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Further Limitations of the HOSPITAL Score in US Hospitals

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interviews with patients, caregivers, and mechanical circulatory support coordinators about the decision-making process for DT LVAD, most found it to be an overwhelming process with many patients and caregivers focused on hope and self-preservation and rejecting discussions of risks and death.<sup>4,5</sup>

These types of conversations can be facilitated by tools, such as formal decision aids. Our group and others have developed a handful of decision support tools for patients and caregivers, and their implementation into real-world practice is now being tested.<sup>6</sup> Complementary to this, a heart failure annual review<sup>7</sup> between patients, caregivers, and their primary clinician—encompassing discussion of current and potential therapies for both anticipated and unanticipated events within the context of patient values, goals, and preferences—would lay the foundation for informed consent and shared decision making when options like DT LVAD become imminent. And none of this will come to fruition until health care financing shifts its emphasis from reimbursing for specific procedures to reimbursing clinicians for helping patients and their loved ones decide which treatment options should and should not be pursued.

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## Further Limitations of the HOSPITAL Score in US Hospitals

**To the Editor** We congratulate Donzé and colleagues on their large, multicenter, international study<sup>1</sup> validating the HOSPITAL score for predicting readmissions, an important topic. However, there are some potential limitations worth considering that may reduce the usefulness of HOSPITAL in real-world practice.

First, the authors report the predictive accuracy of the HOSPITAL score for predicting potentially avoidable 30-day readmissions, which is inconsistent with the definition of readmissions in the United States subject to financial penalties under the Hospital Readmissions Reduction Program. Further, the SQLape tool used to identify avoidable readmissions is proprietary and has only been validated in Switzerland.<sup>2</sup> Preventable readmissions in the United States are highly related to health systems-level factors<sup>3</sup> that are likely to be different in the United States vs other countries. Given the uncertainty of whether these readmissions were truly preventable, it would be interesting to know the C-statistic and calibration of the HOSPITAL score for predicting all unplanned readmissions—the primary policy metric in the United States. In a diverse cohort of 16 430 medicine patients from 6 US hospitals, we found the HOSPITAL score had a modest C-statistic of 0.64 for predicting all unplanned 30-day readmissions and did not perform as well as other models, including the LACE index.<sup>4</sup>

Second, the HOSPITAL score cannot be calculated until discharge. Over half of potentially preventable readmissions in the United States are owing to gaps in care during hospitalization.<sup>3</sup> Accordingly, the most effective transitional care interventions are initiated well before discharge.<sup>5</sup> To circumvent this limitation, Donzé and colleagues<sup>1</sup> suggest using the 3 HOSPITAL elements available on admission for earlier risk stratification, but the validity of this approach was not assessed. We found that predicting readmissions using electronic health record data available on admission works nearly as well as using data from the entire hospitalization.<sup>4</sup>

Finally, Donzé and colleagues propose that the HOSPITAL score be implemented to allow targeted intervention of high-risk patients. However, the proposed high-risk score of greater than or equal to 7 has a likelihood ratio of 2.3,<sup>1</sup> meaning that such a score only modestly increases readmission risk. This is also true of our electronic health record-based models that had comparable likelihood ratios of 2.4 despite better discrimination and calibration.<sup>4</sup> Readmissions prediction modeling may be reaching the maximum achievable performance using hospital-based electronic health record data. Better prediction will likely require integration of more data, despite the desire for parsimony. Much of the unexplained variation in risk is likely owing to patient, system, and community factors not captured in electronic health records.

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**In Reply** The aim of any prediction model for readmission is to identify the patients who are most likely to benefit from intensive transitional care interventions. In our study,<sup>1</sup> we use risk for potentially avoidable readmissions as a proxy for that outcome. While this is different from the Centers for Medicare and Medicaid Services (CMS) definition, the outcome is closer to the desired goal than all-cause readmissions. Of note, we have tested the HOSPITAL score for the particular diagnoses that are part of the CMS Readmissions Reduction Program, and the HOSPITAL score showed good performance (manuscript in preparation).

Regarding SQLape, we agree that identifying readmissions that are truly preventable is hard to do with 100% accuracy. Although the SQLape algorithm cannot pretend to be perfect, the algorithm follows a logical pathway and is fully transparent because all the methodology is available online (<http://www.sqlape.com>). The goal of SQLape is not to be perfect but to identify a cohort enriched with preventable readmissions such that we improve the signal-to-noise ratio when identifying relevant predictors.

Finally, the performance of the HOSPITAL score remains good with a C-statistic of 0.74 (95% CI, 0.74-0.75) by including as the outcome all readmissions and not only those that are potentially preventable. Overall, the HOSPITAL score had a C-statistic of 0.72 across the 6 US hospitals in the study. It would be difficult for us to surmise why the score did not operate as well in the 6 hospitals in the Dallas area.

We agree that interventions to prevent readmission should begin in the hospital, ideally as soon after admission as possible. To that end, we should note that some of the patients could be identified as high risk based on the 3 variables of the HOSPITAL score already known at admission. This early identification does not require any additional validation, because when a patient reaches 7 points or more on the score, the patient is already categorized in the high-risk group regardless of the state of the other later predictors. We agree that the validity of measuring the other factors earlier in the hospitalization, such as sodium or hemoglobin, would require further study.

We agree that predicting the risk of readmission is not perfectly achievable and will never be. It is unlikely that new predictor models will greatly outperform the existing scores, at least not using information currently available in an electronic medical record. Efforts should now turn toward identifying the subgroup of patients most likely to benefit from these interventions (ie, to move away from risk prediction and toward effect modification in rigorously conducted trials). The value of any tool, whether the HOSPITAL score, LACE—the tool derived by Dr Nguyen and colleagues—or others ultimately lies in its ability to identify those most likely to benefit from actions taken by the health care system to improve transitional care.

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1. Donzé JD, Williams MV, Robinson EJ, et al. International validity of the HOSPITAL score to predict 30-day potentially avoidable hospital readmissions. *JAMA Intern Med.* 2016;176(4):496-502.

## Uncontrolled Hypertension and Risk of Cardiovascular Mortality in China

**To the Editor** We read with interest the Original Investigation by Lewington et al<sup>1</sup> published in a recent issue of *JAMA Internal Medicine*. The authors concluded that about 33% of Chinese adults had hypertension which increased risk of cardiovascular disease (CVD) mortality after about 7-year-duration of follow-up. However, there are several limitations for the generality of their findings to the common Chinese adults.

First, this study only included 10 regions (5 urban areas and 5 rural areas) from China and thus the results on hypertension prevalence, awareness, treatment and control were not representative of overall Chinese adults.

Second, this cohort consisted of 41% Chinese men, and the age range was 35 to 74 years. In addition, the majority of participants (80%) were 40 to 69 years old, followed by participants ages 35 to 39 years accounting for 14%, and participants ages 70 to 74 years accounting for only 6%. The unbalanced proportions of sex and age groups and narrow age range (not including adults ages 18-34 years and >74 years) again limited the generality of the results to representative Chinese adults.

Third, from the Statistical Analysis section, we did not find that whether hypertension prevalence, awareness, treatment, and control were sex- and age-standardized to the population composition of China in 2010. Thus, the results were biased by the unbalanced proportions of sex and age groups.