Potentially Avoidable Hospitalizations in Older Patients with Acute Myeloid Leukemia: A Retrospective Analysis

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Running Head: Potentially Avoidable Hospitalizations in AML

Disclaimers: None   Number of pages: 25   Word Count: 3035

Number of tables and figures: 7

Abstract:

Background: Older adults (≥ 60 years) with acute myeloid leukemia (AML) spend a significant proportion of their life in the hospital after diagnosis. We examined reasons for their hospitalizations and identified potentially avoidable hospitalizations (PAH) in this population.

Methods: We conducted a retrospective analysis of 329 consecutive older patients diagnosed with and treated for AML between 5/1/2005-12/23/2011 at two tertiary care hospitals to examine the reasons for hospitalization. Practicing oncologists used a consensus-driven medical record review process to identify the primary reason for each hospitalization and to categorize it as “potentially avoidable” or “not avoidable” based on an adaptation of Graham’s criteria for PAH. We used multivariable logistic regression analyses to identify predictors of PAH.

Findings: We evaluated 1040 hospitalizations (excluding initial diagnosis hospitalization) in 329 patients. The most common primary reasons for hospitalizations were: fever/infection (38.2%), planned hospitalization for chemotherapy or transplant (37.6%), and uncontrolled symptoms (9.8%). We identified 172/649 of unplanned hospitalizations (26.5%) as potentially avoidable; among these, 47.1% were readmissions due to premature prior hospital discharge, 19.0% were due to problems that could have been managed in the outpatient setting, and 15.1% were due to failure of timely outpatient follow-up. In a mixed logistic regression model, higher education (OR 1.43, $P = 0.04$) and the receipt of non-intensive induction chemotherapy (OR 1.97, $P = 0.003$) were predictors of PAH.

Interpretations: Although many hospitalizations in older patients with AML are unavoidable and driven by the illness course and its treatment, a substantial proportion are potentially avoidable. Future interventions to reduce PAH in this population are clearly warranted.

Funding: This study is funded by the NCI Federal Share Program and the National Palliative Care Research Center (Dr. El-Jawahri), the Cambia Health Foundation (Dr. LeBlanc), and K24 CA 181253 (Dr. Temel).

Introduction:

Older patients (≥ 60 years) with acute myeloid leukemia (AML) face a life-threatening illness that carries a poor prognosis, with a median survival of 8-10 months, and low likelihood of long-term disease-free survival. (1-3) Moreover, they are frequently hospitalized and spend a substantial portion of their life after diagnosis in the hospital.(4) Given the tremendous illness burden experienced by older patients with AML, exploring the causes of high health care utilization in this population is clearly warranted.

Hospitalizations are common and distressing experiences for patients with cancer.(5) In fact, studies have shown that patients prefer to maximize their time out of the hospital when faced with a life-threatening illness.(4,6, 7) Unfortunately, older patients with AML experience frequent of hospitalizations throughout their illness regardless of the specific therapy they receive.(4, 8) However, studies exploring the primary reasons for hospitalizations in this population are lacking. Additionally, the rate of potentially avoidable hospitalizations (PAH) in older patients with AML is currently unknown.

While the general internal medicine literature has commonly explored potentially avoidable hospital readmissions,(9-14) the concept of PAH in oncology is relatively novel.(5) Prior studies in oncology have primarily focused on chemotherapy-related hospitalizations, but they have not explored whether these hospitalizations are avoidable.(5,15-18) In one study of 154 patients with gastro-intestinal cancers, 19% of hospitalizations were classified as potentially avoidable.(5) To our knowledge, there are no studies exploring the rate of PAH in patients with hematologic malignancies, particularly older patients with AML who experience high rates of hospitalizations and intense health care utilization.(4)

The aim of our study was to describe the primary reasons for hospitalizations in older patients with AML. We also sought to classify and identify predictors of PAH. By exploring reasons for admissions and classifying PAH in older patients with AML, we can 1) understand the scope and extent of health care utilization in this population; 2) identify patients' specific needs and/or disease-related complications that result in hospitalizations; 3) create a conceptual framework to study PAH in patients with leukemia and hematologic malignancies; and 4) identify targets for future interventions that may reduce PAH and health care utilization in this population.

