26. Armitage P, Berry G. Comparison of several groups: multiple comparisons. In: *Statistical methods in medical research*, 2nd ed. London: Blackwell Scientific Publications; 1996:200–205.
27. Snedecor GW, Cochran WG. Specific indices of interater reliability. In: Snedecor GW, Cochran WG, eds. *Statistical Methods*, 6th ed. Ames, IO: Iowa State University Press; 1989:147–146.
28. Carson RE, Channing MA, Blasberg RG, et al. Comparison of bolus and infusion methods for receptor quantitation: application to [^{18}F]cyclofoxy and positron emission tomography. *J Cereb Blood Flow Metab* 1993;13:24–42.
29. Laruelle M, Abi-Dargham A, Van Dyck CH, et al. D-amphetamine induced dopamine release reduces the binding potential of [^{123}I]IBF for dopamine D2/D3 receptors in humans [Abstract]. *J Nucl Med* 1994;35:84P.
30. Volkow ND, Fowler JS, Wang GJ, et al. Reproducibility of repeated measures of carbon-11-raclopride binding in the human brain. *J Nucl Med* 1993;34:609–613.
31. Abi-Dargham A, Gandelman M, Zoghbi SS, et al. Reproducibility of SPECT measurement of benzodiazepine receptors in human brain with iodine-123-iomazenil. *J Nucl Med* 1995;36:167–175.
32. Seibyl JP, Laurelle M, Van Dyck CH, et al. Reproducibility of iodine-b-CIT SPECT brain measurement of dopamine transporters. *J Nucl Med* 1996;37:222–228.
33. Vingerhoets FJ, Snow BJ, Schulzer M, et al. Reproducibility of fluorine-18-6-fluorodopa positron emission tomography in normal human subjects. *J Nucl Med* 1994;35:18–24.

EDITORIAL

"Yet there is method in't" (Shakespeare)

meth-od* (n.): *a way, technique, or process of or for doing something (Webster's Third International Dictionary) (1)

There is the method school of acting, and as The Bard has noted, there may be method in one's madness. What I would like to consider at this time is method in science: more specifically, the Methods Section of scientific articles. This unsung and often neglected portion of our scientific literature deserves, it seems to me, much more respect than it frequently gets.

Nuclear medicine is a technical specialty. It is reasonable to expect technical excellence in its practitioners and detail in the presentation of technically complex procedures. The Methods section of our literature thus takes on special significance. It is only through the Methods Section that we can get a feeling for the technical competence of a group of investigators. Sadly, a careful reading of much of our literature suggests, all too commonly, a lack of basic understanding of fundamental elements of technique. Even worse perhaps is the complete omission of information needed to assess that technical competence.

Recently this was put into sharp focus when I came across an article comparing SPECT imaging with planar technique for a specific application. The authors had reached the surprising (to me) conclusion that planar imaging was better. On reviewing the images that accompanied the article, the probable reason for this seemingly backward result was obvious. The SPECT images were some of the worst I had ever seen. It was bad enough that these authors could not recognize that their images were dreadful, but when I turned to the Methods Section, it was not possible to determine what had been done wrong. Did they choose the wrong collimator? Was their equipment old and out-of-date? Did they use the wrong processing parameters? It was impossible to tell because all such information was lacking from the Methods Section.

Often a neglected stepchild in the preparation, review and reading of scientific articles, the Methods Section is in fact of vital importance when a reader or reviewer tries to critically assess the value and validity of the results presented. No amount of statistical manipulation can salvage useful meaning if the data has been badly acquired. Furthermore, if a reader wishes to introduce a promising technique into her/his laboratory, the Methods Section must describe the technique in question in sufficient detail to permit its duplication.

Unfortunately, this is often not the case. Although omission of almost all technical detail as described above is unusual, the absence of small but significant details is very common. For example, as I have noted in an earlier essay on the SUV (*2*), it is frequently impossible to tell whether the SUV was calculated on the basis of the average counts within an ROI or if the maximum value was used. The time from injection of tracer to imaging is often omitted. Yet these small variations in technique can have *large* effects on the measured value.

