

External Validation of Risk Factors for Unplanned Hospitalization in Older Adults With Advanced Cancer Receiving Chemotherapy

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ABSTRACT

Background: Older adults (age ≥ 65 years) receiving chemotherapy are at risk for hospitalization. Predictors of unplanned hospitalization among older adults receiving chemotherapy for cancer were recently published using data from a study conducted by the Cancer and Aging Research Group (CARG). Our study aimed to externally validate these predictors in an independent cohort including older adults with advanced cancer receiving chemotherapy. **Methods:** This validation cohort included patients ($n=369$) from the GAP70+ trial usual care arm. Enrolled patients were aged ≥ 70 years with incurable cancer and were starting a new line of chemotherapy. Previously identified risk factors proposed by the CARG study were ≥ 3 comorbidities, albumin level < 3.5 g/dL, creatinine clearance < 60 mL/min, gastrointestinal cancer, ≥ 5 medications, requiring assistance with activities of daily activities (ADLs), and having someone available to take them to the doctor (ie, presence of social support). The primary outcome was unplanned hospitalization within 3 months of treatment initiation. Multivariable logistic regression was applied including the 7 identified risk factors. Discriminative ability of the fitted model was performed by calculating the area under the receiver operating characteristic (AUC) curve. **Results:** Mean age of the cohort was 77 years, 45% of patients were women, and 29% experienced unplanned hospitalization within the first 3 months of treatment. The proportions of hospitalized patients with 0–3, 4–5, and 6–7 identified risk factors were 24%, 28%, and 47%, respectively ($P=.04$). Impaired ADLs (odds ratio, 1.76; 95% CI, 1.04–2.99) and albumin level < 3.5 g/dL (odds ratio, 2.23; 95% CI, 1.37–3.62) were significantly associated with increased odds of unplanned hospitalization. The AUC of the model, including the 7 identified risk factors, was 0.65 (95% CI, 0.59–0.71). **Conclusions:** The presence of a higher number of risk factors was associated with increased odds of unplanned hospitalization. This association was largely driven by impairment in ADLs and low albumin level. Validated predictors of unplanned hospitalization can help with counseling and shared decision-making with patients and their caregivers.

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Background

Older adults with cancer are at a higher risk for hospitalization, which can be a significant burden for patients, caregivers, and the healthcare system.¹ Recent data suggest that 34% of patients with cancer aged 66 to 75 years have unplanned hospitalizations in the first year after cancer diagnosis.² This percentage substantially increases to 43% among those aged > 75 years.² Unplanned hospitalization negatively impacts quality of life and increases the risk of functional decline and loss of independence.^{3,4} Moreover, hospitalization is associated with increased healthcare expenses and a significant financial burden for older adults with cancer and their families.^{5–7} Identification of validated risk factors for hospitalization among older adults could inform treatment and care delivery interventions to minimize risk.

Compared with younger adults, older adults with cancer are more vulnerable to adverse events with cytotoxic chemotherapy. This vulnerability leads to a higher risk of hospitalization because of their aging-related conditions and lower physiologic reserve with organ function.^{8,9} However, risk factors associated with unplanned hospitalization are not well defined among older adults with cancer receiving chemotherapy. The utility of the geriatric assessment (GA) or its components in predicting unplanned hospitalization has previously been investigated. These studies have

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identified geriatric impairments, such as functional dependency, poor nutrition, and polypharmacy (≥ 5 medications), as being associated with an increased risk of hospitalization among older adults with cancer receiving chemotherapy.^{10–12} However, no predictive model has been externally validated for these studies.

A recent study published by the Cancer and Aging Research Group (CARG) identified risk factors associated with unplanned hospitalizations among older patients receiving chemotherapy for cancer.¹³ The 7 risk factors identified were gastrointestinal cancer, higher number of comorbidities (≥ 3), polypharmacy (≥ 5 medications), below-normal creatinine clearance (< 60 mL/min), below-normal albumin level (< 3.5 g/dL), dependence in activities of daily living (ADLs), and availability of social support. The purpose of the current analysis was to (1) externally validate the identified risk factors in an independent cohort of older adults with advanced cancer, and (2) explore additional risk factors associated with unplanned hospitalization in older adults with advanced cancer receiving chemotherapy.