Methods

Study Design:

We evaluated 1040 hospitalizations after a diagnosis of AML in 329 unique patients 60 years or older treated at the Dana-Farber Cancer Institute/Brigham and Women's Hospital or Massachusetts General Hospital between 5/1/2005 and 12/31/2011. We reviewed medical charts and obtained follow-up data on all patients until 12/31/2014 or death. We included patients receiving intensive induction chemotherapy (n=197) or non-intensive therapy (n=132) at the time of diagnosis. We defined intensive induction as receiving standard '7+3' with a combination of cytarabine and an anthracycline or a modification of this regimen on a clinical trial with other agents added to the 7+3 backbone. We defined non-intensive therapy as receiving hypomethylating agents, low-dose cytarabine, or single agent therapy on a clinical trial. We excluded patients with a diagnosis of acute promyelocytic leukemia, and those seen only for a one-time consultation who received primary therapy elsewhere. As one of our primary goals was to examine reasons and characterization of hospitalizations among older patients with AML receiving therapy, we excluded patients who were treated with supportive care alone.

We identified the eligible cohort using the Dana-Farber Cancer Institute and Massachusetts General Hospital Leukemia CRIS (Clinical Research Information Systems) database, which includes all patients with acute

leukemia and related disorders seen at these institutions who have consented to have their medical records abstracted for research purposes. The CRIS database has been described previously in detail.(4) We then conducted a comprehensive chart review to obtain information regarding patients' demographics, comorbidities as measured by the Sorror Comorbidity index,(19) Eastern Cooperative Oncology Group (ECOG) performance status, AML disease risk based on the European Leukemia Net risk stratification (ELN),(20, 21) lines of chemotherapy, receipt of stem cell transplantation, hospitalizations, primary reason for hospitalizations, and dates of death.

Primary reasons for hospitalizations:

A consensus panel of four practicing oncologists (three specializing in leukemia and stem cell transplantation) developed a coding guide to classify the primary reason for hospitalizations in older patients with AML. The consensus panel did not include a geriatrician as they are not routinely involved in the care of patients with AML in the United States. We excluded the initial diagnosis hospitalization from our analyses. The reasons for hospitalizations included in the schema are: fevers/infection, bleeding, planned hospitalization for chemotherapy or stem cell transplantation, hospitalization related to non-cancer medical condition, relapsed disease, graft-versus-host disease, or uncontrolled symptoms. Two coders (MDs: AE and TK) independently reviewed the medical record and utilized the coding schema to classify the primary reason for each hospitalization included in this analysis.

Potentially avoidable hospitalization (PAH):

We utilized a novel adaptation of the Graham's criteria to identify and classify PAH.(22) Graham's criteria, the most commonly referenced criteria in classifying potentially avoidable re-admissions within general internal medicine,(14) classifies hospital readmissions into five groups (unavoidable clinical deterioration, inadequate medical management, patient non-adherence, social problems leading to admission, and inadequate

rehabilitation).(22) Using a consensus panel of the same four practicing oncologists (three specializing in leukemia and stem cell transplantation), we revised and adapted the Graham's criteria to characterize and classify PAH for older patients with AML [Table 1]. We then reviewed each hospitalization using a two-stage review process that has previously been utilized to identify PAH in patients with gastrointestinal cancers.(5) In the first stage of the review, two coders (same MDs who reviewed reasons for hospitalization) independently reviewed each hospitalization using the modified Graham's consensus criteria to identify and classify PAH. In the second stage of the review, the consensus panel reviewed any hospitalization identified as potentially avoidable by at least one coder for a final consensus determination of avoidability. In cases in which the committee was unable to reach consensus, hospitalizations were deemed to be not avoidable. We did not use the Centers for Medicare or Medicaid Services (CMS) billing codes for unplanned admissions for this study since these codes do not apply for patients with AML. Please note although the Centers for Medicare and Medicaid Services (CMS) have some codes for unplanned admissions, those codes do not apply for patients with AML. Notably, the consensus panel did not feel that it is appropriate to classify febrile/neutropenia admission as potentially avoidable given the frequent infectious complications inherent to this disease and the complexity of caring for this population.

