Original Article

Variations in Pain Management Outcomes Among Palliative Care Centers and the Impact of Organizational Factors

Dong Wook Shin, MD, DrPH, MBA[1]; Seung Sik Hwang, MD, PhD[2]; Juhwan Oh, MD, MPH, PhD[3,4]; Jung Hoe Kim, MPH[5];
Jong Hyock Park, MD, MPH, PhD[6]; Juhee Cho, MA, PhD[7,8]; Belong Cho, MD, PhD[1]; Kee Taig Jung, PhD, MBA[9,10];
and Eun-Cheol Park, MD, PhD[6]

BACKGROUND: The assessment of pain management outcomes is important for the quality assurance of palliative care. The objective of this study was to determine whether there are significant variations in pain management outcomes among palliative care centers and whether they are affected by organizational factors. **METHODS:** Data used in this investigation were from the 2009 Korean Terminal Cancer Patient Information System and administrative records of the 34 inpatient palliative care centers designated by the Korean Ministry of Health and Welfare in 2009. Self-reported pain scores (range, from 0 to 10) at admission and 1 week after admission were prospectively collected. Multilevel mixed-effect regression models were used to analyze the variations and the impact of organizational-level factors on 2 pain management outcomes (ie, reduction in average pain score and achievement of adequate pain control at 1 week after admission). **RESULTS:** In total, 1711 patients with terminal cancer were included in the analyses. The mean reduction in the pain score was 0.69 to 1.91 after 1 week, and most patients (82.8%) achieved adequate pain control. There were significant variations in pain management outcomes among palliative care centers. Higher composite scores for human resources adequacy were associated significantly with a greater reduction in pain score (β, 0.11; 95% confidence interval, 0.01-0.21), and achievement of adequate pain control (adjusted odds ratio, 1.26; 95% confidence interval, 1.10-1.45). **CONCLUSIONS:** There were significant variations in pain management outcomes among inpatient palliative care centers, and they were affected by organizational factors, such as human resources adequacy. ***Cancer* 2012;118:5688-97.** *© 2012 American Cancer Society.*

KEYWORDS: pain, cancer, variation, palliative care, multilevel analysis.

INTRODUCTION

Pain is the most common, most feared, and most debilitating symptom of terminal cancer patients, and it plays a central role in their quality of life.[1] Pain is reported by 60% to 70% of patients with advanced cancer[2,3] and increases as patients approach death.[4] Fortunately, in the vast majority of cases, adequate pain control can be achieved by using the World Health Organization guidelines.[5] However, according to recent systematic review, there was large variability in the adequacy of pain control, and under-treatment and inadequate pain control are common.[6]

Pain control is a key component of palliative care, which aims to improve the quality of life for patients with life-threatening illnesses. Assessment of outcome indicators for pain control is especially important for quality assurance of palliative care centers. Previous research has suggested that the organizational context may influence pain control and that variations in pain management outcomes may reflect variations in care delivery.[7,8] However, the issue of intercenter variations of pain management outcomes has received little attention in palliative care. Vainio and Auvinen assessed 1840 cancer patients in 7 hospices and reported significant intercenter variations in pain prevalence and intensity; the proportion of patients with severe pain ranged from 10% to 56%.[1] In a Taiwanese study of 480 cancer patients in 15 outpatient clinics,

Corresponding author: Eun-Cheol Park, MD, PhD, Department of Preventive Medicine and Institute of Health Services Research, Yonsei University College of Medicine, 50 Yonsei-ro, Seodaemun-gu, Seoul, 120-752, Korea; Fax: (011) 82-2-392-8133; ecpark@yuhs.ac

[1]Department of Family Medicine, Seoul National University Hospital, Seoul, Korea; [2]Department of Social and Preventive Medicine, Inha University Hospital, Incheon, Korea; [3]Department of Health Policy Management, Institute of Health Policy and Management, Seoul National University, Seoul, Korea; [4]Department of Society, Human Development, and Health, Harvard School of Public Health, Boston, Massachusetts; [5]Health Insurance Review and Assessment Service, Seoul, Korea; [6]Department of Health Policy and Management, National Cancer Control Institute, Goyang, Korea; [7]Cancer Education Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Suwon, Korea; [8]Department of Epidemiology, Health, Behavior, and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland; [9]Department of Health Services Management, Kyung Hee University, Seoul, Korea; [10]Leonard Davis Institute of Health Economics, University of Pennsylvania, Philadelphia, Pennsylvania.

The following 34 institutions (in alphabetical order) participated in this study and helped with data collection: Busan St. Mary's Medical Center, Calvary Clinic, Catholic University of Korea St. Paul's Hospital, Changwon Fatima Hospital, Chinnam National University Hwasun Hospital, Chunbuk National University Hospital, Chungnam National University Hospital, Daegu Fatima Hospital, Daegu Medical Center, Daegu Veterans Hospital, Emmaus Charity Hospital, Good Samaritan Hospital, Gyeongsang National University Hospital, Jeon Jin Sang Clinic, Keimyung University Dongsan Hospital, Korea University Guro Hospital, Kwangju Chistian Hospital, Mohyun Hospice, Mokpo Jung Ang Hospital, NamWon Medical Center, National Health Insurance Corporation Ilsan Hospital, Saemmul Hospice Mission, SAM Medical Center, Seobuk Hospital, Seoul National University Hospital, St. Carollo Hospital, St. Isidore Hospice, St. John of God Hospital, Suwon Christian Hospice Mission, The Catholic University of Korea, Bucheon St. Mary's Hospital, The Catholic University of Korea-Daejeon St. Mary's Hospital, The Catholic University of Korea-Seoul St. Mary's Hospital, The Catholic University of Korea-St. Vincent's Hospital, and Yeungnam University Medical Center.

