

# 1,116,629 or One Million, One Hundred and Sixteen Thousand, Six Hundred and Twenty-nine? More Sensible Rules for Abbreviations and Acronyms in the Bio-Medical Sciences

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## ABSTRACT

Authors and editors, science writers and reviewers are often in contact with a horde of literature and manuscripts almost on a daily basis. It is common for peer reviewers and editors – who are clearly not linguists nor, in many cases, native English speakers – to preach to authors – who are often native English-speaking scientists – that they should not start a sentence with an abbreviation or an acronym. The frequency of such a blind criticism or advice – often unscreened or unedited by the publisher – has led us to explore, in this paper, the use of abbreviations and acronyms in the English language with the purpose of creating a clearer set of rules or guidelines that would allow scientists – authors and reviewers/editors alike – as well as publishers to better use abbreviations and acronyms in bio-medical journals. It is also common to see predatory publishers claim the use of strict grammar, but on opening the manuscript PDF files, a wealth of grammatical errors, including in the use of abbreviations and acronyms, further fortifying their predatory nature. The rules that we cover in this opinion piece are not necessarily a grammar review, but provide practical examples of what to do and what not to do, and how to make choices related to abbreviations. We further suggest altering several rules which, in the context of science writing, are non-sensical or non-sensible.

**Keywords:** alphabetism, initialism

*No two authorities seem to agree on how we should form the plural of abbreviations, letters, and numbers. Should we add s or 's? Where one style maven sees UFO's, another sees UFOs...this is more a matter of taste and readability than of grammar. (O'Conner, 2009, p. 30)*

## INTRODUCTION

Abbreviations are an important component of most bio-medical papers and, if used effectively, can not only reduce space, but also facilitate the reading of a text that would otherwise be excessively long, hence limiting its effective interpretation. For example, a sentence such as “Protocorm-like bodies can be developed from thin cell layers provided that a suitable medium such as Murashige and Skoog medium is supplemented with plant growth regulators such as 1-naphthaleneacetic acid and 6-benzyladenine.” could be read much more easily by a scientist when the appropriate abbreviations are used, provided that they have been defined earlier on in the text according to genera, pre-defined scientific writing rules or, if an uncommon format is used, to the rule of that particular journal. Thus, in this case, to a knowledgeable scientist, the sentence could be reduced to almost half its size without sacrificing its clarity: “PLBs can be developed from TCLs provided that a suitable medium such as MS medium is supplemented with PGRs such as NAA and BA.”

## ABBREVIATIONS VERSUS ACRONYMS

According to The New Oxford American Dictionary (Angus and Lindberg 2010), an abbreviation is a shortened form of a word or phrase, for example, *etc.* for *et cetera* and *Oct.* for *October*. More specifically, The Dictionary of Linguistics and Phonetics (Crystal 2003) under the headword *abbreviation*, lists specific cases of abbreviations such as initialism, alphabetism, acronyms, clippings, and blends. In

that sense, initialisms and alphabetisms reflect the separate pronunciation of the initial letter of the constituent words such as TV (television) and COD (cash on delivery) while acronyms are pronounced as single words such as NATO (North Atlantic Treaty Organization) or laser (Light Amplification by Stimulated Emission of Radiation); clipped forms or clippings are reductions of longer forms, usually removing the end of the word (ad from advertisement), but sometimes the beginning (plane from aeroplane), or both beginning and ending together (flu from influenza); and blends combine parts of two words (sitcom from situation comedy, motel from motor hotel, or hazmat from hazardous materials).