Statistical methods:

We used descriptive statistics to summarize patient, disease characteristics, and primary reason for hospitalizations for all study subjects. We compared primary reason for hospitalization between patients receiving intensive induction versus non-intensive therapy using chi-square test.

We used descriptive statistics including proportions and frequencies to examine the distribution and classification of PAH. We calculated the proportion of PAH among all unplanned hospitalizations (excluding planned hospitalization for chemotherapy or stem cell transplantation). We determined the inter-coder reliability

regarding classifying hospitalizations as potentially avoidable using weighed kappa statistics. In unadjusted analyses, we used non-linear mixed effects models with binomial distributions to examine the relationship between demographic and clinical characteristics and the risk of having a PAH in order to account for correlations between repeated hospitalizations for each subject. To examine predictors of PAH, variables identified in unadjusted analyses with a p-value ≤ 0.20 along with other predictors known to be associated with complications and re-hospitalizations in other medical populations (gender and performance status) were included in a non-linear mixed effects model with binomial distribution. Since all data were obtained from review of hospitalizations in the electronic medical record, we did not have any missing data for our outcomes of interest. Hence, we conducted all analyses using observed data without imputation for missing data. We performed all statistical analyses using, version Stata 9.3

Role of the sponsor: The sponsor did not have any role in the study design, data collection, data analysis or interpretation, or the writing of this manuscript. The following authors had access to all the data files (AE, TK, and JT).

Results:

Patients Characteristics

Table 2 depicts the clinical characteristics of all patients (n=329) included in this study. Patients receiving supportive care alone at the time of diagnosis of AML were excluded (n = 97). The median age of the cohort was 70 years, and 59.0% (194/329) were male. Among the entire cohort, 59.9% (197/329) received intensive induction, while 40.1% (132/329) received non-intensive therapy. Overall, 33.1% (109/329) underwent stem cell transplantation and 42.3% (139/329) had ELN high risk disease.(20, 21)

Primary Reason for Hospitalization

We analyzed 1040 hospitalizations among 329 unique patients (excluding the first admission to establish the diagnosis of AML). The primary reasons for hospitalizations were: fevers/infections (38.2%, 397/1040), planned admissions for chemotherapy or transplant (37.6%, 391/1040), uncontrolled symptoms (9.8%, 102/1040), unrelated to cancer diagnosis (5.1%, 53/1040), bleeding complications (3.5%, 36/1040), relapse (2.8%, 29/1040), and graft-versus-host disease (2.4%, 25/1040) [Table 3]. Patients receiving non-intensive therapy were less likely to have planned hospitalizations for chemotherapy or transplant (15.4% (49/319) vs. 47.4% (342/721)), and more likely to have hospitalizations for fevers/infections (54.2% (173/319) vs. 31.1% (224/721)) and uncontrolled symptoms (14.1% (45/319) vs. 7.9% (57/721)) [$P < 0.0001$; Table 3].

Potentially Avoidable Hospitalizations

The inter-coder reliability was high ($\kappa = 0.90$, 95% CI 0.87-0.94). The proportion of cases in which the coders disagreed on whether a hospitalization was potentially avoidable was 2.5% (26/1040). In 23 of these cases, the consensus panel was able to reach an agreement. Thus, the remaining three cases were deemed unavoidable. We identified 26.5% (172/649) of unplanned hospitalizations as potentially avoidable. Among patients receiving intensive induction and non-intensive therapy, 24.5% (93/379) and 29.3% (79/270) of unplanned hospitalizations were potentially avoidable. Overall, 31.3% (103/329) of all patients studied accounted for 100% of PAH in this cohort, with 18%, 7%, and 6% of patients having one, two, or more than two PAH respectively .

Table 4 depicts classification of PAH among older patients with AML. Approximately half (47.7%, 82/172) of PAH were due to premature hospital discharge after a prior admission, 18.8% (32/172) were due to problems that could have potentially been managed as outpatient, and 15.3% (26/172) were due to failure of timely outpatient follow-up. Among PAH, 11.8% (20/172) were among patients receiving hospice or supportive care alone after they received initial therapy for AML. Classification of the reason for PAH did not differ among

patients receiving intensive induction vs. non-intensive therapy are shown in Table 1 and appendix A depicts examples of PAH within each classification category.

