



Development and validation of prognostic risk score for cancer patients with neutropenic fever presenting to the emergency department

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Background

Emergency department (ED) visits due to neutropenic fever are common among cancer patients.^{1,2} Identifying patients who are at greater risk of rapid deterioration following their ED visit is important.³ Early recognition of these patients is crucial for ensuring prompt medical intervention and optimizing their chances for better outcomes.³ In this multi-institution study, we aimed to develop and validate prognostic risk score for cancer patients with neutropenic fever presenting to the ED.

Methods

All consecutive adult patients with neutropenic fever who presented to Memorial Sloan Kettering Cancer Center (MSK) ED between January 1, 2016, and December 31, 2020, were included in the development phase, while those who visited MD Anderson Cancer Center (MDACC) ED between January 01, 2019, and June 1, 2020, were used for external validation. The primary outcome of interest was a composite outcome of hospital stay of > 3 days, ICU admission, positive blood culture, supplemental oxygen therapy after ED discharge, or in-hospital death. Descriptive statistics summarized the main characteristics of the cohorts. Univariate and multivariable logistic regression models using clinical variables were used to develop the scoring system with the derivation cohort.

Five-fold cross-validation was used to internally validate the risk score and reporting. The risk score was further applied to the MDACC cohort as an external validation step. The area under the curve (AUC) and its 95% confidence interval of the receiver operating characteristic (ROC) curves were used to examine the performance of the risk score in the derivation and the external validation cohorts. The DeLong test was used to compare if there is a statistically significant difference in the AUCs between the derivation and the external validation cohorts.

Results

A total of 1519 patients fulfilled the eligibility criteria, of which 827 were from MSK (derivation) and 692 from MDACC (validation).

Table 1. Main characteristics of the derivation and validation cohorts

Characteristic	No. of patients (%)	
	MSK (n=827)	MDACC (n=692)
Median age (IQR), years	59 (46-68)	55 (36-67)
Sex		
Female	406 (49.1)	310 (44.8)
Male	421(50.9)	382 (55.2)
Race		
White or Caucasian	569 (68.8)	454 (65.6)
Non-White	258 (31.2)	238 (34.4)
Cancer type		
Hematologic	479 (57.9)	423 (61.1)
Solid tumors	348 (42.1)	269 (38.9)
Acuity/ESI		
Emergent	440 (53.2)	391 (56.5)
Urgent	375 (45.3)	299 (43.2)
Others	12 (1.5)	2 (0.3)
Composite outcome		
No	194 (23.5)	127 (18.4)
Yes	633 (76.5)	565 (81.6)

Table 1 highlights the principal characteristics of the patients. The prevalence of the outcome was 76.5% and 81.6% in the MDACC and MSK cohorts respectively. The final model included cancer type, diastolic blood pressure, sodium, calcium, creatinine, serum glucose, total bilirubin, hemoglobin, and absolute neutrophil count. The maximum score that can be achieved is 22 points (Figure 1). The AUC (95% CI) of the score for MSK was 0.77 (0.73-0.80), which was not significantly different (P=0.527) than the 0.78 (95% CI=0.74-0.82) AUC of MDACC external validation cohort (Figure 2). The mean AUC for the five-fold cross-internal validation was 71.1.

Fig. 1 Final score and assigned points

Variable	Assigned point(s)
Clinical variables	
Hematologic malignancies	2
DBP <60mmHg	2
Oxygen saturation ≤ 94	4
Labratory biomarkers	
ANC >0.1 & <0.5	2
ANC 0-0.1	3
Sodium (Low)	1
Calcium (Low)	2
Hemoglobin (Low)	1
Creatinine (Low or High)	3
Glucose (High)	1
Total Bilirubin (High)	3

