Healthcare 7 (2019) 38–43

Contents lists available at ScienceDirect

Healthcare

journal homepage: www.elsevier.com/locate/healthcare

The impact of two triggered palliative care consultation approaches on consult implementation in oncology

Lisa D. DiMartino[a,e,*], Bryan J. Weiner[b], Laura C. Hanson[c], Morris Weinberger[a], Sarah A. Birken[a], Katherine Reeder-Hayes[d], Justin G. Trogdon[a]

[a] Department of Health Policy and Management, Gillings School of Global Public Health, The University of North Carolina at Chapel Hill, 135 Dauer Drive, Campus Box 7411, Chapel Hill, NC 27599-7411, USA
[b] Department of Global Health, Department of Health Services, Box 357965, University of Washington, Seattle, WA 98195-7965, USA
[c] Division of Geriatric Medicine Center for Aging and Health, UNC Palliative Care Program, 5003 Old Clinic Building, Campus Box 7550, Chapel Hill, NC 27599-7550, USA
[d] Lineberger Comprehensive Cancer Center, The University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, USA
[e] RTI International, 3040 East Cornwallis Road, PO Box 12194, Research Triangle Park, NC 27709-2194, USA

ARTICLE INFO

Keywords:
Triggered palliative care consultation
Inpatient oncology
Implementation effectiveness

ABSTRACT

Introduction: Studies show palliative care delivered concurrently with cancer treatment improves outcomes, yet palliative care integration with inpatient oncology is underused. A promising approach to improve integration is a triggered palliative care consultation (TPCC). This study evaluated the impact of two TPCC approaches on consistency and quality of consult implementation, operationalized as uptake and timeliness, on solid tumor medical and gynecologic oncology services at an academic hospital.

Methods: The study timeframe was 2010–2016. TPCC in gynecologic oncology began in 2014 and was supported by a single strategy (written guideline); TPCC in medical oncology began in 2015 and was supported by multiple strategies (e.g. training, chart review). Palliative care consult information was chart abstracted and linked to hospital encounter data. We compared the effect of a single strategy vs. usual care, and multiple strategies vs. a single strategy on implementation. Difference-in-differences modified Poisson regression models evaluated whether implementation differed after TPCC; we estimated adjusted relative risk (aRR), controlling for patient demographic and clinical characteristics.

Results: Overall, 8.8% of medical oncology and 11.0% of gynecologic oncology inpatient encounters involved palliative care consultation. In regression analyses, TPCC supported by a single strategy in gynecologic oncology was associated with greater uptake vs. usual care (aRR: 1.45, $p < .05$), and TPCC supported by multiple strategies in medical oncology was associated with greater uptake vs. a single strategy (aRR: 2.34, $p < .001$).

Conclusion: Across two inpatient oncology services, TPCC supported by multiple strategies had the greatest impact on uptake. How strategies affect sustained use of palliative care consults remains to be investigated.

1. Introduction

Earlier integration of palliative care with cancer treatment is associated with improved symptom control, reduced intensity of treatment, and similar or improved survival.[1–3] Several studies also show that compared to usual care, receipt of palliative care consultation reduces hospital costs up to 24%, with earlier consultation having a larger cost-saving effect.[4,5] Despite these known benefits, palliative care is underused; many eligible cancer inpatients do not receive palliative care consultation or receive services so late in the disease course that they may not realize its full benefit.[6–10] This may be, in part, because effective implementation of palliative care consults in oncology is logistically challenging for healthcare organizations. Cancer patients are clinically complex and the provision of palliative care consults requires coordination between multidisciplinary palliative care and oncology providers.

Although there are currently no clinical guidelines regarding the timing of palliative care consultation in inpatient oncology,[11] earlier consults during hospitalization have greater benefit and are considered an important indicator of high-quality care.[12] The American Society of Clinical Oncology (ASCO) recommends[13] clinical triggers that alert oncology providers about patients needing palliative care to improve

* Corresponding author.
E-mail addresses: ldimartino@rti.org (L.D. DiMartino), bjweiner@uw.edu (B.J. Weiner), lhanson@med.unc.edu (L.C. Hanson), mweinber@email.unc.edu (M. Weinberger), birken@unc.edu (S.A. Birken), kreederh@email.unc.edu (K. Reeder-Hayes), justintrogdon@unc.edu, trogdonj@email.unc.edu (J.G. Trogdon).

