DEVELOPMENT AND IMPLEMENTATION OF A PREDICTIVE MODEL TO ENHANCE ACADEMIC ADVISING FOR USMLE STEP 1 SUCCESS

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INTRODUCTION

DEFINITIONS

- Comprehensive Basic Science Examination (CBSE)
- Comprehensive Basic Science Self-Assessment (CBSSA)
- Pre-clerkship Course Scores: Average of final scores of pre-clerkship courses

Context:
USMLE Step 1 is a pivotal milestone in medical education affecting student progression and residency opportunities.
Early identification of students at risk for failing Step 1 allows for timely academic support and tailored advising interventions.

Current Challenges:
Traditional advising often relies on subjective evaluation and historical data, which may delay identification of at-risk students.

There is a need for objective, data-driven tools to improve the accuracy and timeliness of risk prediction.

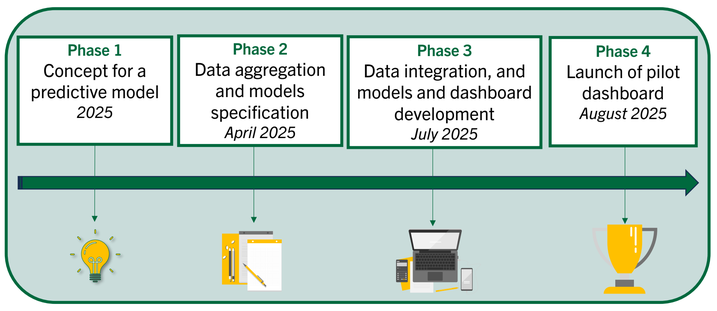
Rationale for Innovation:
Advances in educational data analytics provide opportunities to leverage existing assessment data (CBSE, CBSSA, pre-clerkship course scores) to predict Step 1 outcomes.

Predictive modeling can enhance advising by providing actionable insights earlier in the curriculum.

Purpose:

- Develop and implement a predictive model to estimate the probability of first-attempt Step 1 success using prior academic performance.
- Integrate the model into an interactive dashboard to support timely monitoring and early intervention by advising and student support teams.

Timeline:



QUALITY IMPROVEMENT AIM

- Strengthen evidence-based advising practices.
- Promote efficient allocation of support resources.
- Improve first-attempt Step 1 outcomes while establishing a scalable framework for ongoing refinement and future expansion to additional academic milestones.
- Improve timeliness, accuracy, and consistency of advising decisions compared to traditional approaches that rely heavily on subjective judgement and retrospective indicators
- Enhance organization of this data through use of interactive dashboard.

MODELING APPROACH

Data included CBSE, CBSSA, pre-clerkship course scores, and first-attempt Step 1 results.

Years: 2023 through 2025

A Python-based predictive algorithm was integrated into a Power BI dashboard to enhance end user experience, support interactive visualization, and generate detailed reports.

Seven logistic regression models were developed using single and combined predictors (CBSE, CBSSA, pre-clerkship course scores).

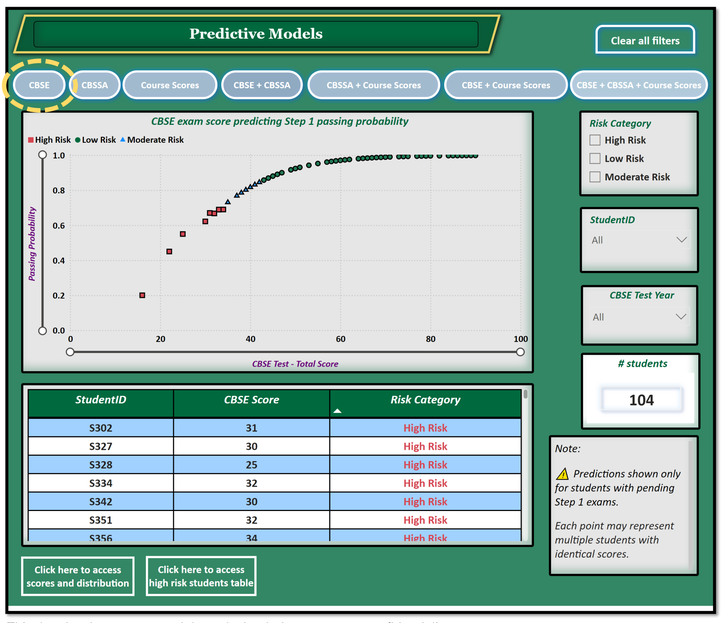
RESULTS

Risk Tier Categorization:
Students were classified into three risk levels based on their passing probabilities: High, Moderate, and Low. The leadership team convened to reach consensus on the categorization of risk tiers.

Early Detection:
Using predictive models, advisors can identify students who have a low probability of passing Step 1 on their first attempt.

Dashboard Functionality:
The dashboard enables users to interact with the visuals and select specific risk tiers. Users can also switch between different models to examine the preferred regression model.

Model Evaluation:
Model performance was assessed through their predictive accuracy. Predictor's importance was determined by their impact on prediction outcomes rather than by statistical significance.



