Impact of Nursing Home Palliative Care Teams on End-of-Life Outcomes

A Randomized Controlled Trial

Helena Temkin-Greener, PhD, Dana B. Mukamel, PhD,† Heather Ladd, MS,‡*
Susan Ladwig, MPH,§ Thomas V. Caprio, MD,§ Sally A. Norton, PhD,||
Timothy E. Quill, MD,§ Tobie H. Olsan, PhD,|| and Xueya Cai, PhD¶

Background: Deficits in end-of-life care in nursing homes (NHs) are reported, but the impact of palliative care teams (PCTeams) on resident outcomes remains largely untested.

Objective: Test the impact of PCTeams on end-of-life outcomes.

Research Design: Multicomponent strategy employing a randomized, 2-arm controlled trial with a difference-in-difference analysis, and a nonrandomized second control group to assess the intervention's placebo effect.

Subjects: In all, 25 New York State NHs completed the trial (5830 decedent residents) and 609 NHs were in the nonrandomized group (119,486 decedents).

Measures: Four risk-adjusted outcome measures: place of death, number of hospitalizations, self-reported moderate-to-severe pain, and depressive symptoms. The Minimum Data Set, vital status files, staff surveys, and in-depth interviews were employed. For each outcome, a difference-in-difference model compared the pre-post intervention periods using logistic and Poisson regressions.

Results: Overall, we found no statistically significant effect of the intervention. However, independent analysis of the interview data found that only 6 of the 14 treatment facilities had continuously working PCTeams throughout the study period. Decedents in homes with working teams had significant reductions in the odds of in-hospital death compared to the other treatment [odds ratio (OR), 0.400; $P<0.001$), control (OR, 0.482;$P<0.05$), and nonrandomized control NHs (0.581; $P<0.01$). Decedents in these NHs had reduced rates of depressive symptoms (OR, 0.191;$P\leq 0.01$), but not pain or hospitalizations.

Conclusions: The intervention was not equally effective for all outcomes and facilities. As homes vary in their ability to adopt new care practices, and in their capacity to sustain them, reforms to create the environment in which effective palliative care can become broadly implemented are needed.

Key Words: palliative care, nursing homes, randomized controlled trial

(*Med Care* 2017;00: 000–000)

The 2014 Institute of Medicine report identified communication skills, interprofessional collaboration, and symptom management to be key palliative care competencies required of providers caring for individuals with advanced illness.[1] Nursing homes (NHs), which care for frail and severely ill residents, and where over 30% of Americans die,[2,3] largely underperform on these competencies.[4,5] Studies have shown insufficient management of symptoms including pain,[6,7] frequent and often unnecessary hospitalizations,[8,9] shortcomings in teamwork and communication,[4,10–12] and inadequate palliative care knowledge and skills among staff in NHs.[13,14]

At the same time, research focusing on health care teams has demonstrated that skills such as communication and interprofessional collaboration are the hallmark of effective teams and drive quality and improved patient outcomes. Studies of NHs have demonstrated that better teamwork among staff, and improved communication between staff and residents/family members, were associated with higher overall quality of care[12,15] and better patient outcomes,[16] including those at the end-of-life (EOL).[11,17]

Currently, the presence of palliative care in NHs, other than through hospice, is rare.[18,19] Moreover, the provision of palliative care either through contractual arrangements with external teams or through facility-based palliative care teams is far from widespread.[20,21] To date, the impact of palliative

---

From the *Department of Public Health Sciences, University of Rochester School of Medicine and Dentistry, Rochester, NY; †Department of Medicine, iTEQC Research Program University of California; ‡Department of Medicine, University of California, Irvine, CA; §Department of Medicine, University of Rochester School of Medicine and Dentistry; ||School of Nursing, University of Rochester; and ¶Department of Biostatistics & Computational Biology, University of Rochester, Rochester, NY.

D.B.M. is co-first author.

This work was supported with funding (Award No. 641) from the Patient Centered Outcomes Research Institute (PCORI). The research contained in this article is solely the responsibility of the authors and does not necessarily represent the views of the PCORI, its Board of Governors, or Methodology Committee.

Presented at the Annual AcademyHealth Research Meeting in New Orleans, LA in June 2017.

The authors declare no conflict of interest.

Reprints: Helena Temkin-Greener, PhD, Department of Public Health Sciences, University of Rochester School of Medicine and Dentistry, 265 Crittenden Boulevard, CU 420644, Rochester, NY 14642. E-mail: helena_temkin-greener@urmc.rochester.edu.

Supplemental Digital Content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's website, www.lww-medicalcare.com.

ISSN: 0025-7079/17/000-000

care teams on EOL outcomes of NH residents has been largely unstudied and untested.