https://doi.org/10.1016/j.hjdsi.2017.12.001
Received 28 April 2017; Received in revised form 31 August 2017; Accepted 5 December 2017
Available online 19 December 2017

implementation. Triggered palliative care consultation (TPCC) is based on predetermined clinical criteria (e.g., metastatic disease, uncontrolled symptoms).[14] Although prior research has shown that TPCC improves consult implementation in the intensive care unit,[15] there is limited evidence regarding the impact of TPCC in inpatient oncology.[11,13,14]

We evaluated the impact of two TPCC approaches on consult implementation in two distinct inpatient services, solid tumor medical oncology and gynecologic oncology, at University of North Carolina (UNC) Hospitals, an 804-bed acute care facility and National Cancer Institute–designated Comprehensive Cancer Center. Theory and prior research suggest that more strategies to promote use of a clinical practice will result in greater implementation.[16,17] Therefore, we hypothesized that TPCC supported by multiple strategies in medical oncology (e.g., training, clinician prompting, chart review) would be associated with more consistent consult implementation (greater uptake) and improved implementation quality (decreased time to consult) compared to a single strategy in gynecologic oncology (i.e., written guideline), and that TPCC supported by a single strategy would be superior to usual care.

2. Methods

2.1. TPCC approaches

Two TPCC approaches were used to promote palliative care consult implementation in the oncology services. TPCC in gynecologic oncology began in August 2014 and was supported by a single strategy—a one-page guideline using clinical criteria to initiate a consult written by oncology clinicians in the service. The criteria included unplanned admissions for management of symptoms of uncontrolled pain, nausea or vomiting, and malignant small bowel obstruction, or need for decision support evidenced by frequent readmissions, request for hospice, or resistance to advanced care planning.

In contrast, TPCC in medical oncology began in October 2015 and was supported by multiple strategies designed by palliative care and oncology clinicians. Additional details on the strategies have been reported elsewhere.[18] Briefly, the clinical criteria for triggering a consult included the presence of metastatic disease and uncontrolled symptoms. A research coordinator manually reviewed charts for all medical oncology admissions. When a patient met trigger criteria, the attending palliative care clinician prompted attending oncologists to consider a consult. Additional strategies, which occurred at approximately the same time as the trigger criteria, included monthly training for residents in palliative care skills of advanced care planning communication, champions from palliative care to promote consultation, and dedicated institutional funds for TPCC. The strategies were initiated by the medical oncology service (i.e., not instituted as part of a broader hospital campaign) and required investment in resources. Table 1 provides a detailed summary of the TPCC approaches used in the oncology services.

2.2. Data Sources

We obtained data on palliative care consults from the UNC Palliative Care Clinical Research database, which includes data abstracted from medical charts for all patients at UNC Hospital who receive a palliative care consultation. This data source provided the dates of service and oncology service line in which the palliative care consult was initiated. Using unique identifiers, we then linked these data to hospital encounter data obtained from the UNC Data Warehouse for Health (a central data repository containing clinical, research, and administrative data sourced from the institution's electronic health record system). This data source provided admitting and discharge service and dates, discharge status, as well as clinical and demographic characteristics. The dataset was then augmented with information on patient cancer stage at diagnosis obtained from the UNC Hospital Cancer Registry. The UNC Institutional Review Board reviewed and approved this study.

2.3. Study Sample

We included admissions and/or discharges from the medical oncology or gynecologic oncology service lines from January 1, 2010, to June 30, 2016, with a solid tumor diagnosis based on *International Classification of Diseases* (ICD) 9 and 10 codes documented during the encounter. If multiple palliative care consults occurred during an encounter, we only included the first one. We excluded 69 palliative care consults that were initiated in a service other than the admitting and/or discharge service (e.g., originated in medical intensive care, but the admitting and/or discharge service was medical oncology).

2.4. Outcomes

The primary outcome, palliative care consult uptake, was a binary variable. We defined uptake as completion of a consult during the encounter. To assess quality of implementation, a secondary outcome was time to palliative care consult after admission, defined as the number of days between admission and palliative care consultation. Using a subsample of encounters that involved a palliative care consult, we explored varying definitions of a binary variable for time to consult based on the following cutoffs: within 2 days of admission (55% of encounters involving a palliative care consult), within 7 days of admission (85%), or 14 days of admission (95%).

