



USE OF SI UNITS

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As a consequence of resolution WHA30.39, the use of SI units is now mandatory in the technical work of WHO, including all publications and documents produced both by headquarters and the Regional Offices. The book The SI for the health professions (Geneva, WHO, 1977) fully explains these units, but it is largely concerned with clinical practice, and some public health fields of concern to WHO are not covered. This document gives guidance on the units that should be used in such fields. For the work of WHO, it has the same authority as the book, since both stem from the resolution of the World Health Assembly.

1. Environmental pollutants, etc.

Use the appropriate quantity and unit as given in Table 7 of The SI for the health professions. Examples:

(a) Particulate matter in air: mass concentration. Unit: mg/m^3 , $\mu\text{g}/\text{m}^3$, etc. (In a few cases, number concentration may be the appropriate quantity, with the unit "number per cubic metre", e.g. number of asbestos fibres per cubic metre of air.) Ambient temperature and pressure should be specified.

(b) Particulate matter in water: mass concentration. Unit: mg/m^3 , $\mu\text{g}/\text{m}^3$, etc. (or, in some cases, mg/l , $\mu\text{g}/\text{l}$, etc.).

(c) Gases and vapours in air: mass concentration, as in (a) above. Ambient temperature and pressure must be specified.

(d) Dissolved substances in water: mass concentration or substance concentration, as appropriate (for mass concentration, the denominator should be either cubic metre or litre, as appropriate; for substance concentration the same is true, but in this case the denominator will usually be the litre).

(e) Deposited matter (deposit gauges): milligram per square metre during a stated period of time (usually 30 days).

2. "Parts per million" and "parts per billion"

These "units" should not be used. Instead, use the appropriate quantity and unit from Table 7 of The SI for the health professions (e.g., instead of "parts per million" use mg/kg , $\mu\text{l}/\text{l}$, mg/l , etc.) Note: owing to its ambiguity, the term "billion" should not be used in any context.

3. Percentages: purity, concentrations of solutions, etc.

As explained in The SI for the health professions, percentages should not be used in expressing the results of certain clinical tests ("clearances"). Similarly, they should not be used to express purity, concentrations of solutions, etc. Thus the designations %, % w/v, % w/w, etc., should not be used. Instead, the appropriate quantity and unit from Table 7 of the book should be used. Examples: purity of solids: mass fraction (e.g. g/kg); concentration of solutions: either mass concentration (e.g. in g/l , gram per litre of solution) or substance concentration (e.g. in mmol/l , millimole per litre of solution). (In some cases, it may be advisable to give concentration of solutions in both forms.) Concentrations of some reagents, such as concentrated acids and ammonia solution, are often best expressed by specifying the density of the solution (using the symbol ρ for density).

4. International units

A number of biologicals (e.g. vaccines) are not yet sufficiently characterized chemically and physically to permit adequate expression in SI units. For these, the "international units" adopted by the World Health Assembly should be used. (It is

advisable, however, to give, somewhere in each publication, the mass of a given biological that contains 1 IU: this information is given in the most recent edition of Biological substances; international standards, reference preparations, and reference reagents.)

IMPORTANT: International units for a number of substances have been withdrawn and should no longer be used (these substances are listed in the publication mentioned in the preceding sentence). Example: the IUs for vitamins A and E were withdrawn in 1954 and 1956, respectively, and quantities of retinol palmitate and 2-ambr- α -tocopherol acetate ("tocopherol acetate") should be expressed in mass units.

ADDITIONAL INFORMATION

For a few components (mostly proteins) that are determined in clinical chemistry, the situation has not yet been fully resolved, as explained in The SI for the health professions. The practice to be followed in WHO publications and documents is outlined below.

1. Hemoglobin

The recommendation of the appropriate international NGO is that hemoglobin (this is the internationally recommended spelling) should, as an interim measure, preferably be expressed in mass concentration (gram per litre), although substance concentration (millimole per litre) may also be used. However, in many countries that have changed to SI units the permitted alternative of substance concentration is now being used rather than mass concentration. In order to follow the recommendation of the NGO and at the same time be helpful to laboratories that are using substance concentration, the only solution is to give all hemoglobin concentrations in both gram per litre and millimole per litre. Example: "hemoglobin(Fe), 148 g/l (9.20 mmol/l)". (This is only an interim measure, and at the appropriate time the use of gram per litre will be dropped.)

2. Plasma proteins, etc.

Albumin can be expressed in substance concentration, but with the exception of IgG all immunoglobulins can at present be expressed only in mass concentration. If, in a given context, the point at issue is the amount of "total" protein and the ratio of albumin to immunoglobulins, it would be absurd to use two different units. In this case, therefore, all values should be given in terms of mass concentration (gram per litre). However, if the point at issue is the relation between albumin and a component other than immunoglobulins, such as bilirubin, all values should be given in terms of substance concentration (since bilirubin is invariably to be reported in this way, the relationship would be obscured by reporting the albumin in mass concentration). (In this particular case, both albumin and bilirubin would be expressed in micromole per litre.) The same applies to the relation between albumin and fibrinogen.

3. Enzymes and pH

Definitive rules on enzyme units will probably be published within the coming year and will be circulated at that time. In the meantime, values should be given in mole (or a submultiple thereof) per second (mol/s or mol s^{-1}). Pending a decision by the appropriate international bodies, pH should continue to be used.

4. Blood pressure

Apart from certain radiation quantities, blood pressure is the only quantity for which all values should routinely be given in both SI and traditional units, as desired by the World Health Assembly. This is fully explained in The SI for the health professions.