With funding from the Patient-Centered Outcomes Research Institute, we undertook a randomized controlled trial (RCT) intervention study to examine the feasibility of implementing facility-based palliative care teams (PCTeams) and their efficacy on residents' outcomes at the EOL. We hypothesized that residents who died in facilities with palliative care teams would have better EOL outcomes compared to residents in the control homes. These outcomes included 4 measures considered important for and by residents at the EOL: death in hospital (vs. in NH), number of hospitalizations, significant pain, and depression, all during the last 90 days of life.[22] In this article, we report on the impact of this RCT intervention on these resident EOL outcomes of interest.

METHODS

Design Overview

The RCT, titled "Improving Palliative Care Through Teamwork" (IMPACTT), used a mixed methods research design with a difference-in-difference (DID) analytic technique. The study started in 2013 with 31 NHs (16 in the treatment and 15 in the control arm) and ended in April of 2016 with 25 facilities (14 treatment and 11 controls). In analyzing the impact of the intervention we also include the comparison to all other New York State (NYS) facilities not included in the intervention. Using this additional "nonrandomized control" group allows us to test the placebo effect, that is the possibility that the participating control homes may have improved care simply because they were aware of the intervention although they did not receive it.

IMPACTT was a facility-level intervention involving a multicomponent strategy that included implementing facility-based palliative care teams and providing staff with palliative and EOL geriatric training. Team development and staff training were followed by a 2-month long active intervention phase during which a gero-palliative care nurse practitioner interventionist rounded with the teams as they saw and/or discussed residents' care. A passive phase of 8 months immediately followed, during which the nurse interventionist was available to further coach the team on as needed/requested basis. The intervention design, sample size and power calculations, implementation, and baseline results are presented in detail elsewhere.[23]

The study was registered at ClinicalTrials.gov (NCT0 1990742), and reviewed and approved by the Institutional Review Board at the University of Rochester.

Data Sources

We employed 3 sources of data to evaluate the impact of the intervention on residents' outcomes. The Minimum Data Set (MDS3.0) and vital status data (to ascertain the date of death) were merged for all NH residents in NYS for the time period October 1, 2012 through September 30, 2013 (preintervention) and for October 1, 2013 through April 30, 2016 (intervention period). We conducted primary data collection through surveys addressed to all direct care staff before the start of the intervention and once it was completed. The surveys focused on key care process measures such as team communication/coordination, cohesion, perceived team performance, palliative care competency, and organizational readiness to implement palliative care. Each care process was measured as a score on a Likert scale ranging from 1 (worse) to 5 (best). These domains, based on psychometrically tested tools,[4,11,24] were revalidated on data from the surveys implemented in the treatment and control homes of the IMPACTT intervention.[23] We also conducted rapid ethnographic assessments in all treatment facilities. These rapid ethnographic assessments were in-depth interviews, with administrators and PCTeam staff, and were designed to complement other data in helping us to understand barriers and challenges in implementing and sustaining the intervention.[25]

Analytical Sample

The sample included decedent Medicare beneficiaries age 65+ who were residents in NYS NHs, died there or were discharged to an acute care hospital where they died within 18 days (90% of residents who died in the hospital die within this time frame), between October 1, 2012 and April 30, 2016. The study sample included 5,830 decedent residents from 25 study facilities (14 intervention and 11 controls) and 119,486 decedents from the remaining 609 facilities in the state, that is the nonrandomized control group.

The preintervention surveys were obtained from 1018 staff respondents (response rate of 30%) in all study participating facilities. The response rate to postintervention surveys was considerably lower ($n = 466$; response rate $= 21\%$), with 3 treatment and 9 control homes not participating at all. This precluded us from conducting the DID analyses comparing treatment and control facilities with regard to the intervention's impact on palliative and EOL care processes. However, we conducted DID on care process measures in the sensitivity analysis on a smaller subset of survey responses available from the treatment NHs (ranging from 911 to 965 depending on the measure).

The in-depth interviews (complementing primary and secondary data collection) were conducted in all 14-treatment facilities with 41 respondents including administrators, directors of nursing, nurses, nursing aides, and social workers.

Outcomes and Risk Factors

We focused on 4 outcomes as measures of EOL quality because these outcomes can be affected by NH staff ability to assess symptoms, coordinate care, communicate with the residents and their family members, and deliver care to the residents. Furthermore, they are considered of importance by patients and their families. We followed the methodology developed and reported on previously.[22] Using the MDS3.0, outcomes were defined as: place of death $= 1$ if death occurred in a hospital, 0 otherwise; number of hospitalizations within the last 90 days of stay (excluding last hospital stay if death occurred in a hospital); self-reported pain $= 1$ if reported as moderate-to-severe, 0 otherwise; and depression $= 1$ if reported/displayed by the residents, otherwise 0. Discharge and readmission records were used to calculate death in hospital and hospitalization. The last assessment before death was used to calculate the pain and depression outcomes. Risk factors were obtained from the last assessment before death or imputed from a prior assessment when necessary.