2.5. Independent variables

For the single strategy (gynecologic oncology) vs. usual care comparison, we included an indicator variable to capture exposure to the single strategy based on admission date (on or after 8/1/2014 through 9/30/2015), oncology service (gynecologic oncology or medical oncology), and the interaction term between these two variables. For the multiple strategies (medical oncology) vs. single strategy comparison,

Table 1
Description of TPCC approaches.

TPCC supported by a single strategy **Service: Gynecologic oncology** **Start date: August 1, 2014**	**TPCC supported by multiple strategies** **Service: Medical oncology** **Start date: October 1, 2015**
• One-page written guideline of clinical criteria for initiating a consult (i.e., uncontrolled pain, nausea or vomiting, malignant bowel obstruction, frequent readmissions, request for hospice, or resistance to advanced care planning).	• Training of residents in palliative care skills of advanced care planning communication. • Clinician prompting of eligible patients by palliative care service. • Medical chart review to identify patients with advanced cancer (i.e., metastatic or uncontrolled symptoms). • Dedicated institutional funding. • Appointed champions from palliative care.

Table 2
Study sample characteristics, by oncology service.

Demographic and clinical characteristics	Medical oncology (n = 5873)	Gynecologic Oncology (n = 3887)
Age, mean (SD)	57.4(13.8)	59.4(14.1)
Race, n (%)		
Black	1661(28.3)	984(25.3)
White	3622(61.7)	2607(67.1)
Other	515(8.8)	212(5.4)
Missing	75(1.3)	84(2.2)
Sex, n (%)		
Female	2872(48.9)	3887(100.0)
Insurance, n (%)		
Medicare	2240(38.1)	1638(42.1)
Medicaid	1286(21.9)	551(14.2)
Other Public	293(5.0)	70(1.8)
Private	1704(29.0)	1353(34.8)
Uninsured	131(2.2)	124(3.2)
Missing	219(3.7)	151(3.9)
Cancer Type, n (%)		
Digestive: Yes	2185(37.2)	1159(29.2)
Breast: Yes	700(11.9)	46(1.2)
Bone/Joint: Yes	1532(26.1)	110(2.8)
Soft Tissue: Yes	245(4.2)	43(1.1)
Skin: Yes	257(4.4)	23(.6)
Head/Neck: Yes	336(5.7)	0(0)
Urological: Yes	484(8.2)	69(1.8)
Lung/Thoracic: Yes	2326(39.6)	260(6.7)
Gynecological: Yes	49(.8)	2618(67.3)
Other/Ill Defined: Yes	1151(19.6)	431(11.1)
CNS: Yes	1017(17.3)	76(1.9)
Missing: Yes	358(6.1)	452(11.6)
Cancer Stage at Diagnosis, n (%)		
0 or I	513(8.7)	585(15.1)
II or III	1596(27.2)	1218(31.3)
IV	1792(30.5)	531(13.7)
Missing	1972(33.6)	1553(39.9)
Comorbidities: Charlson Index, n (%)		
0	4123(70.2)	3078(79.2)
1	1087(18.5)	519(13.4)
> =2	663(11.3)	290(7.5)
Length of Stay, mean days (SD)	6.1(5.7)	6.4(6.7)
PC consultation in a prior hospital encounter, n (% Yes)	200(3.4)	269(6.9)
Hospitalized in Prior 30 days, n (% Yes)	1304(22.2)	988(25.4)
Discharge Status, n (% Deceased)	235(4.0)	64(1.7)

PC: palliative care.
SD: standard deviation.
CNS: Central nervous system.

we included an indicator variable to capture exposure to the multiple strategy based on admission date (on or after 10/1/2015 through 6/30/2016), oncology service, and the interaction term between these two variables.

