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Does Integration of Palliative Care and Infection Management Reduce Hospital Transfers among Nursing Home Residents?

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Abstract

Background: An estimated 50% of nursing home (NH) residents experience hospital transfers in their last year of life, often due to infections. Hospital transfers due to infection are often of little clinical benefit to residents with advanced illness, for whom aggressive treatments are often ineffective and inconsistent with goals of care. Integration of palliative care and infection management (i.e., merging the goals of palliative care and infection management at end of life) may reduce hospital transfers for residents with advanced illness.
Objectives: Evaluate the association between integration and (1) all-cause hospital transfers and (2) hospital transfers due to infection.
Design: Cross-sectional observational study.
Setting/Subjects: 143,223 U.S. NH residents, including 42,761 residents in the advanced stages of dementia, congestive heart failure (CHF), and chronic obstructive pulmonary disease (COPD).
Measurement: Cross-sectional, nationally representative NH survey data (2017–2018) were combined with resident data from the Minimum Data Set 3.0 and Medicare inpatient data (2016–2017). NH surveys measured integration of palliative care and infection management using an index of 0–100. Logistic regression models were used to estimate the relationships between integration intensity (i.e., the degree to which NHs follow best practices for integration) and all-cause hospital transfer and transfer due to infection.
Results: Among residents with advanced dementia, integration intensity was inversely associated with all-cause hospital transfer and transfer due to infection ($p < 0.001$). Among residents with advanced COPD, integration intensity was inversely associated with all-cause hospital transfer ($p < 0.05$) but not transfers due to infection. Among residents with advanced CHF, integration intensity was not associated with either outcome.
Conclusions: NH policies aimed to promote integration of palliative care and infection management may reduce burdensome hospital transfers for residents with advanced dementia. For residents with advanced CHF and COPD, alternative strategies may be needed to promote best practices for infection management at end of life.

Keywords: advance care planning; infection management; nursing homes; palliative care

Introduction

An estimated 1.1–2.7 million infection cases occur in U.S. nursing homes (NH) each year.[1] Many of these infections occur among residents with advanced illness, defined as having one or more conditions serious enough that general health and functioning decline and treatments begin to lose their impact.[2] Infections are common among NH residents with advanced illness and frequently result in death.[1,3,4] Before the COVID-19 pandemic, an estimated 50% of NH residents experienced one or more hospital transfers in their last year of life, often due to infections such as sepsis, pneumonia, and urinary tract infection.[5] Many of these transfers are avoidable because the infection could be managed in the

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NH or because hospitalization is inconsistent with patient preferences.[6–10] In a study of NH residents with advanced dementia, 59% of hospital transfers were due to suspected infections.[11] For residents with advanced illness, hospital transfers due to infection are frequently of little clinical benefit, costly to Medicare, and inconsistent with patients' goals of care.[5,6,9,11–14] Antibiotic use in patients with advanced illness may delay entry into hospice, prolong the dying process, and reduce quality of life.[15,16] Hospital transfers at end of life can also be distressing to patients and families due to the trauma of physical transfer, increased confusion in an unfamiliar setting, and lack of communication about goals of care.[14]

National initiatives originating from the Affordable Care Act have emphasized reduction in unnecessary hospital admissions. In 2012, CMS launched an initiative to reduce avoidable hospitalizations among nursing facility residents through the use of educational interventions to encourage on-site management of common conditions, including infections such as pneumonia and urinary tract infection.[17] Value-based purchasing programs such as the Hospital Readmissions Reductions Program impose financial penalties for hospitals with excess readmissions for conditions such as congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), and pneumonia.[18] Consistent with these national initiatives, between 2011 and 2017, avoidable hospital transfers declined among NH residents with advanced dementia, CHF, and COPD, with no change in mortality rates.[6] However, infections remained the most common cause of potentially avoidable hospital transfers across all groups.[6] In the context of the COVID-19 pandemic, which has disproportionately impacted long-term care residents and staff, policies to reduce avoidable transfers and promote goal concordant care for NH residents with advanced illness are now more critical than ever.[19,20]

Hospital transfer decisions for NH residents should be guided by goals of care.[6] For most residents with advanced illness, the primary goal of care is alleviation of pain and distress rather than prolongation of life.[21–23] The National Academy of Medicine's 2015 report

