*Brief Report*

# Latent Class Analysis of Specialized Palliative Care Needs in Adult Intensive Care Units From a Single Academic Medical Center

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## Abstract

**Context.** In the intensive care unit (ICU), 14% of patients meet criteria for specialized palliative care, but whether subgroups of patients differ in their palliative care needs is unknown.

**Objectives.** The objective of this study was to use latent class analysis to separate ICU patients into different classes of palliative care needs and determine if such classes differ in their palliative care resource requirements.

**Methods.** We conducted a retrospective cohort study of ICU patients who received specialized palliative care, August 2013 to August 2015. Reason(s) for consultation were extracted from the initial note and entered into a latent class analysis model to generate mutually exclusive patient classes. Differences in "high use" of palliative care (defined as having five or more palliative care visits) between classes were assessed using logistic regression, adjusting for age, race, Charlson Comorbidity Index, and length of stay.

**Results.** In a sample of 689 patients, a four-class model provided the most meaningful groupings: 1) Pain and Symptom Management ($n = 218$, 31.6%), 2) Goals of Care and Advance Directives (GCAD) ($n = 131$, 19.0%), 3) All Needs ($n = 112$, 16.3%), and 4) Supportive Care ($n = 228$, 33.1%). In comparison to GCAD patients, all other classes were more likely to require "high use" of palliative care (adjusted odds ratio [aOR] 2.61 [1.41–4.83] for "All Needs," aOR 2.01 [1.16–3.50] for "Pain and Symptom Management," aOR 1.94 [1.12–3.34] for "Supportive Care").

**Conclusion.** Based on the initial reason for consultation, we identified four classes of palliative care needs among critically ill patients, and GCAD patients were least likely to be high utilizers. These findings may help inform allocation of palliative care resources for this population. J Pain Symptom Manage 2019;57:73–78. © *2018 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.*

***Key Words***

*Palliative care, critical illness, intensive care units, pain management, advance directives, referral and consultation*

In the intensive care unit (ICU), approximately 14% of patients meet criteria for palliative care consultation or specialized palliative care.[1] In this setting, palliative care consults may focus on several different aspects of patient care, ranging from symptom management to goals of care discussions.[2] Although the importance of incorporating specialized palliative care in the ICU has been acknowledged,[3] the critically ill population is heterogeneous with regards to severity of illness, likelihood of survival, and the impact of the acute episode of illness on a patient's overall trajectory of care.[4–6] Given this heterogeneity, patients may also differ in their palliative care needs. Although there is evidence that survivors of critical illness may go on to have different subtypes of symptom burden,[7] and that patients in outpatient palliative care settings may be

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classified into different subtypes of illness burden,[8] data on whether and how patients differ in their palliative care needs during an acute episode of critical illness, and whether particular palliative care needs require more or less involvement of specialists, is lacking. Such information may help to clarify the burden of palliative care needs in critically ill patients and inform allocation of specialized palliative care resources given the existing shortage of palliative care—trained physicians in the U.S.[9] Thus, the primary aim of this study was to use latent class analysis (LCA) to evaluate whether patients from a variety of ICU settings can be separated into different classes of palliative care needs and to determine whether such classes are associated with differences in resource requirements and outcomes.

## Methods

### Data Collection

We conducted a retrospective cohort study of all adult (age ≥ 18) ICU patients in a single academic medical center (including medical, cardiac, surgical, cardiothoracic, and neurological ICUs) that received specialized palliative care from August 2013 to August 2015. The study protocol was reviewed and approved by Columbia University Medical Center (IRB-AAAP2112, New York, NY). Written informed consent was waived. Data for this retrospective study came from the Clinical Data Warehouse, a repository of electronic medical records, at Columbia University Medical Center in New York, NY. We obtained demographic and clinical variables from the medical record, and we obtained information about palliative care consultation directly from palliative care notes written in the medical record. Within the initial consultation note, the "reason for consultation" is a nonmutually exclusive check box field. The reason for consultation is documented in every initial consultation note, multiple reasons may be enumerated, and the field must be completed to finalize the note. The palliative care provider fills out this information based on the reason for consult, as specified by the primary team. We determined patients' palliative care needs on initial consultation based on which reasons were specified in this field. The nine reasons for initial palliative care consultation included symptom management (e.g., delirium, anxiety, dyspnea), pain management, goals of care, prognostication, withdrawal of life-sustaining therapy, discharge planning (for dispositions other than hospice), advance directives, hospice referral, and supportive care. More than one reason and up to nine reasons could be chosen for each consultation.