For another example, which seems trivial until it is closely examined, let us look at the manner in which the reconstruction filter is described in SPECT and PET articles. A common description is, "A Shepp-Logan (or Hamming, or Butterworth, etc.) filter was used with a cut-off of 0.3." 0.3 what? This number is *not* dimensionless. It has units. Because different manufacturers use different units, when specifying filters, the exact units used must be given, if this number is to be of any use to the reader.

How common are such problems? A survey of three consecutive recent issues of *The Journal of Nuclear Medicine* gave the following results: Of 30 articles on either PET or SPECT, 16 gave no information about the filter used at all, 8 described the filter but gave no units, and only 6 articles completely and properly specified the filter used.

One might argue that omitting such information is trivial. Certainly articles on CT and MRI never discuss reconstruction filters. For most commercial CT systems, the filter functions are closely held proprietary information and not subject to user scrutiny or modification. This is not, however, the case for nuclear medicine systems. Due to the varying resolution and noise characteristics found with different collimators, tracers and doses administered, patients and system configurations, it is common to use different filters for different types of studies. This is further complicated by widely varying user preferences in terms of final image appearance. It is thus common practice to have the filter type and cut-off value as user specifiable parameters.

Investigators who publish an article lacking this information are doing both themselves and their readers a disservice. Certainly reviewers who pass an article lacking such information are not doing their job properly. How can it be said that one has critically reviewed an article when the reviewer does not know for sure what was done?

Largely ignored, the Methods Section is, perhaps, the single most important part of a scientific article. Only from a careful reading of the methods can one decide whether to believe the results of a study. Only with a complete explication of the

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methods can believing readers translate these results into their own practice. It is, thus, surprising that authors so frequently fail to adequately or properly describe their methods, and it is disturbing that reviewers and editors allow such omissions to slip past unrecognized and unresolved.

In an essay, which introduced an issue of *JAMA* devoted to peer review, Jerome P. Kassirer and Edward Campion (*3*) hypothesize that " . . . the fundamental task of a manuscript reviewer (and editor) is to *detect and describe flaws*." [The emphasis is present in the original]. They go on to provide several tables of the types of flaws that are often discovered. One such flaw, listed under "Deficiencies in Presentation" is "failure to explicate experimental design." Several of the other problems they present are directly related to information provided (or not) in the Methods Section such as "Inappropriate manipulation of data" and "Essential data omitted or ignored."

In an ongoing series, also being published in *JAMA* titled, "Users' Guides to the Medical Literature," the various authors have focused on techniques for determining whether a published study will be useful. In the first article in this series (*4*), they suggest that readers need to satisfy themselves as to the answers to three basic questions. The first of these is "Are the results of the study valid?" This question then becomes the primary topic of a later article in the series (*5*). The answer to this question (not surprisingly) turns out to require careful analysis of the methods presented.

Holmes says to Watson, "You know my methods. . . . " But do we know one another's methods? This is a plea to our editors, and even more so to our authors and reviewers, to give the Methods Section the care and emphasis it deserves. We cheat our readers by ignoring this centerpiece of our presentations, and our readers cheat themselves if they blindly accept the results of a study without critically assessing the methods used to achieve those results. The absolute minimum requirement for the Methods Section of an article should be that a reader could replicate the study from the information given.

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REFERENCES

1. *Webster's Third New International Dictionary.* Springfield MA: Merriam-Webster; 1981:1422–1423.
2. Keyes JW Jr. SUV: standard uptake or silly useless value. *J Nucl Med* 1995;36:1836–1839.
3. Kassirer JP, Campion EW. Peer review: crude and understudied, but indispensable. *JAMA* 1994;272:96–97.
4. Oxman AD, Sackett DL, Guyatt GH. Users' guides to the medical literature. I. How to get started. *JAMA* 1993;270:2093–2095.
5. Jaeschke R, Guyatt G, Sackett DL. Users' guides to the medical literature. 3. How to use an article about a diagnostic test. A. Are the results of the study valid? *JAMA* 1994;271:389–391.