

IFCC Documents and Interpretation of SI Units—An Adaptable Solution

In *Clinical Chemistry* 25/5, 655-657 (1979), Dr. Basil T. Doumas presented an "Opinion" entitled "IFCC documents and interpretation of SI units—a solution looking for a problem," in which he comments on recommendations, provisional or approved, prepared by the IFCC Expert Panel on Quantities and Units and by the IUPAC Commission on Quantities and Units in *Clinical Chemistry* (1-3).¹

In the following, we should like to present some amplifications and explanations of these IFCC/IUPAC Recommendations on Quantities and Units in *Clinical Chemistry*.

First, we wish to comment on some of Dr. Doumas' general remarks.

1. The IFCC/IUPAC Recommendations "have been examined by only a few AACC members." This is mainly an internal problem of the AACC, because IFCC/IUPAC distributes all Provisional Recommendations to the AACC-appointed Associate Member of each authoring Expert Panel, besides publishing them and sending Approved Recommendations to the National Representative for a mail ballot.

2. AACC members' comments on documents were unanswered or "declared 'unacceptable' without further explanation." The Expert Panel makes every effort to respond to all comments. In this particular instance (Recommendation 1977, now 1978) our records show that the text had been submitted for an IFCC Council mail ballot some months before the Expert Panel on Quantities and Units received the comments from the AACC Representative. Thus, only editorial changes could be made—and they were. Other suggestions could not be accepted at that stage. (A copy of the letter of acknowledgment with explanations is available upon request.) A second example, Optical spectroscopy (3), involving "a series of letters," also shows the willingness of the Expert Panel to discuss comments at length.

(*Ed. note: It is worth interjecting here a comment appearing in the minutes of the most recent (June 1979) meeting of the Committee of Editors of Biochemical Journals, an IUB group: "Optical Spectroscopy. The members did not think that it would be advisable to recommend adherence to the new IUPAC document by all CEBJ journals. The opinion was expressed that it is not necessary to conform to SI units in all usage, and that we should be careful not to make changes in established usage unless increased clarity would clearly result."*)

3. "It seems that changes are being made for the sake of change, not because of demonstrable need." This statement

may well be true as seen from the viewpoint of clinical chemistry in the United States. However, the IFCC is an international organization and therefore acts at the international level. Clinical chemistry is to a large degree interdisciplinary, and we must therefore communicate with other branches of science and technology whose principles we use and which obtain data from us. The aim of Expert Panels is to recommend on how to unify and advance our discipline. How this is achieved is open to debate, and Dr. Doumas' letter is part of that ongoing discussion.

4. The AACC Committee on Standards is "concerned about some of the strict and seemingly unnecessary interpretations of the system that are being proposed by a select few." It is true that IFCC/IUPAC recommends and encourages, for instance, the use of particular units, particular unit prefixes, and of molecular concepts. We see nothing wrong with such a goal. No IFCC Recommendation is a law, even when "Approved" by a majority of the IFCC Council. We do not "legislate by committee," but we seek to persuade by reason. If any person or national organization in clinical chemistry does not approve of the details of our Recommendations, they may ignore our proposals and may act otherwise. This procedure has in fact been adopted by the different types of implementation chosen by the countries that have "gone SI." So, IFCC concurs when the *Journal of the American Medical Association* points out that, for the USA, the Metric Conversion Act of 1975 "specified that the metric conversion is to be a voluntary matter."

5. The suggestion that IFCC (among other organizations mentioned) has "no mandate to regulate our affairs and work" is true if one stresses the word "regulate." However, IFCC does have a mandate to guide and, with respect to its Recommendations, this guidance is accepted or rejected for official presentation by the majority vote of Council, not by the expert panels.

6. That the "proposed rules and changes have not been requested by physicians and clinical scientists" is true at the organizational level. However, circumstances meriting, it is the prerogative, even the duty, of IFCC to make suggestions to other professional bodies on matters relating to clinical chemistry—for example, when ideas are put forward in one country or region, but can be applied elsewhere. The principles of the Recommendations 1978 have been officially accepted, not only by IFCC, but also by representatives of the International Committee on Standardization in Hematology, by the World Association of (Anatomic and Clinical) Pathology Societies (4), and by WHO (5)—bodies which together represent many physicians and other clinical scientists. However, we are aware of the fact that many organizations of general practitioners and medical specialists oppose some aspects of the recommendations.

7. Dr. Doumas mentions that NCCLS is the "ideal forum for making decisions on implementation of SI in the U.S." How clinical chemists govern their affairs in the USA is of no

¹ Abbreviations: AACC, American Association for Clinical Chemistry; CIE, International Commission of Illumination; IFCC, International Federation of Clinical Chemistry; ISO, International Organization for Standardization; IUPAC, International Union of Pure and Applied Chemistry; NCCLS, National Committee for Clinical Laboratory Standards; IUB, International Union of Biochemistry; and NBS, National Bureau of Standards.

