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What's a Gram-meter?

To the Editor:—In his recent editorial, Michenfelder informed us of a change in expressing pressure units.[1] No longer shall we use torr, but we will not quite embrace the SI unit (kPa) either. I fail to appreciate the scientific rationality and importance of discarding a unit such as torr while retaining such an imprecise unit as the gram-meter.

But what is a gram-meter? Physicians have been expressing cardiac ventricular work in "gram-meters" for generations.[2] Newton, in the 17th century, defined work as the product of a force acting through a distance. We have that distance in this unit, *i.e.*, the meter, but a gram properly is a unit of mass, not force (International Conference of Weights and Measures, Paris; May, 1875). A correct unit of force would consist of a dyne, newton, or a pound, but it is not scientifically acceptable to use a gram. If we use the gravitational acceleration standard of 980.665 cm/s^2 (5th International Conference on Weight and Measures, 1913; at a standard latitude of 45°), a gram is equal to 980.7 dyn (by Newton's law, weight = mass × gravitational acceleration). After all, we do use the correct SI hydraulic units of $dyn \cdot s \cdot cm^{-5}$ for vascular resistance, a more modern concept.

From whence hath the gram-meter cometh? Tracing back physiology writings to the 19th century, one finds that none other than Starling himself is probably the popularizer.[3,4] An archaic 19th century view of fundamental physics frequently confused mass with force, *i.e.*, weight.

The unit gram, as Starling used it, was really known as gramforce (gf). The "gf" was discarded as a scientific unit at the Paris convention of 1875. It is not hard to imagine how we have forgotten over that time that g-m (gram-meter) is really gf-m (gramforce-meter). So our ventricular stroke work formulas (VSW) would be expressed as: VSW = pressure difference across the ventricle (mmHg) × SV (ml). Now 1 mmHg = 1.333×10^3 dyn/cm^2 (at 0° C), and 1 ml = 1 cm^3 (H_2O at 3.98° C). The product of mmHg × ml = 1.333×10^3 $dyn/cm^2 \times cm^3$ or 1.333×10^3 dyn-cm. Our scaling factor would no longer be 79.9 g-m but 1.333×10^3 dyn-cm. With all this attention devoted to the torr, isn't it time to correct our work unit?

By the way, a dyne-centimeter is really an erg . . .

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Statistics Should Support Rather than Strangle Anesthesiology Literature

To the Editor:—As religious readers, occasional contributers and sometime consultant reviewer (THS) of articles submitted to ANESTHESIOLOGY, we applaud the recent editorial by Dr. Longnecker entitled "Support *versus* Illumination: Trends in Medical Statistics."[1] However, in our opinion, Dr. Longnecker has only stated one side of the problem, namely statistical methods that have been inappropriately utilized in evaluating data. A far more difficult issue surfaces when the problem of statistical analysis is viewed from the perspective of the reader, the researcher, and the editorial reviewer.

There has been a recent explosion of available statistical methods. Part of the explanation of this phenomenon is undoubtedly the availability of sophisticated computers which allow rapid computation of complex statistical equations. Continued development of the computer industry will probably stimulate further interest and development of "more appropriate" and complex medical statistical methods.

Statistical analysis of anesthesiology research data can be likened to the use of a cookbook. Level one users of statistical methods can read the recipes and have sufficient arithmetic and/or computer skills to insert numbers and crank out results. Level two users not only can use the recipes, but also understand, more or less, the assumptions and restrictions for each statistical tool. Level three users can do all of the above plus recreate old recipes and write new ones.

In our observation, the busy clinician reader is often able to read and use the simple recipes (*t* test and chi-square analysis); however, more advanced methods are out of reach because of mathematical unfamiliarity and absence of computational support. The typical research anesthesiologist usually has level two skills for simple statistics (*t* test and chi-square analysis); however, his understanding and use of the more advanced analyses mentioned by Dr. Longnecker (analysis of variance, multivariate analysis of variance, multiple comparisons, multiway contingency table analysis, etc.) is hindered by inadequate foundations in probability theory, calculus, matrix algebra, sampling theory, etc. As editorial reviewers and editorial board members are drawn from the more published and knowledgeable of these researchers, their skills at times may be slightly more advanced. Even academic anesthesiologists/editors are not at level three.

How should readers, researchers, and reviewers respond to this new standard of statistical excellence enunciated by the editorial? It may be appropriate that researchers like ourselves spend more than 30% of our research dollar and research time for statistical consultation, computer programming and computation, and other statistical self education. It also may be appropriate that the tools of reviewers include statistical glossaries, the most up-to-date statistical text books, and paid statistical consultation. But what will the clinician reader do when faced with a journal using incomprehensible statistical methods? One alternative for the non-expert statistical reader of ANESTHESIOLOGY is to simply accept the published statistical method as editorially approved and thus appropriate. Another alternative might be to simply ignore the statistics utilized, scan the data, and make an unsupported "gut feeling" judgement. These approaches can only lead to a more superficial appraisal of research reports.

Without greater efforts devoted to the statistical skills of the clinical reader, even greater estrangement of the clinician from the journal will occur. Some possible solutions include: 1) increased statistical teaching during residency; 2) increased attention to statistical topics during written and oral Board examinations; 3) journal review articles on statistics; 4) refresher course lectures on statistics; 5) frequent exhortations by prominent anesthesiologists for better statistical skills; and 6) statistical teaching in ASA Self Education and Evaluation Programs.

The solution to the posed problem is not easy. However, an appropriate and expedient solution to the problem seems crucial if medical statistics are to *support* rather than *strangulate* future anesthesiology research reporting to the clinician.

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Absence of Evidence Is not Evidence of Absence

To the Editor:—We applaud Longnecker's recent appeal for higher standards of statistical analysis,[1] but we disagree about Glantz's[2] finding that inappropriate use of *t* tests is the most frequently committed error. Using *t* tests to compare more than two means is probably the most frequently committed *Type One Error*[3] (errors that give false-positive results), but *Type Two Errors*[3] (false-negative results) are probably the most frequently committed, and least frequently detected, statistical errors in both social and hard science (including medical science).[4]

Type Two Errors result in the implication, if not the explicit conclusion, that a lack of statistical significance for an observed difference indicates a lack of actual dif-