

Health Care Use by Older Adults With Acute Myeloid Leukemia at the End of Life

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A B S T R A C T

Purpose

Little is known about the patterns and predictors of the use of end-of-life health care among patients with acute myeloid leukemia (AML). End-of-life care is particularly relevant for older adults with AML because of their poor prognosis.

Methods

We performed a population-based, retrospective cohort study of patients with AML who were ≥ 66 years of age at diagnosis and diagnosed during the period from 1999 to 2011 and died before December 31, 2012. Medicare claims were used to assess patterns of hospice care and use of aggressive treatment. Predictors of these end points were evaluated using multivariable logistic regression analyses.

Results

In the overall cohort (N = 13,156), hospice care after AML diagnosis increased from 31.3% in 1999 to 56.4% in 2012, but the increase was primarily driven by late hospice enrollment that occurred in the last 7 days of life. Among the 5,847 patients who enrolled in hospice, 47.4% and 28.8% started their first hospice enrollment in the last 7 and 3 days of life, respectively. Among patients who transferred in and out of hospice care, 62% received transfusions outside hospice. Additionally, the use of chemotherapy within the last 14 days of life increased from 7.7% in 1999 to 18.8% in 2012. Patients who were male and nonwhite were less likely to enroll in hospice and more likely to receive chemotherapy or be admitted to intensive care units at the end of life. Conversely, older patients were less likely to receive chemotherapy or have intensive care unit admission at the end of life, and were more likely to enroll in hospice.

Conclusion

End-of-life care for older patients with AML is suboptimal. Additional research is warranted to identify reasons for their low use of hospice services and strategies to enhance end-of-life care for these patients.

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INTRODUCTION

The prognosis of older patients with acute myeloid leukemia (AML) is poor and has remained unchanged over the past several decades.¹ The median survival for patients with AML ≥ 65 years of age is approximately 2 months and worsens with advancing age to as low as 1 month for patients ≥ 85 years of age.²⁻⁵ Hence, end-of-life care is particularly relevant for this patient population.

Adequate use of hospice care and cautious use of intensive treatment have been proposed and well established as core measures for quality of end-of-life care among patients with cancer.⁶⁻⁸

Although these measures are accepted by most hematologists,⁹ patients with hematologic malignancies often underuse hospice and receive more end-of-life intensive care.¹⁰⁻¹⁵ Patients with hematologic malignancies face special challenges in choosing end-of-life care, such as the need for transfusion among patients with AML, which typically is not provided in the hospice setting.¹⁶

Fragmented end-of-life care may impose an additional burden on patients and their families. For instance, transitions in and out of hospice care are not a rare phenomenon with 8.8% of hospice users in Medicare disenrolled in the last 6 months of life,¹⁷ and 6.6% of hospice users having more than one transition in care after

ASSOCIATED CONTENT



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hospice enrollment.¹⁸ Of hospice users with transitions, 53.4% were admitted to hospitals.¹⁸ However, little is known about hospice transitions in patients with AML.

El-Jawahri et al¹² recently published an intriguing study assessing health care use among older patients with AML treated at two tertiary cancer hospitals. They found that 23.1% of patients were admitted to hospice and only 11.3% stayed in hospice for > 7 days.¹² In contrast, 84.5% of patients were hospitalized within 30 days of death and 61% died in the hospital.¹² These findings inspired us to evaluate the patterns of end-of-life care in a larger, population-based cohort of patients with AML, because hematologic oncologists at tertiary care centers may differ substantially from providers in community settings in their practice of end-of-life discussions with patients who have hematologic malignancies.¹⁹ In addition, by constructing a retrospective cohort of > 13,000 older patients with AML nationwide, we extended the current literature by comprehensively assessing the patterns, trends, and factors associated with their end-of-life health care use, specifically hospice enrollment and use of aggressive treatments.

METHODS

Data Source

We used the Surveillance, Epidemiology, and End Results (SEER) Medicare linked database to assemble a population-based cohort of older adults with AML. The SEER registries account for approximately 28% of the US population.^{20,21} The SEER-Medicare database links patient-level information on incident cancer diagnoses reported to the SEER registries with a master file of Medicare enrollment and claims for inpatient, outpatient, and physician services.²² The Yale human investigation committee determined this study did not directly involve human subjects.