''Dying in America'' recommends that all NHs provide end-of-life care consistent with palliative care goals, including avoidance of unnecessary transfers between health care settings at end of life.[24] A new concept in geriatric palliative care is integration of palliative care and infection management, that is, merging the goals of palliative care and infection management at end of life.[15] Best practices include discussing decisions about infection management at end of life as part of advance care planning and documentation of treatment preferences regarding antibiotic use and hospitalization due to infection.[15,25,26] Nearly all states use Physician Orders for Life-Sustaining Treatment (POLST) forms to document detailed preferences for care, although implementation and uptake of POLSTs varies across NHs.[27,28] Protocols for antibiotic stewardship in NHs should also incorporate resident treatment preferences.[15,25,26] NH policies to promote integration of palliative care and infection management at end of life may reduce burdensome hospital transfers and improve quality of life for NH residents with advanced illness. In this cross-sectional study, we evaluated the impact of integration on all-cause hospital transfers and hospital transfers due to infection among NH residents in the advanced stages of dementia, CHF, or COPD. We chose to focus on these conditions because they are among the most common causes of death in NH residents, and the potential to promote goal concordant care through integration is greatest among residents with advanced illness.

Methods

Data sources

We conducted a cross-sectional, nationally representative NH survey from 2017 to 2018.[15,29,30] The sample included 988 NHs that participated in a previous survey conducted between 2013 and 2014 and a 10% stratified random sample of the United States NHs ($N = 1510$) identified from 2016 Certification and Survey Provider Enhanced Reporting (CASPER) data, a CMS database of NH characteristics and quality measures.[29] The sample was limited to nonspecialized, freestanding NHs with at least 30 beds. Directors of Nursing were invited to complete the survey. Surveys were distributed by mail using a modified Dillman technique, including an initial mailing of the survey with an invitation letter, reminder postcards, and a last chance communication.[29] The survey inquired about the facility's infection prevention and control program, demographics and training of the infection preventionist (IP) in charge of the program, IP staffing (as measured by full time equivalent), palliative care practices, and practices for integration of palliative care and infection management. The survey response rate was 49%.[15]

A total of 838 NHs with complete data were included in this study. Survey data were linked to 2017 CASPER data on facility characteristics, including bed size, nurse staffing measures, ownership, and urbanicity. NH data were combined with resident assessment data (2016–2017) from the Minimum Data Set 3.0 (MDS 3.0), a comprehensive, standardized resident screening and assessment tool mandated for use in all federally licensed NHs in the United States. We included routine MDS assessments that are required upon admission (or readmission), quarterly, and at any time residents have a significant change in health status. Hospital transfers reported in MDS were linked to corresponding inpatient records in the Medicare Provider Analysis and Review file (MedPAR, 2016–2017). This study was approved by the Columbia University Institutional Review Board. All data were de-identified to protect resident privacy.

Advanced illness cohorts

We identified cohorts of residents with advanced dementia, advanced CHF, and advanced COPD using criteria adapted from previous studies.[6,14,31,32] Several studies have defined advanced dementia based on diagnosis of Alzheimer's disease or dementia, cognitive function score, and/or functional limitations.[6,14,31,32] Similarly, previous studies have defined advanced CHF or COPD based on diagnosis of CHF or COPD, symptoms, and functional limitations.[6,32]

Functional abilities, cognitive function scores, and activities of daily living (ADL) scores were obtained from MDS assessment data. Diagnoses of dementia (including Alzheimer's disease and Alzheimer's disease-related dementias), CHF, and COPD were identified using the Medicare Master Beneficiary Summary File. Cohorts were not mutually exclusive (i.e., residents could belong to more than one advanced illness cohort). Advanced dementia was defined using the following criteria: diagnosis of Alzheimer's disease or

Alzheimer's disease-related dementia *and* advanced cognitive impairment as defined by a score of 4 (severe impairment) on the Cognitive Function Scale.[31,33,34] Advanced CHF was defined as the following: diagnosis of CHF *and* symptoms (shortness of breath when sitting OR lying down) *and* needed moderate or substantial assistance (ADL score 3 or 4) with any of the following ADLs: walking across the room, walking in corridor, self-transfer performance, locomotion, or dressing.[6,32] Advanced COPD was defined as the following: diagnosis of COPD *and* symptoms (shortness of breath when sitting OR lying down) *and* needed moderate or substantial assistance (ADL score 3 or 4) with any of the following ADLs: walking across the room, walking in corridor, self-transfer performance, locomotion, or dressing.[6,32]