DOI: 10.1002/cncr.26722, **Received:** September 30, 2011; **Revised:** October 27, 2011; **Accepted:** October 27, 2011, **Published online** May 8, 2012 in Wiley Online Library (wileyonlinelibrary.com)

Hsieh reported major variations in satisfaction with pain control.[9] However, those previous studies did not appropriately consider case-mix or organizational context, which may affect pain management outcomes.[10]

The Korean government began to promote palliative care with its second-term cancer control plan in 2005.[11] The Ministry of Health and Welfare (MW) has established a policy that requires all MW-recognized palliative care centers to be medically based and has subsidized inpatient palliative care services with separate palliative care wards, adequate human resources, and proper facilities and equipment. Because of this initiative, the number of inpatient palliative care services increased from 15 to 40 during the period from 2005 to 2010. At the moment, the Korean standards for hospice and palliative care[12] and government guidelines require patients to forgo anticancer treatment to become eligible for inpatient palliative care services, and approximately 8% to 10% of all patients with terminal cancer in Korea receive palliative care from those services.[13] The government has proposed a per diem payment system for inpatient palliative care regardless of the actual medical treatment received, and a demonstration project is currently ongoing; thus, it has become necessary to conduct a continuous monitoring of the quality of these services.

In 2004, the MW released the *Cancer Pain Management Guideline*,[14] which is based primarily on World Health Organization recommendations. It was drafted by the Cancer Pain Committee of the National Cancer Control Board and has been endorsed by many professional organizations. Opioids and other analgesics are readily available throughout Korea and are prescribed as the standard of care. Various nonpharmacologic interventions also are provided based on the routine practices of each center.

With the funding from the MW, the Korean Terminal Cancer Patient Information System (KTCPIS) was developed to provide national statistics and to assist with evidence-based policy making.[13] The MW mandated all 34 designated palliative care centers to register all new patients who were enrolled between January and December of 2009 in KTCPIS and to prospectively collect data using a web-based information-gathering system (eVelos System; Velos, Fremont, Calif) that was developed in 2008.[13]

In this study of a nationwide, prospective cohort of patients with terminal cancer, our objective was to determine whether there are significant variations in pain management outcomes among palliative care centers and whether they are affected by organizational factors. Among organizational factors, we focused on the adequacy of human resources, such as staffing levels[8] and the training of staff,[15-17] that have been associated with pain management outcomes. For this purpose, we used multilevel statistical models, which provide a technically robust framework when variables are measured simultaneously at the patient and organizational levels.

MATERIALS AND METHODS

Source of Data

Data used in this investigation were from 2 sources: 1) individual-level information was drawn from the 2009 KTCPIS data set; and 2) organizational-level information was drawn from the administrative records of the 34 inpatient palliative care centers designated by the Korean MW in 2009. This study was approved by the Institutional Review Board of the Korean National Cancer Center.

The KTCPIS data set consists of patient-level and episode-level information for each admission. Some patient-level data (cancer type, registration date, etc) are collected from all registered patients, and other patient-level data (health insurance type, marital status, etc) and episode-level information (admission/discharge date, Eastern Cooperative Oncology Group [ECOG] performance status at admission, pain score at admission and at 1 week, etc) are collected only from patients who agree to provide clinical information for the study (Table 1). All participating patients or their primary caregivers provide informed consent. A detailed description of KTCPIS is provided elsewhere.[13,18]

We also used administrative data, which were collected for the 2009 designated program. The preset minimum standards and evaluation criteria were established by the Palliative Care Center Evaluation Committee, which is composed of multidisciplinary experts in palliative care fields and health care. Evaluation criteria included domains of facilities, equipment, human resources, service contents, quality-improvement program, and public services. The committee members visited each palliative care center and evaluated their application; and, in total, 34 palliative care centers were designated in early 2009.

Study Participants

Patients were included if 1) they were admitted to a participating palliative care center in 2009 and 2) they or their family caregivers consented to the collection of their clinical data collection. Because of the government policy of restricting inpatient palliative care to those who forgo anticancer treatment and the current medical practice of

Table 1. Contents of the Terminal Patient Information System

For all patients
- Basic information
- Social security number
- Cancer type
- Certification of terminal status
- Registration date

For patients who agreed to provide their information
- Basic information (at the time of admission)
- Health insurance type
- Marital status
- Religion
- Reason for terminal diagnosis
- Patient's having insight of cancer
- Patient's having insight of terminal status
- Caregiver's having insight of cancer
- Caregiver's having insight of terminal status
- Having completed advance directives
- Caregiver sex
- Caregiver relationship with family
- Contact address

Admission (for each admission)
- Admission/discharge date
- Route of admission
- ECOG performance status at admission
- Mental status at admission
- Pain at admission/pain at 1 week
- Special services provided
- Discharge pattern/provision of home palliative care

Abbreviations: ECOG, Eastern Cooperative Oncology Group.

late referral to palliative care centers, all patients in this study were patients with terminal cancer who had a median survival of 18 days.[18] If a patient could not be interviewed because of poor general condition or mental impairment, then the patient was excluded from analyses.

Outcome Measures

Average pain scores at the time of admission and after 1 week were collected. A 1-week period was selected because previous reports indicated that highly significant pain reduction occurs within 1 week of treatment.[5,19] The pain scores were recorded using a numeric rating scale (NRS), with 0 indicating a pain-free state and 10 indicating the worst pain a patient could imagine. For the analyses, we examined 2 types of pain management outcomes: 1) reduction in the average pain score,[20] defined as a decrease in the average pain score at 1 week after admission; and 2) achievement of adequate pain control, defined as an average pain score ≤ 3 at 1 week after admission.[21]