Study Population

Patients included in our study fulfilled the following eligibility criteria: diagnosed with AML between 1999 and 2011 at ≥ 66 years of age; had known month of diagnosis; was not reported from autopsy or death certificate only; died before December 31, 2012; had continuous Medicare fee-for-service coverage (parts A and B) and were not enrolled in health maintenance organizations from 12 months before diagnosis through death; and had information on type of residential area (urban/rural) and census tract.

Outcomes Measures

We focused on three well-established quality measures of end-of-life care in oncology that can be assessed through claims: hospice enrollment, intensive care unit (ICU) admission, and chemotherapy administration. Hospice enrollment was considered an indicator of appropriate end-of-life care, whereas ICU admission and chemotherapy were indicators of potentially aggressive end-of-life care. For this analysis, we defined late hospice enrollment as one that occurred within the last 7 days of life and aggressive treatment as ICU admission within the last 30 days of life, chemotherapy within the last 14 days of life, or both.

Covariates

We used Medicare claims to identify treatments for AML, including chemotherapy and transfusion. We examined patient characteristics that might influence hospice enrollment and end-of-life health care use, including age at death, sex, race, marital status, comorbidity, state buy-in status within 12 months before death (ie, state payment of part or all of the patient's Medicare Part B premium or the patient is in the Medicaid

program), type of residential area (big metropolitan, metropolitan or urban, less urban or rural), SEER region (Northeast, Midwest, South, or West), median household income at the census-tract level (in quintiles), and year of death (1999 to 2003, 2004 to 2007, or 2008 to 2012). We used inpatient, outpatient, and carrier claims within 12 months before death to calculate a modified Elixhauser comorbidity score.^{23,24} Census-tract level median household income and state buy-in status were used as proxies for neighborhood- and individual-level socioeconomic status, respectively.

Statistical Analysis

Frequencies and percentages were used to describe health care use at the end of life for all patients with AML. Pearson's χ^2 tests were used to compare patterns of use between patients with different characteristics. Locally weighted scatterplot smoothing regression was used to evaluate the prevalence of hospice enrollment and end-of-life aggressive treatment by year. The Cochran-Armitage test was used to test for trend over time.

Table 1. Characteristics of Older Patients Diagnosed With Acute Myeloid Leukemia Between 1999 to 2011 and Who Died During the Period 1999 to 2012 (N = 13,156)

Characteristic	No.	%
Age at death, years		
66-69	1,335	10.2
70-74	2,624	19.9
75-79	3,273	24.9
80-84	3,080	23.4
≥ 85	2,844	21.6
Sex		
Female	6,005	45.6
Male	7,151	54.4
Race		
White	11,780	89.5
Nonwhite	1,376	10.5
Marital status		
Unmarried	5,425	41.2
Married	7,065	53.7
Unknown	666	5.1
Elixhauser comorbidity score before death		
0-1	4,818	36.6
2-3	4,132	31.4
≥ 4	4,206	32.0
Transfusion within last 30 days of life		
No	6,463	49.1
Yes	6,693	50.9
State buy-in status		
No	11,361	86.4
Yes	1,795	13.6
Place of residence		
Big metropolitan	7,169	54.5
Metropolitan/urban	4,538	34.5
Less urban/rural	1,449	11.0
Region		
Northeast	2,648	20.1
Midwest	2,021	15.4
South	2,975	22.6
West	5,512	41.9
Census tract median income, quintile		
First	2,780	21.1
Second	1,986	15.1
Third	2,711	20.6
Fourth	2,570	19.5
Fifth	3,109	23.6
Year of death		
1999-2003	4,149	31.5
2004-2007	4,173	31.7
2008-2012	4,834	36.7

Multivariable logistic regression models were used to identify factors associated with hospice enrollment and use of aggressive end-of-life treatment. In addition, among patients who enrolled in hospice, we assessed factors associated with late enrollment. All significance tests were two sided with an α -level of .05. All analyses were conducted using SAS (version 9.4; SAS Institute, Cary, NC).