Methods

Development Cohort

A recent study published by CARG identified 7 risk factors for unplanned hospitalization among adults aged ≥ 65 years at any cancer stage receiving chemotherapy.¹³ This analysis used data collected in a prospective longitudinal study that evaluated predictors of chemotherapy toxicity in 750 patients aged ≥ 65 years who were initiating a new chemotherapy regimen.^{8,14} Details of the parent cohort study are published elsewhere.⁸ The 7 identified risk factors included a combination of clinical, laboratory, and GA measures.

Study Design

In the current analysis, external validation of the identified risk factors was conducted using data from a nationwide, multicenter, cluster-randomized study that assessed whether providing information regarding GA plus GA-driven recommendations to community oncologists reduced clinician-rated grade 3–5 toxicity in patients aged ≥ 70 years with incurable cancer starting a new cancer treatment regimen (Geriatric Assessment for Patients [GAP70+] study; University of Rochester Cancer Center [URCC] 13059, PI: S.G. Mohile; ClinicalTrials.gov identifier: NCT02054741).¹⁵ In the GAP70+ study, community practices within the NCI's Community Oncology Research Program (NCORP) were randomized to the intervention group (oncologists received a GA summary and recommendations) or the usual care group (no summary or recommendations given except alerts for impaired scores regarding depression or cognitive status). Because the GAP70+ study showed that unplanned

hospitalization was lower in the intervention arm, the current analysis used data from patients in the usual care group only to avoid the possible influence of the intervention. Eligibility criteria for this analysis were (1) age ≥ 70 years, (2) diagnosis of an incurable stage III/IV solid tumor or lymphoma, (3) ≥ 1 GA domain impairment, and (4) a plan to start a new cancer treatment regimen including a chemotherapy drug or other agents with a similar prevalence of toxicity (eg, tyrosine kinase inhibitors such as sorafenib and erlotinib). Eligible regimens were determined based on enrolling physicians' discretion and were reviewed at the primary coordinating site.

Outcome Variable

The primary outcome of this analysis was the proportion of participants who experienced treatment-related unplanned hospitalization(s) within 3 months of starting a new treatment regimen (ie, an overnight hospital stay for any reason that was not scheduled). Any planned or scheduled admissions were excluded from the analysis. Data on hospitalization were prospectively captured by practice staff. Clinic notes and discharge summaries were reviewed by blinded clinicians at the research base at URCC, and the treating physician was queried if there was any discrepancy.

Predictor Variables

For the primary aim, we focused on validation of the 7 identified risk factors proposed by Klepin et al.¹³ Similar to the development cohort, all predictors were treated as categorical dichotomous variables to ease interpretation of the predictors. These risk factors included cancer type (gastrointestinal vs other types of cancer), comorbidity (≥ 3 vs < 3 self-reported comorbid conditions on the Older Americans Resources and Services Multidimensional Functional Assessment Questionnaire–Physical Health subscale), polypharmacy (≥ 5 vs < 5 concomitant medications), creatinine clearance (< 60 vs ≥ 60 mL/min creatinine clearance, calculated using the Jelliffe equation with ideal body weight), albumin level (< 3.5 vs ≥ 3.5 g/dL), assistance required with ADLs (yes vs no), and having someone available to take them to the doctor most or all of the time (yes vs no). All predictor variables were captured at baseline before patients started a new line of cancer treatment. These variables were described previously in the primary study.¹⁵

For the secondary aim of the study, we collected information on the following baseline variables and assessed them in relation to hospitalization: (1) demographic variables including age, gender, race, education, and income; (2) clinical characteristics including cancer stage, treatment regimen (standard vs nonstandard), palliative treatment line (first- vs second-line or greater); and (3) GA variables, including the 15-item Geriatric Depression Scale (GDS-15) to assess psychological status, the Mini-Cog as a cognitive

screening assessment, the Mini Nutritional Assessment (MNA) to assess nutrition, and history of falls in the past 6 months to assess physical function. All GA variables were previously defined and described.¹⁵ The assessed baseline variables were found to be associated with hospitalization or other chemotherapy adverse events among older adults in prior studies.^{9,16–18}

Statistical Analysis

Descriptive statistics (proportions for categorical variables and means for continuous variables) were generated to summarize and compare demographics, GA measures, clinical characteristics, and outcome measures between the development and validation cohorts.