Predictors of PAH in AML:

In unadjusted analyses, gender, marital status, performance status, disease risk, and clinical comorbidities were not associated with the risk of having a PAH [Table 5]. Older age [OR = 1.03, 95% CI (1.01-1.06, P = 0.0020], the receipt of non-intensive chemotherapy [OR = 2.09, 95% CI (1.52 – 2.87, P < 0.0001], and not having a stem cell transplantation [OR = 1.72, 95% CI (1.24- 2.38), P = 0.0010] were significantly associated with a higher likelihood of having a PAH.

Table 6 depicts the mixed effects logistic regression analysis examining predictors of PAH controlling for gender, comorbidities, disease risk, and performance status. Higher level of education [OR = 1.43, 95% CI (1.01-2.00), P = 0.040], and the receipt of non-intensive chemotherapy [OR = 1.97, 95% CI 1.25 – 3.10, P = 0.0030] were associated with a higher likelihood of having a PAH.

Discussion

This study explored in-depth the substantial hospitalization burden in older patients with AML. The majority of hospitalizations in this population were unavoidable with 38% due to planned admissions for chemotherapy or stem cell transplantation, and 38% due to infections and fevers. However, we identified that over a quarter of unplanned hospitalizations in older patients with AML were potentially avoidable. Notably, premature hospital discharge, failure of timely outpatient follow-up, and situations where outpatient medical management is possible were the primary causes of PAH. These findings underscore the need for future interventions to reduce PAH and the health care utilization burden in older patients with AML.

To our knowledge, this is the first study to develop a conceptual framework for identifying PAH in patients with hematologic malignancies, where hospitalizations are frequent. Traditionally, the classification of PAH in the medical literature is hampered by a high degree of subjectivity.(5, 14, 23) Our excellent inter-coder reliability while utilizing a novel classification schema for PAH in older patients with AML highlights the reliability of this approach and offers future opportunities to use a similar framework in studying PAH in patients with hematologic malignancies.

We identified 26.5% of unplanned hospitalizations in older patients with AML as potentially avoidable, which is higher than the proportion reported in patients with gastrointestinal cancers.(5) These findings are not surprising given the intensity of health care utilization in older patients with AML.(4) Although, no national data are available regarding PAH in patients with AML, we suspect that our rate of PAH is generalizable to other academic institutions in the United States and abroad given the patterns of care for AML. Interestingly, premature hospital discharge accounted for half of PAH in our cohort. It is plausible that longer hospital length-of-stay during a previous admission would lead to a lower risk of having a PAH. Thus, it remains unclear to what extent targeting PAH among those discharged prematurely would actually reduce the time patients spend in the hospital. Notably, failure of timely outpatient follow-up and the potential for outpatient management accounted for 19% and 15% of PAH, respectively. Unfortunately, we are unable to ascertain the reason for failure of timely follow-up whether it is missed or cancelled appointments, or unscheduled appointments at the time of discharge. These hospitalizations are amenable to future interventions aimed at reducing PAH in older patients with AML. Specifically, interventions to ensure more frequent follow-up for patients with AML receiving therapy, and identifying triggers for outpatient management of common problems can be tested in the future. Collectively, our findings highlight the complexity of caring for this vulnerable population with significant needs and potential for complications, which necessitates close outpatient monitoring.

Figure 1 depicts our conceptual model for potentially avoidable hospitalizations. Outpatient care including clinic supports and clinical management of medical issues can directly affect the risk of any hospitalization and PAH. Additionally, patient and clinician factors impact the risk of hospitalization and the care patients receive during their hospital stay. Hospital care ultimately leads to care transitions which are influenced by patient factors, disease and treatment factors, and post-discharge environment including social supports, self-management abilities, additional clinical resources, and rehabilitation. Consequently, care transitions play a key role in predicting the risk of PAH. This conceptual model allows us to better identify key points of interventions to reduce PAH such as enhancing discharge preparation, improving the post-discharge environmental factors, and providing additional outpatient care supports.