RESULTS

Sample Characteristics

Our study population included 13,156 patients with AML. Most were white, and more than half were male, married, and resided in big metropolitan areas (Table 1). Median survival was 2.4 months (interquartile range, 1.12-7.16 months). Among the 13,156 patients, 5,847 (44.4%) enrolled in hospice and 5,816 (44.2%) received chemotherapy after their AML diagnosis. A total of 5,662 patients (43.0%) died in hospital and 5,322 (40.5%) died in hospice care.

Hospice Enrollment

Among 5,847 patients who enrolled in hospice at any point between AML diagnosis and death, 47.3% and 28.8% started their first hospice enrollment in the last 7 and 30 days of life, respectively. Although the percentage of patients receiving hospice care increased consistently from 31.3% in 1999 to 56.4% in 2012 (P for trend $< .01$), the increase was mainly due to enrollment that began within the last 7 days before death (Fig 1). Compared with patients who died within 30 days after diagnosis, patients with longer survival were more likely to enroll in hospice (48.1% ν 30.7%; $P < .01$). Among those enrolled in hospice, nearly half (51.2%) of patients who died within 30 days started their first hospice enrollment in the last 3 days of life; in contrast, the percentage among those survived longer was 24.9%.

Patients who were older, female, white, had more comorbidities, resided in regions other than the Northeast or metropolitan/urban areas, died in more recent years, or had longer survival, were more likely to enroll in hospice ($P < .01$ for all; Table 2). Among patients who enrolled in hospice, we further assessed factors that might be related to late hospice enrollment (ie, in the last 7 days before death).

Patients who were older, resided in regions other than the Northeast, or survived longer were less likely to have late enrollment, whereas patients who died in more recent years were more likely to have late enrollment ($P < .05$ for all; Table 2).

A total of 341 patients were discharged from hospice before death; 89 patients of these were last discharged before the last 30 days of life. Additionally, 199 patients had more than one hospice claim, representing transition in and out of hospice enrollment (range, 1 to 5) after AML diagnosis. When patients were in gaps between hospice enrollments, a higher proportion of them received transfusion than chemotherapy (Table 3).

In a sensitivity analysis, we removed patients who survived < 1 month after diagnosis, reducing our sample size from 13,156 to 10,376 and increasing the observed survival from 2.4 to 3.7 months. In this subcohort, over the period of 1999 to 2012, the percentage of patients with hospice enrollment increased from 44.4% to 48.1%; among patients who were enrolled in hospice, the percentage of late enrollment decreased from 47.4% to 42.5%. We also evaluated the pattern of hospice use by chemotherapy status after AML diagnosis. Compared with patients with AML who had undergone some type of chemotherapy ($n = 5,475$), those who had never received chemotherapy ($n = 4,901$) were more likely to receive hospice care (56.1% ν 41.0%; $P < .01$) and start hospice care > 30 days before death (16.2% ν 7.8%; $P < .01$).

Chemotherapy at the End of Life

Overall, 1,528 (11.6%) patients underwent chemotherapy within 14 days before death; the percentage increased from 7.7% in 1999 to 18.8% in 2012 (P for trend $< .01$; Fig 2). Compared with patients who did not receive chemotherapy within 14 days before death, those who did were more likely to have ICU care in the last 30 days of life (43.0% ν 28.4%; $P < .01$) but less likely to enroll in hospice (22.1% ν 47.4%; $P < .01$).

In multivariable analyses, patients who were male, married, or died in more recent years were more likely to receive chemotherapy in the last 14 days of life (Table 4). However, patients less likely to receive chemotherapy at the end of life were older, had state Medicaid buy-in, or did not reside in the Northeast or a big metropolitan area.

