

Color-coded Z scores for the display and analysis of biomedical data

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The ability to review and analyze large amounts of data reliably, rapidly and cost-effectively is important in research, industrial applications and clinical care. We hypothesized that converting raw digital data to standard scores (Z scores) and color-coding them based on their corresponding P values can be used to accomplish this. For each member of a population of data, the calculation of Z scores uses the formula:

$$Z \text{ Score} = (\text{Individual Data Point} - \text{Population Mean}) / \text{Population Standard Deviation}$$

We illustrate the use of the technique with continuously recorded data by showing the simultaneous changes that occur in five relevant parameters during acute myocardial infarction (MI). In addition, using digital electrocardiographic (ECG) data obtained from 1138 subjects, we used color-coded Z scores to develop criteria for prior inferior and anterior MI that gave diagnostic performances that were statistically significantly superior to those of two widely used commercial ECG diagnostic algorithms. Since each Z score is associated with a P value, color-coded Z scores indicate if an individual data point differs statistically significantly from the mean of a relevant population of data. Also, since the method expresses all parameters on the same scale (the standard deviation), it facilitates the meaningful simultaneous monitoring of multiple parameters. Our findings show that color-coded Z scores provide a highly intuitive, accurate, statistically meaningful and widely applicable method of interpreting data that is generated either by continuous recording or by individual tests.

Biography

Robert A. Warner received his MD from the State University of New York (SUNY) in Syracuse in 1969, completed training in cardiology at Duke University Medical Center in 1975 and is board-certified in both internal medicine and cardiology. He has served as Professor of Medicine at SUNY College of Medicine in Syracuse, NY, Chief of Medicine at the Syracuse VA Medical Center, Medical Director of Inovise Medical, Inc. and is the founder of Tigard Research Associates. Dr. Warner is the author of 70 scientific papers and 87 scientific abstracts.