2.6. Key study covariates

Patient-level demographic and clinical characteristics of the oncology services were included as covariates in our models to account for any changes in service composition over time and their hypothesized association with study outcomes. Covariates included categories for race (White – reference, Black, other, missing); sex; insurance status (Medicare – reference, Medicaid, private, other public, uninsured, missing); palliative care consultation in a prior hospital encounter (yes or no); hospitalization in the prior 30 days (yes or no); length of stay (number of calendar days between admission and discharge dates); discharge status (alive or deceased), and solid tumor cancer type (digestive, breast, bone/joint, soft tissue, skin, head/neck, urological, lung/thoracic, gynecological, other/ill defined, central nervous system, missing). Age was included as a continuous variable. Stage of disease at diagnosis was based on the American Joint Committee on Cancer staging criteria (Stage 0 or I, II or III, IV). If stage could not be ascertained, it was categorized as "missing." We assessed comorbidity (0, 1, 2 or more comorbidities) using previously described coding algorithms.[19] Comorbidity ICD codes were derived from the patient's problem list in the electronic health record system. The comorbidities may be added at any time the patient receives care at the institution. We searched the problem list for evidence of comorbidities 30 days before and after the admission date to ensure all comorbidities present at the time of an encounter were captured.

2.7. Statistical analysis

Within each oncology service, we describe the study sample using proportions for categorical variables and means with standard deviations for continuous variables. We examined unadjusted changes in the uptake and time to consult outcomes before and after TPCC using a Chi-square test for categorical variables and Wilcoxin rank sum test for continuous variables.

We used a difference-in-differences approach to evaluate whether implementation differed after TPCC. This approach is robust to differences in overall average palliative care consult uptake across the oncology services. Two difference-in-differences regression models were estimated. The first compared changes in outcomes before (1/1/2010–7/31/2014) and after (8/1/2014–9/30/2015) TPCC in gynecologic oncology (single strategy) to changes over the same time period in medical oncology (usual care). The sample for the single strategy vs. usual care comparison included 8652 admissions. The second compared outcomes before (8/1/2014–9/30/2015) and after (10/1/2015–6/30/2016) TPCC in medical oncology (multiple strategies) to changes over the same time period in gynecologic oncology (single strategy); the sample for this comparison included 2614 admissions.

The analysis of time to palliative care consult was restricted to admissions with a palliative care consult: 746 admissions for comparing use of a single strategy (gynecologic oncology) vs. usual care and 361 admissions for comparing multiple strategies (medical oncology) vs. single strategy. For each comparison, we estimated separate models for palliative care consult within 2 days, 7 days, or 14 days of admission (6 models total). The unit of analysis was the discharge encounter.

We estimated the adjusted relative risk (aRR) and 95% confidence intervals (CI) of palliative care consult uptake and time to palliative care consult using modified Poisson regression.[20] Robust standard errors clustered at the patient level were used to account for autocorrelation across encounters, because some patients may have had multiple hospitalizations. In all models, to minimize the potential for confounding, we controlled for patient demographic and clinical characteristics listed under covariates and a linear time trend (year as a continuous variable). Length of stay was included as an exposure variable to account for different observation periods. We conducted our analyses using Stata version 13.0 (College Station, TX). All statistical tests were two-tailed with a critical alpha equal to .05.

For the difference-in-differences estimates to be valid and unbiased, the *assumption of parallel trends* must be met. Briefly, this means the trends in palliative care consult uptake between the oncology services were the same prior to TPCC.[21] We tested for this assumption using data prior to the implementation of any TPCC strategies: 1/1/2010 to 12/31/2013. We estimated a modified Poisson regression model that controlled for the same demographic and clinical characteristics as the models for the primary analyses in addition to a linear time trend (admission date as a continuous variable), an indicator for oncology service, and the interaction between those two variables. Under the parallel trends assumption, the coefficient of the interaction should equal zero.

Table 3
Unadjusted changes in palliative care consult implementation.

Outcome measures	Medical oncology		Gynecologic oncology	
	Before Initiation of TPCC (1/1/2010-9/30/2015) (n = 5260)	After Initiation of TPCC (10/1/2015-6/30/2016) (n = 613)	Before Initiation of TPCC (1/1/2010-7/30/2014) (n = 2779)	After Initiation of TPCC (8/1/2014-6/30/2016) (n = 1108)
PC consult uptake, n (% Yes)	402(7.6)	113(18.4)‡	258(9.3)	169(15.3)‡
Time to PC consult, mean days from admission (SD)[a,b]	3.8(4.2)	2.8(3.2)†	4.5(6.5)	3.7(5.6)
PC consult within 2-days, n (% Yes)[a]	216(53.7)	67(59.3)	141(54.5)	102(60.4)
PC consult within 7-days, n (% Yes)[a]	345(85.8)	104(92.0)	221(85.7)	149(88.2)
PC consult within 14-days, n (% Yes)[a]	388(96.5)	112(99.1)	240(93.0)	162(95.9)