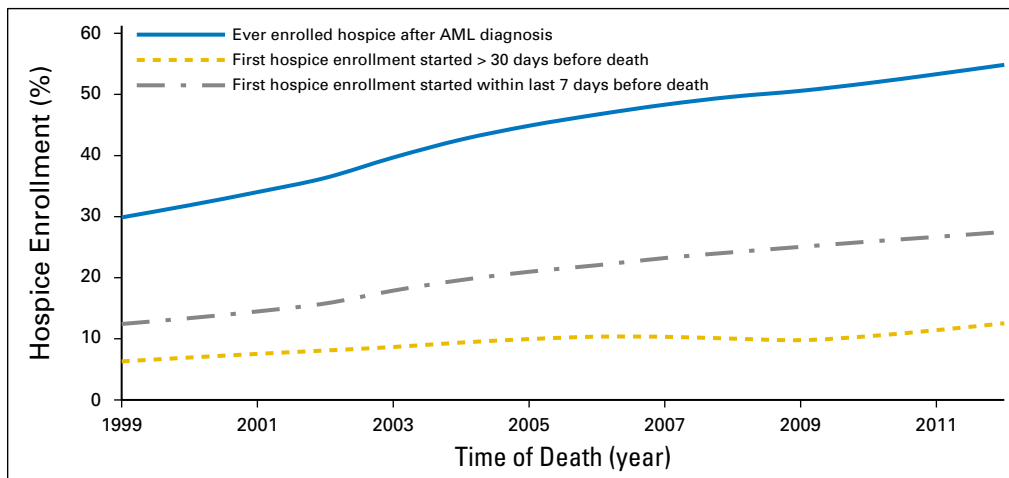


Fig 1. Hospice care from 1999 to 2012 at the end of life in older patients with acute myeloid leukemia (AML).

Table 2. Patient Characteristics Associated With Hospice Enrollment Among Older Patients With Acute Myeloid Leukemia, 1999-2012

Characteristic	Hospice Enrollment (n = 13,156)				Late Hospice Enrollment (n = 5,847)			
	%	OR*	95% CI	P	%	OR†	95% CI	P
Age at death, years								
66-69	30.2	1.00			53.3	1.00		
70-74	36.1	1.30	1.12 to 1.50	< .01	50.4	0.94	0.74 to 1.19	.59
75-79	43.1	1.78	1.55 to 2.05	< .01	48.8	0.82	0.66 to 1.03	.09
80-84	49.3	2.29	1.99 to 2.64	< .01	44.5	0.66	0.53 to 0.83	< .01
≥ 85	55.2	2.89	2.51 to 3.33	< .01	45.3	0.68	0.54 to 0.85	< .01
Sex								
Female	47.7	1.00			45.6	1.00		
Male	41.7	0.81	0.75 to 0.87	< .01	49.0	1.11	0.99 to 1.24	.07
Race								
White	45.6	1.00			47.6	1.00		
Nonwhite	34.7	0.63	0.56 to 0.71	< .01	44.1	0.91	0.75 to 1.11	.36
Marital status								
Unmarried	46.6	1.00			45.9	1.00		
Married	42.5	0.98	0.90 to 1.07	.66	48.3	1.03	0.91 to 1.16	.64
Unknown	47.7	1.09	0.92 to 1.29	.31	50.0	1.09	0.86 to 1.39	.47
Elixhauser comorbidity score								
0-1	40.8	1.00			46.9	1.00		
2-3	47.9	1.32	1.21 to 1.44	< .01	45.7	0.93	0.82 to 1.06	.30
4	45.2	1.16	1.06 to 1.27	< .01	49.5	1.06	0.93 to 1.21	.35
State buy-in status								
No	45.1	1.00			47.7	1.00		
Yes	40.6	0.90	0.81 to 1.01	.08	44.5	0.93	0.79 to 1.10	.41
Place of residence								
Big metropolitan	43.5	1.00			49.3	1.00		
Metropolitan/urban	46.1	1.12	1.03 to 1.21	< .01	45.9	0.93	0.82 to 1.05	.22
Less urban/rural	43.7	0.88	0.76 to 1.00	.06	42.3	0.86	0.70 to 1.05	.15
Region								
Northeast	40.4	1.00			54.8	1.00		
Midwest	53.3	2.01	1.77 to 2.27	< .01	47.4	0.79	0.66 to 0.95	.01
South	45.9	1.50	1.33 to 1.68	< .01	42.9	0.66	0.55 to 0.78	< .01
West	42.4	1.20	1.09 to 1.33	< .01	46.4	0.74	0.64 to 0.86	< .01
Census tract median income, quintile								
First	42.7	1.00			42.1	1.00		
Second	44.8	1.01	0.89 to 1.14	.91	47.3	1.19	0.99 to 1.42	.06
Third	45.5	1.04	0.93 to 1.17	.50	45.7	1.05	0.88 to 1.25	.58
Fourth	44.8	1.07	0.95 to 1.21	.28	49.7	1.17	0.98 to 1.40	.09
Fifth	44.5	1.09	0.96 to 1.23	.16	51.2	1.21	1.01 to 1.45	.04
Year of death								
2000-2003	34.8	1.00			42.8	1.00		
2004-2007	45.9	1.58	1.44 to 1.73	< .01	47.0	1.24	1.08 to 1.43	< .01
2008-2012	51.5	1.99	1.82 to 2.17	< .01	50.2	1.44	1.26 to 1.65	< .01
Survival time, years		1.08	1.04 to 1.13	< .01		0.81	0.75 to 0.86	< .01