For the primary aim, multivariable logistic regression modeling was applied, including the 7 identified risk factors. Discriminative ability of the fitted model was assessed by composing the receiver operating characteristic (ROC) and calculating the area under the ROC (AUC). To investigate additional risk factors unique to our study population, we first ran bivariate analyses using chi-square tests for categorical variables and *t* tests for continuous variables examining the relationship of other baseline demographic, clinical, and geriatric variables with hospitalization. Subsequently, variables with *P* values <.10 were added to the model with the 7 a priori risk factors, and model performance was reassessed.

For all the analyses, 2-sided *P* values ≤.05 were considered statistically significant. All data were analyzed using SAS 9.4 (SAS Institute Inc.).

Results

Table 1 includes patient characteristics for the validation and development cohorts. The mean [SD] age for participants was 77.2 [5.2] years in the validation cohort and 73.1 [6.0] years in the development cohort; 45.3% of patients in the validation cohort were women compared with 55.9% in the development cohort. Lung cancer was the most common cancer type among both the validation (31.4%) and development cohorts (27.6%). The validation cohort included more patients with metastatic (stage IV) disease compared with the development cohort (87.8% vs 58.1%, respectively).

Regarding treatment characteristics, whereas all patients in the development cohort (100%) received chemotherapy agents, we found that 10% of patients in the validation cohort received agents that are considered nonchemotherapy drugs but have a similar prevalence of toxicity (eg, tyrosine kinase inhibitors such as sorafenib and erlotinib). In addition, the development cohort included more patients who received standard-of-care regimens compared with the validation cohort (73.1% vs 65.0%). Similarly, the development cohort included more

patients who received combination chemotherapy agents compared with the validation cohort (70.3% vs 52.7%).

Distribution of the identified risk factors in the validation cohort was as follows: diagnosis of gastrointestinal cancer (*n*=114; 30.9%), ≥3 comorbid conditions (*n*=234; 63.4%), receiving ≥5 medications (*n*=224; 61.0%), creatinine clearance <60 mL/min (*n*=154; 41.7%), albumin level <3.5 g/dL (*n*=155; 42.0%), requiring assistance with ADLs (*n*=90; 24.5%), and having someone available to take them to the doctor most or all of the time (*n*=352; 95.4%). A total of 29% of patients in the validation cohort (*n*=107) experienced unplanned hospitalization within the first 3 months of treatment initiation (compared with 25.0% in the development cohort). When we used the same cut points as the development cohort (0–2, 3, and 4–7 risk factors), the proportions of hospitalized patients were 23%, 28%, and 31%, respectively (Figure 1). Because none of the patients in the validation cohort had 0 risk factors, we also evaluated alternative cut points fitted to this population. In this cohort, a categorization of 0–3, 4–5, and 6–7 identified risk factors corresponded to hospitalization rates of 24%, 28%, and 47%, respectively (*P*=.04) (Figure 2). A higher number of risk factors was associated with a 23% increased odds of unplanned hospitalization (odds ratio [OR], 1.23; 95% CI, 1.05–1.51; *P*=.02).

In bivariate analysis, when examining other baseline variables in relation to hospitalization, we found that a history of falls in the past 6 months (*P*<.01) and impairment on the GDS-15 (*P*<.01) were significantly associated with unplanned hospitalization. Other variables, including age, gender, race, education, income, and cancer stage, were not associated with unplanned hospitalization within 3 months (*P*>.1) (supplemental eTable 1, available with this article at JNCCN.org).

In multivariable analysis, in the model with the 7 identified risk factors, we found that difficulty with ADLs (OR, 1.76; 95% CI, 1.04–2.99) and albumin level <3.5 g/dL (OR, 2.23; 95% CI, 1.37–3.62) were significantly associated with increased odds of unplanned hospitalization (Table 2). When we extended the model to include other significant baseline variables in bivariate analysis, we found that a history of falls in the past 6 months (OR, 1.76; 95% CI, 0.97–3.15) and impairment on the GDS-15 (OR, 1.85; 95% CI, 1.04–3.28) were also associated with increased odds of unplanned hospitalization (supplemental eTable 2).

The AUC of the model including the 7 a priori risk factors (≥3 comorbidities, albumin <3.5 g/dL, creatinine clearance <60 mL/min, gastrointestinal cancer, ≥5 medications, requiring assistance with ADLs, and having someone available to take them to the doctor most or all of the time) was 0.65 (95% CI, 0.59–0.71) (Figure 3A).

