

Development of a Stata command for pediatric risk of mortality (PRISM) calculation

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To The Editor:

Outcome prognostication tools have been used extensively in clinical care and research to calculate the expected mortality and control for illness severity in pediatric intensive care units (PICU). While there are many scores, including the Pediatric Logistic Organ Dysfunction-2 (PELOD-2) and the Paediatric Index of Mortality 3 (PIM-3) scores, the Pediatric Risk of Mortality III (PRISM III) score and its extension, the PRISM IV score, is widely used.¹⁻³ The scores were validated over large patient populations, but they do not prognosticate individual outcomes. The PRISM III score assigns scores correlating to mortality based on diagnosis/disease factors, age, and physiological values at the time of PICU admission.⁴ The PRISM IV score extends this further by calculating the expected mortality using data from the PRISM III score, patient history, principal dysfunction, and admission source.⁵

A major barrier to the widespread usage of the PRISM scores is the complexity of the calculation and the lack of robust open-source implementations. The single publicly available calculator for this score can be inaccurate depending on the units used, offers results inconsistent with the peer-reviewed versions of the scores, and supports data entry for only one patient at a time.⁶ Such challenges restrict the usage of the score to research groups that have implemented the score in their statistical packages. Custom implementations duplicate efforts, are not guaranteed to be consistent, and can have varying performances over large datasets. Here we describe the development of a publicly available Stata command that calculates PRISM III and PRISM IV.

METHODS

We developed a Stata command (*prismscore*) that performs PRISM III and PRISM IV score calculations in Stata/MP 17.0. In addition to implementing the scoring described in the original papers, we added robust error-proofing, data validation, the ability to use both SI and US laboratory value units, and a graphical user interface. The design principle behind the command was based on our experience analyzing large pediatric critical care datasets and observing common pitfalls during data entry and data analysis. We aimed to reduce the possibility of incorrect calculations due to incorrect variable specifications or data entry. We validated the command through unit testing and score calculation on deidentified data. We performed spot checks to double-check the accuracy of the calculation. To test the performance of the command over large datasets, we generated 10,000,000 patient records with random realistic data and predetermined PRISM scores and compared the result to the predetermined score. The run-time of the command was tested by analyzing 5 distinct datasets using Stata/MP 17.0 2-cores. The command is freely available on the Statistical Software Components (SSC) archive (<https://ideas.repec.org/s/boc/bocode.html>), as well as GitHub (<https://razvanazamfirei.github.io/prism-score>). Institutional Review Board approval was not required for the analysis of synthetic data.

RESULTS

The Stata *prismscore* command calculated PRISM scores with 100% accuracy on both the spot checks and the simulated data. The median run-time for PRISM III calculations over 10,000,000 simulated patient records is 50.48 (interquartile range [IQR] 46.74 - 50.83) seconds. The median run-time for PRISM IV calculations over 10,000,000 simulated patient records is 51.52 (IQR 50.46 - 53.44) seconds.

DISCUSSION

The *prismscore* Stata command is a tool that accurately and efficiently calculates PRISM III and PRISM IV scores over datasets of all sizes. The tool is designed to improve the reproducibility of research involving the scores, streamline data analysis for pediatric critical care datasets, and offer significant time and resource savings to the research community. Of note, the score was validated on patient data collected during a defined period (-2 hours to +4 hours from PICU admission). Our command calculates the score based on extracted data; if data from the entire period is not available in the electronic record, or if the data is not extracted correctly, the command may underestimate the expected mortality.

REFERENCES

1. Leteurtre S, Duhamel A, Salleron J, Grandbastien B, Lacroix J, Leclerc F. PELOD-2: an update of the PEdiatric logistic organ dysfunction score. *Crit Care Med*. Jul 2013;41(7):1761-73. doi:10.1097/CCM.0b013e31828a2bbd
2. Straney L, Clements A, Parslow RC, et al. Paediatric index of mortality 3: an updated model for predicting mortality in pediatric intensive care*. *Pediatr Crit Care Med*. Sep 2013;14(7):673-81. doi:10.1097/PCC.0b013e31829760cf
3. Sacco Casamassima MG, Salazar JH, Papandria D, et al. Use of risk stratification indices to predict mortality in critically ill children. *Eur J Pediatr*. Jan 2014;173(1):1-13. doi:10.1007/s00431-013-1987-6
4. Pollack MM, Patel KM, Ruttimann UE. PRISM III: an updated Pediatric Risk of Mortality score. *Crit Care Med*. May 1996;24(5):743-52. doi:10.1097/00003246-199605000-00004
5. Pollack MM, Holubkov R, Funai T, et al. The Pediatric Risk of Mortality Score: Update 2015. *Pediatr Crit Care Med*. Jan 2016;17(1):2-9. doi:10.1097/pcc.0000000000000558
6. Collaborative Pediatric Critical Care Research Network. PRISM IV Calculator. Accessed 09/06/2022, <https://www.cpccrn.org/calculators/prismivcalculator/>