In other words, there is a difference between acronyms and abbreviations. An acronym is an abbreviation formed from the initial letters of each word and pronounced as a word. Therefore, acronyms are a subset of abbreviations. All acronyms are abbreviations, but not all abbreviations are acronyms. Angus and Lindberg explain that an initialism is “an abbreviation consisting of initial letters and pronounced separately” (p 894). Initialisms are often confused with acronyms because they are also made up of initial letters, so they look similar. The difference is that initialisms cannot be pronounced as words. FBI and CIA are examples of initialisms because they are formed from the first letters of Federal Bureau of Investigation and Central Intelligence Agency, respectively, and each letter is pronounced separately. NASA, on the other hand, is an acronym because it is pronounced as a word, NASA, and not by spelling out the letters N. A. S. A., even though it is also made up of the first letters of the department name

(National Aeronautics and Space Administration). Wikipedia (Website 1) recommends the abbreviation of World War II or the Second World War to WWII or WW2 but *The Associated Press Style Guide* (Christian *et al.* 2011) and the *Chicago Manual of Style* (University of Chicago Press 2010) both write it out as "World War II" and do not provide a recommended abbreviation.

To sum up:

- Abbreviations are any shortened form of a word.
- Acronyms are made from the first letters of a string of words and are pronounced as if they were words themselves. Examples include AIDS (Acquired Immune Deficiency Sndrome), NASA, and NIMBY (not in my back yard).
- Initialisms are made from the first letters of a string of words, but cannot be pronounced as words themselves. Examples include FBI, CIA, FYI (for your information), RSVP (repondez s'il vous plaît), and PR (public relations).
- Most rules applicable to abbreviations in science have originated in the USA yet have been applied globally.

In the bio-medical sciences, acronyms and initialisms are generally not differentiated and in fact it is highly likely that many scientists have never even heard of the term initialisms. For the purpose of this paper, we wish not to discriminate between acronyms and initialisms to avoid confusion since, at a practical level, what we truly want to indicate in a scientific paper is the shortened version of a word.

## WHAT DO THE SOCIAL SCIENCES SUGGEST?

The American Psychological Association (APA) style is most commonly used to cite sources within the social sciences. According to the 6th edition, second printing of the APA manual (APA 2010), abbreviations should be limited to instances when a) the abbreviation is standard and will not interfere with the reader's understanding, and b) if space and repetition can be greatly avoided through abbreviation.

There are also a number of interesting and important rules which are listed by APA and which could serve as base guidelines for the use of abbreviations in the bio-medical sciences:

1) When abbreviating a term, use the full term at first use, followed immediately by the abbreviation in parentheses. Standard abbreviations like units of measurement and states do not need to be written out. APA also allows abbreviations that appear as word entries (i.e. that are not labeled *abbr*) in Merriam-Webster's Collegiate Dictionary (2005) to be used without explanation (IQ, REM, AIDS, HIV). In bio-medical journals, however, authors are generally requested to define all abbreviations in full at first mention.

2) Do not use periods or spaces in abbreviations of all capital letters, unless it is a proper name *or* refers to participants using identity-concealing labels such as CD, HTML, USDA *vs.* J. A. Teixeira da Silva *or* N.B., R.I.P. *or* R.S.V.P. Exceptions: Use a period when abbreviating the United States as an adjective (U.S. Marines *or* U.S. Senator).

3) Use a period if the abbreviation is a Latin abbreviation or a reference abbreviation: *etc.*, *e.g.*, *a.m.* *or* Vol. 7, p. 12, 4th ed. However, regarding reference abbreviations, this will depend also on the style employed by each bio-medical journal, which takes preference over this rule (and could thus be one source for confusion among scientists). For example, Elsevier's *Scientia Horticulturae* is abbreviated as *Sci. Hort.* in some journals, but in others it is abbreviated as *Sci. Hortic.* The correct form of the journal's abbreviation should be provided by the publisher on their journal webpage.

4) Do not use periods when abbreviating measurements: *cd*, *ft*, *lb*, *mi*, *min*. There is an exception, however, use a period when abbreviating inch (*in.*) to avoid confusion with the preposition *in*. Units of measurement and statistical ab-

brevisions should only be abbreviated when accompanied by numerical values: 7 mg, 12 mi, M = 7.5 *vs* measured in milligrams, several kilometers after the exit, the means were determined. Here, too, the rule often depends upon the editorial policy of each bio-medical journal. In general, SI (Système Internationale d'Unités) units are required for non-US journals. Website 2 includes a full list of SI units.