Our study builds a foundation for identifying patients at risk for PAH and sets the stages for future interventions to reduce hospitalizations. Overall 31% of all patients studied accounted for 100% of PAH in our cohort. Moreover 43% of patients who had a PAH experienced additional PAH admissions. Interestingly, the receipt of non-intensive chemotherapy were associated with a higher likelihood of having a PAH. Patients receiving non-intensive chemotherapy are generally older and have significant comorbidities. Thus, clinicians may be more inclined to hospitalize them in the face of potential treatment related complications. Higher education was also associated with a higher risk of PAH. It is plausible that highly educated patients are more empowered to discuss issues and problems as they arise during their treatment with their clinicians resulting in higher likelihood of PAH. Thus, future interventions such as more frequent outpatient monitoring, enhanced discharge transition services, or phone interventions targeting patients at risk such as those receiving non-intensive chemotherapy or a history of PAH may reduce hospitalizations and improve the quality of care for this population.(24-27)

Notably, the majority of hospitalizations in older patients with AML were unavoidable. Planned hospitalizations for chemotherapy or transplant, fevers and infections, bleeding, and symptoms were the primary reasons for hospitalization in 90% of patients. Moreover, 12% of PAH occurred in patients receiving hospice or supportive care, where the goal of their treatment is to maximize comfort and reduce time spent in the hospital.

Unfortunately, there are many barriers to achieving this goal in patients with AML including the rapid trajectory of decline at the end of life, the frequency of infectious and bleeding complications, and the intensity of supportive care measures needed, particularly blood product support, which many hospice organizations do not permit due to financial constraints.(28, 29) Our findings highlight the need to develop novel health service delivery models to provide appropriate end-of-life care for patients with AML, which may ultimately reduce a significant proportion of PAH in this population.

Our study has several important limitations. First, patients received their care at two academic institutions in Boston, thereby limiting the generalizability of our findings to other settings. Second, identifying and classifying hospitalizations as potentially avoidable is inherently subjective, because there is no validated objective measure of potentially avoidable oncology hospitalizations. Furthermore, while laboratory findings can be considered in the reviewer's decision to classify hospitalization as potentially avoidable, we did not use absolute numeric cut-offs. However, our high inter-coder reliability when using the modified Graham's criteria followed by a consensus-panel driven review strengthens the validity of our findings. Third, our cohort only included patients receiving treatment for AML, and thus we are unable to comment on to what extent cancer therapy contributes to PAH in this population. Finally, patients may have been hospitalized or received care at facilities outside of our institutions, which might not have been entirely captured by our medical records.

In conclusion, most hospitalizations in older patients with AML are unavoidable, reflecting the burden of this disease and its potential complications. However, a significant proportion of unplanned hospitalizations are

potentially avoidable due to premature discharge from prior hospitalization, failure of timely outpatient follow-up, or situations where outpatient medical management would have been possible. Importantly, our work builds a framework to conceptualize and study PAH in patients with hematologic malignancies, where the intensity of health care utilization is very high. This work underscores the need for future interventions targeting patients at risk for PAH thereby reducing the hospitalization burden and improving the quality of care in this vulnerable population.

Putting Research into Context:

Evidence before the study:

Older patients (≥ 60 years) with acute myeloid leukemia (AML) face a life-threatening illness with a poor prognosis and spend a significant portion of their life after diagnosis in the hospital. Despite the intensity of health care utilization and high hospitalization burden in older patients with AML, studies exploring the primary reasons for hospitalizations and the rate of potentially avoidable hospitalizations (PAH) in this population are lacking. Furthermore, there are no studies exploring PAH in patients with hematologic malignancies and the classification of PAH is hampered by a high degree of subjectivity. By exploring reasons for admissions and classifying PAH in older patients with AML, we can identify patients' specific needs and/or disease-related complications that result in hospitalizations, identify targets for future interventions that may reduce PAH and health care utilization in this population, and create a conceptual framework to study PAH in patients with leukemia and hematologic malignancies.