Statistical Analyses

Defining the Intervention Periods

Resident decedents were assigned to the preintervention period if the majority (>46) of their last 90 days of life occurred before the beginning of the intervention period. Otherwise, these decedents were included in the intervention period.

We defined the intervention period in 2 ways: (1) starting with the active intervention and including both the active and passive periods (definition 1); and (2) as the passive period only, following the end of the active intervention (definition 2). The rationale for employing these 2 definitions is that during the active intervention, NHs were still being trained/coached by the nurse interventionist and that staff's knowledge of palliative and EOL practices was still forming and normalizing during this period. During this period, practices likely have been changing, and hence the intervention might have begun to have an impact. Hence there is no clear pre-post demarcation for this intervention. The start and end points of the active intervention bracket the "intervention period." Our 2 definitions allow for this. For definition 2 residents with a majority of their last 90 days of life falling within the active period were excluded because of the ambiguity in their classification.

Because the intervention started at different times in each intervention facility, there are also no well-defined pre-post dates that could apply to the 2 control groups (participating facilities randomized to the control arm and all other NYS facilities). Therefore, we employed Monte Carlo techniques to randomly match control facilities with pre-post periods. Preintervention and intervention periods were defined for the usual care and NYS facilities by randomly assigning beginning and ending dates of active and passive periods from one of the intervention facilities. The randomization was repeated and each model estimated 200 times for each of the 2 definitions of the intervention period. The effect of the intervention, both pre-post changes in quality and DIDs, were tested with respect to the unidirectional hypothesis that the intervention improved quality, with $P \leq 0.05$ significance level. Coefficients, and P-values were collected for each replication. We report the average odds ratios (ORs) or average incidence rate ratios (IRRs) and the percent of each of the 200 model iterations in which the P-values for the relevant coefficient were below 0.05; in other words, the percent of iterations in which the coefficients were statistically significant ($P<0.05$). The higher this percent the greater is our confidence that the observed effect is statistically significant.

The DID Model

The effect of the intervention was determined by comparing the preintervention and intervention periods and the DIDs—namely comparing the performance differential between the intervention facilities pre and during the intervention to that of the control groups pre and during intervention performance differential. We estimated 4 separate models, one for each outcome. These resident level models predict outcomes controlling for the individuals' clinical risk factors, the type of facility in which they reside (eg, intervention or control) and the period (eg, preintervention). For the outcomes that were binary (death in the hospital, pain and depression) logistic models were estimated. For the hospitalization outcome, which was a count variable, we estimated a Poisson model. Specifically, we estimated models of the following general form:

$$Y_{ij}=\alpha_j+\beta_1 IV_{i,j}+\beta_2 UC_{i,j}+\gamma P_{i,j}+\delta_1 IV_{i,j} \times P_{ij}+\delta_2 UC_{ij}\times P_{ij}+\theta RF_{ij}+U_{i,j}.$$

where Y_{ij} is the outcome (in the case of hospitalization) or its logit (for the other 3 outcomes) for resident i in facility j, IV_{ij} is an indicator variable obtaining the value 1 if patient i resided in intervention facility, $UC_{i,i}$ is an indicator variable obtaining the value 1 if patient i resided in a control facility, with the nonrandomized other NYS facilities serving as the reference. P_{ij} indicates if patient i resided in facility j during the intervention period. The preintervention period served as the reference. The facility type variables (ie, intervention or control) were interacted with the intervention period variable to allow for preintervention and intervention period comparisons for each type of facility. RF_{ij} is the vector of risk factors specific to each outcome.[22] The models were estimated with facility random effects to allow for clustering of residents within facilities.

Sensitivity Analyses

Independent analysis of in-depth interviews with staff in the treatment homes revealed that only 6 of the 14 facilities had consistently working PCTeams throughout the study period. These teams, in contrast to teams in the other 8 treatment NHs, were characterized by clear and shared mission, a sense that the team influenced residents' care, and a perception of continued team sustainability. They also appeared to have a more tangible support from and involvement of their facility leaders including directors of nursing and administrators.[25] For ease of exposition we refer to these 6 NHs as having "working," and the other 8 NHs as having "nonworking," PCTeams. We performed sensitivity analyses, employing the DID models described above, to compare NHs with working and nonworking teams to each other, and to the randomized and nonrandomized controls, on all outcomes of interest.