Abbreviation: OR, odds ratio.

*All odds ratios were derived from a multivariable logistic regression model with hospice enrollment (yes v no) as the dependent variable. All variables listed in the table were simultaneously included in the multivariable model.

†Only among 5,847 older patients with acute myeloid leukemia who enrolled in hospice. All odds ratios were derived from a multivariable logistic regression model with first hospice enrollment occurring within 7 days before death (yes vs no) as the dependent variable. All variables listed in the table were simultaneously included in the multivariable model.

ICU Admission at the End of Life

A total of 3,956 patients (30.1%) were admitted to the ICU within 30 days before death, and the percentage increased from 25.2% in 1999 to 31.3% in 2012 (P for < .01; Fig 2). Patients who were admitted to the ICU within 30 days before death were less likely to enroll in hospice than those who were not (26.7% v 52.1%; P < .01). Factors associated with ICU admission were similar to those associated with the receipt of chemotherapy (Table 4), except that patients with state Medicaid buy-in had a higher chance of ICU admission within the last 30 days of life (odds ratio, 1.19; 95% CI, 1.05 to 1.33; P < .01). Additionally, compared with their white

counterparts, nonwhite patients were more likely to have an ICU admission (odds ratio, 1.22; 95% CI, 1.07 to 1.38; P < .01).

DISCUSSION

In this large, population-based study examining the end-of-life health care use of older patients with AML, fewer than half of patients were enrolled in hospice and, among these patients, approximately half were enrolled in the last 7 days of life. Although the proportion of patients with hospice enrollment increased

Table 3. Patients' Receipt of Transfusion or Chemotherapy Outside Hospice in the Last 30 Days of Life

Period	Total No.	Transfusion, No. (%)	Chemotherapy, No. (%)
Between an earlier hospice discharge and the first hospice enrollment that started within the 30 days before death	89	55 (61.8)	15 (16.8)
Between two hospice claims within 30 days before death	77	57 (74.0)	28 (36.4)
Last hospice discharge to death (last hospice occurred within the 30 days before death)	252	37 (14.7)	—*
Last hospice discharge to death (last hospice occurred > 30 days before death)	81	46 (56.8)	—*

Abbreviation: SEER, Surveillance, Epidemiology, and End Results.
 *Actual value not reportable due to SEER-Medicare patient confidentiality restrictions on reporting results with n < 11.

continuously between 1999 and 2012, most of the increase was driven by enrollment in the last 7 days before death. During the same period, ICU admission in the last 30 days of life and chemotherapy in the last 14 days of life steadily increased.