PC: palliative care.
SD: standard deviation.
†: Significant at the p = .05 level.
‡: Significant at the p = .01 level.
[a] Calculated only for subsample of encounters that involved a palliative care consult.
[b] Calculated using Wilcoxon rank sum test.

Table 4
Changes (difference-in-difference) in palliative care consult implementation associated with TPCC: single strategy vs. usual care.

Outcome measures	N	Adjusted relative risk	95% confidence interval
PC Consult Uptake	8652	**1.45†**	**1.05–2.01**
Time to PC Consult (percentile)	746		
Within 2-days (55th)		1.13	.69–1.87
Within 7-days (85th)		.96	.69–1.34
Within 14-days (95th)		.97	.74–1.28

TPCC: Triggered palliative care consultation.
PC: Palliative care.
†: Significant at the p = .01 level.
NOTE. All regression analyses controlled for differences in age, race, sex, insurance, cancer type, cancer stage, PC consultation in a prior hospital encounter, hospitalization in prior 30 days, comorbidities, discharge status, and a linear time trend. Length of stay was included as an exposure variable.

3. Results

3.1. Patient demographic and clinical characteristics

Table 2 describes the clinical and demographic characteristics of the sample by oncology service. We identified a total of 9760 encounters with an admission and/or discharge from the oncology services between January 1, 2010, and June 30, 2016. Of these, 5873 (60%) of encounters were from medical oncology. Compared to medical oncology, the gynecologic oncology sample was older and more likely to be White, female, and privately insured. The gynecologic oncology sample was also more likely to have had palliative care consultation in a prior hospital encounter and have been hospitalized in the prior 30 days. The medical oncology sample was more likely to have a diagnosis of Stage IV cancer, one or more comorbidities, and a discharge status of deceased (p < .05).

3.2. Unadjusted changes in palliative care consult implementation

3.2.1. Palliative care consult uptake

The unadjusted changes in the outcomes are presented in Table 3. Overall, 8.8% (n = 515) of medical oncology encounters and 11.0% (n = 427) of encounters in gynecologic oncology involved a palliative care consult. Within each service, there was a significant increase in palliative care consult uptake after TPCC. Specifically, TPCC supported by multiple strategies in medical oncology was associated with an increase in consult uptake from 7.6% between 1/1/2010 and 9/30/2015 to 18.4% between 10/1/2015 and 6/30/2016 (p < .05). Similarly, TPCC supported by a single strategy in gynecologic oncology was associated with an increase in consult uptake from 9.3% between 1/1/2010 and 7/30/2014 to 15.3% between 8/1/2014 and 6/30/2016 (p < .05).

3.2.2. Time to palliative care consult

In medical oncology, the mean number of days from admission to palliative care consult decreased significantly after TPCC from 3.8 to 2.8 (p < .05), however no significant differences in mean number of days were found in gynecologic oncology after TPCC. Likewise, across both services, TPCC did not have a significant effect on the timing of consults (i.e., within 2 days, 7 days, or 14 days of admission) (p > .05).

3.3. Adjusted changes in palliative care consult implementation

After adjustment for covariates, there was no significant difference in the trends in palliative care consult uptake between oncology services prior to TPCC (i.e., assumption of parallel trends was met) (p = .20). Tables 4, 5 show the results from the adjusted difference-in-differences estimates. TPCC supported by a single strategy in gynecologic oncology was associated with greater consult uptake compared to usual care (aRR: 1.45, 95% CI: 1.05–2.01, p < .05), and TPCC supported by multiple strategies in medical oncology was associated with greater consult uptake compared to a single strategy (aRR: 2.34, 95% CI:

Table 5
Changes (difference-in-difference) in palliative care consult implementation associated with TPCC: multiple strategies vs. single strategy.