Conceptual Framework and Independent Variables

We developed a theoretical framework for multilevel analyses based on a literature review and experts' discussion (Fig. 1). Our multilevel modeling included patient-level and organizational-level factors that are known to affect pain control. Patient-level variables were selected based on literature review and data availability and included average pain at admission,[22] patient age,[23,24] and performance status.[23,24] Organizational-level variables included type of services and items from "the adequacy of the human resource" domain of the evaluation criteria for the designation program. This domain was designed to evaluate the multidisciplinary composition and training adequacy based on the *Korean Standard of Hospice and Palliative Care*[12] and consisted of staffing levels and palliative care training status of physicians, nurses, and social workers and staffing levels of clergy and volunteers. The MW requires 60 hours of basic training for palliative care professionals.[25] Each item in the domain was given weightings based on the opinion of committee members and summed into a composite score (range, 0-20). The score was then used by the MW in their decision to designate each center (Table 2). Although the composite score of "adequacy of human resources" was not formally validated, its content validity was confirmed by palliative care professionals. Furthermore, a composite index has some strength in that it is less sensitive to measurement bias than variables considered independently.[26]

Statistical Analysis

For descriptive analyses, pain was categorized as absent (0), mild (1-3), moderate (4-6), or severe (7-10), in accordance with current cancer pain management guidelines in Korea.[14] The influence of organizational factors on pain management outcomes were analyzed using multilevel mixed-effect models with the patients (level 1) being nested within the palliative care centers (level 2). Both linear and logistic regression models were used for the continuous outcomes (ie, decrease in average pain score) and binary outcomes (ie, achievement of adequate pain control), respectively.

We increased model complexity at each step using a random intercept model. First, we constructed an "empty" model (Model 1), which only included a random intercept to detect the existence of possible inter-center heterogeneity. Then, we added patient characteristics into the model (Model 2) to investigate the extent to which organizational-level differences were explained by patient composition of the centers. Finally, we added the organizational variable (Model 3) to investigate whether this contextual phenomenon was conditioned by specific organizational variables.

In Model 3, we used 2 different approaches to consider organizational variables. First, each component was

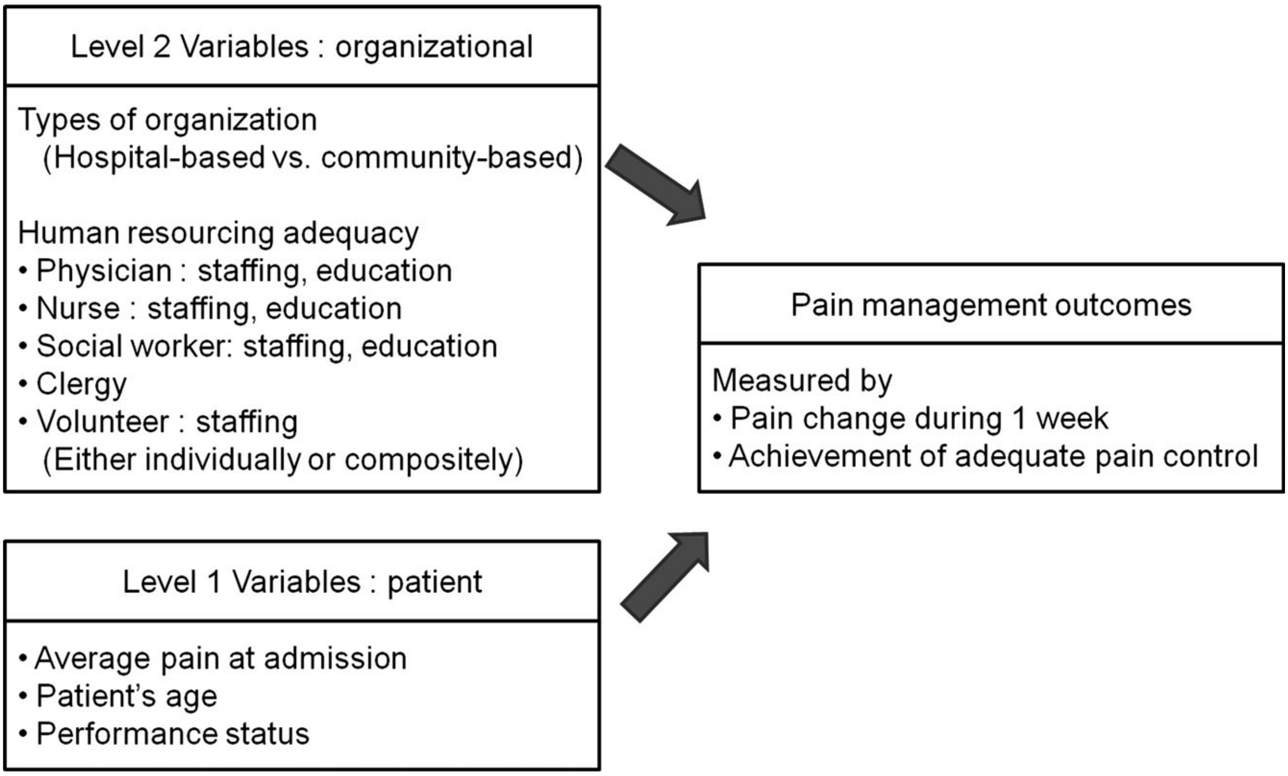

Figure 1. The multilevel framework of the study is illustrated.

treated as a separate variable (Model 3-1); then, a composite score for the "adequacy of human resources" was treated as a single variable (Model 3-2). Independent variables that were included in the multivariate analysis were selected based on a literature review,[8,15,16,22-24] expert opinion, and statistical significance from the bivariate analyses. Likelihood ratio tests were performed to examine model fits. We examined possible colinearity by determining the correlations between independent variables, but the correlations were low.

A 5% level of significance was used for statistical tests. STATA software (version 11.0; STATA Corp., Houston, Tex) was used for statistical computing, and maximum-likelihood estimation using adaptive quadrature was implemented. We used the "xtmemixed" and "xtmelogit" procedures for the analysis of continuous and binary outcomes, respectively.

