STATISTICS IMPROVES BIOMARKER DIAGNOSIS

STATISTICAL SIGNIFICANCE

Statistics helps analyzing, interpreting, and understanding biomarkers and their accuracy.
Statistics provides objective approaches by examining the optimal decision criteria.
Statistics contributes significantly towards global health through quantitative tools.

Biomarker Diagnosis and Validation

Definition of a Biomarker

- A biomarker is "a characteristic that is objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes or pharmacologic responses to a therapeutic intervention" (Biomarker Definition Working Group, 2001, *Clin. Pharmacol. Ther.*).

Key Roles and Applications

- Biomarkers are critical to medical product development, and yet, it is way behind lagged therapeutic development (Woodcock, 2011, *FDA Training Slides*).

- A biomarker can be used as a diagnostic tool for identifying patients with a disease or abnormal condition, for determining the stage a disease has reached, and for the prediction and monitoring of a clinical response to an intervention.

- The Food and Drug Administration's Critical Path Initiative and the European Medicines Agency's Road Map to 2010 advised efficient drug development with biomarkers playing key roles (Wagner, 2009, *Clin. Pharmacol. Ther.*).

Attributes and Validation

- A biomarker should possess these attributes: clinical relevance, sensitivity and specificity to treatment effects, reliability, practicality and simplicity (Lesko & Atkinson, 2001, *Annu. Rev. Pharmacol. Toxicol.*).

- Properties for validation include sensitivity, specificity, bioanalytical assessment, probability of false positive, and probability of false negatives have been shown to predict future clinical outcome (Lesko & Atkinson, 2001, *Annu. Rev. Pharmacol. Toxicol.)*.

Optimization Criteria

- We extended the literature using optimal metrics, such as sensitivity, specificity, distance and information, to estimate task-dependent decision criteria (Perkins & Schisterman, 2006, *Am. J. Epidemiol.*).

- The ultimate goal was to maximize the performance of biomarkers to achieve improved global health.

An image of Biomakers, NIEH of NIH, 2012
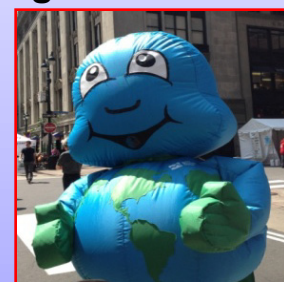
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