5) Only certain units of time should be abbreviated. Do not abbreviate: day, week, month, year. Do abbreviate: h *or* hr (hour), min (minute), ms (millisecond), ns (nanosecond), s (second). Despite this, it is not uncommon to see manuscripts in journals whose publishers are run by non-native English speakers with incorrectly spelt abbreviations. So, gram will often be seen incorrectly abbreviated as gm, day as d, week as wk, month as mo and year as yr.

6) To form the plural of abbreviations, add s alone without apostrophe or italicization: vols., IQs, Eds, QTLs. Exception: Do not add s to pluralize units of measurement (12 m not 12 ms).

## APPLYING RULES TO THE BIO-MEDICAL SCIENCES

In science, an almost silent rule is that in formal writing, words at the beginning of a sentence should not be abbreviated, even if this abbreviation is frequently used in that piece of writing. APA (2010) shares this rule in that a lower case of abbreviation (for example, kg) or a symbol that stands alone (for example,  $\pi$ ) can never begin a sentence. APA, however, states that a sentence may begin with a capitalized abbreviation or acronym (for example, APA) or with a symbol connected to a word ( $\beta$ -Endorphins). However, the abbreviation may be used at the beginning of a sentence when it is preceded with the definite article (even though within the text no article is used before the abbreviation). As for numbers, the general rule governing APA is to use words to express numbers below 10 and numerals for numbers above 10. However, numbers should never appear at the beginning of a sentence, in a title or a text heading; thus, it should be one milliliter instead of 1 ml. The APA even suggests rewording the sentence to avoid beginning with a number.

In statistics, abbreviations such as ANOVA (analysis of variance) or LSD (least square difference) or CV (coefficient of variation) should not be used to start a sentence. Rather the whole phrase needs to be written or a definite article needs to precede the abbreviation (APA 2006). Clearly this is not practical in scientific writing and would be inconsistent with the use of abbreviated formal nouns such as UN (United Nations) or GM (General Motors), which can be used to start a sentence without any problems.

Does this mean that all abbreviations could be used at the beginning of a sentence? Certainly not! Try *e.g.* (for example) *or* *i.e.* (that is). It would be almost non-sensical to use these at the beginning of a sentence. At Global Science Books (GSB), we have assessed the logic and practical implications of using such rules, many of which are unchallenged or followed blindly by too many bio-medical publishers, journals, editors and peer reviewers. Therefore, where GSB has opposed a rule and used another, this is indicated in the text below. Although such a rule is not a rule, but simply a guideline, it is often recommended to authors who submit manuscripts to GSB journals. GSB does not enforce this rule, especially on those from native English speaking countries who may follow other rules (*e.g.* NZ, Australia, Canada, South Africa and the UK). In general, other Anglophone countries (*i.e.*, countries that were formerly British colonies but that maintain English as an official language such as India, Pakistan, Bangladesh, etc.) may have somewhat colourful novelties in grammar, but which might not always be correctly used.

## Numbers

One of the differences between American and British English is the use of a period after abbreviations like Mr. (British, Mr) and Dr. (Br., Dr). The reason is when an abbreviation uses the first and last letter of a word there is no need for the period in British English (example: ft), but not if the abbreviation includes the first letters or principle letters of the word (e.g., Lt., in. and abbr.). It is customary to exclude the period after numbers, no matter what the abbreviation is (reference?).

According to the APA, numbers 1 through 9 should be written in full (i.e., in words) but from 10 onwards they can be written as integers (i.e., as numbers). It should be noted that most publishers have their own styles, some spell out numbers up to 100, some up to 20, and some only to 10 (Judd 2001). Therefore, you must follow the styles of the publishers you are publishing with. As far as numbers is concerned, Judd lists a few exceptions to the rule of spelling out numbers under 100.