RESULTS

Organizational and Patient Characteristics

Table 3 lists the characteristics of the enrolled patients and the 34 facilities where they were treated. Twenty-six centers were hospital-based, including 10 public facilities, 3 private nonreligious facilities, and 13 private and religious facilities. All 8 community-based centers were private and religious.

Among 5818 cancer patients who were admitted to palliative care during 2009, 3867 consented to clinical data collection. Average pain at admission could not be assessed in 921 patients because of their poor physical or mental status, 757 patients died within 1 week of admission, and 478 patients could not be assessed for their pain at 1 week after admission because of deterioration or poor physical or mental status. Finally, in total, 1711 patients were included in our analysis (Fig. 2).

The mean age (±standard deviation) of the study patients was 64.7 ± 12.8 years, and 44.7% were women (Table 1). Lung cancer (19.1%) was the most common primary diagnosis followed by cancers of the stomach, colon, pancreas, liver, and other sites. The study patients differed significantly from the excluded patients in average pain at admission ($P = .044$).

Pain Management Outcomes During the First Week After Admission

Table 4 provides the mean pain scores at admission (2.96 ± 1.93) and at 1 week after admission (2.27 ± 1.71). Overall, there was a reduction in pain score of 0.69 ± 1.91. Most patients (1032; 60.3%) remained in the same

Table 2. Evaluation Criteria for "Human Resources Adequacy" and Composite Scores for the 2009 Designation Program

Item	Points
Physician	
Physician employment status	
Having ≥1 full-time physician(s) dedicated to palliative care	3
Having ≥1 part-time physician(s) involved in palliative care in ≥50% of time	1
Others	0
Percentage of physicians with ≥60 h of palliative care training, %	
≥80	2
≥50	1
<50	
Nurse	
Average no. of patients per nurse	
<1.5	3
1.5-2.0	1
≥2.0	0
Percentage of nurses with ≥60 h of palliative care training, %	
≥80	2
≥50	1
<50	0
Having palliative care specialist nurse(s)	
Yes	4
No	0
Social worker	
Having full-time social worker(s)	
Yes	1
No	0
Having social worker(s) with ≥60 h of palliative care training	
Yes	1
No	0
Clergy	
Having clergy dedicated to palliative care center	
Yes	1
No	0
Volunteers	
Average no. of volunteers per 20 beds/d	
≥5	3
≥3	1
<1	0
Total score	
Possible range	0-20

Table 3. Characteristics of Enrolled Patients (n = 1711) and Palliative Care Centers (n = 34)

Characteristic	No. of Patients (%)
Patient characteristics	
Age: Mean±SD, y	64.7±12.8
Women	764 (44.7)
ECOG performance status	
0-2	729 (42.6)
3-4	982 (57.4)
Cancer type	
Lung cancer	326 (19.1)
Gastric cancer	275 (16.1)
Colon cancer	171 (10)
Pancreatic cancer	167 (9.8)
Hepatic cancer	150 (8.8)
Gallbladder cancer	103 (6)
Breast cancer	79 (4.6)
Others	439 (25.7)
Organization characteristics	
External characteristics of the organization	
No. of beds: Mean±SD [range]	16.1±6.9 [8-33]
Type of organization	
Hospital-based, public	10 (29.4)
Hospital-based, private and nonreligious	3 (8.8)
Hospital-based, private and religious	13 (38.2)
Community-based, all private and religious	8 (23.5)
Adequacy of health care staff	
Physician	
Having full-time physician dedicated to palliative care	19 (55.9)
Percentage of physicians with >60 h of palliative care training: Mean±SD	54.5±44.4
Nurse	
Average no. of patients per nurse: Mean±SD	1.15±0.46
Having palliative care specialist nurse(s)	18 (52.9)
Percentage of nurses with >60 h of palliative care training: Mean±SD	50.5±29.3
Social worker	
Having full-time social worker	22 (64.7)
Having social worker with >60 h of palliative care training	22 (64.7)
Clergy	
Having clergy dedicated to the palliative care center	24 (70.6)
Volunteers	
≥5 per 20 beds/d	18 (52.9)
Composite score for adequacy of health care staff: Mean±SD [range]	12.3±3.6 [6-20]

Abbreviations: ECOG, Eastern Cooperative Oncology Group; SD, standard deviation.

pain category at 1 week after admission, about 30% of patients (506; 29.6%) experienced pain reduction, and approximately 10% (173 patients; 10.1%) experienced an increase in pain. Most patients (1417; 82.8%) achieved adequate pain control based on our criteria.

Variations and Predictors of Pain Management Outcomes

Table 5 provides the results from our multilevel analysis, in which reduction in the average pain score was the outcome. Examination of the empty model revealed significant variations in this outcome among palliative care centers (Model 1). Higher pain scores at admission and older age were associated consistently and significantly with greater pain reduction (Models 2 and 3). When individual human resource characteristics were considered separately, none significantly predicted outcome (Model 3-1). When human resource characteristics were

