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Special Article

Use of algebraic symbols in mathematical formulas of medical scientific articles

Uso de los símbolos algebraicos en las fórmulas matemáticas de los artículos científicos médicos

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INTRODUCTION

This article is not intended to discuss whether medicine is an art or a science, though there is no doubt that it includes both[1]; what is definitely a fact is that its mission is: "*to cure sometimes, to relieve often and to comfort always*"[2,3]. This phrase, which some accredit to Hippocrates[2] and others to French doctors Berard and Gubler[3] cannot become true when mathematical symbols and formulas in scientific medical articles are incorrectly stated.

A person´s life many times depends on the calculation of a given variable: caloric needs, parameters for artificial mechanical ventilation, hydro-mineral balance corrections, atherogenic risk determination, just to mention some examples that are so useful at the bedside; however, it must be remembered that even the diagnostic operations, such as echocardiography, tomography, nuclear medicine, magnetic resonance imaging and the reading of the hundreds of parameters they display, depend above all on the application of mathematical formulas and functions.

What would happen then if they are erroneously expressed and transmitted?

Scientific papers are the way to communicate experiences from practice or research activity and their divulgation is essential for the advancement of science. Their authors employ a series of mathematical symbols along with the written language[4].

Algebra is a branch of mathematics that uses letters to represent arithmetic relations. The classical algebra, which deals with solving equations, implements

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symbols instead of specific numbers and arithmetic operations to determine how to use these symbols. An important breakthrough in algebra took place in the sixteenth century with the introduction of symbols for the unknown quantity, operations and algebraic powers[4,5]. It is essential for the medical staff to know and apply them properly.

ALGEBRAIC SYMBOLS
Among the algebraic symbols there are numbers, letters and signs in order to represent the various arithmetic operations. The grouping of these symbols and the sequence of arithmetic operations are based on the grouping symbols, which guarantee the legibility of algebraic language. These include the parentheses ( ), brackets [ ], braces { } and horizontal lines —also called links— commonly used to represent division and root[6]. The following examples show their application:

- (5a+b) + [3a–2b] – {a–3b}

- $\dfrac{2p-q}{2x+3y}$

- $\sqrt{2a-b}$

Sometimes it is necessary to include expressions containing parentheses within other parentheses as well. In these cases a number of grouping signs (symbols) are used in order to avoid confusion. For example, if we have to subtract from 5a the difference between 3b and a + b, then we write:

5a – [3b – (a+b)]

To simplify these type of expressions, grouping symbols can be successively removed as follows[6]:
1- Start with the innermost, that is, "from inside-out" or else…
2- Start with the outermost, "from outside-in".

The procedure is as follows:
- To remove grouping symbols preceded by the sign +, keep the same sign that has each of the amounts that are inside of it.
- To remove grouping symbols preceded by the sign – change the sign that has each of the amounts that are within it.

Example:

$$2a - \{5a - [3b - (a+b)]\} = 2a - \{5a - [3b -a -b]\}$$
$$= 2a - \{5a - 3b +a +b\}$$
$$= 2a - 5a + 3b -a -b$$
$$= -4a + 2b$$

Moreover, the symbols of the basic arithmetic operations are well known: addition (+), subtraction (–), multiplication (×) and division (:).

In the case of multiplication, the "x" sign is usually omitted or replaced by a point, as in $a \cdot b$. A group of contiguous symbols, such as *abc* represents the product of *a, b* and *c*. Division is usually indicated by horizontal lines. In fractions, an oblique line or a virgule is also used to separate the numerator (to the left of the line) from the denominator (to the right). We must be careful to group the terms properly. For example $ax + b/c - dy$ indicates that *ax* and *dy* are separate terms, as well as *b/c,* while $(ax + b)/(c - dy)$ is an entirely different mathematical function representing the fraction: $\dfrac{ax+b}{c-dy}$

Incorrect use of algebraic symbols
Incorrect application of algebraic symbols is associated with their improper application, or their absence, in the formulas. The following fórmula[7], for instance, presents ambiguities because it is not the same:

QTc = QT / RR x 0,604 que QTc = QT / (RR x 0,604)

This can be demonstrated by another example:

$\dfrac{6}{3}$ x 2 = 4 is not the same that 6/(3 × 2) = 1

The indiscriminate use of the point (.) and the comma (,) to represent decimal numbers should also be noted. We should clarify that, in Cuba, the comma is the proper symbol to be used for this purpose. It will be necessary to reach consensus in case it is copied from a foreign formula. Using the point (.) and the comma (,) in the same formula to represent decimal numbers is a mistake. Example:

QTc = 453,65 x RR1 / 3.02

This same ambiguity occurs with the use of the multiplication sign when in the same article the multiplication in formulas is represented by a point (.) and by an (x) likewise.

Another indiscriminate use of algebraic symbols is to apply them unnecessarily, for example in the formula: $QTc = \log(600)QT/(\log RR)$

The use of parentheses in this formula is not necessary, since in $\log(600)$ the argument of the logarithm is a monomial (a number), not an algebraic expression[8] and in the denominator the $(\log RR)$ is a number too, because RR takes a numeric value. It would be advisable to use the Word-equation editor from Microsoft Office, and write it this way:

$$QTc = \log 600 \cdot \frac{QT}{\log RR}$$

On the other hand, it should be noted that computer programs or scientific calculators, as well as medical devices that read and interpret electrocardiograms or any other waves and images, in which these formulas are introduced to facilitate calculation, are based on the algebra rules that have already been mentioned.

AFTERWORD

The correct use of algebraic symbols is of vital importance when writing formulas in scientific articles, their improper utilization or misuse could lead to confusion and consequently to fatal outcomes.

The use of Internet to clarify doubts and find formulas of interest is more popular every day. Such an error in a medical journal, as simple as it seems, can result in a totally wrong value, with all the potentially serious consequences it implies for the patient.

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