Mind your binomials: a guide to microbial nomenclature and spelling in Sexually Transmitted Infections

Nicola Low,1 Kelly Stroud,2 David A Lewis,3,4 Jackie A Cassell5

Here is a quick quiz:

Question 1: In which published articles is/are the name of the organism or condition spelled correctly?
A. N. gonorrhoeae2
B. Treponema pallidum
C. Chlamydia trachomatis3
D. Neisseria gonorrhoea4
E. Neisseria gonorea

Answer: At the end of this piece.

Question 2: Do you like it when someone misspells your name?
Answer: We don’t like it and you probably don’t either.

There are several reasons for expecting authors to spell scientific terms correctly. First, the conventions for scientific names are meant to allow scientists to communicate precisely and accurately with each other. Incorrect spelling or terminology of the names of microorganisms can cause confusion and perpetuate mistakes. Second, an incorrectly spelled name in the title34 of your research is likely to mislead the reader. Poor spelling gives editors an incorrectly spelled name in the title of your article, which may unfairly affect your chances of publication. Third, the names of microorganisms can cause more than just confusion. Incorrect spelling or terminology of the names of microorganisms can result in errors in the printed version. But authors probably expect copy editors to correct their spelling and editors expect authors to proofread carefully. As our published examples show, failures at both stages result in errors in the printed version. But getting to print is the end of a long process and editors and reviewers will read a manuscript before it is accepted. Authors are responsible for checking their spelling and terminology before submitting a manuscript. First impressions are important so it makes sense to get the spelling and formatting right before submission.

WHAT IS BINOMIAL NOMENCLATURE?
All living organisms have two names (binomial) to describe them: a genus (generic name for a group of closely related organisms) and a species (specific name that distinguishes individual types within the group). Knapp et al6 nicely summarised the origins of the system, which were invented by Carl Linnaeus, a Swedish botanist in the 18th century. Linnaeus suggested two-word ‘nomina trivialia’ to make it easier to remember the names of organisms, which were originally descriptive phrases (‘nomina specifica’) that changed as knowledge accrued. The rules for nomenclature have changed over time and differences between zoology, botany and microbiology have emerged.8

BACTERIA
Bacteria have names in Latin. All bacteria are named in five taxonomic categories: class, order, family, genus and species. The genus and species form the binomial that we use to identify the organism (table 1). The name of the genus can come from the person who discovered it, for example, Neisseria, from Albert Neisser, or a characteristic of the organism, for example, Chlamydia, which is Greek for a cloak and describes its intracellular nature. The genus might have more than one distinct species. For example, many species of Neisseria colonise humans and animals, but only two are human pathogens (N. gonorrhoeae and N. meningitidis).9 Sometimes, the species can be divided into subspecies. For example, we use the binomial Treponema pallidum to refer to the sexually transmitted infection syphilis, but there are three subspecies: T. pallidum subspecies pallidum causes syphilis; T. pallidum subsp. pertenue causes yaws; and T. pallidum subsp. endemicum causes bejel.8 Chlamydia is a bacterium with a contentious taxonomic history, having been called Miyaganaevella, Bedsonia and Rakeia in the past,9 and having initially been thought to be a virus10 or a protozoan.11

VIRUSES
Virologists have adopted different criteria for nomenclature, partly because viruses are not living organisms.12 Viruses often have names in English, for example hepatitis B virus, but they can also have Latin names, for example herpes simplex virus (herpes comes from the Greek herpein, to creep). The generic names of viruses such as HIV are not written in italics; italics are only used for the virus species name or its family. They are not capitalised unless the name is a proper noun, for example Ebola virus.

WHOSE RESPONSIBILITY IS IT TO GET THE NAME RIGHT?
Authors probably expect copy editors to correct their spelling and editors expect authors to proofread carefully. As our published examples show, failures at both stages result in errors in the printed version. But getting to print is the end of a long process and editors and reviewers will read a manuscript before it is accepted. Authors are responsible for checking their spelling and terminology before submitting a manuscript. First impressions are important so it makes sense to get the spelling and formatting right before submission.