Outcome measures	N	Adjusted relative risk	95% confidence interval
PC Consult Uptake	2614	**2.34†**	**1.57–3.49**
Time to PC Consult (percentile)	361		
Within 2-days (55th)		1.23	.67–2.24
Within 7-days (85th)		1.12	.74–1.70
Within 14-days (95th)		1.05	.74–1.49

TPCC: Triggered palliative care consultation.
PC: Palliative care.
†: Significant at the p = .01 level.
NOTE. All regression analyses controlled for differences in age, race, sex, insurance, cancer type, cancer stage, PC consultation in a prior hospital encounter, hospitalization in prior 30 days, comorbidities, discharge status, and a linear time trend. Length of stay was included as an exposure variable.

1.57–3.49, $p < .001$). Across all comparisons, the difference-in-differences estimates showed no significant association between TPCC and time to consult ($p > .05$).

4. Discussion

We examined the impact of two TPCC approaches on consult implementation in inpatient oncology. We found that TPCC supported by a single strategy in gynecologic oncology was associated with greater consult uptake compared to usual care, and TPCC supported by multiple strategies in medical oncology was associated with greater consult uptake compared to a single strategy. Although we were unable to directly compare use of multiple strategies in medical oncology to usual care, it can be inferred from these findings that TPCC supported by multiple strategies would have the largest impact on consult uptake. To date, investigations of the use of TPCC for consult implementation in oncology inpatient settings are limited;[11,13,14] the few extant studies examining this issue have reported unclear evidence for TPCC. For example, among hospitalized patients with advanced cancer, Rocque et al. found TPCC had minimal impact on consult uptake,[22] while Adelson et al. found TPCC doubled rates of consultation.[23] Notably, both studies were limited by small sample sizes, short durations, and being conducted only in medical oncology services. No prior studies have considered the relative effectiveness of TPCC supported by a single strategy versus multiple strategies, yet this information is critical to enhancing the implementation of palliative care consults in oncology. Our study advances prior research by examining the impact of TPCC supported by a single strategy or multiple strategies in two inpatient oncology services—gynecologic oncology and solid tumor medical oncology. In addition, the availability of multiple years of data from a large number of hospitalizations made it possible to account for underlying secular trends or other events that may have affected palliative care consult implementation.[21]

Overall, we found 10% of encounters (8.8% in medical oncology and 11.0% in gynecologic oncology) involved a palliative care consultation. Our palliative care consultation rate was comparable to what has been reported in similar cohorts of hospitalized cancer patients,[8,24] although variable rates have been reported ranging from 5% of patients hospitalized with head and neck cancer[25] to 24% in an inpatient gynecologic oncology service.[26] Notably, there is no benchmark regarding rates of palliative care consultation in inpatient oncology. By establishing benchmark criteria, hospitals could leverage this information to determine the current rate of palliative care consultation, decide whether TPCC is needed, and evaluate the impact of TPCC on uptake.[27]

Contrary to our hypothesis, TPCC did not result in earlier timing of consultation that would be expected to enhance quality of care outcomes. In fact, among encounters that involved a palliative care consult, just over half of encounters across both oncology services involved palliative care consults early during hospitalization (within two days of admission). These findings are consistent with a prior study of TPCC for advanced cancer patients in an emergency department; that study found patients received palliative care consultation within an average of three days of admission and no effect of TPCC on timing.[28] Given our findings, any improvements in timing resulting from TPCC would have been minimal and required a substantially larger sample size to detect any significant differences. Considering earlier palliative care consults during hospitalization are considered an important indicator of high-quality care,[12] additional efforts are needed to develop clinical guidelines regarding timing of consultation in inpatient oncology and examine the potential impact of quality improvement efforts, such as lean methodology,[29] to improve timeliness of consults.

There are several limitations of this study. First, it occurred at a single academic hospital with a well-established palliative care service, which limits generalizability. Nonetheless, our findings may extend to similar large hospital settings seeking to improve implementation of palliative care consults. Second, while the strategies occurred in two different oncology services (i.e., surgical vs. medical specialty), we controlled for patient clinical characteristics in the services, including cancer type, that otherwise may have confounded our findings. However, any unobserved differences in palliative care consult uptake across the two services that changed over time could have biased our estimates of the effect of TPCC on the study outcomes. Third, we lacked data on prior hospice referral or do-not-resuscitate status, however we included several covariates that reflected health status (e.g., hospitalization in the prior 30 days, palliative care consultation in a prior hospital encounter). Fourth, the time to palliative care consult analysis was conducted in a small subsample of encounters in the oncology services, which minimized our statistical power to detect differences across the groups. Finally, TPCC may have impacted important aspects of implementation quality that we were unable to measure.[30] For example, we were unable to assess quality of the consult (e.g., provision of both symptom management and advanced care planning, skill with which the consult was done). Future research should consider investigating the effect of TPCC on these additional quality indicators.

