Performance Of Commonly Used ICU Severity Scoring Systems Among Critically ill Minorities in an Urban City Hospital

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BACKGROUND

- As the population ages and demographics change, it has become increasingly important to assess critical care outcomes among different populations.
- Predictive scoring systems are used to measure severity of illness among critically ill patients and predict outcomes, typically mortality. These scoring systems should however be validated and calibrated for a specific outcome in the population of interest before their use. [1,2].
- Most common scoring systems used to predict mortality in ICU are the Acute Physiologic and Chronic Health Evaluation (APACHE) scoring system [4] and the Mortality Prediction Model (MPM) [5].
- The APACHE II severity score remains the most commonly used scoring system worldwide, despite the availability of the updated APACHE IV score.
- The Mortality Prediction Model (MPM) has three versions which allow sequential calculations of the predicted mortality optionally made at 0, 24, 48, and 72 hours from ICU admission. Variables included in MPM do not require special laboratory testing.
- Despite the availability of such systems for several years, there is scant data on their performance among inner-city critically ill minority population, who are particularly affected by differences related to disease condition, presentation, intervention and access to timely care.

AIMS

1. Evaluate the performance of APACHE-II, APACHE – IV and MPM in a medical ICU that predominantly serves inner city minorities.
1. Assess commonly used outcomes like length of stay (LOS) and mortality and compare with predicted based on the scoring system.

METHODS

- A retrospective chart review of all patients admitted to MICU at SBH Health System during 1-year period from January 1, 2016, to December 31, 2016 was performed. Post-operative and surgical admissions to MICU were excluded from this study.
- Different variables for APACHE II, APACHE IV and MPM_{24} III were collected by trained investigators from the EMR. Predicted mortality scores using the original protocols were calculated. APACHE IV predicted length of stay was also included.
- Observed mortality was evaluated upon discharge or transfer from in-hospital and MICU. In-hospital and MICU length of stay (LOS) was measured in days.
- Discrimination of each measure was assessed using ROC curves. Observed mortality (MICU and Hospital) was modeled using logistic regression with multivariate analyses (age, gender, APACHE II, APACHE IV, MPM_{24} III).
- LOS (Hospital and MICU) was modeled using Negative Binomial regression with multivariate analyses (age, gender, APACHE II, APACHE IV, MPM_{24} III).
- Comparison of the LOS predicted by APACHE IV with the observed length of stay in MICU was assessed using the Wilcoxon rank sum nonparametric test (Table 1).

RESULTS

- 688 patients were included. 59% were men and and 41% women.
- Total observed Hospital mortality was significantly associated with APACHE II scores (OR: 1.03 to 1.05) , APACHE IV (OR 1.05, 95% CI 1.04 to 1.06) and MPM_{24} III (OR 1.05; 95% CI 1.04 to 1.07).
- Similarly observed MICU mortality was significantly associated with all 3 scores (Table 2)

Table 1. Observed and APACHE IV Predicted Length of Stay

LOS	M	SD	
Length of stay in MICU (days)	4.18	4.81	(Range 0-38; Median 2)
APACHE IV - predicted length of stay (days)	4.68	1.97	(Range -1-10.6; Median 4.7)

Table 2. Comparison of predictability of ICD scoring systems on Hospital and MICU mortality

	Area	SE	p-value	95% Confidence Interval	
Hospital mortality					
APACHE II predictive mortality (Non-Operative)	.802	.020	<.001	.762	.841
APACHE IV predictive mortality	.877	.014	<.001	.850	.905
MPM_{24} III	.850	.017	<.001	.817	.883
MICU mortality					
APACHE II predictive mortality (Non-Operative)	.814	.023	<.001	.769	.858
APACHE IV predictive mortality	.865	.017	<.001	.832	.898
MPM_{24} III	.838	.020	<.001	.799	.877

RESULTS CONTINUED

- APACHE II and MPM were not associated with LOS (Hospital and MICU; p>.05), while APACHE IV was significantly associated with hospital LOS (OR=1.005, 95%CI: 1.002-1.009) and MICU LOS (OR=1.009, 95%CI: 1.006-1.012).
- The predicted APACHE IV length of stay of 4.68 days (SD: 1.97, range of -1- 10.6) was significantly higher than the observed MICU LOS of 4.18 days (SD: 4.81, range of 0 to 38) ($p < 0.001$).

CONCLUSIONS

- This is the one of the first studies that reports on the performance of 3 commonly used prognostic scores among an inner-city critically ill minority population. The 3 scores APACHE II, APACHE IV and MPM_{24} III, discriminated patient mortality well in this patient population.
- Overall, APACHE IV score demonstrated the best overall performance when both mortality and LOS are considered.
- Significantly shorter observed LOS noted in our population (compared to APACHE IV predicted) may be a reflection of updated critical care practices and variations in local ICU utilization of beds.

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