CLINICAL INVESTIGATION

Geriatric Emergency Department Innovations: Transitional Care Nurses and Hospital Use

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OBJECTIVES: To examine the effect of an emergency department (ED)-based transitional care nurse (TCN) on hospital use.

DESIGN: Prospective observational cohort.

SETTING: Three U.S. (NY, IL, NJ) EDs from January 1, 2013, to June 30, 2015.

PARTICIPANTS: Individuals aged 65 and older in the ED (N = 57,287).

INTERVENTION: The intervention was first TCN contact. Controls never saw a TCN during the study period.

MEASUREMENTS: We examined sociodemographic and clinical characteristics associated with TCN use and outcomes. The primary outcome was inpatient admission during the index ED visit (admission on Day 0). Secondary outcomes included cumulative 30-day admission (any admission on Days 0–30) and 72-hour ED revisits.

RESULTS: A TCN saw 5,930 (10%) individuals, 42% of whom were admitted. After accounting for observed selection bias using entropy balance, results showed that when compared to controls, TCN contact was associated with lower risk of admission (site 1: −9.9% risk of inpatient admission, 95% confidence interval (CI) = −12.3% to −7.5%; site 2: −16.5%, 95% CI = −18.7% to −14.2%; site 3: −4.7%, 95% CI = −7.5% to −2.0%). Participants with TCN contact had greater risk of a 72-hour ED revisit at two sites (site 1: 1.5%, 95% CI = 0.7–2.3%; site 2: 1.4%, 95% CI = 0.7–2.1%). Risk of any admission within 30 days of the index ED visit also remained lower for TCN patients at both these sites (site 1: −7.8%, 95% CI = −10.3% to −5.3%; site 2: −13.8%, 95% CI = −16.1% to −11.6%).

CONCLUSION: Targeted evaluation by geriatric ED transitions of care staff may be an effective delivery innovation to reduce risk of inpatient admission. **J Am Geriatr Soc 2018.**

Key words: emergency department; transitions of care; admission

The U.S. healthcare system simultaneously faces rising inpatient costs and inefficient and inequitable care, with variable application of evidence-based practices. These pressures may significantly affect one of the most vulnerable populations, older adults, at times of acute illness or injury.[1] An emergency department (ED) visit is often described as a sentinel event signifying a breakdown in care coordination for older adults.[2,3] With the ED at the crossroads of multiple healthcare settings, it has been described as "a portal of entry to inpatient care."[4–7] Both hospitalization and being discharged from the ED carry significant risks for older adults, including iatrogenic complications, functional and cognitive decline, and loss of independence.[8–14] This highlights the importance of greater care to support transitions from the ED.

Programs like Geriatric Emergency Department Innovations in Care through Workforce, Informatics, and Structural Enhancements (GEDI WISE) have been developed to address these challenges. GEDI WISE was a Center for Medicare and Medicaid Innovation (CMMI) Health

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Care Innovation Award program (1C1CMS331055–01).[15] It is a model of geriatric emergency care in 3 large, urban hospitals (Mount Sinai Medical Center (MSMC), New York, NY; St. Joseph's Regional Medical Center (SJRMC), Paterson, NJ; Northwestern Memorial Hospital (NMH), Chicago, IL) that operationalizes the structural and process interventions of the geriatric ED guidelines that national geriatric and emergency medicine organizations have endorsed.[16] GEDI WISE targets older adults in the ED using geriatric clinical protocols; informatics for monitoring and clinical decision-making; and structural enhancements to meet the triple aim of better geriatric emergency care, better older adult health, and lower health care costs. GEDI WISE includes an ED-based transitional care nurse (TCN) program to identify individuals with geriatric-specific health-related needs and coordinate their transition from ED to home with the goal of avoiding inpatient admissions.

The objective of this study was to evaluate the effect of TCN exposure during an ED visit on risk of inpatient admission, admission the days following the ED visit, and ED revisits. We hypothesized that individuals who saw a TCN would have lower risk of admission, lower risk of subsequent admission, but might have more ED revisits.