After extending this model to include a history of falls in the past 6 months and impairment on the GDS-15, the AUC

Table 1. Patient and Treatment Characteristics

Variable	Development Cohort n (%)	Validation Cohort n (%)	P Value
Total, N	750	369	
Sociodemographic variables			
Age, mean [SD], y	73.1 [6.0]	77.2 [5.2]	<.01
Gender ^a			<.01
Male	331 (44.1)	202 (54.7)	
Female	419 (55.9)	166 (45.3)	
Race ^a			<.01
White	632 (84.3)	350 (95.1)	
Black	62 (8.3)	12 (3.3)	
Others ^b	56 (7.5)	6 (1.6)	
Education ^{a,c}			<.01
High school or less	289 (38.5)	178 (48.3)	
College or above	460 (61.4)	190 (51.5)	
Baseline clinical variables			
Cancer type			<.01
Gastrointestinal	203 (27.1)	114 (30.9)	
Lung	207 (27.6)	116 (31.4)	
Genitourinary	80 (10.7)	53 (15.2)	
Others	260 (34.7)	86 (23.3)	
Cancer stage ^{d,e}			—
I	33 (4.4)	—	
II	99 (13.2)	—	
III	175 (23.3)	35 (9.5)	
IV	436 (58.1)	324 (87.8)	
Line of chemotherapy			.19
First-line	531 (70.8)	275 (74.5)	
Second-line or greater	219 (29.2)	94 (25.5)	
Standard chemotherapy ^f			<.01
Yes	548 (73.1)	240 (65.0)	
No	177 (23.6)	129 (35.0)	
Number of chemotherapy agents ^g			<.01
1	223 (29.7)	174 (47.3)	
>1	527 (70.3)	194 (52.7)	

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increased to 0.68 (95% CI, 0.62–0.74) (Figure 3B). The multivariable effect estimates for risk factors associated with hospitalization in the validated and extended models are shown in Table 2 and supplemental eTable 2.

Discussion

This study aimed to validate a group of clinical, laboratory, and GA risk factors for unplanned hospitalization

among older adults with advanced cancer receiving chemotherapy, identified in a prior study conducted by CARG. We found that the presence of a higher number of risk factors was associated with increased odds of unplanned hospitalization. This association was largely driven by impairment in performing ADLs and a low albumin level. In addition, we showed that evaluating these risk factors together has the ability to assist in

Table 1. Patient and Treatment Characteristics (cont.)

Variable	Development Cohort n (%)	Validation Cohort n (%)	P Value
Geriatric assessment and laboratory variables			
Falls in past 6 months ^{a,g}			.26
Yes	145 (19.4)	76 (20.7)	
No	603 (80.6)	292 (79.3)	
Number of comorbidities, median (range)	2 (0–12)	3 (0–9)	—
Polypharmacy ^h			<.01
<5 medications	384 (52.2)	145 (39.3)	
≥5 medications	352 (47.8)	224 (60.7)	
Difficulty with ADLs ^a			<.01
Yes	74 (9.9)	90 (24.5)	
No	676 (90.1)	278 (75.5)	
Social support ⁱ			<.01
Yes	671 (89.8)	352 (95.4)	
No	79 (10.2)	17 (4.6)	
Impairment on GDS-15			—
Yes	NA	84 (22.8)	
No	—	285 (77.2)	
Cognitive impairment ^{c,j}			—
Yes	46 (6.1)	119 (32.2)	
No	703 (93.9)	250 (67.8)	
Albumin level, median (range), g/dL	3.9 (1.0–5.0)	3.6 (1.0–6.9)	—
Creatinine clearance, median (range), mL/min	58.1 (12.3–122.9)	64.2 (9.6–188)	—

Abbreviations: ADLs, activities of daily living; GDS-15, 15-item Geriatric Depression Scale; NA, not assessed.

^aIn the validation cohort, 1 patient had missing data.

^bAmerican Indian or Alaskan Native; Asian; Native Hawaiian or Other Pacific Islander.

^cIn the development cohort, 1 patient had missing data.

^dIn the development cohort, 7 patients had missing data.

^eIn the validation cohort, the remaining 10 patients were in an “Others” category because a different staging system from AJCC was used.

^fIn the development cohort, 25 patients had missing data.

