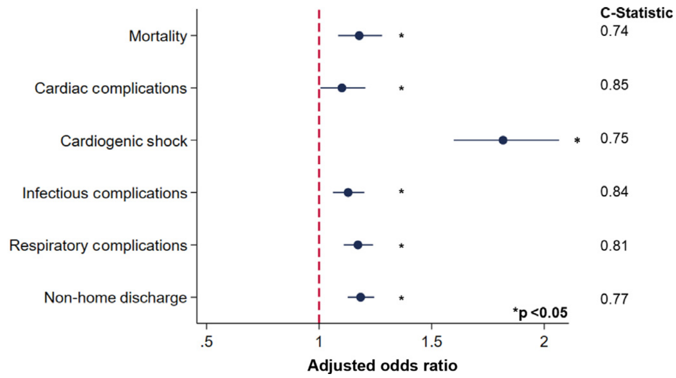

Figure 4. Independent association of care fragmentation with outcomes at readmission.
After risk adjustment, patients experiencing care fragmentation faced greater odds of in-hospital mortality, complications, and nonhome discharge. Reference: Non-CF. Error bars represent 95% confidence intervals.

intervention point. In situations where CF is inevitable, more efficient communication between hospitals, and between hospitals and postacute facilities, may improve outcomes. Although a large majority of hospitals in the United States rely on electronic medical records, the lack of a universal system prevents seamless transfer of information between centers.[34] Technology that can extract the most relevant data from electronic medical records and instantaneously transmit it to other centers that may be involved with the care of a recently discharged patient may mitigate the detrimental impact of CF.

There are several important limitations to the present study. The NRD is a retrospective, administrative database subject to variations in coding practices between physicians and institutions. Only in-hospital events within a single calendar year are captured from NRD-participating centers, so readmissions to non-participating hospitals could not be included. Key clinical characteristics, such as the location or size of the infarct, are not measured and, therefore could not be considered in this analysis. Moreover, patient satisfaction in their care at the index hospital is not documented. The NRD also does not provide data surrounding the number of hospitals in the patient's region, and so we cannot evaluate the full extent of patient choice in readmitting facility. Although we recognize emergency medical services may contribute to the decision of where a patient is readmitted, the NRD does not provide information surrounding patient arrival through car or ambulance or distance traveled to the readmitting facility. In addition, limited granularity in reason for readmission was available. Although not possible using the present data, future analyses should consider these factors. However, we used the largest all-payer dataset in the United States and robust statistical methods to reduce bias and enhance the generalizability of our findings.

In summary, CF is associated with inferior clinical and financial outcomes in patients initially admitted for AMI. Notably, patients primarily insured by Medicaid experienced higher adjusted rates of CF. Given the significant nationwide prevalence of AMI and cardiovascular disease more broadly, targeted interventions, efficient information sharing, and policies to improve healthcare access warrant further exploration to reduce the burden and adverse consequences of rehospitalization and CF.

Disclosures

The authors have no conflicts of interest to declare.

Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.amjcard.2022.10.046.

1. Elhauge E. Why we should care about health care fragmentation and how to fix it. In: Elhauge E, ed. The Fragmentation of U.S. Health Care: Causes and Solutions. Oxford: Oxford University Press; 2010:1–20.
2. McCrum ML, Cannon AR, Allen CM, Presson AP, Huang LC, Brooke BS. Contributors to increased mortality associated with care fragmentation after emergency general surgery. *JAMA Surg* 2020;155:841–848.
3. Zheng C, Habermann EB, Shara NM, Langan RC, Hong Y, Johnson LB, WB Al-Refaie. Fragmentation of care after surgical discharge: non-index readmission after major cancer surgery. *J Am Coll Surg* 2016;222:780–789. e2.
4. Juo YY, Sanaiha Y, Khrucharoen U, Chang BH, Dutson E, Benharash P. Care fragmentation is associated with increased short-term mortality during postoperative readmissions: a systematic review and meta-analysis. *Surgery* 2019;165:501–509.
5. Tsai TC, Orav EJ, Jha AK. Care fragmentation in the postdischarge period: surgical readmissions, distance of travel, and postoperative mortality. *JAMA Surg* 2015;150:59–64.
6. Schuett KA, Lehrke M, Marx N, Burgmaier M. High-risk cardiovascular patients: clinical features, comorbidities, and interconnecting mechanisms. *Front Immunol* 2015;6:591.
7. Mcdermott KW, Roemer M. *Most frequent principal diagnoses for inpatient stays in U.S. Hospitals 2018*. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs. Rockville: Agency for Healthcare Research and Quality (US); 2021.
8. Rymer JA, Chen AY, Thomas L, Fonarow GC, Peterson ED, Wang TY. Readmissions after acute myocardial infarction: how often do patients return to the discharging hospital? *J Am Heart Assoc* 2019;8:e012059.
9. Healthcare Cost and Utilization Project. NRD overview. Available at: https://www.hcup-us.ahrq.gov/nrdoverview.jsp. Accessed on February 28, 2022.
10. Lamori JC, Shoheiber O, Dudash K, Crivera C, Mody SH. The economic impact of acute coronary syndrome on length of stay: an analysis using the Healthcare Cost and Utilization Project (HCUP) databases. *J Med Econ* 2014;17:191–197.
11. Healthcare Cost and Utilization Project. NRD description of data elements. Available at: https://www.hcup-us.ahrq.gov/db/nation/nrd/nrddde.jsp. Accessed on March 14, 2022.