1. Do not begin a sentence with a digit. **At GSB, a sentence may start with a digit**, particularly if it is an exceptionally large or complex number as suggested in the title of this opinion paper.
2. In parallel construction, either use digits or spell out for all numbers. For example, "of the total, 150 were Asian, 45 were American, and 5 were African".
3. Use digits with any rate, for example 5 days per week, 35 words per minute, or 2 students per instructor. At GSB, we extend this rule to all "countable" nouns, and do not restrict the rule to only rates.

If two numbers occur sequentially, spell out one and use digits for the other. The number you choose to spell out may change. If one number is supposed to be written in digits because it is over 100 or used with a unit of measurement, the other has to be spelled out: thirty 10-year-old trees or 30 ten-year-old trees but 500 one-year-old babies, not five-hundred 1-year-old babies, or ten 5-kg bags, not 10 five-kg bags. At GSB, we agree with this rule, for example, forty 10-mer primers so as to not confuse 40 and 10 in 40 10-mer primers.

As suggested in the title, one would most likely never write one million, one hundred and sixteen thousand, six hundred and twenty-nine at the beginning of a sentence. Rather, the numerical form (1,116,629) would make more sense, although I (JATdS) have never personally seen any such title, in verbal or numerical form, probably because most scientists would in fact not know how to deal with this issue. I (JATdS) am of the belief that all numbers should be written in numerical form at any place within a sentence simply for simplicity's sake. Creating different rules for numbers as Judd did with each journal then applying their own separate rule causes chaos, literally, thus one standard rule (a one-size-fits-all approach) would resolve any misunderstandings with only very few exceptions, for example the use of two consecutive digits.

### Applying 8 rules to the bio-medical sciences

The following rules are compiled from rules suggested by APA, Judd, and websites 3 and 4 and modified in the light of the application to the bio-medical sciences.

#### 1. How to handle periods when abbreviating

One of the differences between American and British English is the use of a period after abbreviations like Mr. (British, Mr) and Dr. (Br., Dr). The reason is when an abbreviation uses the first and last letter of a word there is no need for the period in British English (for example: ft (foot), Mr (Mister), and Dr (Doctor)). If the abbreviation, however, includes the first letters or principle letters of the word, a period is needed in both American and British English (for instance, abbr. (abbreviation), anon. (anonymous), and esp. (especially)). It is customary to exclude the period after

numbers, no matter what the abbreviation is.

- a) In general, periods should be eliminated unless the abbreviation spells a normal word. Examples: OPEC (Organization of Petroleum Exporting Countries) vs. in. = inches (not in) or no. = number (not no)
- b) Units of measure that are abbreviated do not have periods, and the same abbreviation is used for both the singular and plural. Examples: cm; kg; mm; h
- c) However, some abbreviations still require periods: a.d.; a.m.; b.c.; Dr.; e.g.; etc.; i.e.; Mr.; p.m.; pp.
- d) When using periods in abbreviations, do not put a space between the period and the next letter. Examples: a.d. (**not** a. d.); i.e. (**not** i. e.)
- e) When an abbreviation ends a sentence, use only a single period: The meeting will begin at 10:00 a.m.

However, if the sentence or clause ends with punctuation other than a period, the other mark of punctuation follows the period of the abbreviation: Will the session be over by 4:30 p.m.? or After 7 p.m., the hotel restaurant is often filled to capacity.

#### 2. How to form plurals of abbreviations

- a. Add an *s*: vols., IQs, Eds, QTLs. No apostrophe or italicization should be used.
- b. To form the plural of the reference abbreviation p. (page), use pp. Do not add *s*.
- c. Do not add *s* to pluralize units of measurement (12 m not 12 ms).

#### 3. May a word be abbreviated that is connected to another word by a hyphen?

No. Spell out abbreviated words that are connected to other words by hyphen.