Added value of the study:

The majority of hospitalizations in older patients with AML were unavoidable with 38% due to planned admissions for chemotherapy or stem cell transplantation, and 38% due to infections and fevers. We identified 26.5% of unplanned hospitalizations in older patients with AML were potentially avoidable. Overall, 31% of all patients accounted for 100% of PAH and 43% of patients who had one PAH experienced additional PAH admissions. Premature hospital discharge, failure of timely follow-up, and situations where outpatient medical management is possible were the primary causes of PAH.

Implications of all available evidence:

In this study, we developed a novel conceptual framework for identifying PAH in patients with hematologic malignancies and demonstrated excellent inter-coder reliability while utilizing a novel classification schema for PAH in older patients with AML, which offers future opportunities to use similar framework in studying PAH in patients with hematologic malignancies. Our findings underscore the need for future interventions to reduce PAH and health care utilization burden in older patients with AML. Future interventions such as more frequent outpatient monitoring, enhanced discharge transition services, or phone interventions targeting patients at risk such as those with history of PAH may reduce hospitalizations and improve quality of care for this population.

Figures & Tables Legends:

Table 1: Criteria for Potentially Avoidable Hospitalization for Patients with AML: PAH = potentially avoidable hospitalization.

Table 2: Patients characteristics: SD = Standard deviation; ECOG = Eastern Cooperative Oncology Group; HCT = Hematopoietic Stem Cell Transplantation, IQR = interquartile range.

Table 3: Primary reason for hospitalizations in older patients with AML: GVHD = graft-versus-host-disease.

Table 4: Classifications of Potentially avoidable hospitalizations in older patients with AML: PAH = potentially avoidable hospitalization.

Table 5: Unadjusted analyses: predictors of potentially avoidable hospitalization: HCT-CI: hematopoietic stem cell transplant- comorbidity index.

Table 6: Mixed effect logistic regression analyses: predictors of potentially avoidable hospitalization: HCT-CI: hematopoietic stem cell transplant- comorbidity index.

Figure 1: Conceptual model for potentially avoidable hospitalizations: PAH = potentially avoidable hospitalizations.

Table 1:

Criteria for PAH	Definition
Inadequate medical management	- Patient complained of a symptom during the last clinic visit prior to admission that was not addressed, which ultimately led to hospitalization. - Patient with borderline low blood counts during the last clinic visit prior to admission, admitted due to transfusion needs or bleeding. - Patient with an infection noted during the last clinic visit that was not adequately treated, which ultimately led to hospitalization. - Patient with abnormal lab values during the last clinic visit that was not adequately addressed, which ultimately led to hospitalization. - Other
Premature discharge from prior hospitalization	- Patient readmitted to the hospital within 7 days from discharge with the same complaint/symptom of their prior hospitalization
Failure of timely follow-up	- Patient with ≥ 7 days from hospital discharge to a follow-up clinic appointment. - Patient receiving active chemotherapy seen less than once per week in follow-up clinic visits.
Social problems leading to admission	- Patient receiving chemotherapy without adequate social support at home. - Patient on hospice or supportive care admitted due to patient's or family's misunderstanding of the goals of care.
Patient non-adherence	- Patient non-adherent to medications - Patient non-adherent or missing appointments and clinic visits
Inadequate rehabilitation	- Patient discharged to home from a prior hospitalization without a physical therapy assessment, or with a physical therapy assessment recommending services that were not utilized.
Patient either on hospice or supportive care alone admitted to hospital	- Patient with clear documentation of receiving hospice care or supportive care alone being admitted to the hospital
Outpatient management is potentially possible	- Clinicians' (coders') judgment

Table 2:

Variable	All Patients (n=329)
Median age (IQR)	69 (9)
Gender (%)	
Male	194 (59.0)
Female	135 (41.0)
White Race (%)	320 (97.3)
Marital status (%)	
Single	36 (10.9)
Married	242 (73.6)
Divorced	26 (7.9)
Widowed	25 (7.6)
Education (%)	
8 th grade	3 (0.9)
Some high school	43 (13.1)
High school degree	90 (27.4)
Some college	51 (15.5)
College degree	98 (29.8)
Post grad degree	44 (13.4)
ECOG Performance status (SD)	0.88 (0.56)
HCT-Comorbidity Index (SD)	1.9 (1.8)
Hospitalizations	
Median number of Hospitalizations (range)	4 (0-18)
Median number of days in hospital (range)	54 (0-224)
Induction therapy	
Intensive induction	197 (59.9)
Non-intensive therapy	132 (40.1)
Received HCT (%)	109 (33.1)
Disease risk (%)	
Low	25 (7.6)
Intermediate	164 (50.2)
High	139 (42.3)