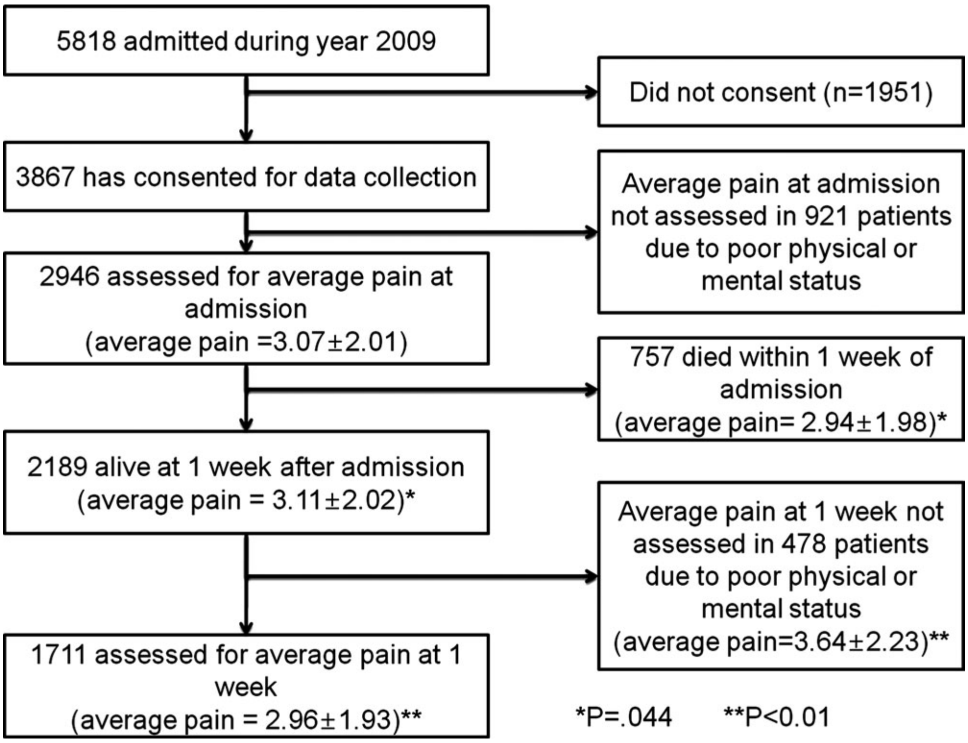

Figure 2. This chart illustrates the flow of study participants. *P* values are for the difference between patients who remained and patients who were excluded.

Table 4. Pain Scores at Admission and 1 Week After Admission

	Pain Score 1 Week After Admission (Mean±SD, 2.27±1.71): No. of Patients				
Pain Score at Admission (Mean±SD, 2.96±1.93)	None (0)	Mild (1-3)	Moderate (4-6)	Severe (7-10)	Total
None (0)	79	48	10	0	137
Mild (1-3)	102	807	85	7	1001
Moderate (4-6)	13	317	127	23	480
Severe (7-10)	6	45	23	19	93
Total	200	1217	245	49	1711

Abbreviations: SD, standard deviation.

considered as a composite score, a higher human resources adequacy score was associated significantly with greater pain reduction (β, 0.11; 95% confidence interval [CI], 0.01-0.21). The addition of the composite score reduced the variance at this level from 1.04 to 0.89 and explained 14.8% of the between-organization variance. However, a large amount of unexplained between-organization variance remained (Model 3-2).

Table 6 provides the results from our multilevel analysis, in which the achievement of adequate pain control was the outcome. Examination of the empty model revealed significant variations in this outcome among palliative care centers (Model 1). Lower pain at admission and old age consistently and significantly predicted the achievement of adequate pain control. When individual human resource characteristics were considered separately, higher nurse case load (adjusted odds ratio [aOR], 0.36; 95% CI, 0.10-1.32) was associated negatively with adequate pain control, whereas the presence of clergy (aOR, 1.94; 95% CI, 0.65-5.80) or sufficient volunteers (aOR, 2.91; 95% CI, 0.97-8.75) had some positive associations (Model 3-1). When human resource characteristics were considered as a composite score, a higher human resources adequacy score was associated significantly with adequate pain control (aOR, 1.26; 95% CI, 1.10-1.45). Between-organization variance was reduced substantially (32.5%) when the composite score was added (Model 3-2), but substantial variance remained.

Table 5. Predictors of Reduction in Average Pain as the Outcome: Results of Mixed-Effect Linear Regression Analyses

	β (95% CI)			
Variable	**Model 1: Empty Model**	**Model 2: Level 1 Variables**	**Model 3-1: Level 1 Variables and Level 2 Individual Variables**	**Model 3-2: Level 1 Variables and Level 2 Composite Score**
Fixed effects				
Intercept	0.65 (0.39, 0.91)	−2.10 (−2.60, −1.60)	−2.44 (−4.30, −0.58)	−3.46 (−4.82, −2.09)
Patient-level variables				
Pain at the time of admission: NRS scale, 0-10		0.71 (0.68, 0.75)[a]	0.71 (0.68, 0.75)[a]	0.71 (0.68, 0.75)[a]
Age		0.01 (0.00, 0.01)[a]	0.01 (0.00, 0.01)[a]	0.01 (0.00, 0.01)[a]
ECOG PS 3-4 vs 0-2		0.01 (−0.14, 0.16)	0.01 (−0.14, 0.16)	0.01 (−0.13, 0.16)
Organization-level variables				
Community-based vs hospital-based			−0.29 (−1.37, 0.80)	0.01 (−0.79, 0.80)
Having vs not having full-time physician dedicated to palliative care			0.10 (−0.54, 0.75)	
Physician who received >60 h palliative care training, %			0.00 (−0.01, 0.01)	
Average no. of patients per nurse, per individual			−0.33 (−1.24, 0.59)	
Having vs not having palliative care specialist nurse			−0.13 (−1.04, 0.78)	
Nurse who received >60 h palliative care training, %			0.00 (−0.01, 0.02)	
Having vs not having full-time social worker			−0.01 (−0.97, 0.95)	
Social worker who received >60 h palliative care training			0.09 (−0.41, 0.60)	
Having clergy dedicated to palliative care center			0.25 (−0.54, 1.03)	
Volunteers: ≥5 vs <5 per 20 beds/d			0.20 (−0.61, 1.00)	
Composite score for adequacy of health care staff: Range, 6-20				0.11 (0.01, 0.21)[a]
Random effects				
Variance: Mean±SE				
Between organizations: Intercept	0.49±0.15	1.04±0.29	1.00±0.28	0.89±0.25
Between patients: Intercept	3.22±0.11	1.64±0.06	1.64±0.06	1.64±.06
Intraclass correlation, %	13.3	38.8	30.5	27
Deviance: Goodness of fit of the model	6920.2	5808.1	5805.8	5803.3
Proportional change in variance by the new model, %				
Between organizations	Reference	−111.6	3.8	14.8
Between patients	Reference	49.1	0	0

Abbreviations: CI, confidence interval; ECOG PS, Eastern Cooperative Oncology Group performance status; NRS, numeric rating scale; SE, standard error.

