

# Impact of a Connected Care Model on 30-Day Readmission Rates from Skilled Nursing Facilities

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**BACKGROUND:** About one-fifth of hospitalized Medicare beneficiaries are discharged to skilled nursing facilities (SNFs) for post-acute care. Readmissions are common but interventions to reduce readmissions are scarce.

**OBJECTIVE:** To assess the impact of a connected care model on 30-day hospital readmission rates among patients discharged to SNFs.

**DESIGN:** Retrospective cohort.

**SETTING:** SNFs that receive referrals from an academic medical center in Cleveland, Ohio.

**PARTICIPANTS:** All patients admitted to Cleveland Clinic main campus between January 1, 2011 and December 31, 2014 and subsequently discharged to 7 intervention SNFs or 103 control SNFs.

**INTERVENTION:** Hospital-employed physicians and advanced practice professionals (nurse practitioners and physician

assistants) visited SNF patients 4 to 5 times per week.

**RESULTS:** During the study period, 13,544 patients were discharged to SNFs within a 25-miles radius of Cleveland Clinic main campus. Of these, 3334 were discharged to 7 intervention SNFs and 10,201 were discharged to 103 usual-care SNFs. During the intervention phase (2013-2014), adjusted 30-day readmission rates declined at the intervention SNFs (28.1% to 21.7%,  $P < 0.001$ ), while there was a slight increase at control SNFs (27.1% to 28.5%,  $P < 0.001$ ). The absolute reductions ranged from 4.6% for patients at low risk for readmission to 9.1% for patients at high risk, and medical patients benefited more than surgical patients.

**CONCLUSION:** A program of frequent visits by hospital-employed physicians and advanced practice professionals at SNFs can reduce 30-day readmission rates. *Journal of Hospital Medicine* 2017;12:238-244. © 2017 Society of Hospital Medicine

Approximately 20% of hospitalized Medicare beneficiaries in the U.S. are discharged to skilled nursing facilities (SNFs) for post-acute care,<sup>1,2</sup> and 23.5% of these patients are readmitted within 30 days.<sup>3</sup> Because hospital readmissions are costly and associated with worse outcomes,<sup>4,5</sup> 30-day readmission rates are considered a quality indicator,<sup>6</sup> and there are financial penalties for hospitals with higher than expected rates.<sup>7</sup> As a result, hospitals invest substantial resources in programs to reduce readmissions.<sup>8-10</sup> The SNFs represent an attractive target for readmission reduction efforts, since SNFs contribute a disproportionate share of readmissions.<sup>3,4</sup> Because SNF patients are in a monitored environment with high medication adherence, risk factors for readmission likely differ between patients discharged to SNFs and those sent home. For example, 1 study showed that among heart failure patients with cognitive impairment, those discharged to

SNFs had lower readmissions during the first 20 days, likely due to better medication adherence.<sup>11</sup> Patients discharged to SNFs generally have more complex illnesses, lower functional status, and higher 1-year mortality than patients discharged to the community.<sup>12,13</sup> Despite this, SNF patients might have infrequent contact with physicians. Federal regulations require only that patients discharged to SNFs need to be seen within 30 days and then at least once every 30 days thereafter.<sup>14</sup> According to the 2014 Office of Inspector General report, one-third of Medicare beneficiaries in SNFs experience adverse events from substandard treatment, inadequate resident monitoring and failure or delay of necessary care, most of which are thought to be preventable.<sup>15</sup>

To address this issue, the Cleveland Clinic developed a program called “Connected Care SNF,” in which hospital-employed physicians and advanced practice professionals visit patients in selected SNFs 4 to 5 times per week, for the purpose of reducing preventable readmissions. The aim of this study was to assess whether the program reduced 30-day readmissions, and to identify which patients benefited most from the program.

