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The use of SI in reporting results in pathology[1]

The Système International d'Unités (SI) is becoming the approved means of expressing information in all branches of science and technology (including medicine) in this country. This affects pathologists in two ways, both in scientific writing and in expressing results on specimens from patients. The medical editorial aspect has been covered by a working party, originally sponsored by the Royal Society of Medicine, and a booklet containing recommendations on units, symbols, and abbreviations will shortly appear.

The application of SI to pathological reports on patients involves the choice of units of measurement and of their method of expression. The changes now recommended involve mainly the nomenclature of units, and conform to those made for other sciences. Changes to units which would involve an alteration in the numerical value of results (such as occurred when mEq/1 replaced mg/100 ml for electrolytes) have not been proposed now, and would have to be introduced more gradually with interdisciplinary agreement of the medical profession in general. Here unfamiliarity could lead to lethal misunderstanding.

SI has six basic units: metre, kilogram(me), second, ampere, kelvin, and candela, supplemented by the radian and steradian, and with the addition of the mole. All other units are derived from these.

Multiples and Submultiples

Decimal multiples and submultiples of units are formed by the use of prefixes, according to the Table.

Multiple	*Prefix*	*Symbol*	*Submultiple*	*Prefix*	*Symbol*
10^{12}	tera	T	10^{-1}	deci	d
10^{9}	giga	G	10^{-2}	centi	c
10^{6}	mega	M	10^{-3}	milli	m
10^{3}	kilo	k	10^{-6}	micro	μ
10^{2}	hecto	h	10^{-9}	nano	n
10	deca	da	10^{-12}	pico	p
			10^{-15}	femto	f
			10^{-18}	atto	a

Compound prefixes should *not* be used. Thus 10^{-9} × metre is nanometre (nm), *not* millimicrometre (mμm).

In general multiples and submultiples are used in steps of 10^3.

All typewriters should have one key changed to μ (cost about £2).

Expression of Large Numbers

Because in many countries the comma is used for the decimal point, the comma should be *avoided as the spacer in* expressing large numbers. Instead (if there are more than four digits) groups of three digits are to be separated by a half-space. Thus, one million five hundred thousand is $1{\cdot}5 \times 10^6$ or 1 500 000.

For high or low values of units, it is preferable to use an appropriate prefixed unit, if possible ensuring that the resulting numerical value is between 0·1 and 1000. Thus 50 000 g is better expressed as 50 kg; 0·000 075 m is better expressed as 75 μm and *not* as 0·075 mm.

It is suggested that red cell counts should be expressed as $x \times 10^6/\mu$l (range of x about 0·5-10·0), and platelet counts as $y \times 10^4/\mu$l (range of y about 0·1-200). However, strict adherence to the principles of SI might be thought to imply expression of platelet counts as $z \times 10^3/\mu$l (range of z, 1-2000)?

Symbols for Units

These are in upright type, without a full stop, and do *not* alter in the plural. A capital letter is used only in the symbol for units, such as Ci (curie), which are derived from proper names (Curie).

MULTIPLE UNITS

Powers

'Squared' and 'cubed' are to be expressed as numerical powers and *not* by abbreviations. Thus the area square centimetre is cm^2 *not* sq cm.

Combination of units

When only two units are concerned, one being divided by the other, the divider, 'per', may be represented by the single solidus (/) or by the use of negative powers. Thus 'millilitres per square metre' is ml/m^2, *or* ml m^{-2}.

[1]Report of a working party set up by the Royal College of Pathologists.

Use of more than one solidus must be avoided as this leads to mathematically ambiguous statements: *not* ml/m²/h, *but* ml m^{-2} h^{-1} *or* ml/m² h.

IMPERIAL UNITS

These are to be abandoned. If it is ever necessary to quote measurements made in Imperial units, then the SI (metric) measurement derived by an appropriate conversion factor must also be given.

Special Applications to Pathology

LENGTH

The basic unit is the metre (m).

The ångstrom unit (Å) should not be used, and the measurement should be converted to nanometres (1 Å = 10^{-1} nm).

The micron (μ) as a name for a unit of length (10^{-6} m) is obsolete: the correct name for this unit is the micrometre (μm).

VOLUME

The basic unit is the cubic metre (m³).

Working unit is litre (l), which is an alternative name for the cubic decimetre (dm³).

In pathology multiples and submultiples of the litre (including, for example, 100 ml) should be used for all measurements of volume.

The lambda (λ) as a name for a unit of volume (10^{-6}l) is obsolete: the correct name for this unit is the microlitre (μl).

Per cent (%) means 'per hundred parts of the same'. Thus 'mg %' means milligrams per hundred milligrams', and must *never* be used to mean 'milligrams per hundred millilitres', which differs by a factor of the order of one thousand.

MASS

The basic unit is the kilogram (kg); working unit is gram (g). [It has recently been agreed that the spellings kilogram, gram, etc, are accepted for use in Britain.]

Multiples and submultiples are of the gramme and not of the kilogramme.

The gamma (γ) as a name for a unit of mass (10^{-6} g) is obsolete: the correct name for this unit is the microgram (μg).

ENZYMES

There is as yet no agreed system of units applicable to *all* enzymes measured in pathology. Care must be taken, unless a familiar method and unit are being used, strictly to define the unit quoted.

PRESSURE

The basic unit is the newton per square metre (N/m²). The alternative name for this unit is the Pascal (Pa).

Conventional units are millimetres of mercury (mmHg), centimetres of water (cmH_2O).

In pathology, as in medicine in general, pressure measurements made on the height of a liquid column will continue to be so expressed.

Conversion factors (at stp): 1 mmHg ≈ 133 N/m², 1 cmH_2O ≈ 98 N/m².

TIME

The basic unit is the second (s). Other working units are minute (min), hour (h), day (d), year (a).

THERMODYNAMIC TEMPERATURE

The basic unit is the kelvin (K) *not* degree Kelvin (°K).

The working unit (customary temperature) is the degree Celsius (°C).

AMOUNT OF SUBSTANCE

The basic unit is the mole (mol). The mole replaces the gram-molecule, gram-ion, gram-equivalent, etc.

It is recommended that the use of the equivalent and its submultiples (eg, milliequivalent) be abandoned. Where monovalent ions are concerned (eg, Na^+), 1 mEq is numerically identical to 1 mmol, and their analytical results should therefore be expressed as mmol/l or mmol/d etc. It is suggested that, in expressing analytical results, extension of the mole as a unit to non-monovalent ions such as calcium, or to nonionic substances such as glucose, should be deferred until clinicians become familiar with this new unit. At that time both units will be used until the new units become familiar. The mole system is inapplicable to substances of ill defined molecular weight, or to mixtures.

M is *not* the symbol for the amount 'mole', but for the concentration 'molar' (mol/l). If there is any possibility of confusion, mol/l should be used.