### Statistical Analysis

LCA is a statistical method that may be used to define subgroups of patients (latent classes) using observed variables[10]; this technique has been previously used to identify clinical phenotypes of palliative care in patients with cancer.[11,12] In this study, the observed variables were the initial reason(s) for palliative care consultation. For these variables, no data were missing, resulting in inclusion of all eligible patients into the model. These nine reasons were entered into a series of LCA models specifying increasing numbers of latent classes (two to seven classes) to generate mutually exclusive classes of patients. Models were then compared for relative fit using three information criteria: Akaike (AIC), Bayesian (BIC), and sample-size-adjusted BIC (SABIC).[13] A variety of fit indices can be used as criteria for model selection with most studies evaluating multiple indices; however, SABIC has been found to be the most accurate and consistent of the information criterion tests.[14,15] Selection of the number of latent classes in the final model relied on minimizing the value of the information criteria, as well as interpretability of the model.

After the selection of the final model, each patient was assigned to the specific class for which they had the highest probability of belonging (the posterior probability). After this assignment, the frequency of each palliative care need at the time of initial consultation was assessed for patients in each class. Based on the prevalence of particular needs in each class (in relation to their prevalence in the overall study population), classes were given a descriptive name (e.g., "All Needs"). We then examined differences in demographic (age, gender, race) clinical characteristics (Charlson Comorbidity Index, time to palliative care consultation, primary diagnosis, code status at the time of initial consultation) and outcomes (hospital length of stay, death in hospital, and hospital discharge location) of patients in each latent class using appropriate bivariate testing. We also examined whether patients in specific latent classes required "high use" of palliative care (defined as having five or more visits by the palliative care team, which represented the highest quartile of palliative care use) using logistic regression, before and after adjustment for a priori selected confounders (age, race, Charlson Comorbidity Index, and hospital length of stay). To further characterize palliative care involvement, we determined the number of visits by different members of the palliative care team (medical doctors [MDs] and nurse practitioners [NPs], social workers and chaplains) and analyzed differences in the number of visits by clinician type using negative binomial and zero-inflated negative binomial regression, adjusting for overall number of visits and hospital length of stay. Database management and analysis were conducted using Stata 13.1 (Statacorp LP, College Station, TX) and MPlus 7.1 (Muthén & Muthén, Los Angeles, CA).

## Results

Our study consisted of 689 ICU patients who had a palliative care consultation. Model fit statistics suggested that a five-class model had optimal fit with the lowest SABIC (2-class 4994, 3-class 4970, 4-class 4951, 5-class 4936, 6-class 4936, 7-class 4970); however, the four-class model yielded the most clinically meaningful subgroups. Balancing model fit and interpretability, we ultimately chose the four-class model with the following groups: 1) Pain and Symptom Management ($n$ = 218, 31.6% of the study cohort), 2) Goals of Care and Advance Directives (GCAD) ($n$ = 131, 19.0%), 3) All Needs ($n$ = 112, 16.3%), and 4) Supportive Care ($n$ = 228, 33.1%). The patients in "All Needs" and "Pain and Symptom Management" classes had a higher probability of requiring pain and symptom management which was not seen in the other classes. While goals of care was commonly a reason for consultation in all classes, it was required in nearly all consults in patients in the GCAD and "All Needs" classes. In addition, these two classes had a need for advance directives discussions not seen in the other classes. All patients in the "Supportive Care" class required supportive care; all other needs were uncommon, with the exception of goals of care, which still occurred with less frequency than in other classes. Other less common needs (prognostication, withdrawal of life-sustaining therapy, discharge planning, and hospice referral) were only found in the "All Needs" class of patients (Fig. 1).

There were no significant differences in age, sex, race, or hospital length of stay between classes. However, there were differences in common primary diagnoses between classes, with patients in the "Pain and Symptom Management" class having the highest rate of respiratory failure ($P = 0.04$), patients in the "Supportive Care" class having the highest rate of cardiac arrest ($P = 0.001$) and cancer ($P = 0.005$), and patients in the GCAD class having the highest rate of congestive heart failure ($P < 0.001$). Patients in the GCAD class were less likely to have a do-not-resuscitate status at the time of initial consultation ($P < 0.001$) (Table 1).