METHODS

Study Design, Setting, and Participants

This was a prospective observational cohort study of individuals aged 65 and older with an ED visit at a GEDI WISE hospital during the program implementation period (January 1, 2013 to July 30, 2015 for MSMC and SJRMC; April 1, 2013 to July 30, 2015 for NMH) (Table 1).

To evaluate the effect of the TCN intervention, individuals exposed to the TCN at least once during the study period were included in the intervention group. Individuals with no TCN contact during the study period were in the control group. All comparisons were performed with the unit of analysis restricted to the first TCN contact for the treated group and the first ED visit for the control group (henceforth defined as the index visit) during the study period. Analyses were stratified according to site using standardized data for all 3 sites.

Table 1. Geriatric Emergency Department (ED) Innovations in Care through Workforce, Informatics, and Structural Enhancements Site Characteristics (2013–15)

Hospital	Mount Sinai Medical Center	Northwestern Memorial Hospital	St. Joseph's Regional Medical Center
Annual ED visits all ages, n	109,258	86,998	157,413
Annual ED visits age ≥65, n (%)	18,574 (17)	16,530 (19)	16,218 (10)
Location	New York, NY	Chicago, IL	Paterson, NJ
Total hospital beds, n	1,127	881	651
Total ED beds, n	48	64	88
Geriatric ED structural beds, n	10	28	24
Race and ethnicity, %			
White	36	63	14
Black	40	35	26
Hispanic	24	7	47
Other	<1	2	10
Emergency Severity Index level, %			
1 (most acute)	<1	1	1
2	16	37	18
3	46	40	54
4	29	20	23
5 (least acute)	8	2	2
Transitional care nurses, n	2	4	2
ED practitioners, n			
Attending	39	33	55
Resident	60	48	24
Physician assistant	6	1	1
Nurse practitioner	0	2	7
Nurses	92	120	119
Social workers	4	0.5	1
Pharmacists	5	1	1
Electronic medical record	EPIC	Cerner	MedHost

Intervention

The GEDI WISE TCN intervention consisted of emergency nurses trained to facilitate care transitions of older adults in the ED to the community with the goal of avoiding inpatient admission when possible. This included evaluation of functional and cognitive impairment, physical frailty, and medical complexities common in older adults that often limit their ability to navigate the outpatient healthcare system. Sites customized the TCN intervention to address patient needs and site-specific resources available, reflecting best practices for implementation projects. The TCN model at NMH and MSMC have been previously described.[17,18]

At all sites, the TCN was a nurse or nurse practitioner. Individuals who saw the TCN were assessed for cognitive function (Short Portable Mental Status Questionnaire[19] or Mini-Cog[20]), delirium (Confusion Assessment Method (CAM),[21] Richmond Agitation Sedation Scale,[22] or CAM for the intensive care unit[23]), functional status (Katz activities of daily living),[24] falls risk (Timed Up and Go Test),[25] care transitions (Care Transitions Measure-3),[26] and caregiver strain (Modified Caregiver Strain Index). Choice of GEDI WISE assessments was based on preexisting hospital programs or staff choice.

The TCN initiated interdisciplinary ED geriatric care using resources available to the ED based on physical, functional, cognitive, or other needs identified during the GEDI WISE assessment. Thus, the individual's assessment and transitional care needs determined the extent of ED resources delivered; some required little support, others required extensive transitional resources. All TCN interactions were recorded in the medical record or in logs that staff kept and imported to a secure database from the institutions' data warehouses.