^gIn the development cohort, 2 patients had missing data.

^hIn the development cohort, 14 patients had missing data.

ⁱHaving someone available to take them to the doctor most or all of the time.

^jCognitive impairment was assessed through the Blessed Orientation Memory Concentration test (ie, a validated test that assesses the degree of intellectual and personality deterioration in dementia among older adults) in the development cohort and the Mini-Cog test in the validation cohort.²⁹

discriminating the hospitalization risk in older adults with cancer during their treatment course. Furthermore, we explored additional risk factors unique to older adults with advanced cancer and found that the risk of unplanned hospitalization was higher among patients with a history of falls in the past 6 months and those who screened positive on the GDS-15.

This is the first study to externally validate predictors for unplanned hospitalization among older adults with cancer receiving chemotherapy. Validated risk factors of unplanned hospitalization are of particular interest for oncologists. First, they would allow clinicians to estimate the risk of hospitalization before cancer treatment is planned.

Second, validated predictors of unplanned hospitalization can help with counseling and shared decision-making with patients and their caregivers. Moreover, identifying these predictors can guide the development of interventions to reduce risk of hospitalization and improve both patient and caregiver outcomes.

Despite the differences in treatment characteristics between the 2 cohorts (ie, more patients in the development cohort received standard-of-care regimens and were on combination treatment), the current analysis showed that the incidence of unplanned hospitalization was greater among the validation cohort (29%) compared with the incidence of hospitalization in the development cohort (25%).¹³

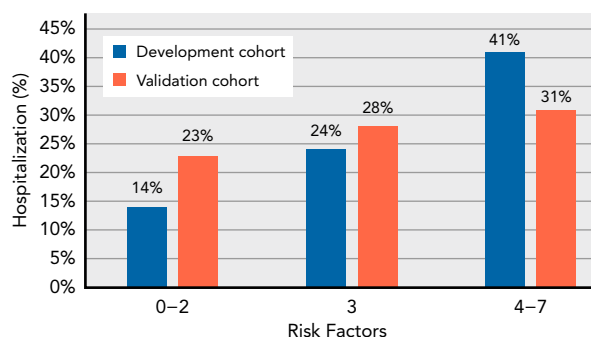


Figure 1. Proportion of older adults hospitalized during chemotherapy by presence of number of identified risk factors among development and validation cohort (using original cutoff values of risk factors; 0–2, 3, and 4–7).

Risk factors included gastrointestinal cancer, comorbidity, polypharmacy, below-normal creatinine clearance and albumin levels, requiring assistance with ADLs, and having someone available to take them to the doctor most or all of the time.

Abbreviation: ADLs, activities of daily living.

We found that most risk factors identified in the development cohort were not significantly associated with hospitalization when we assessed their individual effect estimates in our validation cohort. These findings could be attributed to the difference in the characteristics between the 2 cohorts. Although the development cohort included patients with different cancer stages (I–IV), the validation cohort was restricted to patients with incurable cancers (stages III–IV), who are typically frailer and have more aging-related conditions.¹⁹ In addition, all the participants in the validation cohort were impaired on at least one geriatric domain per trial eligibility. Accordingly, the proportion of patients who had 4 to 7 identified risk factors (ie, intermediate and most-frail groups) was greater among the validation cohort compared with the development cohort (59.0% vs 32.0%).

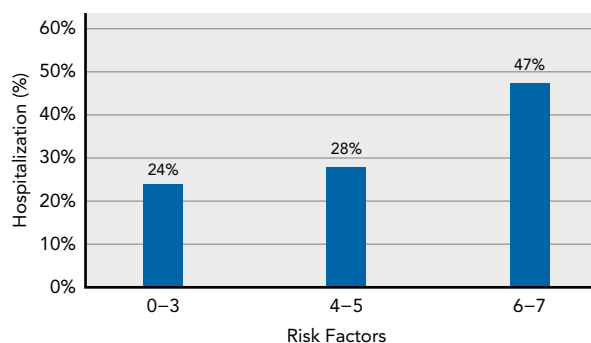


Figure 2. Proportion of older adults hospitalized during chemotherapy by presence of number of identified risk factors among validation cohort (using new cutoff values of risk factors; 0–3, 4–5, and 6–7).

Risk factors included gastrointestinal cancer, comorbidity, polypharmacy, below-normal creatinine clearance and albumin levels, requiring assistance with ADLs, and having someone available to take them to the doctor most or all of the time.

