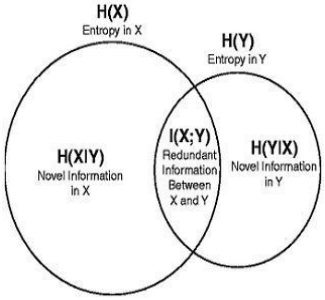
ICU
MANAGEMENT & PRACTICE

Using Information Theory to Detect Redundancy in Lab Tests



A new study in *BMC Medical Informatics and Decision Making* describes how information theory can be used to quantify the amounts of redundant information associated with common ICU laboratory tests. Researchers say that information theory can help identify and discourage unnecessary testing and bloodwork, and can be a useful data analytic tool especially for clinicians that deal with information overload.

This proof-of-concept study was conducted by Joon Lee, PhD, of the School of Public Health and Health Systems, University of Waterloo (Canada), and David M. Maslove, MD, MS, FRCPC, of the Department of Medicine, Queen's University (Canada).

"Frequent blood draws remain commonplace in most ICUs, especially within the first few days of admission to ICU," the authors write in the BMC report. "Our results suggest that even in these periods during which physiologic changes may be most pronounced, the amount of novel information gleaned from repeated blood testing may be limited."

Previous applications of information theory to medical decision making have mainly focused on the evaluation of diagnostic tests, by determining the conditional probability of a disease state given the result of the test. Using similar methods, the researchers defined common information theory parameters including entropy and mutual information for common lab tests done concurrently or sequentially, without reference to a final diagnosis.

For this study, Drs. Lee and Maslove analysed the information content of 11 laboratory test results from 29,149 adult ICU admissions in the MIMIC II database. Information theory was applied to quantify the expected amount of redundant information both between lab values from the same ICU day, and between consecutive ICU days.

The researchers found most lab values showing a decreasing trend over time in the expected amount of novel information they contained. Platelet, blood urea nitrogen (BUN), and creatinine measurements exhibited the most amount of redundant information on days 2 and 3 compared to the previous day. The creatinine-BUN and sodium-chloride pairs had the most redundancy.

"The redundancy in information between BUN and creatinine...suggests that if one is known, the other can be inferred with reasonable confidence," the authors say. "If a hospital were to restrict one of these tests, our results suggest it may be better to reduce testing of creatinine, and to order BUN alone instead, reflecting the asymmetrical relationship between these two tests."

While the addition of creatinine to BUN values may not on average add much novel information, Drs. Lee and Maslove note that "clinical judgment is still needed to assess the value added from this test on a case-by-case basis (such as when upper gastrointestinal bleeding is suspected, in which case the BUN data may provide information beyond its reflection of renal function)."

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