



Is ICD-9-based Trauma Mortality Prediction Model (TMPM-ICD9) applicable to studying survival disparities after traumatic injury?

Sylvia Hobbs, MPH¹; Turner Osler, MD, MSc²; Frederic Milham, MD³; Wenjun Li, PhD⁴

¹ Center for Health Information & Analysis ² University of Vermont, ³ South Shore Hospital, ⁴ University of Massachusetts Medical School



Introduction

Survival following injury is an important measure of the success of health care and racial disparities on this fundamental metric have been documented in Massachusetts (MA). The introduction of health care reform in 2006 provided a natural experiment to examine the effect of universal access to health care on racial disparity in survival following trauma. However, because survival depends upon several factors (e.g. severity of injury, age, physiologic derangement) accurate risk adjustment is required for meaningful comparisons. Datasets available in MA lack injury severity information, but fortunately they contain injury descriptions as ICD-9 codes. We have previously created a risk adjusted trauma mortality models (Trauma Mortality Prediction Model: TMPM-ICD-9) that relies on ICD-9 codes to incorporate injury severity into survival models, but the reliability of this model across race was unknown.

Methods

The TMPM-ICD9 model was constructed using all ICD9 diagnostic fields to ensure its applicability to data from both trauma centers and community hospitals. We fit a logistic mortality model that controlled for TPM as well as other important predictors available in data routinely collected by MA databases and examined this model's overall performance (Hosmer-Lemeshow statistic (HL statistic), ROC area). We also examined the calibration of our model (HL stat, calibration plots) in four racial groups. (The calibration of a model is a measure of how accurate its predictions are. The HL statistic formalizes this notion as a chi-square test. The ROC area is a measure of how well a model discriminates between survivors and non-survivors.) Failure of our model to fit in a racial group might suggest either an unmeasured confounder or a missing interaction term in our model.