## METHODS

### Setting and Intervention

The Cleveland Clinic main campus is a tertiary academic medical center with 1400 beds and approximately 50,000

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admissions per year. In late 2012, the Cleveland Clinic implemented the Connected Care SNF program, wherein Cleveland Clinic physicians regularly visited patients who were discharged from the Cleveland Clinic main campus to 7 regional SNFs. Beginning in December 2012, these 7 high-volume referral SNFs that were not part of the Cleveland Clinic Health System (CCHS) agreed to participate in the program, which focused on reducing avoidable hospital readmissions and delivering quality care (Table 1). The Connected Care team, comprised of 2 geriatricians (1 of whom was also a palliative medicine specialist), 1 internist, 1 family physician, and 5 advanced practice professionals (nurse practitioners and physician assistants), provided medical services at the participating SNFs. These providers aimed to see patients 4 to 5 times per week, were available on site during working hours, and provided telephone coverage at nights and on weekends. All providers had access to hospital electronic medical records and could communicate with the discharging physician and with specialists familiar with the patient as needed. Prior to the admission, providers were informed about patient arrival and, at the time of admission to the SNF, providers reviewed medications and discussed goals of care with patients and their families. In the SNF, providers worked closely with staff members to deliver medications and timely treatment. They also met monthly with multidisciplinary teams for continuous quality improvement and to review outcomes. Patients at Connected Care SNFs who had their own physicians, including most long-stay and some short-stay residents, did not receive the Connected Care intervention. They constituted less than 10% of the patients discharged from Cleveland Clinic main campus.

### Study Design and Population

We reviewed administrative and clinical data from a retrospective cohort of patients discharged to SNF from the Cleveland Clinic main campus from January 1, 2011 to December 31, 2014. We included all patients who were discharged to an SNF during the study period. Our main outcome measure was 30-day all-cause readmissions to any hospital in the Cleveland Clinic Health System (CCHS), including the main campus and 8 regional community hospitals. Study patients were followed until January 30, 2015 to capture 30-day readmissions. According to 2012 Medicare data, of CCHS patients who were readmitted within 30 days, 83% of pneumonia, 81% of major joint replacement, 72% of heart failure and 57% of acute myocardial infarction patients were readmitted to a CCHS facility. As the Cleveland Clinic main campus attracts cardiac patients from a 100+-mile radius, they may be more likely to seek care readmission near home and are not reflective of CCHS patients overall. Because we did not have access to readmissions data from non-CCHS hospitals, we excluded patients who were discharged to SNFs beyond a 25-mile radius from the main campus, where they may be more likely to utilize non-CCHS hospitals for acute hospitalization. We also exclud-

**TABLE 1. Connected Care SNF Program**

#### Connected Care providers:

- Have access to hospital EMR and review of patient information prior to admission to SNFs
- Round daily during weekday and within 48 hours visit for weekend admissions
- Provide on call coverage to reduce readmissions during off hours
- Communicate with subspecialists, hospital team and ED physicians
- Conduct goals-of-care discussion on admission
- Lead monthly meeting to review 30-day readmission outcome and other quality measures
- Are evaluated on 30-day readmission performances rather than productivity
- Emphasize timely medication administration and physician communication at SNFs

NOTE: Abbreviations: ED, emergency department; EMR, electronic medical records; SNF, skilled nursing facility.

ed patients discharged to non-CCHS hospital-based SNFs, which may refer readmissions to their own hospital system. Because the Connected Care program began in December 2012, the years 2011-2012 served as the baseline period. The intervention was conducted at 7 SNFs. All other SNFs within the 25-mile radius were included as controls, except for 3 hospital-based SNFs that would be unlikely to admit patients to CCHS. We compared the change in all-cause 30-day readmission rates after implementation of Connected Care, using all patients discharged to SNFs within 25 miles to control for temporal changes in local readmission rates. Discharge to specific SNFs was determined solely by patient choice.