The TCN intervention had limited staffing and thus targeted patients based on criteria or availability. At MSMC, individuals with an Identification of Senior At

Risk (ISAR)[27] score of 4 or higher, an Emergency Severity Index (ESI)[28] of 3 or higher, hospital discharge 30 days before the index ED visit, or request by ED clinicians were eligible to see the TCN, who was available 7 days a week from 11:00 a.m. to 8:00 p.m. At NMH, individuals with an ISAR score of 3 or higher or at the request of the ED clinicians saw the TCN on weekdays from 9:00 a.m. to 8:00 p.m. At SJRMC, all individuals aged 65 and older placed in the geriatric ED zone on weekdays from 9:00 a.m. to 5:00 p.m. were evaluated. At all sites, the TCN evaluated individuals only when the TCN was available. Thus, many did not receive the intervention for reasons unrelated to risk factors and so were similar to those who received the intervention. We sought to identify these controls who were eligible for the TCN intervention, were similarly sick, and had similar likelihood of discharge but not see the TCN.

Intervention participants were defined as having any TCN contact, regardless of duration or extent of geriatric care provided. TCN contact was identified according to medical record reports, consultation requests, visits recorded in the TCN logs, and documentation of a TCN geriatric assessment.

Data

Data were collected from electronic health record reports and institution data warehouses. Through a data use agreement, NMH and SJRMC transmitted files securely to MSMC to create a standardized 3-site database. There were 58,310 unique individual ED visits during the study period. Because the TCN did not target individuals with high acuity, our analysis focused on 57,287 individuals with an ESI score greater than 1.

Use Outcomes

The primary outcome was inpatient admission on the index ED visit (admission on Day 0). Observation admissions were excluded because they were not available at all sites. Secondary outcomes for participants discharged during the index ED visit included any subsequent 72-hour ED revisit and any inpatient admission within 30 days of the index ED visit.

Analysis

Analyses were conducted according to site; data were not pooled because hospitals varied in clinical implementation, TCN workflow, and duration of geriatric ED programs (e.g., SJRMC had had a geriatric ED program since 2009, whereas NMH established one in 2013).

Individuals receiving and not receiving TCN contact may have differed in systematic ways that could bias our intervention effect estimates if not accounted for in analyses. To account for selection bias and ensure that intervention and control group participants were as similar as possible, we used entropy balancing[29–31] to obtain a weighted comparison group with covariate means and distributions similar to those of the TCN (intervention) group for each site. We completed multivariable regression modeling on the weighted datasets.

Entropy Balancing

In entropy balancing, treated individuals (TCN intervention) are assigned a weight of 1. Comparison (control) individuals are assigned weights so that, in the aggregate, the means of dichotomous variables and the means and variances of continuous variables are equal for the intervention and control participants. Weights for controls are then normalized so that their sum equals the number of treated individuals. Entropy balancing is akin to survey weighting, in which weights are assigned to respondents so that their characteristics are representative of the population from which they were derived.[29] Entropy balancing allowed us to create a comparison control group similar to the TCN group, except for receipt of the TCN intervention.[31,32]

Our treatment and comparison groups were balanced on the following (measured during the index ED visit): risk of adverse outcome (ESI: 2 (more urgent), 3, 4–5 (less urgent);[28] ISAR: 0–1 vs ≥ 2[27]), likelihood of not encountering TCN intervention (index ED visit occurred at night (9:00 p.m. to 9:00 a.m.) or on the weekend (yes/no); placement in a geriatric ED structural environment (yes/no)), overall clinical status (discharge from hospital in previous 30 days; Charlson comorbidity score (0, 1, 2, 3, ≥ 4);[33] the 6 most common chief complaints at all sites for older adults (pain, falls, difficulty breathing, weakness, altered mental status, psychiatric)), and sociodemographic characteristics (age; sex). Balance in covariates across treatment groups was assessed using standardized differences, with differences of less than 10% considered ideal.