[a] *P*<.05 (positive coefficients denote greater reduction of average pain).

DISCUSSION

To the best of our knowledge, the current study of Korean patients is the first multilevel analyses of pain management outcomes using prospective, longitudinal data from the national registry. The strengths of this study include the use of a relatively large and nationally representative sample, the use of an established theoretical framework, and the use of appropriate statistical methodologies. Our study has 2 significant results. First, there were significant variations in pain management outcomes among the palliative care centers. Second, some organizational factors, such as human resources adequacy, affect pain management outcomes, suggesting that multidisciplinary composition and interaction among team members are important.

The average pain score was reduced at 1 week after admission to palliative care centers, and most patients achieved adequate pain control, supporting previous studies of the effectiveness of pain control at the end of life.[5,27] Although absolute reduction was not large and many patients remained in the same category, this is meaningful, because pain increases as patients approach death.[4]

Table 6. Predictors of Achieving Adequate Pain Control as the Outcome: Results of Mixed-Effect Logistic Regression Analyses

	aOR (95% CI)			
Variable	**Model 1: Empty Model**	**Model 2: Level 1 Variables**	**Model 3-1: Level 1 Variables and Level 2 Individual Variables**	**Model 3-2: Level 1 Variables and Level 2 Composite Score**
Fixed effects				
Patient-level variables				
Pain at the time of admission: NRS scale, 0-10		0.70 (0.65, 0.77)[a]	0.70 (0.65, 0.76)[a]	0.70 (0.65, 0.76)[a]
Age		1.02 (1.01, 1.03)[a]	1.02 (1.00, 1.03)[a]	1.02 (1.00, 1.03)[a]
ECOG PS 3-4 vs 0-2		0.92 (0.65, 1.31)	0.93 (0.65, 1.32)	0.92 (0.65, 1.32)
Organization-level variables				
Community-based vs hospital-based			1.39 (0.31, 6.26)	1.73 (0.55, 5.42)
Having vs not having full-time physician dedicated to palliative care			0.84 (0.34, 2.09)	
Percentage of physicians who received >60 h of palliative care training		1.00 (0.99, 1.02)		
Average no. of patients per nurse			0.36 (0.10, 1.32)	
Having vs not having palliative care specialist nurse			0.88 (0.25, 3.08)	
Percentage of nurses who received >60 h of palliative care training		1.00 (0.98, 1.02)		
Having vs not having full-time social worker			1.14 (0.30, 4.38)	
Having vs not having a social worker who received >60 h of palliative care training		0.99 (0.49, 1.98)		
Having clergy dedicated to palliative care center			1.94 (0.65, 5.80)	
Volunteers: ≥5 vs <5 per 20 beds/d			2.91 (0.97, 8.75)	
Composite score for adequacy of health care staff: Range, 6-20				1.26 (1.10, 1.45)[a]
Random effects				
Organization-level variance: Mean±SE	2.71±0.87	2.24±0.73	1.65±0.56	1.51±0.51
Intraclass correlation: Latent variable method, %	45.2	40.5	33.3	32.4
Deviance: Goodness of fit of the model	1301.2	1216.2	1208.6	1206.8
Proportional change in variance at different levels, %	Reference	17.7	26.4	32.5

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; ECOG PS, Eastern Cooperative Oncology Group performance status; NRS, numeric raging scale; SE, standard error.

[a] $P<.05$: An OR >1 denotes greater probability of achieving adequate pain control (average pain at 1 week after admission, ≤3).

However, there were significant variations in the pain management outcomes among the palliative care centers, and such variations remained significant after adjusting for possible patient factors that may be associated with outcomes. The presence of these variations indicates that some centers are not as effective as others in managing pain and that they need to improve their pain management. The well known variations in physicians' attitudes and practices about pain may be among the reasons for such variations.[28-33]

Consistent with previous studies, our pain management outcomes depended on average pain at admission[22,34] and patient age.[23,24,34] Higher pain scores at admission were associated positively with the degree of pain reduction in absolute value but were associated negatively with the achievement of adequate pain control. In other words, it is difficult to reduce severe pain to an adequate level, although it can be eliminated a fair amount. Conversely, performance status was not associated significantly with pain management outcomes, contrary to some previous studies.[23,24,34] In addition, in our study, primary cancer site was not predictive of pain management outcomes, probably because cancer patients at the very end of life have a common terminal pathway.[1]

It is noteworthy that some organizational factors, represented by a composite score of human resources adequacy, were associated with pain management outcomes. In addition, lower nurse case load and staffing of social workers and volunteers tended to be associated with better outcomes. It seems logical that sufficient staffing and proper training would be associated with better pain management outcomes. Indeed, the National Quality Forum recognizes the importance of the general structure of care as the first domain of preferred practice and underscores the responsiveness of care provision and adequate training.[35] Similarly, a previous study of the staffing-quality correlation in a nursing home suggested that staffing levels are a proxy for care process and are weakly associated with the quality of care.[8]

It also should be noted that our pain management outcomes were associated with the composite score but not with individual components of human resources adequacy. Similarly, a nursing home study reported only a weak influence of staffing level on quality of care but reported a strong influence when professional staff mix was included.[8] Cancer pain is multidimensional and includes psychosocial and spiritual components,[36] and multidisciplinary pain management is widely accepted as a standard of care.[4,37] Physicians certainly play key roles in pain management, especially in the prescription of opioids. However, nurses also play key roles in pain management, because they are involved in pain assessment, patient education about pain medication, nonpharmacologic management, and management of medication side effects.[38] Social workers often are involved in the psychological and social aspects of pain management and may be in the best position to educate caregivers.[17] Spiritual counselors also may help patients cope with existential pain, and volunteers may help by relieving the sense of social isolation or providing nonpharmacologic relief. Our results are consistent with the multidimensional psychosocial-spiritual model of pain management and highlight the importance of an interdisciplinary approach in the management of cancer pain.[35]