### Data Collection

For each patient, we collected the following data that has been shown to be associated with readmissions:<sup>16-18</sup> demographics (age, race, sex, ZIP code), lab values on discharge (hemoglobin and sodium); hemodialysis status; medicine or surgical service; elective surgery or nonelective surgery; details of the index admission index (diagnosis-related group [DRG], Medicare severity-diagnosis-related groups [MS-DRG] weight, primary diagnosis code; principal procedure code; admission date; discharge date, length of stay, and post-acute care provider); and common comorbidities, as listed in Table 2. We also calculated each patient's HOSPITAL<sup>19,20</sup> score. The HOSPITAL score was developed to predict risk of preventable 30-day readmissions,<sup>19</sup> but it has also been validated to predict 30-day all-cause readmission rates for patients discharged to SNF.<sup>21</sup> The model contains 7 elements (hemoglobin, oncology service, sodium, procedure, index type, admissions within the last year, length of stay) (supplemental Table). Patients with a high score (7 or higher) have a 41% chance of readmission, while those with a low score (4 or lower) have only a 15% chance.<sup>21</sup> We assessed all cause 30-day readmission status from CCHS administrative data. Observation patients and outpatient

**TABLE 2.** Characteristics of Patients Discharged in 2011-2012 vs. 2013-2014 to 7 Intervention SNFs and 103 Usual-Care SNFs

	Intervention 7 SNFs		P value	Usual-Care 103 SNFs		P value
	2011-2012 (n = 1547)	2013-2014 (n = 1787)		2011-2012 (n = 5095)	2013-2014 (n = 5115)	
	N (%) or mean (SD)	N (%) or mean (SD)		N (%) or mean (SD)	N (%) or mean (SD)	
Age, y (SD)	75.6 (12.3)	75.6 (12.0)	0.99	70.2 (14.3)	69.4 (14.2)	0.006
Race						
White	749 (48.4)	853 (47.7)	0.69	2982(58.5)	2943 (57.5)	0.14
African American	704 (45.5)	779 (43.6)		1826(35.9)	1918 (37.5)	
Other	94 (6.0)	155 (8.7)		287(5.6)	254 (5.0)	
Male sex	603 (39.0)	711 (39.8)	0.63	2272 (44.6)	2370 (46.3)	0.07
Hemoglobin on discharge (g/dL)	9.9 (1.9)	9.9 (1.9)	0.82	9.9 (2.0)	9.9 (2.0)	0.14
Sodium on discharge(mmol/L)	136.3 (13.1)	136.4 (14.2)	0.82	135.8 (15.5)	136.3 (14.2)	0.06
Elective surgery	337 (21.8)	455 (25.5)	0.01	1177 (23.1)	1261 (24.7)	0.07
Hemodialysis	164 (10.6)	157 (8.8)	0.07	482 (9.5)	577 (11.3)	0.002
Last 1 y admissions	1.6 (2.2)	1.6 (2.2)	0.46	1.8 (2.4)	2.0 (2.6)	0.01
Oncology discharge	48 (3.1)	57 (3.2)	0.88	171 (3.4)	194 (3.8)	0.23
HOSPITAL score	5.9 (2.1)	5.8 (2.0)	0.10	6.0 (2.0)	6.1 (2.1)	0.14
HOSPITAL score						
High	435 (42.8)	431(41.5)		1414 (44.3)	1292 (44.9)	
Intermediate	349 (34.3)	344(33.1)	0.43	1061 (33.3)	945 (32.9)	0.89
Low	233 (22.9)	263(25.3)		716 (22.4)	639 (22.2)	
Service						
Medicine	1017 (65.7)	1038 (58.1)	<0.001	3191 (62.6)	2876 (56.2)	<0.001
Surgical	530 (34.3)	749 (41.9)		1904 (37.4)	2239 (43.8)	
MS-DRG weight	2.4 (2.1)	2.5 (2.2)	0.22	2.4 (2.2)	2.5 (2.2)	0.33
Index length of stay	9.3 (7.9)	9.4 (7.7)	0.56	9.6 (8.9)	9.8 (8.6)	0.29
Payer						
Medicare	1318 (85.2)	1549 (86.7)	0.81	3638 (71.4)	3580 (70.0)	<0.001
Medicaid	19 (1.2)	24 (1.3)		668 (13.1)	842 (16.5)	
Other	210 (13.6)	214 (12.0)		789 (15.5)	693 (13.5)	
MI	174 (11.2)	242 (13.5)	0.05	525 (10.3)	629 (12.3)	0.002
CHF	557 (36.0)	652 (36.5)	0.77	1484 (29.1)	1548 (30.3)	0.21
PVD	255 (16.5)	363 (20.3)	0.004	771 (15.1)	928 (18.1)	<0.001
CVA	349 (22.6)	447 (25.0)	0.10	1092 (21.4)	1143 (22.4)	0.25
Dementia	183 (11.8)	241 (13.5)	0.15	557 (10.9)	605 (11.8)	0.15
COPD	364 (23.5)	442 (24.7)	0.41	1109 (21.8)	1301 (25.4)	<0.001
Connective tissue disease	61 (3.9)	67 (3.7)	0.77	169 (3.3)	176 (3.4)	0.73
Peptic ulcer	73 (4.7)	111 (6.2)	0.06	224 (4.4)	296 (5.8)	<0.001
DM	617 (39.9)	760 (42.5)	0.12	1945 (38.2)	1984 (38.8)	0.51
CKD	432 (27.9)	506 (28.3)	0.80	1157 (22.7)	1306 (25.5)	<0.001
Hemiplegia	92 (5.9)	84 (4.7)	0.13	263 (5.2)	253 (4.9)	0.62
Leukemia	10 (0.6)	23 (1.3)	0.06	76 (1.5)	100 (2.0)	0.07
Lymphoma	39 (2.5)	41 (2.3)	0.67	93 (1.8)	115 (2.2)	0.13
Solid tumor	486 (31.4)	559 (31.3)	0.93	1295 (25.4)	1334 (26.1)	0.46
Liver disease	292 (18.9)	422 (23.6)	<0.001	1131 (22.2)	1317 (25.7)	<0.001
AIDS	0 (0)	2 (0.1)	0.18	38 (0.7)	27 (0.5)	0.17