Measures

The NH survey included validated measures of NH policies, including palliative care intensity,[35] infection outbreak control,[30,36] and integration of palliative care and infection management (i.e., the degree to which best practices for integration are followed).[15] Each policy variable was standardized to range from 0 to 100, with higher scores representing greater intensity of best practices.[15,30] The validated 9-item instrument used to measure integration assessed three domains: patient/caregiver involvement in advance care planning (2 items), formalized advance care planning (i.e., documentation of treatment preferences as medical orders and inclusion of a proxy in decision making, 5 items), and routine practices for integration of palliative care and infection management (2 items).[15] The specific items that comprise each of these domains are reported in the Appendix (Supplementary Appendix Table SA1). Additional details regarding validation of the instrument have been reported previously.[15] A composite integration intensity score was calculated as the number of items that received the highest possible response divided by nine and multiplied by 100, with higher scores representing greater intensity of best practices for integration.[15]

Outcomes

The two outcomes of interest were quarterly indicator variables for all-cause hospital transfer and hospital transfer due to infection, obtained from MDS assessments. Hospital transfers reported in MDS were linked to corresponding inpatient records in MedPAR. Infections were identified based on ICD-10 codes in MedPAR. Infections were classified by site, that is, respiratory, urinary tract infection, gastrointestinal, skin/soft tissue, IV catheter related, and all (including other). Transfers with a sepsis diagnosis were also identified. Hospital transfers were classified according to infection, if (1) infection was the primary diagnosis and present on admission (POA) or (2) infection was indicated as the MedPAR admitting diagnosis code and POA.

We estimated transfers due to infection as conditional on hospital transfer. This approach was necessary because 17% of hospital transfers reported in MDS did not have a corresponding inpatient record in MedPAR and were therefore missing the ICD-10 codes to identify whether the transfer was due to infection. Missingness of MedPAR data was not fully explained by observable resident characteristics such as insurance type (i.e., Medicare Advantage). MedPAR data were missing for 15% of hospital transfers among Medicare fee-for-service enrollees and 25% of hospital transfers among Medicare Advantage enrollees. Due to the missing data, the odds of hospital transfer due to infection could not be estimated directly. Instead, we estimated the quarterly predicted probability of transfer due to infection as the product of two outcomes: (1) the probability of a hospital transfer and (2) the probability that the transfer was due to infection, conditional on having a transfer. Given the complexity of determining whether a hospital transfer is "avoidable,"[37] we did not attempt to classify hospital transfers as potentially avoidable versus not avoidable. In a sensitivity analysis excluding beneficiaries enrolled in Medicare Advantage during any month of 2016 or 2017, no appreciable differences were observed in the results.

Covariates

Regression models were adjusted for resident and NH characteristics. Resident characteristics include age, sex, and functional status. Functional status was measured using the validated MDS Long Form ADL scale,[38] which sums the responses to the seven individual ADL items (eating, locomotion, bed mobility, toileting, transferring, hygiene, dressing). Scores range from 0 to 28, with higher scores indicating greater dependence. NH characteristics included registered nurse (RN) and licensed practical nurse (LPN) staffing (as measured by hours worked per resident day), IP staffing (as measured by full time equivalent), bed count, indicators for type of ownership (for profit, nonprofit, government), and urbanicity (metropolitan, rural remote, rural adjacent).

Statistical analyses

Adjusted logistic regression models were used to estimate the effects of integration intensity on the odds of all-cause hospital transfer and the predicted probability of hospital transfer due to infection. Because the odds of hospital transfer due to infection could not be estimated directly, we estimated the change in predicted probability of hospital transfer due to infection associated with a one-standard deviation increase in integration intensity. Models were estimated among all NH residents and stratified by advanced illness cohort (dementia, CHF, and COPD).

Results

Table 1 reports descriptive characteristics of the NHs and residents in our sample. On average, residents were 83.7 years old, 69.5% were female, and mean ADL score was 17.1 out of 28 (with 28 representing total dependence for all ADLs).[38] In total, 29.9% of NH residents had one or more advanced illnesses. The prevalence of advanced dementia, advanced CHF, and advanced COPD in NH residents was 15.6%, 12.7%, and 11.1%, respectively. There was some overlap among cohorts: 10.4% of NH residents had both advanced CHF and advanced COPD, and 2.7% had both advanced dementia and advanced CHF or COPD.