Abbreviation: ADLs, activities of daily living.

Table 2. Multivariable Analysis of 7 Identified Risk Factors Associated With Hospitalization

Risk Factor	Odds Ratio (95% CI)
Gastrointestinal cancer	1.37 (0.80–2.33)
Difficulty with ADLs	1.76* (1.04–2.99)
Impaired polypharmacy	0.95 (0.57–1.56)
Creatinine clearance (<60 mL/min)	1.21 (0.74–1.96)
≥3 comorbid conditions	1.20 (0.72–2.01)
Albumin level (<3.5 g/dL)	2.23* (1.37–3.62)
Social support ^a	0.92 (0.28–3.05)

Abbreviation: ADLs, activities of daily living.

^aHaving someone available to take them to the doctor most or all of the time.

* $P < .05$.

Despite these differences, the current analysis indicated a significant association between an increased number of these risk factors and the risk of hospitalization. In addition, when we classified the 7 clinical, laboratory, and GA identified risk factors into different risk categories that better fit our frail and homogeneous population (ie, 0–3, 4–5, and 6–7 risk factors), we found that compared with patients in the low-risk category (0–3 risk factors), the odds of experiencing unplanned hospitalization were >2 times greater for patients in the high-risk category. This finding reinforces the hypothesis that these risk factors (ie, aging-related conditions) are not considered discrete diseases and are closely linked with each other.

It is worth noting that we observed only a modest discriminative ability when we compared the hospitalization risk among the different risk categories used in the development cohort (0–2, 3, and 4–7 risk factors; 23%, 28%, and 31%, respectively). This loss of discrimination in external validation cohorts has been described previously¹⁴ but in this case may be largely attributable to known differences between the study populations. We observed the biggest difference in performance of the prediction tool between the development and the validation cohorts in the incidence of outcome in low-risk patients. This observation could be explained by all the participants in the validation cohort having impairment on at least one geriatric domain per trial eligibility, which reflects a frailer cohort compared with the development cohort in the low-risk group. Specifically, the validation cohort excluded truly low-risk patients by design. Despite its modest discriminative ability, this model still provides some risk stratification to support its use in the clinical setting, where providers will see a heterogeneous population, including those who match the validation cohort population along with those who were represented in the development cohort (ie, more fit patients).

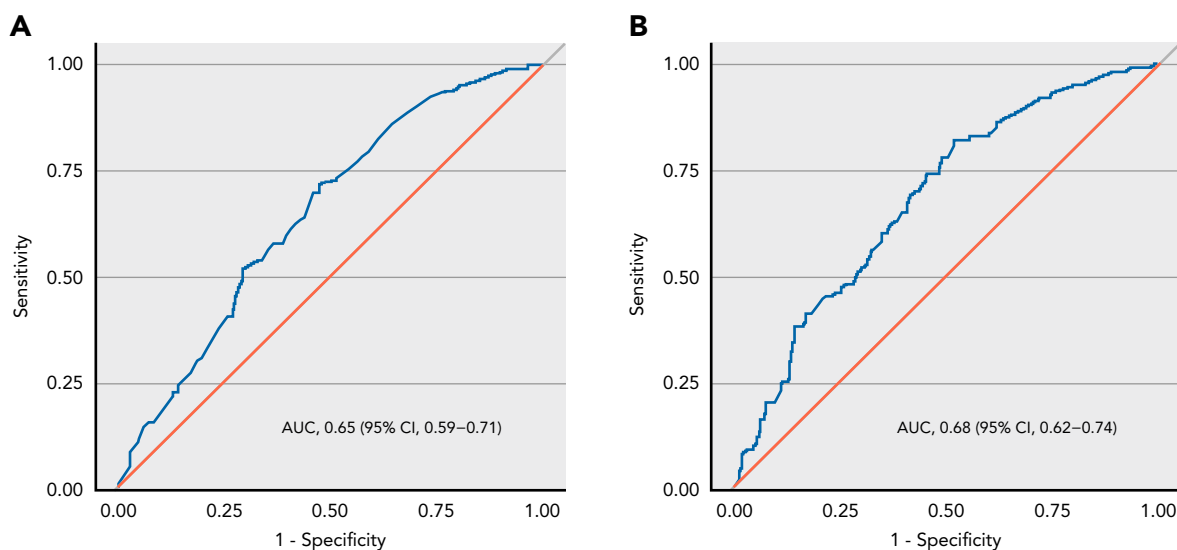


Figure 3. ROC curves for the examined risk factors in relation to unplanned hospitalization. Abbreviations: AUC, area under the ROC curve; ROC, receiver operating characteristic.