Although the rate of hospice use we observed (44.4%) was higher than a previous report (23.2%),¹² it is considerably lower than that reported for patients with cancer enrolled in Medicare in general (54.6% for 2003 to 2007 and 61.3% for 2010).²⁵ In our study, male and nonwhite patients were less likely to enroll in hospice, which is consistent with the recognized sex and racial disparities in end-of-life care.²⁶⁻³² The sex and racial disparities in hospice use may be addressable through physician and patient education, and by improving the provision of culturally sensitive end-of-life care.

Previous studies have also reported that patients with hematologic malignancies have a high rate of late hospice enrollment.^{12,13,33} At two tertiary-care hospitals only 11.3% of patients with AML enrolled in hospice for > 7 days.¹² In a hospice network, 40.3% of patients with leukemia used hospice for < 7 days.¹³ Patients with hematologic malignancies were more likely to be admitted to hospice in the last 3 days of life than those with solid tumors.³⁴ The high rate of late hospice enrollment may be related

to the overall short survival of patients with AML. A sizable proportion of older patients with AML may have an abrupt decline close to the end of life, making it difficult to identify a natural transition to the end-of-life phase³⁵ and hampering timely referral to hospice.¹¹

One medical complication that may not be optimally treated under current hospice models is cytopenia. Transfusion is an important part of supportive care for patients with AML,³⁶ whether or not a patient is at the end of life. However, a national survey of 591 hospices revealed that 40% of hospices did not admit patients with transfusion needs.¹⁶ Although many hematologic oncologists acknowledged the importance of hospice care, the lack of availability of transfusions in the hospice setting is an important concern for hospice referral.³⁵ We observed that some patients with AML disenrolled from hospice and then received treatment outside of hospice, consisting most often of transfusion support rather than chemotherapy. Taken together, the transfusion needs of patients with AML may constitute a barrier to timely hospice enrollment and prompt hospice disenrollment. Alternative policies allowing the provision of transfusion in hospice care may better meet the specific needs of older patients with AML, and possibly other patients who may benefit from transfusion near the end of their life. Under current circumstance, physicians likely consider a patient's need of transfusion when discussing or recommending hospice enrollment.

Our findings suggest that hospice is not being used optimally to provide end-of-life care for older patients with AML. Unrealistic expectations of patients, families, and physicians have been cited as factors contributing to the underuse of hospice in patients with AML,⁹ but the current hospice model itself may not be well suited to handle the rapid clinical decline and medical complications commonly experienced by older patients with AML approaching the end of life. The increased overall use of hospice with concomitant increase in the proportion admitted within 7 days of death raises the question of whether patients are simply being admitted to hospice to manage death rather than obtaining the benefits of symptom management and palliative support that hospice can provide. Further studies are needed to evaluate the effect of fragmented end-of-life care and develop specific end-of-life quality metrics for patients with hematologic

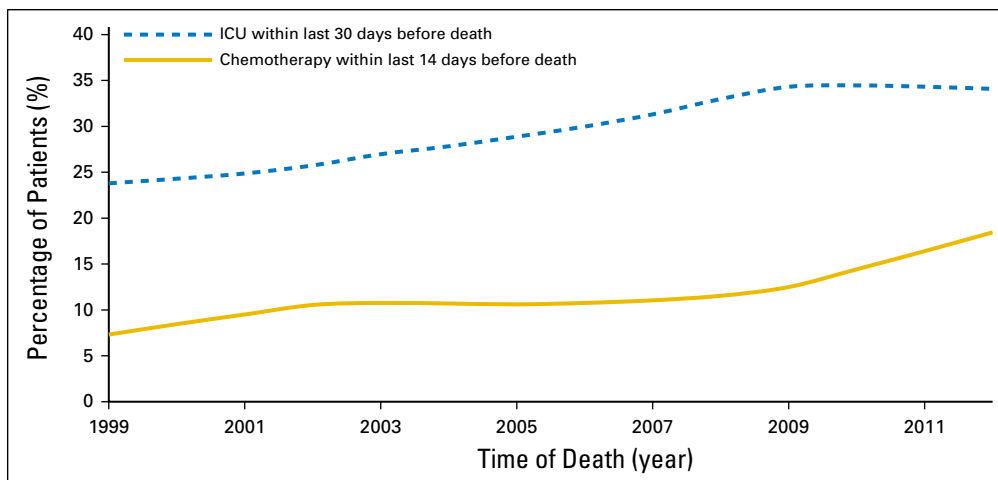


Fig 2. Intensive care unit (ICU) admission and chemotherapy from 1999 to 2012 at the end of life in older patients with acute myeloid leukemia from 1999 to 2012.