Table 2 reports all-cause hospital transfers and the percent of transfers due to infection among NH residents. All-cause hospital transfers were more frequent among residents with advanced CHF or COPD, relative to those with advanced dementia. Across all cohorts, a large share of hospital transfers (over 40%) was due to infection. Transfers with a sepsis diagnosis accounted for the majority (over 50%) of

Table 1. Nursing Home and Resident Characteristics

Characteristic	*Mean (SD) or percent*
Nursing home characteristics ($n = 838$)	
Ownership	
For profit	61.2%
Nonprofit	30.9%
Government	8.0%
Setting	
Metropolitan	76.3%
Rural remote	13.9%
Rural adjacent	9.8%
Number of beds	155.2 (109.4)
Staffing levels, hours per resident day	
Registered nurse	0.84 (2.22)
Licensed practical nurse	0.82 (0.96)
Infection preventionist staffing, full time equivalent	0.36 (0.26)
Resident Characteristics ($n = 143{,}238$)	
Age, years	83.8 (8.8)
Sex, female	69.5%
ADL score, 0–28	17.1 (6.1)
Advanced illnesses	
Advanced dementia	15.6%
Advanced CHF	12.7%
Advanced COPD	11.1%

SD, standard deviation; ADL, activities of daily living; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease.

transfers due to infection across all cohorts. Other common infection types across all cohorts were respiratory and urinary tract infection. Transfers due to respiratory infection were more common in patients with advanced CHF or COPD, while transfers due to urinary tract infection and sepsis were more common in patients with advanced dementia.

The weighted mean integration intensity was 42.8 (SE 0.94) on a scale of 0–100, indicating that, on average, NHs followed 42.8% of best practices for integration of palliative care and infection management. The majority of scores were concentrated around the mean. Integration intensity scores ranged from 0 to 100, indicating that some NHs did not follow any best practices for integration and others followed all best practices. Of the three domains that comprise the measure of integration, scores were highest for patient/caregiver involvement in care planning (74.5% of NHs followed best practices). Scores were lower for formalized advance care planning and routine practices of integration (34.0% and 33.0% of NHs, respectively, followed best practices).

Table 3 reports adjusted odds ratios (ORs) estimating how NH and resident characteristics correlated with all-cause hospital transfer among all residents and stratified by advanced illness cohorts. Among all NH residents, higher integration intensity was associated with lower odds of hospital transfer (OR 0.93, 95% CI: 0.90, 0.96). Palliative care intensity, outbreak policy, and IP staffing were not significantly associated with hospital transfers. Higher RN staffing was associated with lower odds of hospital transfer (OR 0.93, 95% CI: 0.88–0.98); the opposite was true for LPN staffing (OR 1.08, 95% CI: 1.02–1.14). Resident characteristics associated with higher odds of hospital transfer included younger age, male sex, lower ADL impairment, and the presence of advanced CHF or COPD. Advanced dementia was associated with lower odds of hospital transfer. After stratification by advanced illness cohort, the association between integration intensity and hospital transfer was most pronounced among residents with advanced dementia (OR 0.85, 95% CI: 0.79–0.91). Higher integration intensity was also associated with lower odds of hospital transfer among residents advanced COPD (OR 0.94, 95% CI 0.90–0.99) but was not significantly associated with transfers among residents with CHF.

Table 4 reports quarterly predicted probability of hospital transfer due to infection at varying integration intensity among all NH residents and stratified by advanced illness cohorts. Similarly, the effects of integration were greater among residents with advanced dementia. Relative to NHs with average integration intensity, a 1-standard deviation (SD) increase in integration intensity was associated with a 5.74% ($p < 0.01$) decrease in hospital transfers among all NH residents and a 12.84% ($p < 0.001$) decrease in hospital transfers among residents with advanced dementia. Among residents with advanced CHF or COPD, increased integration intensity was not associated with a statistically significant change in transfers due to infection, although these two cohorts had the highest quarterly probability of transfer due to infection (nearly 10% for both).

Discussion

To our knowledge, no previous researchers have examined the impact of integration of palliative care and infection management on NH resident outcomes. Our findings suggest

Table 2. All-Cause Hospital Transfers and Percent of Transfers Due to Infection among Nursing Home Residents, 2016–2017

	All residents (n = 143,223)	*Residents with advanced dementia (n = 21,938)*	*Residents with advanced CHF (n = 21,128)*	*Residents with advanced COPD (n = 18,414)*
Hospital transfers per resident per year	0.348	0.335	0.602	0.602
Percent of transfers due to infection (any)	39.8%	48.1%	44.5%	46.3%
Percent of transfers due to respiratory infection	9.4%	9.3%	13.0%	14.6%
Percent of transfers due to urinary tract infection	6.7%	9.3%	5.5%	5.4%
Percent of transfers due to sepsis*	21.9%	29.3%	25.4%	26.2%

*Sepsis is not mutually exclusive with other infection types.