Regression Models

Adjusted regression models on weighted samples allowed us to account for potential covariate imbalance that could remain after entropy balancing, allowing a doubly robust estimation.[34,35] Models included all covariates used to create entropy balance weights.[34,35] Within each site, we estimated a multinomial logistic regression model to examine the relationship between TCN intervention and 3 potential outcomes: discharge with no ED revisit within 72 hours (the ideal outcome and reference category), discharge with an ED revisit within 72 hours, and hospital admission. Results are presented as incremental average marginal effects (AMEs) by percent change (i.e., mean change in likelihood of hospital admission when a participant is moved from the control group to the TCN group, holding all other covariates at their weighted values). Logistic regression was used to examine the relationship between TCN intervention and hospital admission within 30 days. Sensitivity analyses were conducted with the comparison groups being restricted to ED patients that arrived only during daytime hours and weekdays. (Table S1).

All analyses were conducted using Stata version 14.2 (Stata Corp., College Station, TX). The institutional review boards at all 3 sites approved this evaluation.

RESULTS

During the study period, 57,287 individuals aged 65 and older with an ESI greater than 1 made 120,221 ED visits at the 3 participating hospitals. Ten percent were exposed

to a TCN (10%, 2,137/21,593 patients at MSMC; 12%, 2,406/20,040 patients at NMH; 9%, 1,387/15,654 patients at SJRMC). During the study period, the average rate of Day 0 inpatient admission of individuals aged 65 and older with an ESI greater than 1 was 42% (MSMC 46%, NMH 35%, SJRMC 44%).

With entropy balancing, we created weighted comparison groups for each site that were similar to the TCN group except for receipt of the TCN intervention (Table 2). After balancing, standardized differences in risk for adverse outcomes, clinical characteristics, and sociodemographic characteristics approached 0 (Figure 1).

In bivariate analyses of balanced samples, individuals receiving TCN care on their index ED visit had significantly lower Day 0 inpatient admission rates than controls at all 3 hospitals (MSMC: 36% TCN vs 46% control, $P < .001$; NMH: 36% TCN vs 53% control, $P < .001$; SJRMC: 46% TCN vs 51% control, $P = .01$). Participants with TCN contact discharged from the ED during the index visit were significantly more likely than controls to have a 72-hour ED revisit at MSMC (3% TCN vs 2% control, $P = .03$) but not at SJRMC (3% vs 2%, $P = .77$) or NMH (3% vs 1%, $P = .06$). Lower rates of any inpatient admission from Days 0 to 30 for TCN participants were sustained at MSMC (43% TCN vs 51% control, $P < .001$) and NMH (42% TCN vs 56% control, $P < .001$) but not SJRMC (52% TCN vs 53% control, $P = .43$).

In multivariable logistic regression models, many of these findings persisted. From the multinomial model, TCN participants at all sites were less likely to require a Day 0 inpatient admission than those discharged with no 72-hour ED revisits (meaning they did not come back to the ED for a second visit within 72 hours) (MSMC: AME = −9.9%, 95% CI = −12.3 to −7.5; NMH: AME = −16.5%, 95% CI = −18.7 to −4.2; SJRMC: AME = −4.7%, 95% CI = −7.5 to −2.0). At MSMC and NMH, there was a greater risk of 72-hour ED revisit for TCN participants than for those who were discharged and did not return to the ED (MSMC: AME = 1.5%, 95% CI = 0.7–2.3; NMH: AME = 1.4%, 95% CI = 0.7–2.1) but not at SJRMC. From logistic regression, participants at MSMC and NMH were less likely to have any inpatient admission in the subsequent 30 days (MSMC: AME = −7.8%, 95% CI = −10.3 to −5.3; NMH: AME = −13.8%, 95% CI = −16.1 to −11.6) (Table 3).