We also employed a generalized linear model with facility random effects to examine the differences between homes with working and nonworking teams in 5 care process measures (team cohesion; communication/coordination; perceived team performance; perceived palliative care competency; and organizational readiness for palliative care), and performed a DID comparing the 2 types of NHs, preintervention and postintervention.

RESULTS

In Table 1, treatment and control homes are compared at baseline on several characteristics, including the 4 outcomes of interest. The control homes had significantly fewer deficiency citations, compared with the treatment facilities. There were no other statistically significant differences at baseline between the treatment and the control NHs, or vis-à-vis the remaining NYS facilities. The comparisons of resident characteristics are presented in the Appendix, Tables A.1 and A.2 (Supplemental Digital Content 1, http://links.lww.com/MLR/B489) and include all of the risk factors used in the outcome models.[22]

Tables 2 and 3 present the results of the multivariate analyses. The first set of columns show the pre-post differences

TABLE 1. Baseline Facility Characteristics: Randomized Controlled Trial Participating and Other Nonrandomized NHs in NYS

Facility Characteristics	Treatment NHs (N = 14)		Control NHs (N = 11)		Nonrandomized NYS Facilities† (N = 609)	
Ownership [n (%)]‡						
For-profit	6 (42.9)		1 (9.1)		347 (57.9)	
Nonprofit	7 (50.0)		9 (81.8)		214 (35.7)	
Government	1 (7.1)		1 (9.1)		38 (6.3)	
	Mean(SD)		Mean(SD)		Mean(SD)	
Certified beds (N)‡	190.9(106.8)		174.6(111.0)		186.0(131.0)	
Occupancy rate‡	91.9(8.5)		94.4(2.9)		93.8(54.5)	
5-Star quality‡						
Overall	3.6(1.2)		3.2(1.1)		3.4(1.3)	
Deficiencies	3.1(1.3)		2.0(0.8)*		2.9(1.3)	
Staffing	3.4(1.2)		4.0(0.9)		2.8(1.2)	
Quality measures	4.2(0.6)		4.0(1.1)		4.3(0.9)	
EOL outcomes§	Mean	Treatment vs. control P	Mean	Control vs. NYS P	Mean	Treatment vs. NYS P
Death in hospital	−0.102	0.756	−0.112	0.001	0.034	0.003
Moderate-severe pain	0.056	0.680	0.069	0.032	0.017	0.128
Depressive symptoms	0.016	0.243	0.065	0.902	0.060	0.363
No. hospital stays in last 90 d	−0.088	0.894	−0.095	0.069	0.031	0.105

†When facility data were missing percentages were based on the number of NHs with available information.

‡Statistical significance is for comparison to treatment facilities; $*P < 0.05$.

§Mean baseline values represent the facility-level difference between the observed and expected risk-adjusted rates. These measures represent outcomes that patients prefer to avoid, thus lower values are interpreted as better quality.[22]

EOL indicates end-of-life; NH, nursing homes; NYS, New York State.

in each outcome for each group of facilities in terms of IRRs for number of hospitalizations and ORs for the other outcomes. The second set of columns, reporting the DID, presents the average of the ratios of ORs or IRRs. If this ratio is <1, then residents in the reference facility type did better relative to the comparison facility.

Table 2 presents the results of the main analysis. When testing the hypothesis of improvement in quality in the postperiod, we find that the large group of nonrandomized NYS facilities showed a significant improvement for pain and depression, but not for the 2 hospitalization measures. The randomized treatment and control groups show no significant improvement, as inferred by examining the percent of iterations in which the relevant coefficient reached the significance level 0.05. The impact of the intervention is demonstrated by the DID analysis. We find no significant effects of the intervention, using the same criteria.

Table 3 presents the sensitivity analysis of treatment NHs with working and nonworking teams. Facilities with working PCTeams exhibited a decline for in-hospital deaths and for depressive symptoms when comparing the preintervention and postintervention periods, while facilities with nonworking teams did not. The DID analysis shows that in facilities with working PCTeams, compared with those with nonworking teams, decedents had improved outcomes for in-hospital death (ratio of ORs around 0.4) and depressive symptoms (ratio of ORs around 0.2). With respect to the randomized controls, NHs with working teams improved for in-hospital death (ratio of ORs around 0.5) but only when using the passive intervention period definition. These facilities also improved on this outcome compared with all other NYS facilities with a ratio of ORs of about 0.6. However, with regard to depressive symptoms the DID analysis did not demonstrate a statistically significant difference between NHs with working teams and the controls (randomized and nonrandomized).