Results

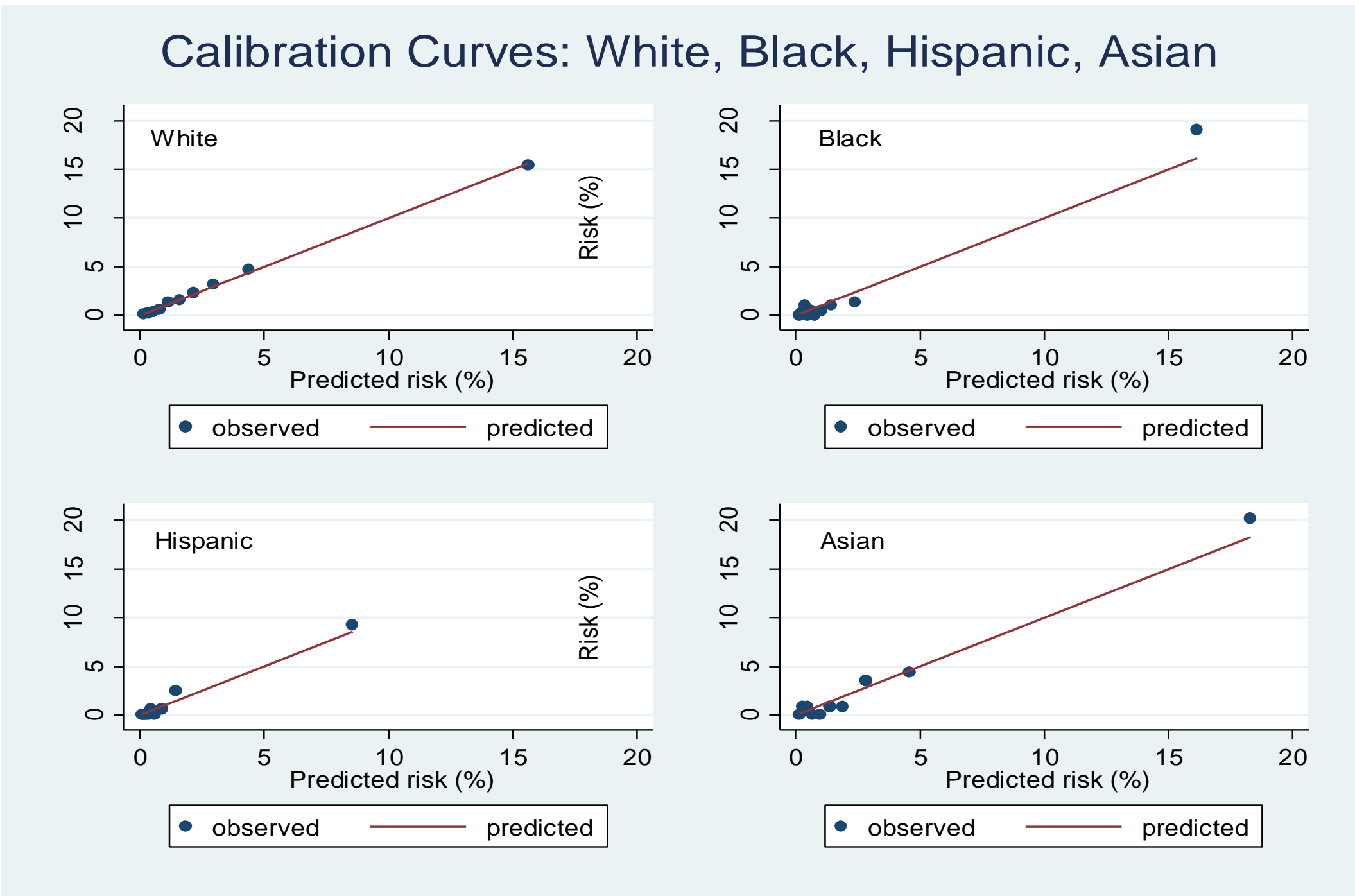
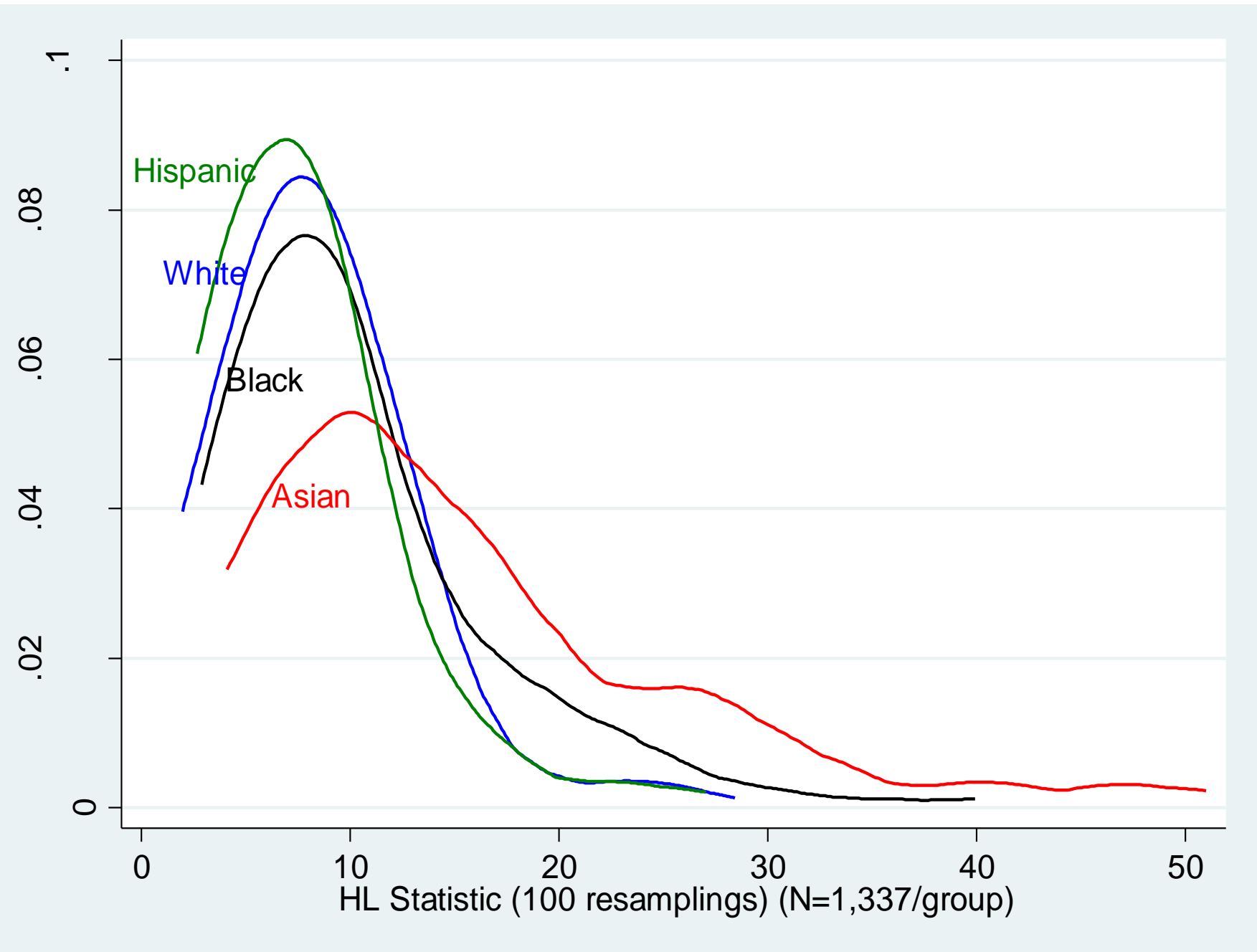
Death	Odds Ratio	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
ICD9TMPM	5.760911	.4349191	23.19	0.000	4.968552	6.679631
blunt	.7875677	.0806783	-2.33	0.020	.6443042	.9626864
male	1.642761	.1254402	6.50	0.000	1.414416	1.907971
Age^3	1.573598	.2123456	3.36	0.001	1.207899	2.050016
Log(Age)	11.69438	3.380085	8.51	0.000	6.636673	20.6065
Asian	1.188234	.1959674	1.05	0.296	.8600411	1.641667
Black	.9714845	.1015109	-0.28	0.782	.7915775	1.19228
Hispanic	.664621	.1566527	-1.73	0.083	.4187394	1.054883
White	1	(omitted)				
Non-TC	.6810599	.1188508	-2.20	0.028	.4837749	.9587983
TC-Level13	.55958	.1458575	-2.23	0.026	.3357314	.9326794
TC-Level12	.7398796	.1291755	-1.73	0.084	.5254724	1.041771
TC-Level11	1	(omitted)				
SBP>0	.0345212	.0299971	-3.87	0.000	.0062869	.1895556
SBP>0 X SBP	.9957368	.0016189	-2.63	0.009	.9925689	.9989147
_cons	30.60735	28.76073	3.64	0.000	4.852656	193.051

