

## Quantities and Units in Clinical Chemistry<sup>1)</sup>

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*From the Commission on Quantities and Units in Clinical Chemistry (of IUPAC)<sup>2)</sup> and the International Federation for Clinical Chemistry*

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### Introduction

The Commission on Clinical Chemistry (CCC) of IUPAC<sup>2)</sup> in 1965 nominated a Subcommittee for Standards and Units in Clinical Chemistry (1). Concerning units the primary task of the subcommittee was to study

- 1) the individual and national efforts to counteract the increasingly chaotic use of quantities and units in clinical chemistry,
- 2) the current usage in related fields of science, especially biochemistry and general chemistry, and
- 3) the official recommendations from IUPAC, IUB<sup>3)</sup>, IUPAP<sup>4)</sup>, and ISO<sup>5)</sup>.

Secondarily, the subcommittee was to submit a draft for a CCC Recommendation.

An intermediate result, the pamphlet *A Primer of Quantities and Units in Clinical Chemistry (1966)* (2), was distributed among a number of national clinical chemical societies (3) (all the members of IFCC<sup>6)</sup>) and criticism was invited. At the Sixth International Congress of Clinical Chemistry in Munich, 1966, the contents were approved — with minor modifications — by CCC and IFCC.

The preparation of a draft for the Recommendation 1966 of CCC and IFCC was left to R. DYBKÆR and K. JØRGENSEN. The result was approved by the Titular members of CCC (4) and forms part of the recently published, more comprehensive treatise *Quantities and Units in Clinical Chemistry (1967)* (5)<sup>7)</sup>. The Recommendation 1966 was finally accepted by the IUPAC Section on Clinical Chemistry in Prague 1967, and the future development was entrusted to the newly created Commission on Quantities and Units in Clinical Chemistry (CQUCC) (6).

### Recommendation 1966 of CCC and IFCC

The Recommendation 1966 consists of a systematic and thorough discussion of the *basic and derived kinds of*

*quantities and their appropriate units* of main interest to the clinical chemist, especially for his communication with the clinicians. The foundation is the recommendations from IUPAC, IUB, IUPAP, and ISO.

While the monograph (5) should be consulted for an appreciation of the background, principles and details of the Recommendation 1966, two points merit special mention. Firstly, it is recommended, as far as possible, to use the 'chemical' basic kind of quantity 'amount of substance' with its basic unit 'mole' (symbolized mol) instead of 'mass' and mass units. (The concept 'equivalent' as a unit is ambiguous and unnecessary.) Secondly, the 'litre' (or 'liter'; symbolized l) as redefined internationally (in 1964) is retained also in clinical chemistry as the fundamental unit of volume. (One litre is equal to one cubic decimetre (exactly) (7). The coherent unit in the *Système Internationale d'Unités* is 'cubic metre'.) The application of these two principles entails that derived kinds of quantities employing 'amount of substance' instead of 'mass' are preferred, e. g. 'molar concentration' in 'mole per litre' for 'mass concentration' (in 'kilogramme per litre').

The preferred *factor symbols* for units are powers of ten having whole number exponents which are simple multiples of three; the internationally approved list now ranges from 10<sup>12</sup> (tera-, T) to 10<sup>-18</sup> (atto-, a). Consequently, 'decilitre' (= 10<sup>-1</sup> l = 100 ml) is not recommended. In derived units only the numerator should contain a factor symbol; thus, mmol/l,  $\mu$ mol/l, etc. are preferred for  $\mu$ mol/ml, nmol/ml respectively, and the use of, e. g., mg/100 ml and mol/100 ml is discouraged. With regard to *quantity names* the Recommendation 1966 states the principle that they should be unambiguous and — at least in print — should include three segments of information: the kind of system investigated, the component of special interest in this system (with a 'formula unit' appended if doubt may arise), and the kind of quantity employed; this is followed by the product of the numerical value and an appropriate recommended unit.

### Supplementary information

Apart from the Recommendation 1966 the monograph contains historical and chemical *background information, proposals for future recommendations* on kinds of quantities

1) Published in several pertinent periodicals  
2) International Union of Pure and Applied Chemistry  
3) International Union of Biochemistry  
4) International Union of Pure and Applied Physics  
5) International Organization for Standardization  
6) International Federation for Clinical Chemistry  
7) See review on page 504

with appropriate units, and suggestions for the construction of *systematic quantity names in clinical chemistry*. CQUCC and IFCC do not, at present, make recommendations on the specific form of the names or abbreviations employed. They may vary with language and local requirements. Application of the naming principle given in the Recommendation 1966 may lead to systematic forms like, e. g.,

Serum-Acid phosphatase, enzyme concentration (JACOBSSON 1960) = 3.9 U/l;

Serum-Albumin, mass concentration = 52 g/l;

24-hours-Urine-Calcium ion(Ca), amount of substance = 4.3 mmol;

Blood-Hemoglobin(Fe), molar concentration = 8.9 mmol/l;

Patient-Plasma, volume = 2.9 l;

Plasma-Thrombocytes, particle concentration =  $300 \times 10^9/l$ .

The use of appropriate abbreviations for kind of system and kind of quantity appreciably shortens the length of the systematic names as shown in a *list of examples*; the

longest of the above names, e. g., may be abbreviated dU-Calcium ion(Ca), *ams*. The list also contains *factors for conversion* between some commonly used, but less satisfactory, expressions of quantities and those recommended.

### Concluding remarks

The aim of the Recommendation 1966 is

1) to reduce the number of usages for presentation of clinical chemical data and

2) to close the existing gap between the nomenclature in clinical chemistry and that of allied fields of science.

CQUCC and IFCC share the hope that the joint Recommendation 1966 — which is in agreement with those of other pertinent international bodies — will meet with approval in principle, and, eventually, lead to an international and consistent nomenclature and use of quantity names and units in clinical chemistry. This, ultimately, should benefit the scientific worker as well as — and most important — the patient undergoing diagnosis and treatment, because misunderstandings will be fewer.

### References

1. COURTOIS, J. E., president (Paris), R. DYBÆK and P. LOUS (Copenhagen), N. F. MACLAGAN (London), M. RUBIN (Washington, D. C.), and M. C. SANZ (Geneva). — 2. DYBÆK, R. and K. JØRGENSEN, A primer of quantities and units in clinical chemistry. Made on behalf of the Subcommittee for Standardization of Units in Clinical Chemistry of IFCC. 25 pp. Copenhagen (1966). — 3. Australia, Belgium, Canada, Czechoslovakia, Denmark, Federal Republic of Germany, Finland, France, Iran, Japan, Netherlands, Norway, Sweden, Switzerland, UK, USA, and USSR. — 4. J. E. COURTOIS, president (France), J. de WAEL (Netherlands), S. H. JACKSON (Canada), A. L. LATNER for N. F. MACLAGAN (UK),

V. N. OREKHOVITCH (USSR), M. RUBIN (USA), R. RUYSSSEN (Belgium), and M. C. SANZ, secretary (Switzerland). — 5. DYBÆK, R. and K. JØRGENSEN, Quantities and Units in Clinical Chemistry. Including Recommendation 1966 of the Commission on Clinical Chemistry of the International Union of Pure and Applied Chemistry and of the International Federation for Clinical Chemistry. pp. X + 102. Munksgaard, Copenhagen (1967). — 6. ARMBRECHT, B. H., (Beltsville, Maryland, USA), R. DYBÆK, president (Copenhagen), K. JØRGENSEN (Copenhagen), P. METAIS (Strasbourg). — 7. Conférence Générale des Poids et Mesures, 1964.

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