To shed light on these findings, we also conducted a DID analysis on care process measures, which the intervention was designed to influence (Table 4). With regard to team cohesion, communication/coordination, perceived team performance, and organizational readiness for palliative care, homes with working teams were significantly better than those with nonworking teams both before and after the intervention; there was no difference with respect to perceived palliative care competency. The largest pre-post period impact was in communication/coordination and the smallest with regard to palliative care competency. However, the DID analysis showed no statistically significant differences between NHs with working and nonworking teams in any care process measures.

DISCUSSION

Palliative care intervention research in NHs, particularly using RCT design, has been quite rare. Of the published RCT interventions, several had very circumscribed palliative care-related objectives, such as improving pain management,[26] increasing completion of advance directives[27,28] or testing the effect of clinical pathways for pneumonia treatment.[29] There have been no RCTs in which palliative care is viewed as a system of care designed to incorporate all of these components.[30] In particular, the efficacy of facility-based palliative care teams on residents' outcomes has not been rigorously evaluated through RCTs.

TABLE 2. Impact of Intervention on End-of-Life Outcome Measures: Average Odds/Incidence Rate Ratios by Randomized Controlled Trial Arm

		Differences in Outcomes: Intervention Period Compared to the Preintervention Period[†]			DID: Intervention Period Compared With Preintervention Period[*]		
					Compared With Intervention Facilities		Compared With Control Facilities
Outcome Measure	**Intervention Period**	**Treatment Facilities (% $P < 0.05$)**	**Control Facilities (% $P < 0.05$)**	**Other NYS Facilities (% $P < 0.05$)**	**Control Facilities (% $P < 0.05$)**	**Other NYS Facilities (% $P < 0.05$)**	**Other NYS Facilities (% $P < 0.05$)**
Death in a hospital	Definition[‡]	1.038 (0)	1.178 (2)	0.970 (32)	0.904 (2)	1.071 (0)	1.216 (1)
	Definition§	1.022 (0)	1.174 (3)	0.961 (50)	0.895 (2)	1.064 (0)	1.223 (2)
Self-reported moderate to severe pain	Definition[‡]	1.171 (0)	0.904 (13)	**0.879 (95)**	1.329 (0)	1.335 (0)	1.030 (2)
	Definition§	1.188 (0)	0.927 (12)	**0.875 (93)**	1.342 (0)	1.359 (0)	1.061 (4)
Depressive symptoms	Definition‡	1.469 (0)	0.791 (35)	**0.875 (97)**	1.943 (0)	1.681 (0)	0.905 (2)
	Definition§	1.517 (0)	0.809 (32)	**0.870 (96)**	1.982 (0)	1.745 (0)	0.931 (18)
No. of hospital stays in the last 90 d	Definition[‡]	1.091 (0)	1.046 (1)	1.010 (0)	1.054 (0)	1.080 (0)	1.036 (1)
	Definition[§]	1.068 (0)	1.035 (3)	1.015 (0)	1.050 (0)	1.053 (0)	1.020 (3)

Bolded cells are those where the estimated coefficients were significant at the 0.05 level in at least 90% of the iterations for the unidirectional hypothesis of improvement in the post period. Values below 1 indicate intervention success.

[*] The reported DID values are the average of the ratios of the reference group to the control group. A ratio of <1 indicates that the reference group improved relative to the control during the intervention period.

[†] The reported values for hospital deaths, pain and depressive symptoms are odds ratios. The reported value for number of hospital stays is incidence rate ratio. A value <1 indicates improvement in the postperiod.

[‡] Intervention period is defined as the active intervention plus the passive intervention.

[§] Intervention period is defined as the passive intervention. Active intervention residents are excluded from the model.

DID indicates difference-in-difference; NYS, New York States.

In this paper we report the results of a multifaceted RCT designed to create a model of palliative care delivery in NHs through focused interdisciplinary teams. Our findings are both disappointing and intriguing. Disappointing, because we did not demonstrate a significant impact of the intervention on residents' risk-adjusted outcomes, when treating the findings in the traditional RCT framework. Intriguing, because in the sensitivity analysis, in which we bring to bear additional information based on qualitative data, regarding the success of the intervention in developing and sustaining palliative care teams,[25] we did find statistically significant impact of the intervention on selected outcomes. Furthermore, our findings from staff surveys revealed that facilities with continuously working PCTeams were significantly more ready at baseline to incorporate palliative care into their daily practice, compared with the remaining treatment homes. Compared with the latter, staff in NHs with working teams did not report higher perceived palliative care skill levels, but did report higher (better) scores on all domains of teamwork and on organizational readiness to adopt palliative care into daily practice. These higher scores continued postintervention demonstrating greater gains in NHs with working PCTeams, compared with those without, with regard to communication/coordination and team cohesion. NHs with working PCTeams not only started from a better position, but also seem to have been better able to learn the lessons offered by the intervention.