Table 4. Potential Predictors of End-of-Life Aggressive Treatment Among Older Patients With Acute Myeloid Leukemia from 1999 to 2012 (N = 13,156)

Characteristic	ICU Admission Within Last 30 Days*				Chemotherapy Within Last 14 Days*			
	%	OR	95% CI	P	%	OR	95% CI	P
Age at death, years								
66-69	37.8	1.00			17.1	1.00		
70-74	34.3	0.89	0.77 to 1.02	.09	16.3	0.94	0.78 to 1.12	.48
75-79	30.9	0.74	0.65 to 0.85	< .01	12.8	0.70	0.59 to 0.84	< .01
80-84	27.8	0.62	0.54 to 0.71	< .01	9.4	0.49	0.41 to 0.60	< .01
85+	24.1	0.50	0.43 to 0.57	< .01	5.7	0.30	0.24 to 0.37	< .01
Sex								
Female	28.2	1.00			10.1	1.00		
Male	31.6	1.13	1.05 to 1.23	< .01	12.9	1.15	1.02 to 1.29	.02
Race								
White	29.3	1.00			11.8	1.00		
Nonwhite	36.6	1.22	1.07 to 1.38	< .01	9.7	0.87	0.72 to 1.06	.17
Marital status								
Unmarried	28.6	1.00			9.0	1.00		
Married	31.3	1.09	1.00 to 1.19	.06	13.4	1.22	1.08 to 1.39	< .01
Unknown	28.7	1.01	0.84 to 1.22	.90	13.2	1.36	1.06 to 1.74	.02
Elixhauser comorbidity score								
0-2	32.2	1.00			11.0	1.00		
3-4	28.1	0.80	0.73 to 0.88	< .01	11.8	1.02	0.89 to 1.17	.77
≥ 5	29.6	0.81	0.74 to 0.89	< .01	12.1	1.02	0.90 to 1.17	.73
State buy-in								
No	29.4	1.00			12.1	1.00		
Yes	34.6	1.19	1.05 to 1.33	< .01	8.4	0.75	0.62 to 0.91	< .01
Place of residence								
Big metropolitan	34.4	1.00			12.6	1.00		
Metropolitan/urban	25.6	0.62	0.57 to 0.68	< .01	10.8	0.84	0.74 to 0.95	< .01
Less urban/rural	22.6	0.52	0.45 to 0.61	< .01	9.5	0.76	0.61 to 0.95	.02
Region								
Northeast	31.0	1.00			14.5	1.00		
Midwest	24.8	0.82	0.71 to 0.94	< .01	9.5	0.67	0.55 to 0.81	< .01
South	28.5	0.98	0.86 to 1.11	.76	11.4	0.81	0.69 to 0.97	.02
West	32.4	1.07	0.96 to 1.18	.23	11.1	0.77	0.67 to 0.89	< .01
Census tract median income, quintile								
First	29.4	1.00			9.6	1.00		
Second	28.0	0.95	0.83 to 1.09	.45	10.3	1.05	0.86 to 1.28	.63
Third	28.8	0.90	0.80 to 1.02	.11	11.6	1.12	0.93 to 1.35	.23
Fourth	31.6	0.94	0.82 to 1.07	.36	12.7	1.14	0.94 to 1.38	.19
Fifth	31.8	0.88	0.77 to 1.00	.06	13.3	1.13	0.94 to 1.37	.19
Year of death								
2000-2003	25.0	1.00			10.1	1.00		
2004-2007	29.8	1.35	1.22 to 1.49	< .01	10.6	1.07	0.93 to 1.24	.34
2008-2012	34.6	1.75	1.59 to 1.93	< .01	13.8	1.45	1.26 to 1.65	< .01
Survival time, years		0.82	0.77 to 0.86	< .01		1.03	0.97 to 1.09	.33

Abbreviations: ICU, intensive care unit; OR, odds ratio.