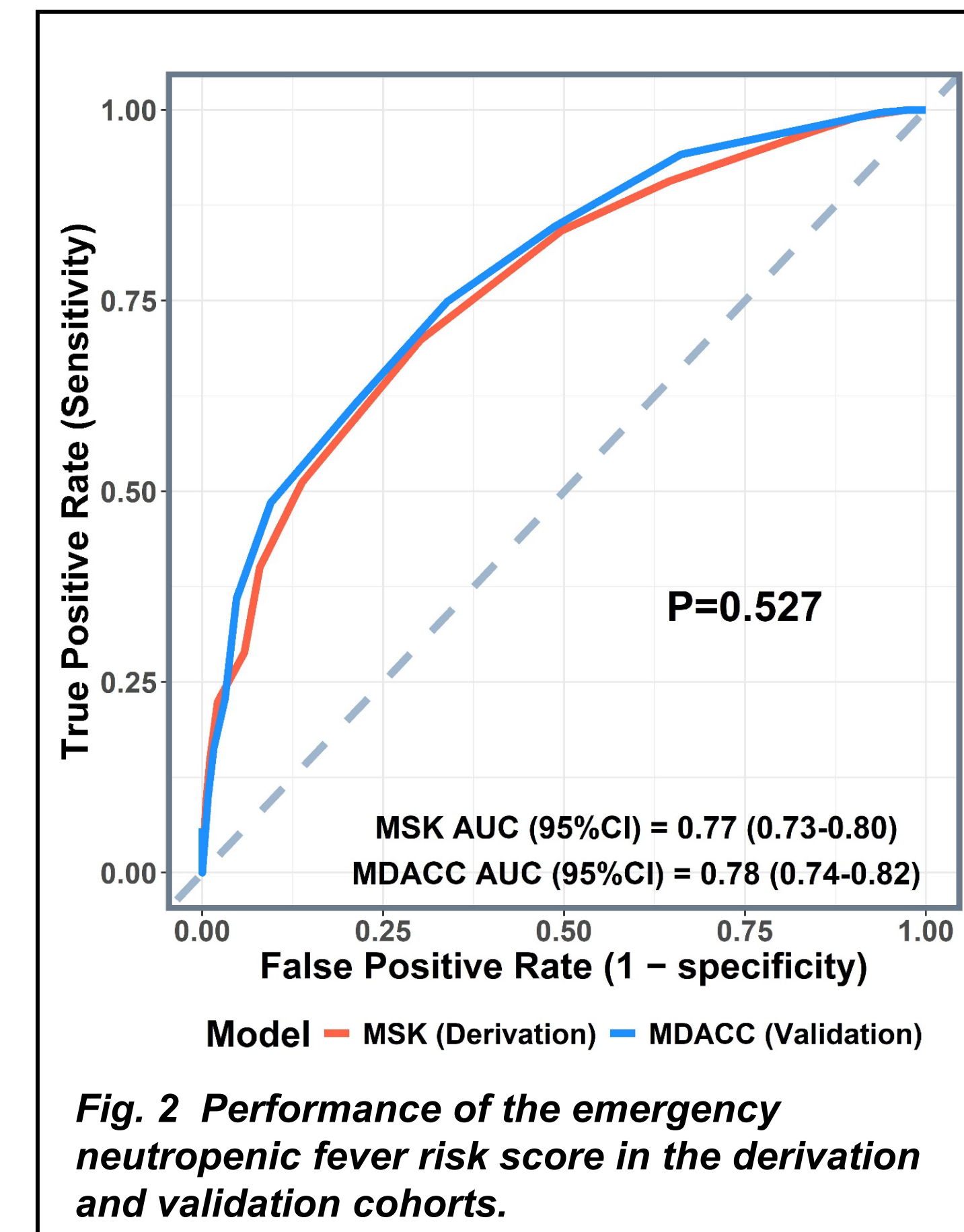


Fig. 2 Performance of the emergency neutropenic fever risk score in the derivation and validation cohorts.

Conclusions

We have developed and externally validated a new prognostic risk score for cancer patients presenting to the ED with neutropenic fever. This new risk score has a good performance in predicting a poor outcome for the patient including ICU admission and death. Further research is needed to compare it with other existing scores, such as the MASCC score, and to prospectively validate it.

References

- 1) Workina A, Habtamu A, Zewdie W. Reasons for Emergency Department Visit, Outcomes, and Associated Factors of Oncologic Patients at Emergency Department of Jimma University Medical Centre. *Open Access Emerg Med.* 2022;14:581-590. Published 2022 Oct 28. doi:10.2147/OAEM.S381816
- 2) Gallaway MS, Idaikkadar N, Tai E, et al. Emergency department visits among people with cancer: Frequency, symptoms, and characteristics. *J Am Coll Emerg Physicians Open.* 2021;2(3):e12438. Published 2021 May 1. doi:10.1002/emp2.12438
- 3) Keck JM, Wingle MJB, Cretella DA, et al. Approach to fever in patients with neutropenia: a review of diagnosis and management. *Ther Adv Infect Dis.* 2022;9:20499361221138346. Published 2022 Nov 26. doi:10.1177/20499361221138346