Compared to the GCAD class of patients, patients in the "All Needs" class were less likely to be discharged home ($P = 0.005$) (Table 1) and more likely to require "high use" of palliative care (19.1% vs. 35.7%, odds

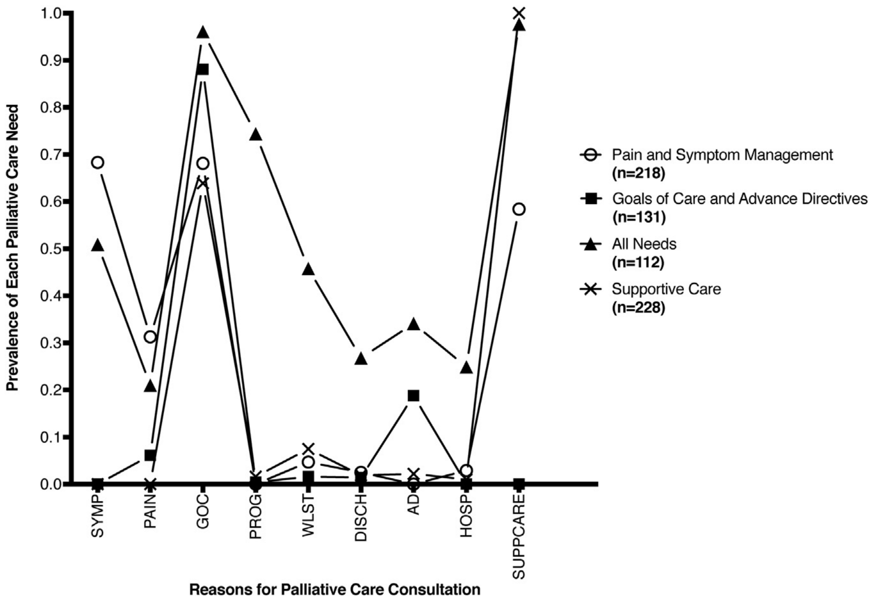

Fig. 1. Proportion of patients within each latent class with individual palliative care needs. Each mark denotes the proportion of patients with a specific palliative care need. Circles denote proportions for patients in the "Pain and Symptom Management" class, squares denote proportions for patients in the "Goals of Care and Advance Directives" class, triangles denote proportions for patients in the "All Needs" class, and X's denote proportions for patients in the "Supportive Care" class. Patients assigned to a given class have a higher prevalence of specific needs in comparison to the prevalence in the overall sample. For example, patients in the "Pain and Symptom Management" class had a higher prevalence of pain and symptom management in comparison to patients in other classes. AD = advance directives; DISCH = discharge planning; GOC = goals of care; HOSP = hospice referral; PAIN = pain management; PROG = prognosis; SUPPCARE = supportive care; SYMP = symptom management; WLST = withdrawal of life-sustaining therapy.

*Table 1*

**Characteristics of Intensive Care Unit Admissions Who Received a Palliative Care Consultation, Stratified by Latent Class Membership**