We also note that a significant portion of the variation in pain management outcomes in our study remained largely unexplained, even after controlling for patient-level and organizational-level factors. Despite the statistical significance and the practical implications of our findings, the impact of the organizational characteristics was not large. This suggests that there are other characteristics that we did not consider that may affect pain management outcomes. It is possible that some unknown patient factor(s) may be associated with enrollment at a specific palliative care center and with pain management outcomes. In addition, some unmeasured organizational factors, such as management practice, may influence care processes and staffing decisions.[39]

The seemingly lower pain severity in our study compared with that of other studies was noteworthy.[3] Possible reasons for this include Asians' reluctance to report pain because of cultural influences,[34,40-43] possible selection bias from attrition, and unique practice characteristics of pain management and palliative care referral in Korea.[18]

The current study had limitations. First, there was a large amount of attrition during our observation period, raising some concerns for potential risk of selection bias. This is because of the practice of very late referral to palliative care in Korea,[18] which means that many patients who enter palliative care become unable to provide a pain score because of their altered level of consciousness, dyspnea, or extreme fatigue.[4] Second, this study was based on an administrative database, so we lacked extensive clinical data on pain etiology and treatment. In particular, detailed data on the location of pain, mechanism of pain (cancer itself, treatment, etc), and nature of pain (somatic, visceral, neuropathic) were not collected. In addition, information on opioid type and dose, adjuvant analgesics (antidepressants, anticonvulsants, corticosteroids, etc), and use of additional measures for pain relief (eg, nerve block, radiotherapy) were not collected. However, the focus of our study was not to examine the effect of specific interventions but to examine the variation in pain control among institutions, regardless of the exact measures used at the different care centers. In addition, it is known that nonpharmacologic measures, such as nerve blocks, play only a minor role in patients with end-stage disease,[27] especially in Korea.[13] Third, there may be limitations in the pain outcomes measure that we used. Identification of the most valid indicator of pain outcomes and determining when these measures should be obtained are critical but unsolved issues for the determination of pain management outcomes.[7] Finally, we could only examine the association between structural components and outcomes, and we lacked data on the pain management process, especially the interdisciplinary collaboration. Further study is needed to examine the association of the pain management process and outcomes to further elucidate how organizational characteristics affect pain management outcomes.

Despite the above-mentioned limitations, our study has several important implications. From a clinical perspective, our results indicate the importance of a multidisciplinary approach in the management of pain for patients with end-stage cancer. From the public health and research perspectives, we believe that more research is needed to identify organizational factors that affect pain management outcomes. Measures should be taken to reduce organizational factors that are associated with inadequate pain management.

FUNDING SOURCES

This work was supported by a grant from the National Research and Development Program for Cancer Control (0920350) and received administrative support from the Korean Ministry of Health and Welfare.

CONFLICT OF INTEREST DISCLOSURES

The authors made no disclosures.