NOTE: Abbreviations: AIDS, acquired immunodeficiency syndrome; CHF, congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; DM, diabetes mellitus; HOSPITAL, /hemoglobin, oncology service, sodium, procedure, index type, admissions within the last year, length of stay; MI, myocardial infarction; MS-DRG, Medicare severity-diagnosis-related group; PVD, peripheral vascular disease; SNF, skilled nursing facility; SD, standard deviation.

**TABLE 3.** Adjusted 30-Day Readmission Rates, 2011-2012 vs. 2013-2014 from 7 Intervention SNFs and 103 Usual-Care SNFs

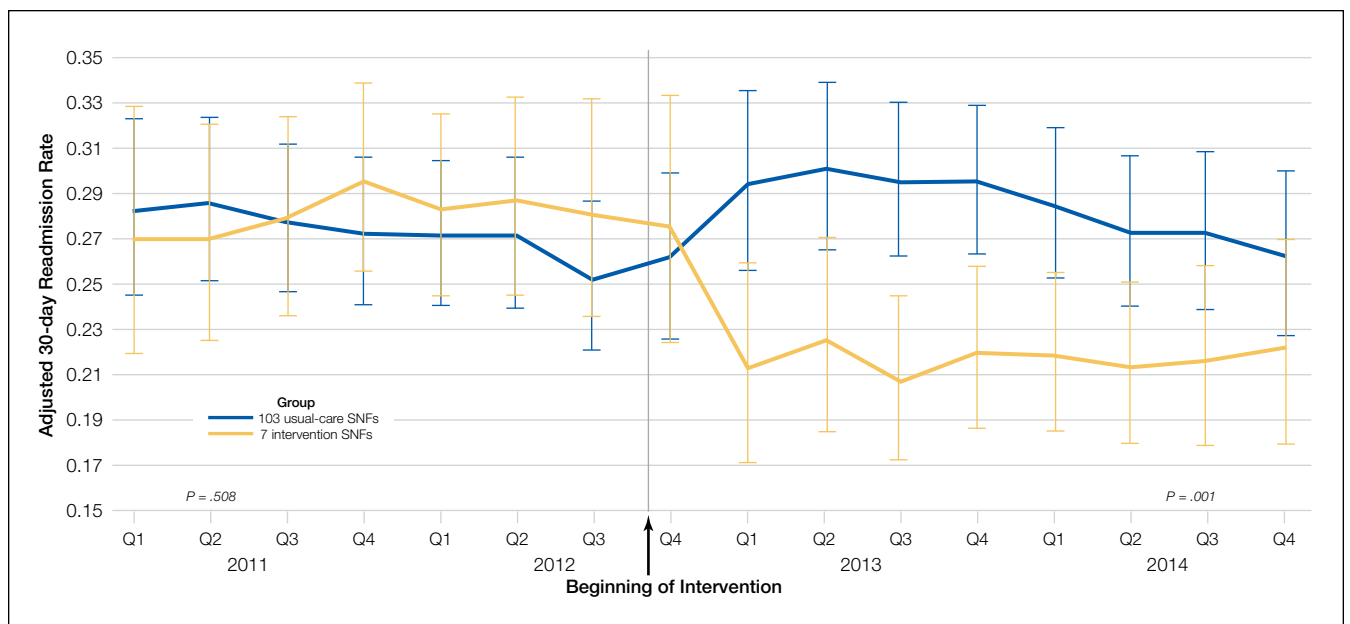
	Intervention 7 SNFs		P value	Usual-Care 103 SNFs		P value
	2011-2012 (n = 1547), rate (95% CI)	2013-2014 (n = 1787), rate (95% CI)		2011-2012 (n = 5095), rate (95% CI)	2013-2014 (n = 5115), rate (95% CI)	
Overall	28.1% (23.6-33.0)	21.7% (18.0-25.8)	<0.001	27.1% (23.8-30.7)	28.5% (25.1-32.2)	<0.001
Services						
Medical	31.0% (26.3-36.1)	24.6% (20.6-29.0)	<0.001	30.2% (26.8-33.9)	31.8% (28.3-35.6)	<0.001
Surgical	22.4% (18.4-27.0)	17.7% (14.4-21.4)	<0.001	21.9% (18.9-25.4)	24.2% (21.1-27.7)	<0.001
HOSPITAL score						
High (≥7)	37.3% (32.0-42.9)	30.0% (25.3-35.0)	<0.001	36.6% (32.6-40.7)	39.1% (35.0-43.4)	<0.001
Intermediate (5-6)	27.1% (22.7-31.9)	21.7% (17.9-25.9)	<0.001	26.2% (23.0-29.7)	27.2% (23.9-30.8)	0.15
Low (0-4)	25.2% (21.2-29.6)	19.5% (16.2-23.3)	<0.001	23.7% (20.9-26.7)	24.1% (21.3-27.2)	<0.001

NOTE: Abbreviations: CI, confidence interval; HOSPITAL, hemoglobin, oncology service, sodium, procedure, index type, admissions within the last year, length of stay; SNF, skilled nursing facility.

same-day surgeries were not considered to be admissions. For patients with multiple admissions, each admission was counted as a separate index hospitalization. Cleveland Clinic's Institutional Review Board approved the study.