Hosmer-Lemeshow Statistics: By race:

Race	N	HL Stat	p-value
Overall:	58,753	18.08	0.021
White:	52,098	14.79	0.063
Black:	3,889	16.13	0.041
Hispanic:	1,623	4.22	0.837
Asian:	1,143	5.06	0.752

*Because the HL statistic is a function of both calibration and sample size we equalized the sample size for all racial groups before computing the distribution of HL statistics for each racial group by randomly sampling without replacement white, black and Hispanic groups to match the size of the Asian group (N=1,143).

Hosmer-Lemeshow Statistics: By race, controlled for sample size* (N=1,337)



Conclusions

1. Our model has excellent discrimination (ROC=0.85) and is well calibrated overall (HL=18.08). HL statistics vary for individual races due to the differing sizes of racial cohorts.
2. Calibration across racial cohorts is almost identical

Discussion

In all racial groups, the TMPM-ICD9 performed well in predicting mortality based on MA Trauma Registry data 2008-2010. This model may allow meaningful comparison of survival rates for individual races before and after the introduction of health care reform in MA. Because of its excellent discrimination, this model should have considerable power to detect racial disparities in survival after traumatic injury.

Acknowledgement

This study is supported by the National Institute On Minority Health And Health Disparities of the National Institutes of Health under Award Number R01MD006231. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health