In our validation cohort, the association between the number of risk factors and increased odds of unplanned hospitalization was largely driven by impairment in performing ADLs and low albumin level before treatment. Difficulty performing ADLs such as bathing and dressing (ie, functional impairment) affected approximately one-quarter of our validated cohort. Older adults who develop such difficulties, commonly caused by frailty and other age-related conditions, are at increased risk of chemotherapy adverse events, including unplanned hospitalization.^{9,19,20} Moreover, previous data have shown that a reduction in serum albumin, which is more pronounced in older patients with poor nutrition (38% of the study participants), may lead to increased risk of chemotherapy adverse events, including unplanned hospitalization.^{13,21} The reduction in serum albumin increases the free fraction of the drug in plasma, which has been reported with multiple chemotherapeutic agents, such as cisplatin, etoposide, and taxanes.^{21,22}

In our analysis, we found that a history of falls in the past 6 months was associated with increased risk of hospitalization. Prior studies have shown that patients hospitalized for cancer have higher frequencies of falls when compared with hospitalized patients who do not have cancer.^{23,24} Some chemotherapeutic drugs, such as platinum compounds and taxanes, are known to be neurotoxic, resulting in peripheral neuropathy, which can cause gait and balance issues, and an increased risk of falling.^{25,26} We also noticed a positive association between impairment on the GDS-15 scale and an increased risk of hospitalization. Studies have suggested that psychological impairments including depression

are common among older adults with cancer.²⁷ Moreover, depression has been associated with adverse outcomes such as functional impairment and poor survival in this population.^{9,28}

It is worth noting that most of the risk factors predicting unplanned hospitalization are part of the GA, which underscores the importance of performing geriatric screening before initiation of chemotherapy among older adults with cancer and aging-related conditions. One advantage of the risk factors predicting unplanned hospitalization in our study is that they can be easily assessed and gathered during routine clinical practice. Accordingly, they can be easily implemented in daily oncology care compared with a full GA, which may be difficult to perform within the time constraints of busy clinical practices in limited-resource settings.

A major strength of this study is its inclusion of a population that is typically marginalized in oncology trials: older adults with advanced cancer receiving care in community oncology (ie, real-world) practices. In addition, the prospective capturing of hospitalization data limited the problem of recall bias. Our study also has some limitations. First, the enrollment of the patients in this study as part of a GA intervention clinical trial may have introduced bias upon the population selecting to participate, which may have limited the study's generalizability. Second, because our patients were primarily non-Hispanic White and well-educated, our findings may not be applicable to patients of other races/ethnicities or with lower levels of education.

Conclusions

This study contributes to informed clinical decision-making regarding planning treatment and expectation of adverse outcomes in this vulnerable population. The identified and validated clinical and GA predictors can be used to identify high-risk patients in order to guide interventions to reduce hospitalization in older adults with cancer.

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Supplemental online content for:

External Validation of Risk Factors for Unplanned Hospitalization in Older Adults With Advanced Cancer Receiving Chemotherapy

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eTable 1: Bivariate Analyses of Baseline Variables and Unplanned Hospitalization Within 3 Months

eTable 2: Multivariable Analysis for Risk Factors Associated With Hospitalization Including History of Falls in the Past 6 Months and Impaired Depression

eTable 1. Bivariate Analyses of Baseline Variables and Unplanned Hospitalization Within 3 Months