Table 3. Adjusted Odds Ratios Estimating the Effects of Nursing Home and Resident Characteristics on Hospital Transfer

Predictors	*All residents*	*Residents with advanced dementia*	*Residents with advanced CHF*	*Residents with advanced COPD*
Integration intensity	0.93*** [0.90, 0.96]	0.85*** [0.79, 0.91]	0.96 [0.92, 1.00]	0.94* [0.90, 0.99]
Palliative care intensity	1.00 [0.97, 1.04]	1.01 [0.94, 1.09]	0.98 [0.94, 1.03]	1.00 [0.95,1.04]
Outbreak policy intensity	0.98 [0.95, 1.01]	1.02 [0.96, 1.08]	0.97 [0.93, 1.01]	0.98 [0.93, 1.02]
RN staffing, hours per resident day	0.93** [0.88, 0.98]	0.90 [0.80, 1.02]	0.94 [0.87, 1.02]	0.94 [0.87, 1.02]
LPN staffing, hours per resident day	1.08* [1.02, 1.14]	1.11 [0.98, 1.26]	1.05 [0.97, 1.15]	1.07 [0.98, 1.16]
IP staffing, full time equivalent	1.00 [0.97, 1.03]	1.00 [0.93, 1.07]	1.01 [0.97, 1.06]	1.01 [0.95, 1.06]
Resident characteristics				
Age	0.83*** [0.82, 0.84]	0.89*** [0.85, 0.92]	0.80*** [0.78, 0.82]	0.81*** [0.79, 0.84]
Male	1.35*** [1.31, 1.38]	1.64*** [1.53, 1.75]	1.30*** [1.23, 1.38]	1.25*** [1.18, 1.32]
ADL score	1.13*** [1.11, 1.15]	0.88*** [0.84, 0.93]	1.12*** [1.08, 1.16]	1.15*** [1.11, 1.19]
Advanced dementia	0.94* [0.89, 0.99]	—	—	—
Advanced CHF	1.88*** [1.80, 1.97]	—	—	—
Advanced COPD	1.34*** [1.28, 1.40]	—	—	—

All models adjusted for resident characteristics (age, sex, ADL score) and nursing home characteristics (integration intensity, palliative care intensity, outbreak policy intensity, RN/LPN staffing, IP staffing, bed count, ownership [for profit, government, nonprofit], and urbanicity [metropolitan, rural remote, rural adjacent]).

*$p < 0.05$.

**$p < 0.01$.

***$p < 0.001$.

RN, registered nurse; LPN, licensed practical nurse; IP, infection preventionist.

that NH policies to promote integration may reduce burdensome hospital transfers, particularly for residents with advanced dementia. Integration appeared to have less impact on hospital transfers among residents with advanced CHF or COPD, who experienced much more frequent transfers overall compared to residents with dementia. This is consistent with previous findings that NHs tend to provide less aggressive care to residents with dementia, potentially due to increasing recognition of dementia as a terminal illness.[39] Avoidance of hospital transfers may be more difficult among residents with CHF or COPD, who experience frequent transfers related to exacerbation of their underlying conditions.[6,40] Conditions that can present with shortness of breath, such as CHF, COPD, and respiratory infections, commonly lead to potentially avoidable transfers from NH to hospital.[40] For these residents, alternative strategies may be needed to promote best practices for infection management at end of life. We found that palliative care intensity and outbreak control practices in NHs were not significantly associated with all-cause hospital transfers or transfers due to infection across any of the advanced illness cohorts, potentially because these policies do not directly impact hospital transfer decisions.

Consistent with previous work, we found that infections—particularly sepsis, respiratory, and urinary tract infections—accounted for a large share of hospital transfers among NH residents with advanced illness. In a study to examine trends in hospital transfers from 2011 to 2017 among NH residents with advanced dementia, CHF, and COPD, McCarthy et al. found that sepsis was the most frequent condition attributed to potentially avoidable transfers in all cohort years for all groups, followed by pneumonia and urinary tract infections for residents with advanced dementia, and CHF and pneumonia for residents with advanced CHF and COPD.[6]

An important component of integration is advance care planning, which encompasses the process of discussing end-of-life care, clarification of patient values and goals, and completion of advanced directives to document treatment preferences. In previous studies, researchers have observed

