Let Us Now Praise SI Units and Those Who Begat Them

Barbara J. Bain

Correspondence: Barbara J. Bain (e-mail: b.bain@imperial.ac.uk).

The modern metric system of units has its origins in France at the time of the Revolution when, on June 22, 1799, 2 platinum standards representing the meter and the kilogram were placed in the Archives de la République in Paris. Further developments occurred throughout the 19th century, with the Convention du Mètre being signed in Paris in 1875 by representatives of seventeen nations under the auspices of the Conférence Générale des Poids et Mesures (General Conference on Weights and Measures). Development continued throughout the 20th century, culminating in the establishment of the SI units at the 11th General Conference on Weights and Measures in 1960.

The Système International has base units, which include the meter, the kilogram, the second and the mole, and derived units; the derived units have their own names and symbols, and are related to the basic units by 10³, 10⁻³, or multiples thereof (see Table 1). In addition to the base units, derived units of relevance to medicine are the gray and the becquerel. Furthermore the degree Celsius (°C), used in medicine, is exactly equivalent to the Kelvin. There are also a number of non-SI units that are accepted for use with the Système International, specifically the minute (min), the hour (h), the day (d), the liter (L) and the Dalton (Da). Unit symbols generally take the lowercase unless, like the ampere (A) or the Kelvin (K), they are derived from a proper name. Use of upper case ‘L’ has also been permitted as an abbreviation of ‘liter’ since this avoids the potential confusion between the letter ‘l’ and the number ‘1’, which is possible with some fonts. However this does lead to inelegant abbreviations such as fl. for the femtoliter, in hematology, confusion is unlikely and there is no reason to avoid the abbreviation ‘l’ unless national policies (perhaps dictated by biochemists) require the use of ‘L’.

It should be noted that it is erroneous to use a prefix as a unit. The ‘G’ is thus an abbreviation for giga, as in ‘gigabyte’. It is erroneous to represent a white cell count of, for example, 3.4 × 10⁹/l as 3.4 G/L or G/L. Similarly, it is incorrect to express a red cell count as Tera/L. It should also be noted that, although a decimal comma is not erroneous when using SI units, a decimal point is always used in English language publications. Since English is the language of communication adopted by the EHA, a decimal point should be used. When a number is between k and 1 the decimal point should be preceded by a zero (e.g., 0.23).

It is important when seeking to introduce uniform units within and between countries to try to avoid changes that may impinge on patient safety. Thus it is quite correct, in the Système

Let us now praise famous men and our fathers who begat them. (Ecclesiasticus, Chapter 4, verse 1).

Communication of new knowledge, continuing education of hematologists and patient safety require clear communication. Achieving these aims would be facilitated by the universal adoption of the Système International d’Unités (SI units). Europe gave birth to SI units and European hematologists could lead the way. In the interests of the same aims, consideration should also be given to the use of consistent abbreviations, correct gene names, correct names of microorganisms, and international nonproprietary (generic) names for drugs.

The creation of the European Hematology Association (EHA) led to extensive cooperation between hematologists in various European countries to the benefit of us all. A further development that would enhance European hematology would be the universal adoption of the SI units. This is an internationally agreed system of units and symbols, which has been adopted in some but not all European countries. The incomplete adoption of the system means that presentations at meetings and scientific publications sometimes use outdated units (e.g., cells/mm³ for the white cell count) and sometimes use erroneous units (e.g., G/L, Giga/L, K/cu mm or K/µL for the white cell count). Errors are likely to occur if hematologists use outdated or incorrect units in their own laboratories but seek to use SI units in publications or presentations. This has led to erroneous and confusing data in publications, for example, it is incorrect to say that a patient’s blood count showed a “raised white blood cell count” of 1.3 × 10³/mm³; similarly, a patient does not have “thrombocytosis (platelet count 71 × 10⁹/L).” In these sentences either the count or the descriptive term is wrong. Clinical staff may be resistant to change but they can be gradually educated to use SI units, as has been demonstrated in the United Kingdom. Use of SI units is the policy of EHA and also of the International Council for Standardization in Haematology (ICSH).
International, to express hemoglobin concentration (Hb) in either g/l or mmol/l. However it is important to note that not only clinicians but also hematologists are more likely to be able to adapt to an Hb expressed, for example, as 112 g/l than one expressed as 6.95 mmol/l. For this reason it is very reasonable to prefer g/l to mmol/l. This is the advice of the ICSH. Hematologists from countries where use of mmol/l for the Hb has been adopted should give the equivalent in g/l when publishing or when making presentations at international conferences.

If scientific journals choose to retain non-SI units it is important, in the interests of clarity, to also provide SI units and the equivalent normal range, as is done, for example by the New England Journal of Medicine.

To improve communication between European hematologists, there are also other international conventions that should be followed (Tables 2 and 3).

1. The International Committee (now Council) for Standardization in Haematology advised standardised abbreviations for the components of the full blood count (Table 2). Note that ‘hematocrit’ is preferred to ‘packed cell volume’ for the automated measurement.
2. Standardised gene names, as advised by the Gene Nomenclature Committee of the Human Genome Project should be used and should be up to date, for example, ABL1 not ABL or abl, MYC not c-MYC, RUNX1 not AML1, KMT2A not MLL.
3. When genus and species is given, the format is Streptococcus pyogenes whereas when only genus is given it is streptococcus.
4. Generic names of drugs (the international non-proprietary name) should be used, not trade names. If the trade name is needed for clarity or precision it should be given in brackets after the generic name.

The EHA has been important in facilitating cooperation and collaboration between European hematologists. Clarity of communication could be further improved by the universal adoption of SI units and recommended terminology for hematological variables, gene names and drugs. Educational programs should be developed in European countries that are not yet consistently using SI units in order to introduce these units also into medical practice within countries.

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