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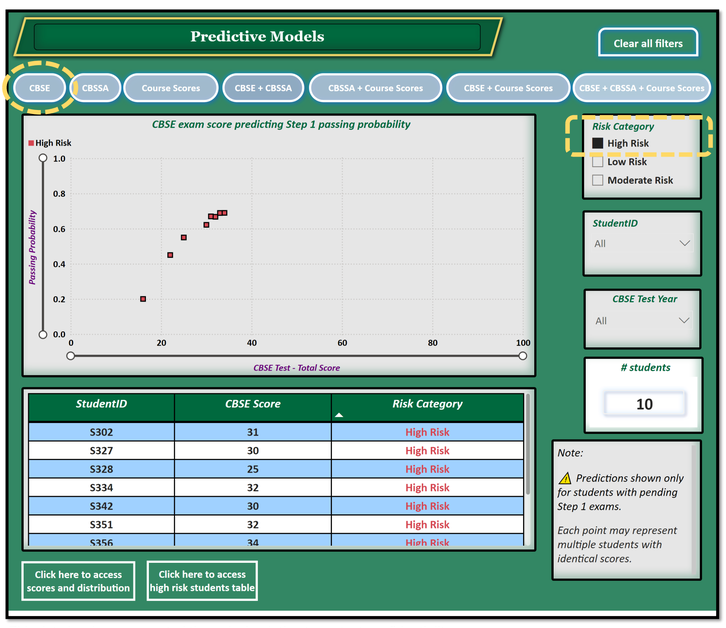

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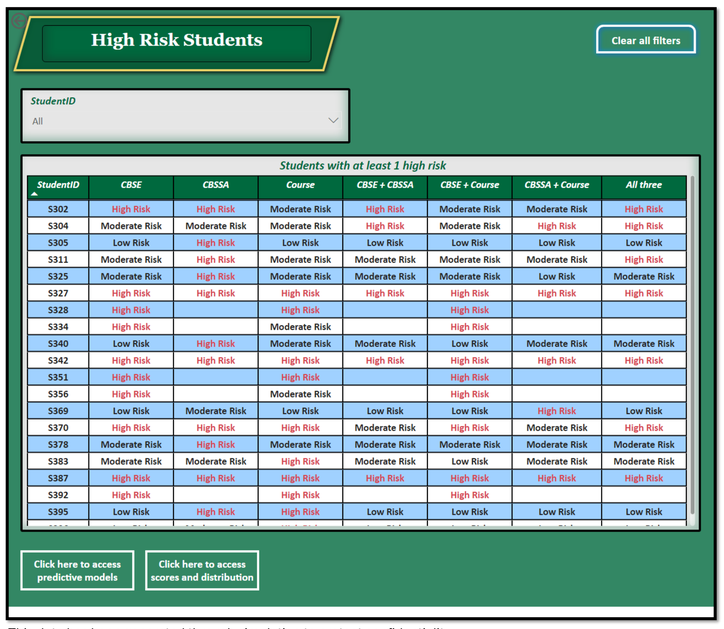

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DISCUSSION

- Demonstrates the feasibility and utility of a predictive model using routinely collected academic data to estimate medical students' likelihood of first-attempt Step 1 success.
- Integrates academic data using logistic regression to enhance data-driven advising practices.
- An interactive Power BI dashboard enables timely monitoring student progress, early identification of at-risk learners, and tailored interventions.
- The model demonstrated strong performance in retrospective validation, supporting its use alongside traditional advising methods, which often rely on subjective judgement or incomplete information.
- This approach aligns with the growing focus on evidence-based educational practices and learning analytics in medical education.
- User feedback supports the feasibility and acceptability of integrating the dashboard into routine advising workflows, with potential to improve student support efficiency.
- By sharing the development process and implementation experience, this work contributes to the broader application of predicative analytics in medical education to support student success.
- Provides an adaptable, data-informed advising framework for institutions with similar data infrastructures.
- Future work will focus on prospective validation and exploring integration with other academic and wellness metrics to further refine predictive accuracy and holistic student support.

PROJECT LIMITATIONS

- Developed and validated using retrospective, single institution data, which may limit generalizability to other medical schools with different curricula or assessment structures.
- Relies on available academic metrics, which may omit other influential factors such as student well-being, study habits, or external stressors that affect Step 1 performance.
- Predictive performance depends on the quality and completeness of institutional data, which may vary across cohorts and over time.
- Implementation depends on access to specific data platforms and analytic infrastructure (e.g., OASIS, Power BI), which may not be available at all institutions.

FUTURE DIRECTIONS

- Validate models with incoming student cohorts to assess predictive accuracy and advising impact
- Integrate additional variables such as student wellness, study behaviors, and demographic factors to enhance model precision
- Expand the dashboard to include predictive analytics for other critical milestones (e.g., Step 2 CK, clinical performance) to support longitudinal advising
- Collaborate with other institutions to test model generalizability and adapt the approach to diverse curricular settings
- Evaluate model effectiveness in improving student outcomes through targeted interventions informed by predictive insights

CONCLUSIONS

- Predictive modelling using academic performance data provides a valuable, data-driven tool to enhance advising for the Step 1 success.
- An interactive dashboard delivers timely, objective insights, supporting early identification of at-risk students and facilitating targeted interventions.
- While current validation demonstrates strong predictive capability, ongoing refinement and prospective evaluation will strengthen its utility.
- This innovation highlights the potential of predictive analytics to transform student support and underscores the importance of leveraging institutional data to promote academic success in medical education.

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Northeast Group on Educational Affairs (NEGEA) Meeting
Scranton, PA
March 2026

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