Variable	All Patients n (%)	No Hospitalization n (%)	Hospitalization n (%)	P Value
Total, N	369 (100)	262 (71.00)	107 (28.99)	
Sociodemographic variables				
Mean age, y	77.2	77.55	77.05	.39
Gender ^a				.27
Male	202 (54.7)	139 (53.05)	63 (59.43)	
Female	166 (45.3)	123 (46.95)	43 (40.57)	
Race ^a				.86
White	350 (95.1)	246 (93.89)	101 (95.28)	
Black	12 (3.3)	9 (3.44)	3 (2.83)	
Others ^b	6 (1.6)	7 (2.67)	2 (1.89)	
Education ^a				.26
Less than high school	53 (14.4)	33 (12.60)	20 (18.87)	
High school	125 (33.9)	93 (35.50)	32 (30.19)	
College or above	190 (51.5)	136 (51.91)	54 (50.94)	
Income ^a				.99
≤\$50,000	182 (49.3)	130 (49.62)	52 (49.06)	
>\$50,000	96 (26.0)	68 (25.95)	28 (26.42)	
Declined to answer	90 (24.4)	64 (24.43)	26 (24.53)	
Baseline clinical and laboratory variables				
Cancer type ^c				.03
Gastrointestinal	114 (30.9)	85 (32.44)	29 (27.10)	
Lung	116 (31.4)	72 (27.48)	44 (41.12)	
Genitourinary	53 (14.4)	44 (16.79)	9 (8.41)	
Others	86 (23.3)	61 (23.28)	25 (23.36)	
Number of comorbidities (mean) ^c	3.24	3.14	3.48	.10
Cancer stage				.28
III	35 (9.5)	21 (8.02)	14 (13.08)	
IV	324 (87.8)	233 (88.93)	91 (85.05)	
Other	10 (2.7)	8 (3.05)	2 (1.87)	
Creatinine clearance ^c , mL/min				.14
≥60	215 (58.2)	159 (60.69)	56 (52.34)	
<60	154 (41.8)	103 (39.31)	51 (47.66)	
Creatinine clearance ^c (mean), mL/min	68.38	68.95	66.92	.49
Albumin level ^c (mean), g/dL	3.57	3.62	3.46	.03

(continued on next page)

eTable 1. Bivariate Analyses of Baseline Variables and Unplanned Hospitalization Within 3 Months (cont.)				
Variable	All Patients n (%)	No Hospitalization n (%)	Hospitalization n (%)	P Value
Geriatric variables				
Difficulty with ADLs ^{a,c}				.01
No	278 (75.5)	207 (79.01)	71 (66.98)	
Yes	90 (24.5)	55 (20.99)	35 (33.02)	
Impairment on GDS-15				<.01
No	285 (77.2)	215 (82.1)	70 (65.4)	
Yes	84 (22.8)	47 (17.9)	37 (34.6)	
Impairment on Mini-Cog				.11
No	250 (67.8)	184 (70.2)	66 (61.7)	
Yes	119 (32.2)	78 (29.8)	41 (38.3)	
Falls in past 6 months ^a				<.01
No	291 (79.1)	217 (82.82)	74 (69.81)	
Yes	77 (20.9)	45 (17.18)	32 (30.19)	
Social support ^{a,c,d}				.73
Yes	352 (95.6)	250 (95.42)	102 (96.23)	
No	16 (4.4)	12 (4.58)	4 (3.77)	

Abbreviations: ADLs, activities of daily living; GDS-15, 15-item Geriatric Depression Scale.

^aData were missing for 1 patient.

^bAmerican Indian or Alaskan Native; Asian; Native Hawaiian or Other Pacific Islander.

^cIdentified risk factors from Klepin HD, Sun CL, Smith DD, et al. Predictors of unplanned hospitalizations among older adults receiving cancer chemotherapy. *JCO Oncol Pract* 2021;17:e740–752.

^dHaving someone available to take them to the doctor most or all of the time.

eTable 2. Multivariable Analysis for Risk Factors Associated With Hospitalization Including History of Falls in the Past 6 Months and Impaired Depression

Risk Factor	Odds Ratio (95% CI)
Gastrointestinal cancer	1.34 (0.78–2.30)
Difficulty with ADLs	1.36 (0.77–2.40)
Impaired polypharmacy	0.92 (0.55–1.53)
Creatinine clearance (<60 mL/min)	1.21 (0.74–1.98)
≥3 comorbid conditions	1.04 (0.61–1.76)
Albumin level (<3.5 g/dL)	2.17* (1.33–3.57)
Social support ^a	0.99 (0.29–3.36)
Falls in past 6 months	1.76 (0.97–3.15)
Impairment on GDS-15	1.85* (1.04–3.28)

Abbreviations: ADLs, activities of daily living; GDS-15, 15-item Geriatric Depression Scale.

^aHaving someone available to take them to the doctor most or all of the time.

* $P < .05$.