12. Agency for Healthcare Research and Quality. Using appropriate price indices for expenditure comparisons. Available at: https://meps.ahrq.gov/about_meps/Price_Index.shtml. Accessed on March 14, 2022.
13. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. *Med Care* 1998;36:8–27.
14. Sanaiha Y, Hadaya J, Cale M, Cho NY, Madrigal J, Sareh S, Benharash P. Impact of interhospital transfer on clinical outcomes and resource use after cardiac operations: insights from a national cohort. *Surgery* 2020;168:876–881.
15. Williamson CG, Tran Z, Kim ST, Hadaya J, Biniwale R, Benharash P. Center volume impacts readmissions and mortality after congenital cardiac surgery. *J Pediatr* 2022;240:129–135. e2.
16. Cuzick J. A Wilcoxon-type test for trend. *Statist Med* 1985;4:87–90.
17. Leuven E, Sianesi B. PSMATCH2: Stata module to perform full mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. Ideas. Available at: https://ideas.repec.org/c/boc/bocode/s432001.html. Accessed on May 1, 2022.
18. Zou H, Hastie T. Regularization and variable selection via the elastic net. *J Royal Statistical Soc B* 2005;67:301–320.
19. Forster AJ, Murff HJ, Peterson JF, Gandhi TK, Bates DW. The Incidence and severity of adverse events affecting patients after discharge from the hospital. *Ann Intern Med* 2003;138:161–167.
20. Volpe M, Chin D, Paneni F. The challenge of polypharmacy in cardiovascular medicine. *Fundam Clin Pharmacol* 2010;24:9–17.
21. Sinvani LD, Beizer J, Akerman M, Pekmezaris R, Nouryan C, Lutsky L, Cal C, Dlugacz Y, Masick K, Wolf-Klein G. Medication reconciliation in continuum of care transitions: a moving target. *J Am Med Dir Assoc* 2013;14:668–672.
22. Schrag D, Xu F, Hanger M, Elkin E, Bickell NA, Bach PB. Fragmentation of care for frequently hospitalized urban residents. *Med Care* 2006;44:560–567.
23. Gray M. Value based healthcare. *BMJ* 2017;356:j437.
24. Juo YY, Sanaiha Y, Khrucharoen U, Tillou A, Dutson E, Benharash P. Complete impact of care fragmentation on readmissions following urgent abdominal operations. *J Gastrointest Surg* 2019;23:1643–1651.
25. Sommers BD, Baicker K, Epstein AM. Mortality and access to care among adults after state Medicaid expansions. *N Engl J Med* 2012;367:1025–1034.
26. Hall EC, Zheng C, Langan RC, Johnson LB, Shara N, WB Al-Refaie. Medicaid beneficiaries undergoing complex surgery at quality care centers: insights into the Affordable Care Act. *Am J Surg* 2016;211:750–754.
27. Agha L, Frandsen B, Rebitzer JB. Causes and consequences of fragmented care delivery: theory, evidence, and public policy 2017. Available at: http://www.nber.org/papers/w23078. Accessed on March 1, 2022.
28. Pham HH, Schrag D, O'Malley AS, Wu B, Bach PB. Care patterns in Medicare and their implications for pay for performance. *N Engl J Med* 2007;356:1130–1139.
29. Hyman DA. Healthcare fragmentation: we get what we pay for; 2009. Available at: http://papers.ssrn.com/pape.tar?abstract_id=1377051. Accessed on April 2, 2022.
30. Tran DT, Welsh RC, Ohinmaa A, Thanh NX, Kaul P. Resource use and burden of hospitalization, outpatient, physician, and drug costs in short- and long-term care after acute myocardial infarction. *Can J Cardiol* 2018;34:1298–1306.
31. Phillips CO, Wright SM, Kern DE, Singa RM, Shepperd S, Rubin HR. Comprehensive discharge planning with postdischarge support for older patients with congestive heart failure: a meta-analysis. *JAMA* 2004;291:1358–1367.
32. Natale-Pereira A, Enard KR, Nevarez L, Jones LA. The role of patient navigators in eliminating health disparities. *Cancer* 2011;117(suppl):3543–3552.
33. Wissel J, Olver J, Sunnerhagen KS. Navigating the poststroke continuum of care. *J Stroke Cerebrovasc Dis* 2013;22:1–8.
34. Mamlin BW, Tierney WM. The Promise of information and communication technology in healthcare: extracting value from the chaos. *Am J Med Sci* 2016;351:59–68.