REFERENCES

1. Vainio A, Auvinen A. Prevalence of symptoms among patients with advanced cancer: an international collaborative study. Symptom Prevalence Group. *J Pain Symptom Manage*. 1996;12:3-10.
2. Portenoy RK. Cancer pain. Epidemiology and syndromes. *Cancer*. 1989;63(11 suppl):2298-2307.
3. van den Beuken-van Everdingen MH, de Rijke JM, Kessels AG, Schouten HC, van Kleef M, Patijn J. Prevalence of pain in patients with cancer: a systematic review of the past 40 years. *Ann Oncol*. 2007;18:1437-1449.
4. Peng WL, Wu GJ, Sun WZ, Chen JC, Huang AT. Multidisciplinary management of cancer pain: a longitudinal retrospective study on a cohort of end-stage cancer patients. *J Pain Symptom Manage*. 2006;32:444-452.
5. Zech DF, Grond S, Lynch J, Hertel D, Lehmann KA. Validation of World Health Organization guidelines for cancer pain relief: a 10-year prospective study. *Pain*. 1995;63:65-76.
6. Deandrea S, Montanari M, Moja L, Apolone G. Prevalence of under treatment in cancer pain. A review of published literature. *Ann Oncol*. 2008;19:1985-1991.
7. Hester NO, Miller KL, Foster RL, Vojir CP. Symptom management outcomes. Do they reflect variations in care delivery systems? *Med Care*. 1997;35(11 suppl):NS69-NS83.
8. Castle NG, Engberg J. Further examination of the influence of caregiver staffing levels on nursing home quality. *Gerontologist*. 2008;48:464-476.
9. Hsieh RK. Pain control in Taiwanese patients with cancer: a multicenter, patient-oriented survey. *J Formos Med Assoc*. 2005;104:913-919.
10. Brook RH, McGlynn EA, Shekelle PG. Defining and measuring quality of care: a perspective from US researchers. *Int J Qual Health Care*. 2000;12:281-295.
11. Ministry of Health and Welfare. Cancer Control 2015: The Second Term Cancer Control Plan in Korea. Seoul, Korea: Ministry of Health and Welfare; 2005.
12. National Cancer Center. The Korean Standard of Hospice and Palliative Care. Goyang, Korea: National Cancer Center; 2003.
13. Shin DW, Choi JY, Nam BH, et al. The current status of utilization of palliative care units in Korea: 6 month results of 2009 Korean Terminal Cancer Patient Information System. *Korean J Hosp Palliat Care*. 2010;13:181-189.
14. Ministry of Health and Welfare. Cancer Pain Management Guideline. 4th ed. Seoul, Korea: Ministry of Health and Welfare; 2010.
15. Chassany O, Boureau F, Liard F, et al. Effects of training on general practitioners' management of pain in osteoarthritis: a randomized multicenter study. *J Rheumatol*. 2006;33:1827-1834.
16. Leong L, Ninnis J, Slatkin N, et al. Evaluating the impact of pain management (PM) education on physician practice patterns—a continuing medical education (CME) outcomes study. *J Cancer Educ*. 2010;25:224-228.
17. Oliver DP, Wittenberg-Lyles E, Washington K, Sehrawat S. Social work role in pain management with hospice caregivers: a national survey. *J Soc Work End Life Palliat Care*. 2009;5:61.
18. Baek YJ, Shin DW, Choi JY, et al. Late referral to palliative care services in Korea. *J Pain Symptom Manage*. 2011;41:692-699.
19. Pasman HR, Brandt HE, Deliens L, Francke AL. Quality indicators for palliative care: a systematic review. *J Pain Symptom Manage*. 2009;38:145-156.
20. Apolone G, Bertetto O, Caraceni A, et al. Pain in cancer. An outcome research project to evaluate the epidemiology, the quality and the effects of pain treatment in cancer patients [serial online]. *Health Qual Life Outcomes*. 2006;4:7.
21. Nelson JE, Mulkerin CM, Adams LL, Pronovost PJ. Improving comfort and communication in the ICU: a practical new tool for palliative care performance measurement and feedback. *Qual Saf Health Care*. 2006;15:264-271.
22. Fainsinger RL, Fairchild A, Nekolaichuk C, Lawlor P, Lowe S, Hanson J. Is pain intensity a predictor of the complexity of cancer pain management? *J Clin Oncol*. 2009;27:585-590.
23. Cleeland CS, Gonin R, Hatfield AK, et al. Pain and its treatment in outpatients with metastatic cancer. *N Engl J Med*. 1994;330:592-596.
24. Larue F, Colleau SM, Brasseur L, Cleeland CS. Multicentre study of cancer pain and its treatment in France. *BMJ*. 1995;310:1034-1037.
25. Kang J, Koh SJ, Yoo YS, et al. Development of the standard hospice and palliative care education program in Korea: results from the demonstration project. *J Palliat Med*. 2010;13:703-710.
26. Pornet C, Dejardin O, Morlais F, Bouvier V, Launoy G. Socioeconomic determinants for compliance to colorectal cancer screening. A multilevel analysis. *J Epidemiol Commun Health*. 2010;64:318-324.
27. Grond S, Zech D, Schug SA, Lynch J, Lehmann KA. Validation of World Health Organization guidelines for cancer pain relief during the last days and hours of life. *J Pain Symptom Manage*. 1991;6:411-422.
28. Cleeland CS, Cleeland LM, Dar R, Rinehardt LC. Factors influencing physician management of cancer pain. *Cancer*. 1986;58:796-800.
29. Von Roenn JH, Cleeland CS, Gonin R, Hatfield AK, Pandya KJ. Physician attitudes and practice in cancer pain management. A survey from the Eastern Cooperative Oncology Group. *Ann Intern Med*. 1993;119:121-126.
30. Wolfert MZ, Gilson AM, Dahl JL, Cleary JF. Opioid analgesics for pain control: Wisconsin physicians' knowledge, beliefs, attitudes, and prescribing practices. *Pain Med*. 2010;11:425-434.
31. Barni S, Maltoni M, Tuveri G, et al. Attitude of Italian medical oncologists toward palliative care for patients with advanced cancer: results of the SIO Project. *Support Care Cancer*. 2011;19:381-389.
32. Larochelle MR, Rodriguez KL, Arnold RM, Barnato AE. Hospital staff attributions of the causes of physician variation in end-of-life treatment intensity. *Palliat Med*. 2009;23:460-470.
33. Zerzan J, Benton K, Linnebur S, O'Bryant C, Kutner J. Variation in pain medication use in end-of-life care. *J Palliat Med*. 2010;13:501-504.
34. Bell CL, Kuriya M, Fischberg D. Pain outcomes of inpatient pain and palliative care consultations: differences by race and diagnosis. *J Palliat Med*. 2011;14:1142-1148.
35. Ferrell B, Paice J, Koczywas M. New standards and implications for improving the quality of supportive oncology practice. *J Clin Oncol*. 2008;26:3824-3831.
36. Otis-Green S, Sherman R, Perez M, Baird RP. An integrated psychosocial-spiritual model for cancer pain management. *Cancer Pract*. 2002;10(suppl 1):S58-S65.
37. Jacox A, Carr DB, Payne R. New clinical-practice guidelines for the management of pain in patients with cancer. *N Engl J Med*. 1994;330:651-655.
38. Terry RH. The Nurse's Role in Pain Management. Available at: https://medical.wesrch.com/User_images/Pdf/MS1_1225761426.pdf. Accessed December 5, 2010.
39. Anderson RA, Issel LM, McDaniel RR Jr. Nursing homes as complex adaptive systems: relationship between management practice and resident outcomes. *Nurs Res*. 2003;52:12-21.
40. Chen CH, Tang ST. Meta-analysis of cultural differences in Western and Asian patient-perceived barriers to managing cancer pain [published online ahead of print April 7, 2011]. *Palliat Med*. 2011.
41. Lo RS, Ding A, Chung TK, Woo J. Prospective study of symptom control in 133 cases of palliative care inpatients in Shatin Hospital. *Palliat Med*. 1999;13:335-340.
42. Sze FK, Chung TK, Wong E, Lam KK, Lo R, Woo J. Pain in Chinese cancer patients under palliative care. *Palliat Med*. 1998;12: 271-277.
43. Lee SC. Management of cancer pain in Korea. *Eur J Pain*. 2007; 8(suppl 1):6-9.