10-meter pole (**not** 10-m pole); 6-inch pipe (**not** 6-in. pipe).

#### 4. When may a unit of measurement, such as *in.* or *ft.*, be abbreviated?

Do not abbreviate a unit of measurement unless it is used in conjunction with a number:

The measurements in the schematic diagram are given in meters and feet. (*not* m and ft)

vs

The building that we are planning to use for storing supplies is 24 m by 40 m.

The diameter of the opening is 3 cm.

#### 5. Do not repeat abbreviated units of measurement when expressing multiple amounts.

16 – 30 kHz; 0.3, 1.5, and 3.0 mg/dl

#### 6. When is it permissible to use the symbol forms of abbreviations?

Avoid using symbol forms of abbreviations except in graphs, charts, illustrations, and other visual aids:

36.38 in. (*not* 36.38"); 22 pct (*not* 22%). This rule is possible for the humanities, but is not practically useful for the bio-medical sciences. Thus, at GSB, we are of the opinion that this rule reads badly within a scientific paper, and thus the symbol form of abbreviations should always be used in the text and in all visual aids such as figures or tables. This is not necessarily true for the humanities.

#### 7. May an abbreviation be used at the beginning of a sentence?

The preference (although not a rule or a law) is to spell out abbreviations that begin a sentence (except for abbreviated words that are never spelled out, like Mr. and Mrs.):

Electromotive force causes a greater quantity of elec-

tricity to flow through an electric circuit.

*not*

Emf causes a greater quantity of electricity to flow through an electric circuit.

*but*

Dr. Alfonso Sanchez will assume the position of chief controller on Wednesday.

At GSB, provided that the rule is used in a standard way throughout the entire text, we do not oppose the use of abbreviations at the beginning of a sentence. Thus, the sentences that follow are perfectly legitimate, in our opinion:

P concentration of leaves was 5 mg/l. (where P = Phosphorous)

TCLs served as the perfect explant source. (where TCL = thin cell layer)

5-cm PLBs were used as initial explants. (where PLB = protocorm-like body)

### 8. Is it permissible to abbreviate the names of months and days in normal text?

Generally (although this appears to be a personal choice rather than a rule), avoid abbreviating the names of months and days in normal text. Reserve the use of these abbreviations for tables, charts, chronologies, and other visual representations:

Our Quality Improvement Program will officially commence in September 1996. (*not* Sep 1996 or 9/96)

At GSB, we follow this rule.

### 9. How are acronyms appropriately handled?

An unfamiliar acronym or abbreviation that will appear numerous times in a document should be clarified by enclosing its unabbreviated form within parentheses after its first use. For example, thin cell layer (TCL), protocorm-like body (PLB), or Single Sequence Repeat (SSR).

This is not necessary for more commonly used acronyms or abbreviations:

One liter contains one dm<sup>3</sup> (cubic decimeter) of water and weighs one kg (kilogram). However, these are very common abbreviations and units in science, and generally

do not need to be defined. Thus, it is customary to see "One L contains one dm<sup>3</sup> of water and weighs one kg." However, at GSB, we prefer to see this written as: 1 L contains 1 dm<sup>3</sup> of water and weighs 1 kg.

Placing the unabbreviated form first (and the acronym in parentheses) is not incorrect, but it may inhibit the reader's comprehension since the acronym will not be enclosed in parentheses in the remainder of the document.

Obviously, it is useless to introduce an acronym with its unabbreviated form if it will only be used once in the same document. According to the APA (2010), if an abbreviation introduced on first mention of a term is used fewer than three times thereafter, particularly in a long paper, it is probably better to write them out each time.

### SUMMARY

Abbreviations are very commonly used in the bio-medical sciences. In many cases, they are so commonly used that many scientists are not even aware, possibly, of the rules involved. In this short piece, we wanted to highlight some of the important points regarding the use of abbreviations in bio-medical journals.

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