### Statistical Analysis

For the 7 intervention SNFs, patient characteristics were summarized as means and standard deviations or frequencies and percentages for the periods of 2011-2012 and 2013-



**FIG.** Adjusted 30-day readmission rates on 7 intervention SNF discharged patients by quarters from 2011 to 2014 and yearly 30-day readmission rates on all SNF discharged patients. P is for comparing readmission rates of 7 intervention SNFs before and after intervention.

2014, respectively, and the 2 periods were compared using the Student *t* test or  $\chi^2$  test as appropriate.

Mixed-effects logistic regression models were used to model 30-day readmission rates. Since the intervention was implemented in the last quarter of 2012, we examined the difference in readmission rates before and after that time point. The model included the following fixed effects: SNF type (intervention or usual care), time points (quarters of 2011-2014), whether the time is pre- or postintervention (binary), and the 3-way interaction between SNF type, pre- or postintervention and time points, and patient characteristics. The model also contained a Gaussian random effect at the SNF level to account for possible correlations among the outcomes of patients from the same SNF. For each quarter, the mean adjusted readmission rates of 2 types of SNFs were calculated from the fitted mixed models and plotted over time. Furthermore, we compared the mean readmission rates of the 2 groups in the pre- and postintervention periods. Subgroup analyses were performed for medical and surgical patients, and for patients in the low, intermediate and high HOSPITAL score groups.