Surprisingly, however, while our outcome analysis detected a significant difference between facilities with and without the working PCTeams, the analysis of care processes did not, although it demonstrated an effect in the expected direction. It is possible that the outcome measures we used are more sensitive to change than the care process measures so that for the former we were able to detect the impact of the intervention but not for the latter. Another possibility is that the care processes had larger measurement errors that overwhelmed the small effect size of the intervention. Because of high staff turnover the pre-post intervention assessments of care processes were most likely completed by different individuals. While staff responding to preintervention and postintervention surveys in NHs with working teams may have perceived care processes to be good, they most likely did not share the same reference point and thus their responses did not reflect improvement.

Furthermore, it may be argued that an outcome such as death occurring in a NH (as opposed to in-hospital) would indeed be most responsive to improvement in facilities where communication between staff and with residents/families is better; allowing staff to be more familiar with residents' treatment preferences and making sure both residents and their families understand the benefits and the drawbacks of hospitalizing patients with advanced illness.[11] Better communication among staff is also thought to be a necessary precondition for identifying residents with depressions and to improve depression management.[31,32] But in order to improve an outcome such as pain, improvements in palliative care competency, which we did not observe, may be also necessary. We also did not observe a significant effect on the number of hospitalizations occurring in the last 90 days of life. This should not be too surprising as our intervention did

TABLE 3. Sensitivity Analysis—Impact of Intervention on End-of-Life Outcomes: Average Odds/Incidence Rate Ratios by Randomized Controlled Trial Arm and Treatment Facility Type

		Differences in Quality: Intervention period Compared With the Preintervention Period*				DID: Intervention Compared With Preintervention†				
		Treatment NHs (% $P < 0.05$)				Compared With Treatment NHs With Working PCTeams			Compared With Treatment NHs with Nonworking PCTeams	
Quality Measure	**Intervention Period**	**Working PCTeam**	**Nonworking PCTeam**	**Control NHs (% $P < 0.05$)**	**All Other NYS NHs (% $P < 0.05$)**	**Treatment NHs With Nonworking PCTeam (% $P < 0.05$)**	**Control Facilities (% $P < 0.05$)**	**All Other NYS Facilities (% $P < 0.05$)**	**Control Facilities (% $P < 0.05$)**	**All Other NYS Facilities (% $P < 0.05$)**
Death in a hospital	Definition‡	**0.630 (100)**	1.418 (0)	1.163 (2)	0.969 (32)	**0.445 (100)**	0.542 (85)	**0.650 (100)**	1.219 (0)	1.463 (0)
	Definition§	**0.558 (100)**	1.395 (0)	1.158 (3)	0.960 (50)	**0.400 (100)**	**0.482 (97)**	**0.581 (100)**	1.205 (0)	1.452 (0)
Self-reported moderate to severe pain	Definition‡	1.198 (0)	1.152 (0)	0.893 (13)	**0.878 (95)**	1.040 (0)	1.342 (0)	1.364 (0)	1.290 (0)	1.312 (0)
	Definition§	1.158 (0)	1.207 (0)	0.907 (12)	**0.875 (93)**	0.959 (0)	1.277 (0)	1.324 (0)	1.331 (0)	1.380 (0)
Depressive symptoms	Definition‡	**0.528 (100)**	2.841 (0)	0.773 (35)	**0.874 (97)**	**0.186 (100)**	0.683 (4)	0.604 (0)	3.674 (0)	3.250 (0)
	Definition§	**0.526 (100)**	2.745 (0)	0.787 (32)	**0.870 (96)**	**0.191 (100)**	0.668 (11)	0.604 (32)	3.490 (0)	3.157 (0)
No. of hospital stays in the last 90 d	Definition‡	1.005 (0)	1.141 (0)	1.041 (1)	1.010 (0)	0.881 (0)	0.965 (0)	0.995 (0)	1.096 (0)	1.129 (0)
	Definition§	0.806 (0)	1.202 (0)	1.027 (2.5)	1.015 (0)	0.671 (0)	0.786 (3)	0.795 (0)	1.171 (0)	1.184 (0)

Bolded cells are those where the estimated coefficients were significant at 0.05 in at least 90% of the iterations for the unidirectional hypothesis of improvement in the postperiod. Values <1 indicate treatment success.

[*] The DID coefficients are the average of the ratios of the reference group to the control group. A ratio <1 indicates that the reference group improved relative to the control during the intervention period.