Despite these limitations, our study has important implications. Inpatient palliative care programs are increasingly available, yet many eligible cancer inpatients do not receive palliative care. In light of the recent ASCO guideline[13] underscoring that oncology services should consider using clinical triggers, our study findings are timely and add to the growing evidence base indicating TPCC can promote the use of palliative care for cancer inpatients. Of note, a recent National Comprehensive Cancer Center survey suggested that inpatient palliative care programs using TPCC may be constrained by workforce limitations in their ability to respond to all patients in need.[31] When deciding whether to use TPCC and standardize delivery of palliative care, clinicians' desire to provide these services will need to be balanced by availability of trained workforce that can deliver quality palliative care. As our findings indicate, TPCC supported by multiple strategies had the greatest impact on consult uptake, however a single strategy may provide adequate support to improve the integration of palliative care in inpatient oncology. How the strategies affect the sustained use of palliative care consults remains to be investigated.

Conflict of interest

The authors have no conflicts to disclose.

Funding

Dr. DiMartino's work on this research was supported by grant funding from the National Cancer Institute Cancer Control Education Program (R25 CA057726). The project described was supported by the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant Award Number TL1TR001110. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

References

1. Bakitas M, Lyons KD, Hegel MT, et al. Effects of a palliative care intervention on clinical outcomes in patients with advanced cancer: the Project ENABLE II randomized controlled trial. *JAMA: J Am Med Assoc.* 2009;302(7):741–749.
2. Temel JS, Greer JA, Muzikansky A, et al. Early palliative care for patients with metastatic non-small-cell lung cancer. *New Engl J Med.* 2010;363(8):733–742.
3. Zimmermann C, Swami N, Krzyzanowska M, et al. Early palliative care for patients with advanced cancer: a cluster-randomised controlled trial. *Lancet.* 2014.
4. May P, Garrido MM, Cassel JB, et al. Prospective cohort study of hospital palliative care teams for inpatients with advanced cancer: earlier consultation is associated with larger cost-saving effect. *J Clin Oncol: Off J Am Soc Clin Oncol.* 2015;33(25):2745–2752.
5. Morrison RS, Dietrich J, Ladwig S, et al. Palliative care consultation teams cut hospital costs for Medicaid beneficiaries. *Health Aff.* 2011;30(3):454–463.
6. Fadul N, Elsayem A, Palmer JL, Zhang T, Braiteh F, Bruera E. Predictors of access to palliative care services among patients who died at a Comprehensive Cancer Center. *J Palliat Med.* 2007;10(5):1146–1152.

