Changing the status of mmHg

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Abstract

The new International System of Units (SI) came into force this May, and while the media and public attention are focused on the changes in the base units, there are also other changes introduced. One of them is the abolition of millimetre of mercury (mmHg). This simplifies the SI but also can cause problems to the patients which are extremely conservative user groups (although this unit is still supported by some other authoritative documents). Hence, it is necessary to increase awareness of both the medical doctor and the patients.

Keywords SI · Pressure units · Sphygmomanometry · Eye tonometry

In November 2018, the General Conference on Weights and Measures adopted the redefinitions of four SI base units (*kilogram*, *ampere*, *kelvin* and *mole*) and the new formulations of the remaining three (*second*, *metre* and *candela*). Thus, the last two definitions based on an artefact (i.e. kilogram and to a certain extent kelvin) were retired, and now all base units are defined based on physical and technical constants, the magnitudes of which were fixed by the CGPM. The new SI came into force on 20 May 2019, and the 9th edition of the SI Brochure (an official document issued by the International Bureau of Weights and Measures) which includes these changes is available on-line [1].

While media attention is focused mainly on the changes in the base units, the 9th edition of the SI Brochure brings significant changes in the list of the “Non-SI units accepted for use with the SI units”. The 8th edition of the SI Brochure divides the non-SI units in four classes: “Non-SI units accepted for use with the International System of Units”,

“Non-SI units whose values in SI units must be obtained experimentally”, “Other non-SI units” and “Non-SI units associated with the CGS and the CGS-Gaussian system of units”. In contrast, the 9th edition dedicates only one chapter to the non-SI units: “Non-SI units that are accepted for use with the SI”. The millimetre of mercury listed under “Other non-SI units” in the 8th edition is no longer present in the 9th edition. Hence, this is the first and only edition of the SI Brochure not recommending the use of mmHg.

Besides, the SI Brochure there are a series of official documents concerning or addressing non-SI measurement units. ISO 80000-4:2013 mentioned the mmHg in the informative “Appendix C—Using these units is not recommended”, therefore not supporting its use. In August 2019, a new version ISO 80000-4:2019(E) was issued which does not contain mmHg. The Regulation (EU) 2017/745 on medical devices states that “The measurements made by devices with a measuring function shall be expressed in legal units conforming to the provisions of Council Directive 80/181/EEC”. The Council Directive 80/181/EC allows the use of mmHg specifically for blood pressure and pressure of other body fluids indications. An Amendment of this Directive was issued in July 2019, but it focused only on the base SI units and did not affect mmHg. Hence, while currently the use of mmHg is (restrictively and in geographically limited scope) still supported by some official documents, the future situation is uncertain.

Although it is clearly beneficial to adhere to the coherent SI units, this change imposes significant inconvenience for the medical world and the patients. On one side, the two

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categories are known for being rather conservatives with respect to mmHg, and on the other side, such a change will need a long transition period and a clear plan on how this should be initiated and consistently conducted and communicated in time to all concerned parties.

The use of kPa instead of mmHg was considered previously for medical measurements, not long after the introduction of the Pascal [2]. Resistance from the medical world followed immediately [3, 4], arguing not only for the continuity, but mainly for its direct connection to the measurement methods. The WHO followed a compromise approach recommending that both kPa and mmHg should be used simultaneously in the interim [5], the main concern being a risk of rounding the decimal fraction of the blood pressure values expressed in kPa. With the advancements and spread of alternative blood pressure measurement techniques where the connection between the mmHg and the measurement method does not exist anymore, the view in favour of the kPa reappeared [6]. While the fact that mmHg is no longer supported by the prevailing measurement method is acknowledged by some opponents of the kPa, they do not consider the kPa a viable alternative and propose the introduction of a new unit, centimetre of blood [7], a unit inadequately defined at the moment.

Although the mmHg is still widely used and supported in some regions by official documents, its status weakens in the medical metrology both due to normative reasons and due to the progress in the field of sphygmomanometry and eye tonometry. It is imperative to be and to make the concerned parties aware of these gradual changes, in order to be prepared for a possible ultimate transition to the “pure SI”.

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References

1. SI Brochure: The International system of Units (SI) (2019) BIPM <https://www.bipm.org/en/publications/si-brochure/>
2. Kappagoda CT, Linden RJ (1976) The use of SI units in cardiovascular studies. *Br Heart J* 38:219–224
3. Rose JC (1978) Pressures on the millimetre of mercury. *N Engl J Med* 298:1361–1364
4. Laros RK (1980) Implications of metric conversion. *Obstet Gynecol* 56:646–648
5. Braga EPF (1981) The use of SI units in medicine: a WHO Memorandum. *Bull World Health Organ* 59:865–866
6. O'Brien E (1998) Will the millimetre of mercury be replaced by the kilopascal? *J Hypertens* 16:259–261
7. MacGregor G (2001) What unit for blood pressure? *Lancet* 357:1452

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