*All odds ratios and 95% CIs were derived from a multivariable logistic regression model with the binary outcome of interest (ie, aggressive treatment, admission to an intensive care unit in the last 30 days of life, or chemotherapy in the last 14 days of life) as the dependent variable. All variables listed in the table were simultaneously included in the multivariable model.

malignancies (eg, metrics related to transfusion or bone marrow assessment).

Between 1999 and 2012, the percentage of patients receiving chemotherapy in the last 14 days of life almost doubled in our study. Other investigators have also observed a high rate of aggressive treatment at the end-of-life in patients with hematologic malignancies.^{10,12,26,37} The increased use of potentially aggressive treatments, especially chemotherapy, may be partly attributable to the introduction of less-toxic treatments such as the hypomethylating agents azacitidine and decitabine, which are often used off label to treat older patients with AML.³⁸ For inpatient care, SEER-Medicare provides information on whether chemotherapy was administered but does not distinguish chemotherapy given for

palliative purposes, which limits our conclusions as to the appropriateness of chemotherapy.

Some patients are willing to receive treatments with much more toxicity for a smaller benefit than will their providers.³⁹ Even among older adults with AML, a fraction of patients who receive intensive therapy may have favorable long-term outcomes.⁵ This allure of being an outlier in terms of prolonged response may influence patient and provider decisions about therapies right to the end of life. Moreover, there are no clear stopping rules for anticancer treatment.⁴⁰ Because novel therapies increasingly offer durable clinical responses in a small proportion of patients, improved predictive models and better communication strategies are needed to ensure patients understand the risks and benefits of

a given therapy and that end-of-life care remains aligned with the patient's goals and preferences.

As a claim-based retrospective study, our study has several limitations. First, the cohort only included older patients with AML with Medicare coverage. Thus, our results may not be generalizable to all patients with AML. Second, we measured health care use and treatment on the basis of Medicare claims and did not have information regarding patient preferences or physician recommendations. Third, the diagnostic codes in Medicare claims are not as reliable as the other codes used to identify procedures, tests, therapies, or hospice enrollment, so the reliance on diagnostic codes for the construction of comorbidity as a covariate is a potential limitation. Fourth, we were unable to determine appropriateness of care at the individual level. For example, for a patient who received chemotherapy in the last 14 days of life, we could not tell whether it was used with a palliative intent or for active treatment. Last, we retrospectively assessed the care received by patients from death (ie, starting from death and looking backward in time) and considered a late referral to hospice and/or aggressive treatments shortly before death suboptimal end-of-life care. This approach was subject to attribution bias^{41,42} because older patients with AML may frequently experience death from early complications of treatment, and intensive treatments may fail to achieve the intended remission. It is easy to assess the appropriateness of care afterward, but much more difficult to do so prospectively.

Our study also has notable strengths. It is the first, to our knowledge, to examine end-of-life health care use of older patients with AML in a large population-based cohort. This allowed us to assess secular trends in hospice enrollment and end-of-life

treatment over a 14-year period. In addition, drawing on the longitudinal nature of the linked SEER-Medicare database, we measured health care use for patients starting from their date of AML diagnosis through the date of death. The comprehensive data available also allowed us to adjust for many other factors known or suspected to influence end-of-life health care use in patients with cancer, improving the validity of our findings.

In conclusion, we found that the current end-of-life care for older patients with AML is suboptimal, as reflected by low hospice enrollment and high use of potentially aggressive treatment. Transfer in and out of hospice was associated with the receipt of transfusions. Changes to current hospice services, such as enabling the provision of transfusion support, and improvements in physician-patient communications, may help facilitate better end-of-life care in this patient population.

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Disclosures provided by the authors are available with this article at jco.org.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Health Care Use by Older Adults With Acute Myeloid Leukemia at the End of Life

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