DISCUSSION

At a time of increasing pressure to deliver efficient healthcare to an aging population that often requires greater services, opportunities to improve quality and reduce use are needed. With more than one-third of U.S. outpatient care delivered in the acute care setting,[36] the ED is a significant place for medical decision making, conduit for inpatient admissions, and setting not only where safety net care is delivered, but also where care transition programs can be integrated.[37]

In this study, individuals exposed to a TCN had a significantly lower risk of inpatient admission during the index ED visit at all 3 hospitals, and for 2 of the 3 hospitals, this risk persisted over the subsequent 30 days. We anticipated that an initiative designed to decrease inpatient admissions might result in greater ED use if the discharge was unsuccessful. This occurred at 2 of the hospitals, although the likelihood of admission from Day 0 to 30 remained lower for the TCN group. At a time when the national average for ED admissions with older adults is a third being admitted,[38] *ED-based programs that can reduce this risk are significant in their potential for impact – especially at these study hospitals with higher than national average rates of admission of older adults (35–46%)*. At the GEDI WISE hospitals, the TCNs saw approximately 10% of individuals in the ED and were able to reduce the risk of admission for these patients by 5% to 16%.

The ED-based TCN intervention is unique in its focus on averting inpatient admissions for older adults while in the ED. Hospital and community-based care coordination programs aimed at improving outcomes and reducing unnecessary healthcare use for older adults have proliferated over the last 2 decades. Evidence of the effect of these programs on admissions is mixed,[39,40] and none have been ED based with a strategy to avoid hospitalization during the ED visit. Other ED-based programs have focused on coordination of care and transitions at the end of an ED visit or post-ED discharge of individuals expected to be or already discharged from the ED—when there is limited or no time to avoid hospitalization from the ED for those already admitted.[41] Some programs have demonstrated early evidence of success with comprehensive geriatric assessments and interdisciplinary teams that have kept discharged individuals from future admissions and ED visits,[42–44] but these studies were limited in terms of single-site evaluation and methodology or were not systematically evaluated for effect.[40,41] *None of these programs attempted to avert and analyze risk of inpatient admissions for older adults presenting to the ED*.

To our knowledge, this is the first study to show a significant decrease in hospitalization risk through an ED-based geriatric assessment and care transitions program.[45] Many people seen in the ED setting appropriately require inpatient admission, and older adults have higher rates of admission than the general population,[46] but retrospective review of existing hospitalization data indicates that many of these admissions may be avoidable.[47] Hospitalization of older adults has significant risks of iatrogenic complications, including potentially inappropriate medication prescribing.[8] During and after hospitalization, many older adults experience functional decline and deconditioning, worse quality of life, cognitive decline, and loss of independence.[9–13] More than 30% of older adults develop hospitalization-associated disability. After an acute admission, many older adults do not return to their previous functional state and often acquire additional geriatric syndromes.[13] Although potentially preventable admissions have decreased over the past decade, the basis for this decrease remains uncertain, and the challenge remains in providing assessments and programs to support the safe discharge of older adults from the ED. The ED may play a significant role in changing the trajectory and impact of these adverse effects and sequelae of hospitalization on older adults.

This study has several limitations. Although entropy balancing was used to account for observed selection bias, there may be unobserved confounders associated with TCN use

Table 2. Comparison of Weighted Controls and Transitional Care Nurse (TCN) Intervention According to Site (Unique First-Time Emergency Department (ED) Visits)