[†] The coefficients for hospital deaths, pain and depressive symptoms.

[‡] Intervention period is defined as the active plus the passive intervention.

[§] Intervention period is defined as the passive intervention. Active intervention residents are excluded from the model.

DID indicates difference-in-difference; NH, nursing home; NYS, New York State; PCTeam, palliative care teams.

TABLE 4. Comparison of Mean Differences in Care Processes† in Treatment Facilities With and Without Working PCTeams

Care Process Measures	Preintervention		Postintervention		Difference: Postintervention Compared With Preintervention Period‡		Difference-in-Difference: Working PCTeam Compared With Nonworking PCTeam‡	P
	Nonworking PCTeam	Working PCTeam	Nonworking PCTeam	Working PCTeam	Nonworking PCTeam	Working PCTeam		
Team cohesion	3.727	3.896*	3.725	3.944**	−0.002	0.048	0.051	0.601
Communication/coordination	3.298	3.469**	3.270	3.518***	−0.028	0.050	0.078	0.394
Organizational readiness for palliative care	3.791	3.999**	3.725	3.948**	−0.067	−0.052	0.015	0.879
Perceived team effectiveness	3.947	4.168**	3.932	4.151**	−0.015	−0.016	−0.002	0.987
Perceived palliative competency	3.749	3.898	3.771	3.903	0.021	0.006	−0.015	0.885

†Scores range from 1 to 5, with higher scores indicating better performance.
‡Positive numbers indicate improvement.
PCTeam indicates palliative care teams.
Statistical significance is for the comparison to facilities with nonworking PCTeam, during the same period: *P <0.05.
**P < 0.01.
***P < 0.001.

not provide NHs with skills or resources to more effectively manage acute care conditions on site. Good communication alone is not likely to be sufficient in reducing hospital transfers. This is consistent with the findings of a recently completed evaluation of the 2012 CMS' initiative to reduce avoidable hospitalizations in selected facilities in 7 states.[33] Only facilities in which advanced practice nurses were well integrated to provide clinical support were able to effect reductions in hospital admissions.

Several limitations should be noted. First, we are unable to distinguish the relative importance of the individual intervention components. However, given that only those homes that were better equipped at baseline to move forward with the intervention were more successful, it may be more important to first understand what made these facilities better to start with. Second, some treatment homes were clearly better prepared to provide palliative care than others, and this was evident in the impact of the intervention. However, we were not able to differentiate between these 2 groups of NHs by simply relying on the characteristics available to us for a baseline comparison. Third, our findings were confined to regional facilities, and while we demonstrated some significant effects of the intervention on resident risk-adjusted outcomes, we are unable to generalize these findings elsewhere.

Improving palliative and EOL care in NHs is much needed and possible. Interventions may provide NHs that at baseline are primed to implement palliative care with an opportunity to succeed, but interventions alone are not likely to effect broad and generalizable improvements. Policy changes that prioritize and incentivize facilities to adopt palliative and EOL care practices, and regulatory efforts to include performance measures that are specific to patients with advanced illness, are needed to create an environment in which effective palliative care can become sustainable.

REFERENCES

1. Institute Of Medicine. *Dying in America: Improving Quality and Honoring Individual Preferences Near the End of Life*. Washington, DC: National Academies Press; 2014.
2. Weitzen S, Teno JM, Fennell M, et al. Factors associated with site of death: a national study of where people die. *Med Care*. 2003;41:323–335.
3. Gruneir A, Mor V. Nursing home safety: current issues and barriers to improvement. *Annu Rev Public Health*. 2008;29:369–382.
4. Temkin-Greener H, Zheng N, Norton SA, et al. Measuring end-of-life care processes in nursing homes. *Gerontologist*. 2009;49:803–815.
5. Unroe KT, Cagle JG, Lane KA, et al. Nursing home staff palliative care knowledge and practices: results of a large survey of frontline workers. *J Pain Symptom Manage*. 2015;50:622–629.
6. Teno JM, Kabumoto G, Wetle T, et al. Daily pain that was excruciating at some time in the previous week: prevalence, characteristics, and outcomes in nursing home residents. *J Am Geriatr Soc*. 2004;52:762–767.
7. Hanson LC, Eckert JK, Dobbs D, et al. Symptom experience of dying long-term care residents. *J Am Geriatr Soc*. 2008;56:91–98.
8. Gozalo P, Teno JM, Mitchell SL, et al. End-of-life transitions among nursing home residents with cognitive issues. *N Engl J Med*. 2011;365: 1212–1221.
9. Xing J, Mukamel DB, Temkin-Greener H. Hospitalizations of nursing home residents in the last year of life: nursing home characteristics and variation in potentially avoidable hospitalizations. *J Am Geriatr Soc*. 2013;61.
10. Zheng NT, Temkin-Greener H. End-of-life care in nursing homes: the importance of CNA staff communication. *J Am Med Dir Assoc*. 2010;11: 494–499.

