20 Statistical Errors Even YOU Can Find

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Tom Lang has become the biomedical editor's go-to guy for answers to statistical questions. His concerns about the problems of statistical reporting are well founded and have been documented extensively in the biomedical literature.

In this workshop, he exhorted editors to be aware of some of the most common statistical errors that authors commit and that editors can recognize in the manuscripts they edit. With each point raised, he suggested how the editor might correct the error or ask the author to do so. In many cases, recognizing the inappropriate method or description of results can prompt the editor to frame an intelligent question to the author that will improve the content of the manuscript.

Space limitations restrict complete description of the errors and their solutions here, but many resources are available for editors to learn more about appropriate statistical methods and reporting. The following list of the 20 points may guide editors' thinking as they approach the statistical sections and results in the manuscripts they edit. "To keep the tension mounting in an often dull subject", Lang said, he presented the guidelines in order of increasing importance.

1. Reporting measurements with unnecessary precision.
2. Dividing continuous data into ordinal categories without explaining why or how the categories were formed.
3. Reporting group means for paired data without reporting within-pair changes.
4. Using descriptive statistics incorrectly (using the mean and standard deviation, rather than the median and interquartile range, to describe skewed data).
5. Using the standard error of the mean (SEM) as a descriptive statistic (rather than the standard deviation) or as a measure of precision for an estimate statistic (rather than the 95% confidence interval).
6. Reporting only *P* values for results (without confidence intervals or "effort-to-yield" measures, such as the number needed to treat).
7. Not confirming that the data met the assumptions of the statistical tests used to analyze them.
8. Using linear regression analysis without establishing that the relationship is linear.
9. Not accounting for all data and all patients.
10. Not reporting whether or how adjustments were made for multiple hypothesis tests.
11. Unnecessarily reporting baseline statistical comparisons in randomized trials.
12. Not defining the implications of *normal* or *abnormal* when reporting diagnostic test results.
13. Not explaining how uncertain (equivocal) diagnostic test results were treated when the test's characteristics (such as sensitivity and specificity) were calculated.
14. Using figures and tables only to "store" data rather than to assist readers.
15. Using a chart or graph in which the visual message does not support the message of the data on which it is based.
16. Confusing "units of observation" when reporting and interpreting results (such as eyes vs patients).
17. Interpreting studies with nonsignificant results and low statistical power as "negative" when they are inconclusive.
18. Not distinguishing between "pragmatic" (effectiveness) and "explanatory" (efficacy) studies when designing and interpreting biomedical research.
19. Not reporting results in clinically useful units.
20. Confusing statistical significance with clinical importance.

Proposed solutions to the problem of poor statistical reporting have included cries for journals to call attention to the problem, to publish statistical reporting guidelines, and to employ statistical reviewers, as well as efforts to educate medical students, physicians, and researchers (and journal editors and peer reviewers) better in statistical analysis and reporting. None of those solutions has been widely successful. Lang's solution is to heighten the awareness of authors, editors, and reviewers to the problem and to provide them with a comprehensive and comprehensible set of reporting guidelines that they can apply when preparing and reviewing manuscripts.