Table 3

Primary reason for hospitalization	All hospitalizations (N = 1040)	Intensive Induction (N =722)	Non-intensive induction (N =319)	P-value
Symptoms	102 (9.8%)	57 (7.9%)	45 (14.1%)	< 0.0001
Fever	397 (38.1%)	224 (31.0%)	173 (54.2%)	
Bleeding	37 (3.6%)	20 (2.8%)	17 (5.3%)	
Planned	391 (37.6%)	342 (47.4%)	49 (15.4%)	
Not related to cancer	53 (5.1%)	33 (4.6%)	20 (6.3%)	
Relapse	29 (2.8%)	22 (3.1%)	7 (2.2%)	
GVHD	25 (2.4%)	20 (2.8%)	5 (1.6%)	
Other	7 (0.7%)	4 (0.6%)	3 (0.9%)	

Table 4

Classification of PAH	All PAH (N = 172)	Intensive Induction (N =93)	Non-intensive induction (N =79)	P-value
Inadequate management	5 (2.9%)	3 (3.3%)	2 (2.6%)	0.24
Premature discharge	82 (47.7%)	49 (52.7%)	33 (41.8%)	
Failure of timely follow-up	26 (15.3%)	15 (16.3%)	11 (14.1%)	
Social problems leading to admission	3 (1.8%)	2 (2.2%)	1 (1.3%)	
Patient non-adherence	2 (1.2%)	0 (0.0%)	2 (2.6%)	
Inadequate rehabilitation	2 (1.2%)	0 (0.0%)	2 (2.6%)	
Patient either on hospice or supportive care	20 (11.8%)	7 (7.6%)	13 (16.7%)	
Outpatient management possible	32 (18.8%)	17 (18.5%)	15 (19.2%)	

Table 5:

Variables	Odds Ratio	95% Confidence Interval	P-value
Age	1.037	1.01 – 1.06	0.002
Female gender	1.17	0.85 – 1.60	0.34
Marital status (married)	1.05	0.72 – 1.53	0.79
Higher-education	1.45	1.04 – 2.01	0.028
Performance Status	1.04	0.78 – 1.40	0.79
Disease risk (1 comparator)			
2	1.30	0.69 – 2.45	0.42
3	1.90	0.97 – 3.51	0.058
HCT-CI	1.04	0.95 – 1.13	0.41
No transplant	1.72	1.24 – 2.38	0.0010
Non-intensive induction	2.09	1.52 – 2.87	< 0.0001
Hospital effect 1 vs. 2	3.09	0.47 – 20.40	0.24

Table 6:

Variables	Odds Ratio	95% Confidence Interval	P-value
Age	1.00	0.97 – 1.03	0.92
Female gender	1.15	0.83 – 1.60	0.39
Higher education	1.43	1.01 – 2.00	0.040
Disease risk			
2	1.26	0.65 – 2.42	0.50
3	1.74	0.90 – 3.34	0.10
HCT-CI	0.99	0.91 – 1.10	0.93
ECOG PS	0.83	0.91 – 1.10	0.93
Non-intensive induction	1.97	1.25 – 3.10	0.0030
No transplant	1.18	0.78 – 1.78	0.43

Figure 1

Acknowledgements:

Author Contributions: Dr. Temel and Dr. El-Jawahri had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: El-Jawahri, Keenan, Abel, Steensma, Traeger, LeBlanc, Chen, Hobbs, DeAngelo, Stone, and Temel.

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Statistical analysis: El-Jawahri and Traeger

Obtained funding: El-Jawahri, and Temel

Administrative, technical, or material support: El-Jawahri, Temel, Abel, Steensma, Stone, DeAngelo, Wadleigh, Ballen, Fathi, and Amrein

Study supervision: El-Jawahri, and Temel

Role of the Sponsor: None

Additional Contributions: None

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