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concern to the Expert Panel on Quantities and Units. However, the results of the NCCLS procedure are excellent, as indicated by their Proposed Position Paper: PPC-11, Quantities and Units (SI), published in part in *Clinical Chemistry* 25/5, 657-658 (1979). The paper is a good example of how a nation may work towards a goal at a suitable pace.

Although the generalities are perhaps more important, we should like, within the space available, to respond to a few of the specific items and questions raised. Several are answered in the original IFCC/IUPAC publications (1-3).

8. On symbols, the Expert Panel does little more than reproduce the recommendations of other international bodies such as IUPAC and ISO. The choices are intended to minimize double meanings of symbols in particular types of data. The symbol for transmittance is τ . The symbol T (or τ_i) is reserved for internal transmittance, which is what clinical chemists are concerned with in absorption spectrometry.

9. The Expert Panel has never declared that "only prefixes for powers of 10 divisible by 3 may be employed"; IFCC/IUPAC has only indicated (1) that such prefixes are "especially recommended." The four SI prefixes h, da, d, and c are also bona fide SI prefixes. In practice, their use is often cumbersome when data are drawn together from different sources.

10. The unit cm^{-1} is accepted for wavenumber in the IFCC/IUPAC Provisional Recommendation 1978 (3; p 248). Here, we agree with Paul Vigoureux (*Dimensions*; NBS, November 1977).

11. The units mol/m^3 and mmol/L are both acceptable when reporting substance concentrations in blood. They give identical numerical values, but the latter is preferred by NCCLS, as well as by IFCC/IUPAC, not for logical reasons, but for convenience, and because of the widespread use of the litre in several disciplines. We submit that further compromises of a similar nature should be discouraged in any particular field of science, because the effectiveness of SI as a common language of science and technology would soon break down.

12. The term "molar lineic absorbance" may seem strange and unnecessary when one is familiar with "molar absorptivity." But CIE and IUPAC attach another meaning to absorptivity, namely absorptance (not absorbance) divided by length. The adjectives "massic" and "volumic" sound un-English to the British or American ear. Let us stress that the recommendations we prepare are not just on English usage; they are international documents, primarily written in English, and they may contain some terms and practices that are borrowed and adapted from other languages, because German or French ways of expression may better convey the idea of the quantity involved. Such openness to the introduction of new words is a hallmark of the English language. The adjective "molar" in English, as well as in French or German, usually means "divided by amount of substance," though in our term, in "molar absorptivity," and in a few other quantity names, it indicates "divided by (amount-of-) substance concentration." The French adjective *linéique* means "divided by length." Therefore, one possible systematic name is the proposed "molar lineic absorbance," which directly is seen to mean "absorbance divided by substance concentration and further divided by (path) length." However, the ambiguity of "molar" remains in this term, as it does in the accepted synonym "molar absorptivity."

13. Both Dr. Doumas and Dr. Pardue prefer the unit $\text{l. mol}^{-1}\text{-cm}^{-1}$ to the coherent SI unit $\text{m}^2\text{-mol}^{-1}$ when measuring molar lineic absorbance. They are entitled to do so, but not because "their" unit conveys information about the quantity or the instrumental procedure. Such information is stated in

the description of the quantity. The widespread assumption that the unit explains the quantity is unfortunate, because a given unit may be used for different quantities; for instance, kg/m^3 ($= \text{g}/\text{L}$) does not distinguish mass density from mass concentration. For quantities of dimension one, the coherent unit is 1, irrespective of the kind of quantity involved, be it relative density, volume fraction, or mass fraction. This viewpoint—that units cannot, not "must not," convey information about the quantity—is shared by metrologists in general, including Drs. Vigoureux and Page (of NBS), who also prefer $\text{m}^2\text{-mol}^{-1}$ for molar lineic absorbance.

14. Laboratory-report forms may include a general statement that, for example, mmol/L implies substance concentration, thereby avoiding the need to present the name of the kind of quantity every time.

15. The definition of pH is now either operational (with buffers produced according to molality) or is based on molal activity; thus, the kilogram is involved, not the cubic metre.

16. The problem of reporting results in pharmacotherapy is interesting and not yet solved. Yet, many of us do report substance concentration of drugs and their metabolites in body fluids, just as we do for glucose, even though the patient may have regulated his food uptake according to tables with mass (fraction) of carbohydrates.

Finally, and as a practical point, it would be fair to say that since 1972 the IFCC/IUPAC Recommendations have been the foundation for implementation of a new nomenclature of quantities and of SI units in several countries. Thousands of clinical chemists and physicians, serving a population of one hundred to two hundred million people, use the new terminology in their daily practice. The fears for patient safety, often expressed prior to conversion, proved to be much exaggerated. Also, some physicians now admit to a better understanding of pathobiological relations by the molecular approach.

The extent and modes of implementation of SI vary from one country to another, and it is the prerogative of AACC and NCCLS, in consultation with NBS (6), to define them for the United States. IFCC makes recommendations, approved by international consensus, but each country, region, and ultimately any individual is free to accept or reject them.

References

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