All analyses were performed using RStudio (Boston, Massachusetts). Statistical significance was established with 2-sided *P* values less than 0.05.

## RESULTS

We identified 119 SNFs within a 25-mile radius of the hospital. Of these, 6 did not receive any referrals. Three non-CCHS hospital-based SNFs were excluded, leaving a total of 110 SNFs in the study sample: 7 intervention SNFs and 103 usual-care SNFs. Between January 2011 and December 2014, there were 23,408 SNF discharges from Cleveland Clinic main campus, including 13,544 who were discharged to study SNFs (Supplemental Figure). Of these, 3334 were discharged to 7 intervention SNFs and 10,210 were discharged to usual care SNFs. Characteristics of patients in both periods appear in Table 2. At baseline, patients in the intervention and control SNFs varied in a number of ways. Patients at intervention SNFs were older (75.6 vs. 70.2 years;  $P < 0.001$ ), more likely to be African American (45.5% vs. 35.9%;  $P < 0.001$ ), female (61% vs. 55.4%;  $P < 0.001$ ) and to be insured by Medicare (85.2% vs. 71.4%;  $P < 0.001$ ). Both groups had similar proportions of patients with high, intermediate, and low readmission risk as measured by HOSPITAL score. Compared to the 2011-2012 pre-intervention period, during the 2013-2014 intervention period, there were more surgeries (34.3% vs. 41.9%;  $P < 0.001$ ), more elective surgeries (21.8% vs. 25.5%;  $P = 0.01$ ), fewer medical patients (65.7% vs. 58.1%;  $P < 0.001$ ), and an increase in comorbidities, including myocardial infarction, peripheral vascular disease, and liver disease (Table 2).

Table 3 shows adjusted 30-day readmissions rates, before and during the intervention period at the intervention and usual care SNFs. Compared to the pre-intervention period, 30-day all-cause adjusted readmission rates declined in the

intervention SNFs (28.1% to 21.7%,  $P < 0.001$ ), while it increased slightly at control sites (27.1% to 28.5%,  $P < 0.001$ ). The Figure shows the adjusted 30-day readmission rates by quarter throughout the study period.

Declines in 30-day readmission rates were greater for medical patients (31.0% to 24.6%,  $P < 0.001$ ) than surgical patients (22.4% to 17.7%,  $P < 0.001$ ). Patients with high HOSPITAL scores had the greatest decline, while those with low HOSPITAL scores had smaller declines.

## DISCUSSION

In this retrospective study of 4 years of discharges to 110 SNFs, we report on the impact of a Connected Care program, in which a physician visited patients on admission to the SNF and 4 to 5 times per week during their stay. Introduction of the program was followed by a 6.8% absolute reduction in all-cause 30-day readmission rates compared to usual care. The absolute reductions ranged from 4.6% for patients at low risk for readmission to 9.1% for patients at high risk, and medical patients benefited more than surgical patients.

Most studies of interventions to reduce hospital readmissions have focused on patients discharged to the community setting.<sup>7-9</sup> Interventions have centered on discharge planning, medication reconciliation, and close follow-up to assess for medication adherence and early signs of deterioration. Because patients in SNFs have their medications administered by staff and are under frequent surveillance, such interventions are unlikely to be helpful in this population. We found no studies that focus on short-stay or skilled patients discharged to SNF. Two studies have demonstrated that interventions can reduce hospitalization from nursing homes.<sup>22,23</sup> Neither study included readmissions. The Evercare model consisted of nurse practitioners providing active primary care services within the nursing home, as well as offering incentive payments to nursing homes for not hospitalizing patients.<sup>22</sup> During a 2-year period, long term residents who enrolled in Evercare had an almost 50% reduction in incident hospitalizations compared to those who did not.<sup>22</sup> INTERACT II was a quality improvement intervention that provided tools, education, and strategies to help identify and manage acute conditions proactively.<sup>23</sup> In 25 nursing homes employing INTERACT II, there was a 17% reduction in self-reported hospital admissions during the 6-month project, with higher rates of reduction among nursing homes rated as more engaged in the process.<sup>23</sup> Although nursing homes may serve some short-stay or skilled patients, they generally serve long-term populations, and studies have shown that short-stay patients are at higher risk for 30-day readmissions.<sup>24</sup>