| Characteristic | All ($N = 689$) | Class 1 Pain and Symptom Management ($n = 218$) | Class 2 Goals of Care and Advance Directives ($n = 131$) | Class 3 All Needs ($n = 112$) | Class 4 Supportive Care ($n = 228$) | *P*-value |
|---|---|---|---|---|---|---|
| Age, mean (SD)[a] | 66.0 (15.9) | 67.1 (16.1) | 65.4 (13.8) | 67.3 (15.4) | 64.6 (16.8) | 0.38 |
| Male, %[b] | 63.3 | 64.7 | 64.9 | 52.7 | 66.2 | 0.09 |
| Race, %[b,c] | | | | | | 0.21 |
| Caucasian | 39.5 | 41.3 | 40.5 | 37.5 | 38.2 | |
| African-American | 11.2 | 10.6 | 17.6 | 7.1 | 10.1 | |
| Asian/other | 18.7 | 19.3 | 13.7 | 17.9 | 21.5 | |
| Unknown | 30.6 | 28.9 | 28.2 | 37.5 | 30.3 | |
| Charlson Comorbidity Index, %[b] | | | | | | 0.03 |
| 0 | 27.0 | 24.3 | 19.9 | 35.7 | 29.4 | |
| 1–2 | 47.3 | 46.8 | 50.4 | 38.4 | 50.4 | |
| ≥3 | 25.7 | 28.9 | 30.0 | 25.9 | 20.2 | |
| Primary diagnosis, %[b] | | | | | | |
| Congestive heart failure or cardiogenic shock | 18.4 | 14.2 | 35.1 | 12.5 | 15.8 | <0.001 |
| Respiratory failure | 8.1 | 11.9 | 3.8 | 5.4 | 8.3 | 0.04 |
| Cardiac arrest | 3.2 | 0.5 | 1.5 | 3.6 | 6.6 | 0.001 |
| Cancer | 13.8 | 9.6 | 13.7 | 8.9 | 20.2 | 0.005 |
| DNR at the time of initial consultation, %[b] | 34.4 | 39.0 | 19.1 | 48.2 | 32.0 | <0.001 |
| Median time from ICU admission to consultation, days (IQR)[d] | 4 (2–9) | 4 (2–9) | 5 (2–9) | 5 (1–10.5) | 4.5 (1.5–10) | 0.63 |
| Median time from hospital admission to consultation, days (IQR)[d] | 9 (4–17) | 9 (4–17) | 8 (4–16) | 10 (4–21) | 8 (4–17) | 0.66 |
| Hospital length of stay, days (IQR)[d] | 20 (11–36) | 18 (10–34) | 23 (12–40) | 20 (10–33) | 20.5 (11.5–38) | 0.18 |
| Discharge destination, %[b,c] | | | | | | 0.005 |
| Died in hospital | 53.1 | 51.9 | 45.3 | 56.3 | 57.1 | |
| Home | 24.1 | 24.3 | 37.5 | 17.9 | 19.5 | |
| SNF | 11.9 | 10.8 | 6.3 | 17.0 | 13.7 | |
| Rehabilitation facility | 1.3 | 0.9 | 1.6 | 1.8 | 1.3 | |
| Other care facility | 6.5 | 6.1 | 7.8 | 6.3 | 6.2 | |
| Hospice | 3.1 | 6.1 | 1.6 | 0.9 | 2.2 | |

DNR = do-not-resuscitate; ICU = intensive care unit; IQR = interquartile range; SNF = skilled nursing facility.

[a] Results of simple linear regression.

[b] Results of Pearson's chi-squared or Fisher's exact test.

[c] For race, data were missing or unknown for 30.6% of patients. For discharge destination, data were missing for 1.3% of patients. Data were not missing for any other listed variables.

[d] Results of Kruskal-Wallis test.

ratio [OR] 2.36, 95% CI [1.32–4.22], $P = 0.03$). This difference persisted after adjustment for selected confounders; compared to GCAD patients, all other classes were more likely to require "high use" of palliative care (adjusted odds ratio [aOR] 2.61 [1.41–4.83], $P = 0.002$ for "All Needs," aOR 2.02 [1.16–3.50], $P = 0.01$ for "Pain and Symptom Management," aOR 1.94 [1.12–3.34], $P = 0.02$ for "Supportive Care") (Table 2).

We also observed differences in the number of visits by different types of palliative care clinicians between classes. In comparison to patients in the GCAD class, patients in the "Supportive Care" class were significantly more likely to have visits from the palliative care social workers (aOR 1.40 [1.10–1.79], $P = 0.007$) and less likely to have visits from MDs/NPs (aOR 0.79 [0.66–0.95], $P = 0.01$). Patients in this class were also more likely to have visits from the palliative care chaplain, although this finding did not reach statistical significance (aOR 2.29 [0.99–5.28], $P = 0.052$). Patients in the "All Needs" class had a significantly higher number of MD/NP visits in comparison to patients in the GCAD class (aOR 1.31 [1.08–1.60], $P = 0.007$), whereas patients in the "Pain and Symptom Management" class did not significantly differ from patients in the GCAD class for any type of clinician visit (Table 3).

Given that the SABIC model fit indices suggested that a five-class model would have been optimal, we also examined the association of this model with high use of palliative care. The five-class model yielded similar groupings to the four-class model, but separated "Goals of Care" and "Advance Directives" into two classes, with the "Advance Directives" class representing only 3.5% of the overall cohort ($n = 24$). When we examined differences in high use of palliative care using the five-class model, patients in the "Advance Directives" class were not significantly different than the "Goals of Care" class with regard to high use of palliative care, and results for other

*Table 2*
**Association Between Latent Class Membership and High Use of Specialized Palliative Care**

| | Crude (OR [95% CI]) | *P*-value | Adjusted[a] (aOR [95% CI]) | *P*-value |
|---|---|---|---|---|
| Goals of Care and Advance Directives | Ref | — | Ref | — |
| Pain and Symptom Management | 1.76 [1.04–2.98] | 0.03 | 2.02 [1.16–3.50] | 0.01 |
| All Needs | 2.36 [1.32–4.22] | 0.004 | 2.61 [1.41–4.83] | 0.002 |
| Supportive Care | 1.88 [1.12–3.16] | 0.02 | 1.94 [1.12–3.34] | 0.02 |

OR = odds ratio; aOR = adjusted odds ratio; Ref = reference.