Variable	Mount Sinai Medical Center			Northwestern Memorial Hospital			St. Josephs Regional Medical Center		
	Weighted Control	Weighted TCN Intervention	Standardized Difference	Weighted Control	Weighted TCN Intervention	Standardized Difference	Weighted Control	Weighted TCN Intervention	Standardized Difference
	N = 2,137	N = 2,137		N = 2,406	N = 2,406		N = 1,387	N = 1,387	
Age, mean ± standard deviation	78.9 ± 8.9	78.9 ± 8.6	0.0	79.0 ± 9.0	79.0 ± 8.4	0.0	76.4 ± 8.4	76.3 ± 8.5	0.0
Male (%)	748.2 (35.0)	748.0 (35.0)	0.0	898.0 (37.3)	898.0 (37.3)	0.0	552.0 (39.8)	552.0 (39.8)	0.0
ED visit, night or weekend presentation (%)	513.5 (24.0)	513.0 (24.0)	0.1	464.0 (19.3)	464.0 (19.3)	0.0	352.0 (25.4)	352.0 (25.4)	0.0
Emergency Severity Index (%)									
2	398.8 (18.7)	398.0 (18.6)	0.1	1,203.0 (50.0)	1,203.0 (50.0)	0.0	1,054.0 (76.0)	1,054.0 (76.0)	0.0
3	1,535.34 (71.9)	1,536.0 (71.9)	0.1	983.0 (40.9)	983.0 (40.9)	0.0	245.0 (17.7)	245.0 (17.7)	0.0
ED visit occurring in geriatric ED structural environment (%)	1,527.4 (71.5)	1,529.0 (71.6)	0.2	995.0 (41.4)	995.0 (41.4)	0.0	1,015.0 (73.2)	1,015.0 (73.2)	0.0
Prior 30-day hospital discharge (%)	187.9 (8.8)	188.0 (8.8)	0.0	318.0 (13.2)	318.0 (13.2)	0.0	183.0 (13.2)	183.0 (13.2)	0.0
Identification of Senior At Risk score (%)									
0–1	768.0 (35.9)	768.0 (35.9)	0.1	448.0 (18.6)	448.0 (18.6)	0.0	129.0 (9.3)	129.0 (9.3)	0.0
≥2	1,369.0 (64.1)	1,369.0 (64.1)	0.0	1,958.0 (81.4)	1,958.0 (81.4)	0.0	423.0 (30.5)	423.0 (30.5)	0.0
Charlson Comorbidity Index (%)									
1	528.0 (24.7)	528.0 (24.7)	0.0	424.0 (17.6)	424.0 (17.6)	0.0	376.0 (27.1)	376.0 (27.1)	0.0
2	316.0 (14.8)	316.0 (14.8)	0.0	296.0 (12.3)	296.0 (12.3)	0.0	259.0 (18.7)	259.0 (18.7)	0.0
3	254.0 (11.9)	254.0 (11.9)	0.0	240.0 (10.0)	240.0 (10.0)	0.0	166.0 (12.0)	166.0 (12.0)	0.0
≥4	512.0 (24.0)	512.0 (24.0)	0.0	627.0 (26.1)	627.0 (26.1)	0.0	222.0 (16.0)	222.0 (16.0)	0.0
Chief complaint (%)									
Pain	360.8 (16.9)	361.0 (16.9)	0.0	353.0 (14.7)	353.0 (14.7)	0.0	200.0 (14.4)	200.0 (14.4)	0.0
Falls	258.9 (12.1)	259.0 (12.1)	0.0	298.0 (12.4)	298.0 (12.4)	0.0	129.0 (9.3)	129.0 (9.3)	0.0
Difficulty breathing	129.1 (6.0)	129.0 (6.0)	0.0	136.0 (5.7)	136.0 (5.7)	0.0	109.0 (7.9)	109.0 (7.9)	0.0
Weakness	128.0 (6.0)	128.0 (6.0)	0.0	114.0 (4.7)	114.0 (4.7)	0.0	97.0 (7.0)	97.0 (7.0)	0.0
Altered mental status	58.0 (2.7)	58.0 (2.7)	0.0	70.0 (2.9)	70.0 (2.9)	0.0	74.0 (5.3)	74.0 (5.3)	0.0
Psychiatric	43.0 (2.0)	43.0 (2.0)	0.0	63.0 (2.6)	63.0 (2.6)	0.0	51.0 (3.7)	51.0 (3.7)	0.0