11. Temkin-Greener H, Li Q, Li Y, et al. End-of-life care in nursing homes: from care processes to quality. *J Palliat Med*. 2016;19:1–8.
12. Temkin-Greener H, Zheng NT, Cai S, et al. Nursing home environment and organizational performance: association with deficiency citations. *Med Care*. 2010;48:357–364.
13. Whittaker E, George Kernohan W, Hasson F, et al. The palliative care education needs of nursing home staff. *Nurse Educ Today*. 2006;26:501–510.
14. Whittaker E, George Kernohan W, Hasson F, et al. Palliative care in nursing homes: exploring care assistants' knowledge. *Int J Older People Nurs*. 2007;2:36–44.
15. Gittell J, Weinberg D. Impact of relational coordination on job satisfaction and quality outcomes: a study of nursing homes. *Hum Resource Manage J*. 2008;18:154–170.
16. Temkin-Greener H, Cai S, Zheng NT, et al. Nursing home work environment and the risk of pressure ulcers and incontinence. *Health Serv Res*. 2012;47(pt 1):1179–1200.
17. Miller SC, Lima JC, Thompson SA. End-of-life care in nursing homes with greater versus less palliative care knowledge and practice. *J Palliat Med*. 2015;18:527–534.
18. Lester PE, Stefanacci RG, Feuerman M. Prevalence and description of palliative care in US nursing homes: a descriptive study. *Am J Hosp Palliat Care*. 2016;33:171–177.
19. Tyler DA, Shield RR, Miller SC. Diffusion of palliative care in nursing homes: lessons from the culture change movement. *J Pain Symptom Manage*. 2015;49:846–852.
20. Huskamp HA, Stevenson DG, Chernew ME, et al. A new Medicare end-of-life benefit for nursing home residents. *Health Aff*. 2010;29:130–135.
21. Temkin-Greener H, Ladwig S, Caprio T, et al. Developing palliative care practice guidelines and standards for nursing home–based palliative care teams: a Delphi study. *J Am Med Dir Assoc*. 2015;16:86.e1–86.e7.
22. Mukamel D, Ladd H, Caprio T, et al. Prototype end-of-life quality measures based on MDS 3 Data. *Med Care*. 2016;54:1024–1032.
23. Temkin-Greener H, Ladwig S, Ye Z, et al. Improving palliative care through teamwork (IMPACTT) in nursing homes: study design and baseline fndings. *Contemp Clin Trials*. 2017;56:1–8.
24. Temkin-Greener H, Zheng N, Katz P, et al. Measuring work environment and performance in nursing homes. *Med Care*. 2009;47:482–491.
25. Norton S, Ladwig S, Caprio T, et al. Staff experiences forming and sustaining palliative care teams in nursing homes. *Gerontologist*. 2017. [In press].
26. Jones KR, Fink R, Vojir C, et al. Translation research in long-term care: improving pain management in nursing homes. *Worldviews Evid Based Nurs*. 2004;1(suppl 1):S13–S20.
27. Molloy DW, Guyatt GH, Goeree R, et al. Systematic implementation of an advance directive program in nursing homes. *JAMA*. 2000;283: 1437–1444.
28. Lindner SA, Ben Davoren J, Vollmer A, et al. An electronic medical record intervention increased nursing home advance directive orders and documentation. *J Am Geriatr Soc*. 2007;55:1001–1006.
29. Loeb M, Carusone SC, Goeree R, et al. Effect of a clinical pathway to reduce hospitalizations in nursing home residents with pneumonia: a randomized controlled trial. *JAMA*. 2006;295:2503–2510.
30. Ersek M, Carpenter JG. Geriatric palliative care in long-term care settings with a focus on nursing homes. *J Palliat Med*. 2013;16: 1180–1187.
31. Brown EL, Raue PJ, Klimstra S, et al. An intervention to improve nurse-physician communication in depression care. *Am J Geriatr Psychiatry*. 2010;18:483–490.
32. Sprangers S, Dijkstra K, Romijn-Luijten A. Communication skills training in a nursing home: effects of a brief intervention on residents and nursing aides. *Clin Interv Aging*. 2015;10:311–319.
33. Ingber M, Feng Z, Khatutsky G, et al. Initiative to reduce avoidable hospitalizations among nursing facility residents shows promising results. *Health Aff*. 2017;36:441–450.