

Detecting Deviations from Usual Medical Care

James Mezger¹, Gregory F. Cooper¹ MD, PhD,
Milos Hauskrecht¹ PhD, Gilles Clermont¹ MD, M.S., Shyam Visweswaran¹ MD, PhD
¹University of Pittsburgh, Pittsburgh, PA

Abstract

Detecting deviations from usual medical care is valuable in identifying interesting or concerning patient management events. We describe a statistical method for identification of deviations in medication administration. Preliminary results show that plausible deviations can be identified, the clinical validity of which needs further evaluation.

Introduction

Developing automatic methods to detect deviations from usual medical care can be very useful in alerting clinicians to an unusual treatment choice. Here we investigate a statistical technique for detecting unusual medication therapy using previously collected patient data.

Methods

A dataset of 9,000 admissions to Intensive Care Units (ICU) at a major metropolitan hospital was utilized to construct and evaluate models of usual care. Patient attributes used in model construction were the admitting diagnosis, floor location, age, gender, and the APACHE score. The treatment decisions being modeled consisted of the medications administered within the first 24 hours. The dataset was split into a training set of 6,000 cases and a test set of 3,000 cases. For each medication a logistic regression model was constructed from the training set and applied to the test set to predict the probability of the medication being given. From these probabilities, the area under the ROC curve (AUROC) and the p-value of the Hosmer-Lemeshow statistic (HLS) was computed for each medication model. Models with an AUROC greater than 0.80 (indicating superior discrimination) and an HLS p-value greater than 0.05 (indicating better calibration) were chosen and their predictions on the test cases were examined for deviations from usual care. A deviation was defined as a predicted probability ≥ 0.80 that a medication should have been given when the patient actually did not receive it.

Results

Of the original 152 medication administration models generated from the training data, 9 fell above the

thresholds set for AUROC and HLS p-value (see Figure 1). These 9 models yielded 54 test cases of deviation (representing a 0.2% rate of deviation from usual care). As an example, Table 1 shows the two patient cases that were flagged as deviant by the lactulose model. The model predicts with high probability that these two cases should receive lactulose. Since, lactulose is used in hepatic encephalopathy and acute hepatic failure to counteract hyperammonemia, the flagging of these deviations seem clinically appropriate.

Conclusion

Our preliminary results support the ability of statistical methods in identifying deviations from usual medical care. We plan to evaluate these deviations for clinical validity.

Ag	ICU	Se	Apach	Diagnosis	Probabilit
51	11F	M	87	HEPENEPH	0.98
24	MICU	M	38	ACUHEPFAI	0.86

Table 1. Deviations predicted by the lactulose model.

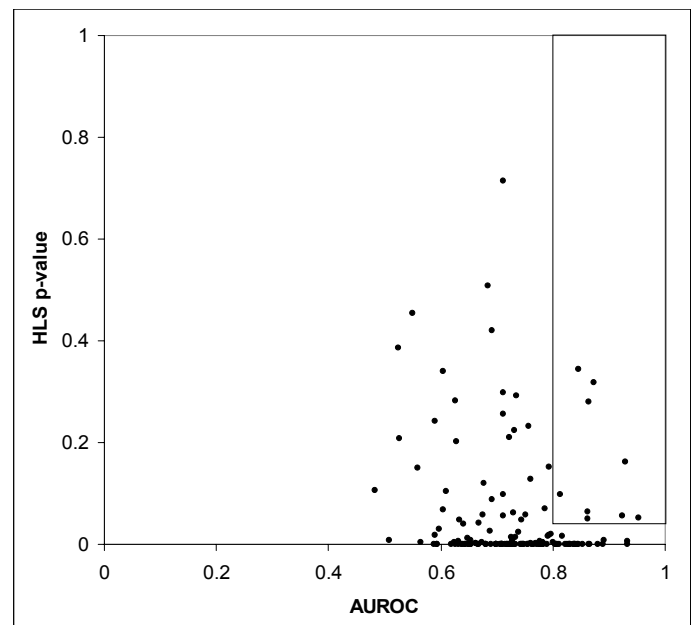


Figure 1 Each point represents a logistic regression model for a medication. The AUROC and the HLS p-value were computed from the test set.