Table 4. Quarterly Predicted Probability of Hospital Transfer Due to Infection at Varying Integration Intensity

	Quarterly predicted probability of hospital transfer due to infection			
Resident cohort	*Mean integration intensity*	*1 SD above mean integration intensity*	*Percent change*	p
All residents	4.70%	4.43%	−5.74%	<0.01
Advanced dementia	5.53%	4.82%	−12.84%	<0.001
Advanced CHF	9.64%	9.58%	−0.62%	0.85
Advanced COPD	9.90%	9.73%	−1.72%	0.50

Intensity of best practices for integration of palliative care and infection management (integration intensity) is measured using an index of 0–100, with a higher score indicating greater intensity of best practices. *p*-values are calculated for the difference in predicted probability of hospital transfer for a 1-standard deviation (SD) change in integration intensity.

beneficial effects of advance care planning interventions in the NH population, including fewer hospitalizations, increased palliative care referrals, and lower likelihood of dying in the hospital.[41–44] However, findings have varied; in one study, a multisite intervention to implement systematic advance care planning for NH residents was not associated with reduction in potentially avoidable hospitalizations.[45] NH policies to promote patient and caregiver engagement in advance care planning for infection management, including formalized documentation of preferences, may help to prevent hospitalizations for infection that are inconsistent with patient wishes. POLST forms have advantages over traditional methods to communicate preferences for life-sustaining treatment, as they include detailed treatment preferences beyond cardiopulmonary resuscitation, and NH residents with POLSTs are more likely to have preferences documented as medical orders.[46] All state POLST forms include preferences for hospital transfer, and the majority also include preferences for antibiotic use.[27]

Our findings highlight the importance of advance care planning for infectious diseases, as well as the need for greater integration of palliative care and infection management to provide better quality of care to NH residents at end of life. This is especially relevant in light of the COVID-19 pandemic, which has heightened public awareness of the importance of advance care planning for NH residents, given their susceptibility to infection and death from COVID-19.[47] Understanding patient values and goals is particularly important for effective discussions about end-of-life care. Clinicians have called for a more tailored approach to advance care planning for COVID-19, including documentation of ''COVID-19 preparedness plans'' that address patient preferences related to the most common complications of COVID-19 (e.g., respiratory failure, renal failure, stroke, postintensive care syndrome, postacute care needs).[48] This tailored approach may help to promote goal concordant care for NH residents who are most vulnerable to severe infections.

Our findings should be interpreted in the context of several limitations. First, we cannot establish a causal relationship between integration and hospital transfers. Second, our estimates are subject to response bias, as survey respondents differed from nonrespondents in some characteristics (e.g., respondents had fewer Medicare residents, were more likely to be nonprofit, and were less likely to have received infection control or quality of care citations).[29] Population weights were applied to increase national generalizability. Third, NH surveys relied on self-reported data and are subject to social desirability bias as a result of recent CMS regulations for long-term care facilities.[49] Fourth, claims-based measures do not fully capture NH residents' health status or the circumstances leading to hospital transfer. Diagnosis codes on hospital claims are assigned at discharge and may not fully capture the reason for admission. Finally, due to missing data (i.e., not all transfers reported in MDS had corresponding records in MedPAR), we were not able to directly estimate the effects of NH policies on hospital transfers due to infection.

Conclusions

Our study has important implications for infection management in NHs. Hospital transfers due to infection remain common among NH residents at end of life, despite national initiatives to reduce avoidable hospitalizations. Our findings suggest that policies implemented at the facility level to promote integration of palliative care and infection management may be effective in reducing hospital transfers among NH residents with advanced illness, particularly those with advanced dementia. For residents with advanced CHF and COPD, alternative strategies may be needed to promote best practices for infection management at end of life.

Authors' Contributions

J.M.H.: Conception and design of the work; analysis and interpretation of data for the work; drafting the work and revising it critically for important intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

M.A.: Conception and design of the work; revising the work critically for important intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

P.S.: Conception and design of the work; acquisition and interpretation of data for the work; revising the work critically for important intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

T.G.: Conception and design of the work; analysis and interpretation of data for the work; revising it critically for important intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

M.S.: Acquisition and interpretation of data for the work; revising the work critically for important intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

A.D.: Conception and design of the work; acquisition, analysis, and interpretation of data for the work; revising the work critically for important intellectual content; final approval of the version to be published; agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Author Disclosure Statement

No competing financial interests exist.

Supplementary Material

Supplementary Appendix Table SA1

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