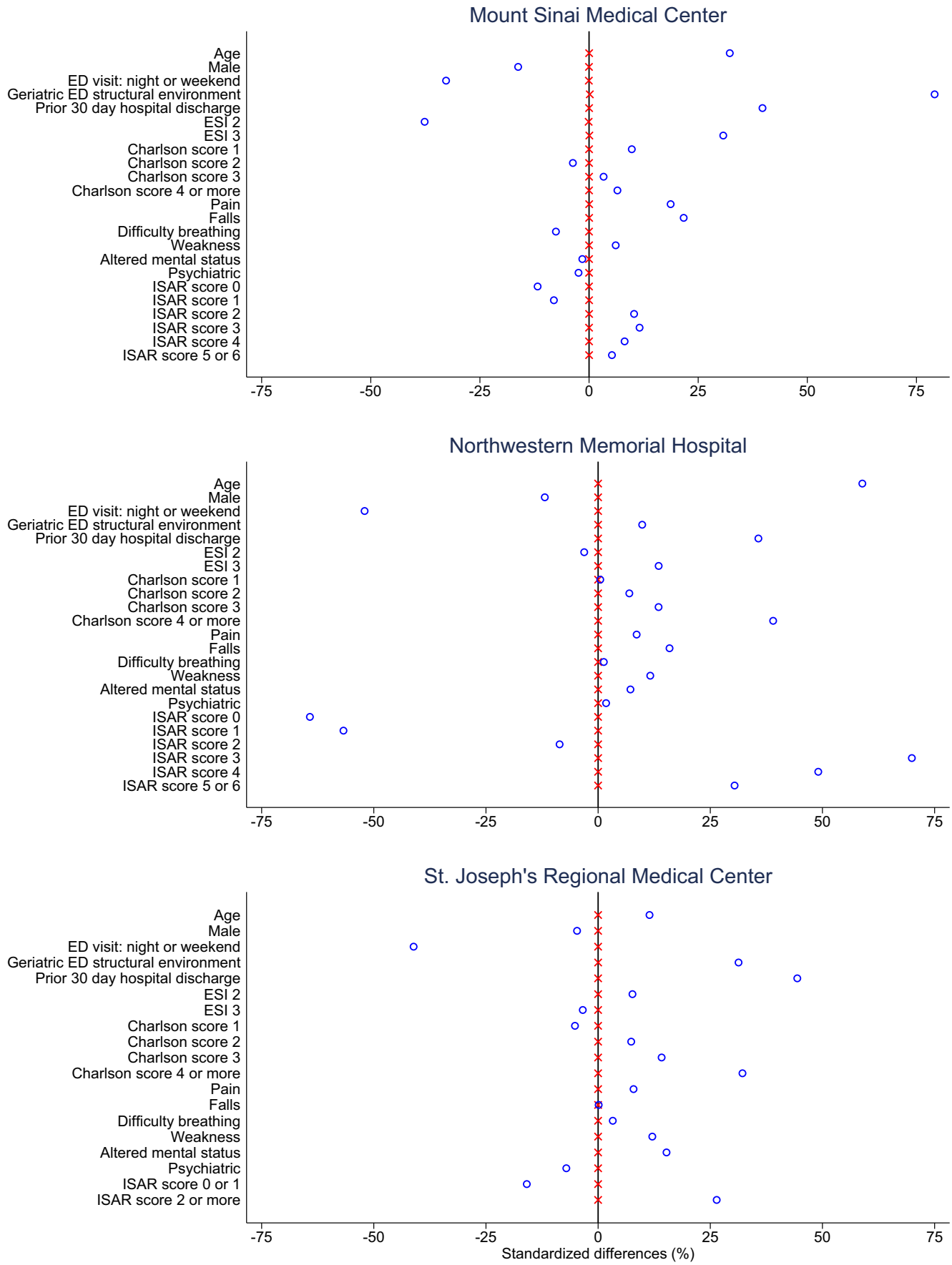

Figure 1. Entropy balancing resulted in better covariate balance (smaller absolute value of standardized difference) across treatment and comparison groups for each site. X is weighted and O is unweighted.