There are a number of reasons that short-term SNF patients are at higher risk for readmission. Although prior to admission, they were considered hospital level of care and received a physician visit daily, on transfer to the SNF, relatively little medical care is available. Current federal regulations regarding physician services at a SNF require the

resident to be seen by a physician at least once every 30 days for the first 90 days after admission, and at least once every 60 days thereafter.<sup>25</sup>

The Connected Care program physicians provided a smooth transition of care from hospital to SNF as well as frequent reassessment. Physicians were alerted prior to hospital discharge and performed an initial comprehensive visit generally on the day of admission to the SNF and always within 48 hours. The initial evaluation is important because miscommunication during the handoff from hospital to SNF may result in incorrect medication regimens or inaccurate assessments. By performing prompt medication reconciliation and periodic reassessments of a patient's medical condition, the Connected Care providers recreate some of the essential elements of successful outpatient readmissions prevention programs.

They also worked together with each SNF's interdisciplinary team to deliver quality care. There were monthly meetings at each participating Connected Care SNF. Physicians reviewed monthly 30-day readmissions and performed root-cause analysis. When they discovered challenges to timely medication and treatment delivery during daily rounds, they provided in-services to SNF nurses.

In addition, Connected Care providers discussed goals of care—something that is often overlooked on admission to a SNF. This is particularly important because patients with chronic illnesses who are discharged to SNF often have poor prognoses. For example, Medicare patients with heart failure who are discharged to SNFs have 1-year mortality in excess of 50%.<sup>13</sup> By implementing a plan of care consistent with patient and family goals, inappropriate readmissions for terminal patients may be avoided.

Reducing readmissions is important for hospitals because under the Hospital Readmissions Reduction Program, hospitals now face substantial penalties for higher than expected readmissions rates. Hospitals involved in bundled payments or other total cost-of-care arrangements have additional incentive to avoid readmissions. Beginning in 2019, SNFs will also receive incentive payments based on their 30-day all-cause hospital readmissions as part of the Skilled Nursing Facility Value-Based Purchasing program.<sup>25</sup> The Connected Care model offers 1 means of achieving this goal through partnership between hospitals and SNFs.

Our study has several limitations. First, our study was observational in nature, so the observed reduction in readmissions could have been due to temporal trends unrelated to the intervention. However, no significant reduction was noted during the same time period in other area SNFs. There was also little change in the characteristics of patients admitted to the intervention SNFs. Importantly, the HOSPITAL score, which can predict 30-day readmission rates,<sup>20</sup> did not change throughout the study period. Second, the results reflect patients discharged from a single hospital and may not be generalizable to other geographic areas. However, because the program included 7 SNFs, we believe it could be reproduced in other settings. Third, our readmis-

sions measure included only those patients who returned to a CCHS facility. Although we may have missed some readmissions to other hospital systems, such leakage is uncommon—more than 80% of CCHS patients are readmitted to CCHS facilities—and would be unlikely to differ across the short duration of the study. Finally, at the intervention SNFs, most long-stay and some short-stay residents did not receive the Connected Care intervention because they were cared for by their own physicians who did not participate in Connected Care. Had these patients' readmissions been excluded from our results, the intervention might appear even more effective.

## CONCLUSION

A Connected Care intervention reduced 30-day readmission rates among patients discharged to SNFs from a tertiary academic center. While all subgroups had substantial reductions in readmissions following the implementation of the intervention, patients who are at the highest risk of readmission benefited the most. Further study is necessary to know whether Connected Care can be reproduced in other health care systems and whether it reduces overall costs.

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