7. Walling AM, Asch SM, Lorenz KA, et al. The quality of supportive care among inpatients dying with advanced cancer. *Support Care cancer: Off J Multinatl Assoc Support Care Cancer.* 2012;20(9):2189–2194.
8. Reville B, Miller MN, Toner RW, Reifsnyder J. End-of-life care for hospitalized patients with lung cancer: utilization of a palliative care service. *J Palliat Med.* 2010;13(10):1261–1266.
9. Walling AM, Tisnado D, Asch SM, et al. The quality of supportive cancer care in the veterans affairs health system and targets for improvement. *JAMA Intern Med.* 2013;173(22):2071–2079.
10. Scibetta C, Kerr K, McGuire J, Rabow MW. The costs of waiting: implications of the timing of palliative care consultation among a cohort of decedents at a comprehensive cancer center. *J Palliat Med.* 2016;19(1):69–75.
11. Humphreys J, Harman S. Late referral to palliative care consultation service: length of stay and in-hospital mortality outcomes. *J Community Support Oncol.* 2014;12(4):129–136.
12. Dy SM, Kiley KB, Ast K, et al. Measuring what matters: top-ranked quality indicators for hospice and palliative care from the American Academy of Hospice and Palliative Medicine and Hospice and Palliative Nurses Association. *J Pain symptom Manag.* 2015;49(4):773–781.
13. Ferrell BR, Temel JS, Temin S, et al. Integration of palliative care into standard oncology care: American society of clinical oncology clinical practice guideline update. *J Clin Oncol0(0):JCO.* 2016;2070:1474.
14. Kamal AH, Bull J, Kavalieratos D, Taylor Jr DH, Downey W, Abernethy AP. Palliative care needs of patients with cancer living in the community. *J Oncol Pract / Am Soc Clin Oncol.* 2011;7(6):382–388.
15. Nelson JE, Curtis JR, Mulkerin C, et al. Choosing and using screening criteria for palliative care consultation in the ICU: a report from the Improving Palliative Care in the ICU (IPAL-ICU) Advisory Board. *Crit care Med.* 2013;41(10):2318–2327.
16. Grimshaw JM, Shirran L, Thomas R, et al. Changing provider behavior: an overview of systematic reviews of interventions. *Med Care.* 2001;39(8Suppl 2):II2–II45.
17. Klein KJ, Sorra JS. The challenge of innovation implementation. *Acad Manag Rev.* 1996;21(4):1055–1080.
18. Hanson LC, Collichio F, Bernard SA, et al. Integrating palliative and oncology care for patients with advanced ancer: a quality improvement intervention. *J Palliat Med.* 2017.
19. Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Med Care.* 2005;43(11):1130–1139.
20. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol.* 2004;159(7):702–706.
21. Dimick JB, Ryan AM. Methods for evaluating changes in health care policy: the difference-in-differences approach. *JAMA: J Am Med Assoc.* 2014;312(22):2401–2402.
22. Rocque GB, Campbell TC, Johnson SK, et al. A quantitative study of triggered Palliative care consultation for hospitalized patients with advanced cancer. *J Pain symptom Manag.* 2015;50(4):462–469.
23. Adelson K, Paris J, Smith CB, Horton J, Morrison RS. Standardized criteria for required palliative care consultation on the solid tumor oncology service. *J Clin Oncol: Off J Am Soc Clin Oncol.* 2013;31(suppl 31):37 [abstr].
24. Dhillon N, Kopetz S, Pei BL, Fabbro ED, Zhang T, Bruera E. Clinical findings of a palliative care consultation team at a comprehensive cancer center. *J Palliat Med.* 2008;11(2):191–197.
25. Mulvey CL, Smith TJ, Gourin CG. Use of inpatient palliative care services in patients with metastatic incurable head and neck cancer. *Head Neck.* 2016;38(3):355–363.
26. Lefkowits C, Binstock AB, Courtney-Brooks M, et al. Predictors of palliative care consultation on an inpatient gynecologic oncology service: are we following ASCO recommendations? *Gynecol Oncol.* 2014;133(2):319–325.
27. Partridge AH, Seah DS, King T, et al. Developing a service model that integrates palliative care throughout cancer care: the time is now. *J Clin Oncol: Off J Am Soc Clin Oncol.* 2014;32(29):3330–3336.
28. Kistler EA, Sean Morrison R, Richardson LD, Ortiz JM, Grudzen CR. Emergency department-triggered palliative care in advanced cancer: proof of concept. *Acad Emerg Med: Off J Soc Acad Emerg Med.* 2015;22(2):237–239.
29. Glasgow JM, Scott-Caziewell JR, Kaboli PJ. Guiding inpatient quality improvement: a systematic review of Lean and Six Sigma. *Jt Comm J Qual Patient Saf.* 2010;36(12):533–540.
30. Dy SM, Kiley KB, Ast K, et al. Measuring What Matters: Top-Ranked Quality Indicators for Hospice and Palliative Care From the American Academy of Hospice and Palliative Medicine and Hospice and Palliative Nurses Association. Journal of pain and symptom management. 49(4):773-781.
31. Calton BA, Alvarez-Perez A, Portman DG, Ramchandran KJ, Sugalski J, Rabow MW. The current state of palliative care for patients cared for at leading US cancer centers: the 2015 NCCN palliative care survey. *J Natl Compr Canc Netw.* 2016;14(7):859–866.