Table 3. Percentage Change in Day 0 Inpatient Admissions, Discharges with Subsequent 72-Hour Emergency Department (ED) Visits from Multinomial Logistic Model, and Any Admission in the 30 Days After ED Discharge Associated with Transitional Care Nurse (TCN) Intervention from Logistic Model

Outcome (Reference Discharged with No Repeat 72-Hour ED Visit[a])	Mount Sinai Medical Center	Northwestern Memorial Hospital	St. Joseph's Regional Medical Center
	Effect of TCN vs Control (95% Confidence Interval)		
Inpatient admission (Day 0)[a]	−9.90 (−12.31 to −7.47)	−16.46 (−18.68 to −14.24)	−4.72 (−7.47 to −1.98)
Discharged with subsequent 72-hour ED visit[a]	1.49 (0.65–2.33)	1.38 (0.65–2.12)	0.37 (−0.53–1.28)
Any inpatient admission (Day 0–30)[b]	−7.79 (−10.33 to −5.25)	−13.82 (−16.07 to −11.58)	−1.38 (−4.04–1.27)

Results obtained from [a]multinomial logistic regression models or [b]logistic regression models, which were adjusted for age; sex; index ED visit at night (9:00 p.m. to 9:00 a.m.) or during the weekend; Emergency Severity Index; use of a geriatric ED structural environment during the index ED visit; discharge from a hospital admission in the prior 30 days; Charlson Comorbidity Index score; chief complaint related to pain, falls, difficulty breathing, weakness, altered mental status, psychiatric; Identification of Senior At Risk score.

and usage outcomes. Outcomes for individuals who may have gone to other hospitals could not be evaluated. Exposure to the intervention was defined as any contact from the TCN. The degree to which the TCN provided and facilitated care transitions for individual participants was not measured. The implementation and operationalization of the TCN intervention, which patients they saw, and what resources were available to older adults varied across the 3 sites. These differences, along with duration of geriatric emergency care programs at each site, may account for the variation in outcomes between sites. The reduction in hospital admission risk at SJRMC was smaller than at the other 2 hospitals. This effect attenuated and became insignificant over the subsequent 30 days. SJRMC had a geriatric ED program for several years before implementation of the GEDI WISE programs. The baseline opportunity for improvement may have already changed with earlier programs and thus the hospital may have been susceptible to contamination bias. Analyses also could not account for other programs and policies at the hospitals that may have influenced the outcomes presented (e.g., other departmental transition programs, policies targeting inpatient admissions). This is why analyses were stratified according to site and not pooled. Nevertheless, even with the known variability in intervention implementation not only according to site, but also within site, we observed a consistent and significantly lower risk of admission for individuals who saw a TCN, strengthening our results that may be conservative in estimated effects. It is likely that our approach of evaluating only the first TCN contact, regardless of intensity, provides conservative estimates of the intervention's potential effect on outcomes evaluated here. Further research is needed to observe and evaluate how TCN care is provided, what elements of the care transitions processes and care coordination were delivered, and the amount of time spent on each person and to determine which of these are associated with better outcomes. These findings should be replicated in a randomized control trial in the ED setting to demonstrate causal effect.

In summary, programs focused on improving care transitions for older adults seen in the ED may be an effective way to reduce risk of inpatient admission during an ED visit (and the following 30 days) but may lead to an increase in ED revisit rates. Targeted evaluation by clinically trained nursing staff focused on improving the ED transitions of care may be an effective delivery innovation to reduce likelihood of hospital admission, subsequent complications, loss of function and independence associated with hospitalizations, and costly inpatient care.

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Conflict of Interest: MSR is a member of the American College of Emergency Physicians board of directors. DMC is president of the Society for Academic Emergency Medicine board of directors.

Author Contributions: Hwang, Loo, Sze, Vargas-Torres had access to the data and take responsibility for the integrity of the data and the accuracy of the data analysis. Hwang, Loo, Garrido, Sze, Vargas-Torres: data analysis. All remaining authors: study concept and design, interpretation of data, preparation of manuscript.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Table S1 Percentage Change in Day 0 Inpatient Admissions, Discharges with Subsequent 72-Hour Emergency Department (ED) Visits from Multinomial Logistic Model, and Any Admission in the 30 Days After ED Discharge Associated with Transitional Care Nurse (TCN) Intervention from Logistic Model without Patients Seen at Night or Over the Weekend

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