[a] Adjusted for age, race, Charlson Comorbidity Index, and hospital length of stay. For the race variable, "missing" was a separate category, resulting in inclusion of all patients in the analysis.

groups were qualitatively unchanged with all other groups being more likely to require high use of palliative care.

## *Discussion*

Based on the initial reason for consultation, we identified four different latent classes of palliative care needs among critically ill patients. The GCAD class of patients were least likely to be high utilizers of specialized palliative care and most likely to be discharged home. Not surprisingly, the "All Needs" class of patients were most likely to be high utilizers of specialized palliative care and least likely to be discharged home. We also observed differences in the number of visits by different members of the palliative care team between classes. These data demonstrate that palliative care needs among critically ill patients are heterogeneous and suggest that the intensity of specialized palliative care involvement may differ among patients based on their initial palliative care needs.

Although specialized palliative care referral may be requested for multiple reasons,[2] thus far, there has been no differentiation of palliative care phenotypes, and of how such phenotypes may relate to resource utilization. Currently, referrals from the ICU account for approximately a quarter of U.S. adult palliative care teams' consult volume.[16] Identifying which patients are likely to be high versus low utilizers of specialized palliative care may aid hospitals and palliative care teams in understanding staffing requirements to meet patient needs in the ICU. Furthermore, despite the shortage of palliative care–trained physicians[9] and urgent calls for generalists to deliver basic palliative care to offload specialist teams,[17] there have been scant data to help differentiate which critically ill patients may benefit most from involvement of specialized palliative care. Such differentiation becomes even more pressing given increasing evidence of the benefit of specialized palliative care for other patient populations[18,19] and of generalist palliative care interventions in the ICU.[20,21]

Limitations of our study include the fact that palliative care needs were defined based only on the initial consultation note; as in a previous study, patients were found to develop additional needs on follow-up consultation.[2] In addition, we only included patients who received a palliative care consultation in this study; other critically ill patients may have had specialist-level palliative care needs that were not referred. We also did not examine differences in non-ICU patients requiring palliative care consultation, and our results may not translate to this population. In examining differences in palliative care use between classes, the possibility of residual confounding still exists despite our adjusted analyses. Finally, the data come from a single center (likely with particular referral patterns) which may limit generalizability.

Using latent class analysis, we were able to identify clinically meaningful classes of palliative care needs among critically ill patients that were associated with differences in utilization of specialized palliative care. Future work should be directed toward understanding which critically ill patients benefit most from involvement of specialized palliative care, so that we may appropriately target this scarce and valuable resource.

*Table 3*
**Association Between Latent Class Membership and Number of Visits by Type of Palliative Care Clinician**

| | MD/NP[a] (aOR [95% CI]) | *P*-value | Social Worker[b] (aOR [95% CI]) | *P*-value | Chaplain[b] (aOR [95% CI]) | *P*-value |
|---|---|---|---|---|---|---|
| Goals of Care and Advance Directives | Ref | — | Ref | — | Ref | — |
| Pain and Symptom Management | 1.10 [0.92–1.31] | 0.31 | 1.00 [0.77–1.30] | 1.00 | 1.69 [0.72–4.00] | 0.23 |
| All Needs | 1.31 [1.08–1.60] | 0.007 | 1.06 [0.79–1.42] | 0.71 | 0.91 [0.34–2.42] | 0.85 |
| Supportive Care | 0.79 [0.66–0.95] | 0.01 | 1.40 [1.10–1.79] | 0.007 | 2.29 [0.99–5.28] | 0.052 |

MD = medical doctor; NP = nurse practitioner; aOR = adjusted odds ratio; Ref = reference.

[a] Results of negative binomial regression, adjusted for overall number of visits and hospital length of stay.

[b] Results of zero-inflated negative binomial regression, adjusted for overall number of visits and hospital length of stay.

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