Table 1 Nomenclature for bacteria and general principles for formatting

<table>
<thead>
<tr>
<th>Genus</th>
<th>Formatting</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Italicised, uppercase first letter</td>
<td>Neisseria gonorrhoeae</td>
</tr>
<tr>
<td>Condition</td>
<td>Not italicised, lowercase except when used at start of a sentence</td>
<td>gonorrhoea (UK), gonorrhoea (US)</td>
</tr>
<tr>
<td>Abbreviation of genus</td>
<td>May be used when several species from the same genus are named or the same species is mentioned repeatedly. Write the genus in full the first time, then abbreviate with a full stop after the initial</td>
<td>“The sample contained Neisseria gonorrhoeae, N. meningitidis and N. lactamica”</td>
</tr>
<tr>
<td>Unknown species</td>
<td>If the precise species is not known, use sp. If there is more than one species, use spp.</td>
<td>“The condition was caused by a Neisseria sp.” “They identified several Neisseria spp. in the sample”</td>
</tr>
</tbody>
</table>
Table 2 Organism names and abbreviations for bacteria and protozoa

<table>
<thead>
<tr>
<th>Binomial name</th>
<th>Genus</th>
<th>Abbreviation of organism name</th>
<th>Condition*</th>
<th>Abbreviation of infection name†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlamydia trachomatis</td>
<td>Chlamydia</td>
<td>C. trachomatis</td>
<td>Chlamydia</td>
<td>CT</td>
</tr>
<tr>
<td>Mycoplasma genitalium</td>
<td>Mycoplasma</td>
<td>M. genitalium</td>
<td>M. genitalium infection†</td>
<td>MG</td>
</tr>
<tr>
<td>Neisseria gonorrhoeae‡</td>
<td>Neisseria</td>
<td>N. gonorrhoeae</td>
<td>Gonorrhoea‡</td>
<td>NG†</td>
</tr>
<tr>
<td>Treponema pallidum</td>
<td>Treponema</td>
<td>T. pallidum</td>
<td>Syphilis</td>
<td>TP</td>
</tr>
<tr>
<td>Trichomonas vaginalis</td>
<td>Trichomonas</td>
<td>T. vaginalis</td>
<td>Trichomonias</td>
<td>TV</td>
</tr>
</tbody>
</table>

* Only capitalise first letter if used at the start of a sentence, otherwise lowercase.
† In general, we discourage the use of abbreviated names for conditions. These abbreviations can be used in tables and figures where space is limited. They still need to be spelled out at the first use.
‡ There is no agreed name at present.
§ Please note the ‘e’ at the end of the Latin species name. There is no ‘e’ at the end of the name of the condition. We use UK English spelling, which has an extra ‘o’ in the name of the condition.
¶ GC cannot be used to abbreviate Neisseria gonorrhoeae. GC is used mainly in the UK as an abbreviation of gonococcus, the shape of the bacterium (see table 3).

Table 3 Adjectives for describing shapes of bacteria

<table>
<thead>
<tr>
<th>Shape singular/plural</th>
<th>Description</th>
<th>Example</th>
<th>Plural</th>
<th>Adjective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coccus/cocci</td>
<td>Spherical bacteria; can be in pairs (diplococci) or chains (streptococci)</td>
<td>Gonococcus</td>
<td>Gonococci</td>
<td>Gonococcal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pneumococcus</td>
<td>Pneumococci</td>
<td>Pneumococcal</td>
</tr>
<tr>
<td>Bacillus/bacilli*</td>
<td>Rod-shaped bacteria</td>
<td>Spirochaet†</td>
<td>Spirochaetes</td>
<td>Bacillary</td>
</tr>
<tr>
<td>Spiral</td>
<td>Spiral-shaped bacteria</td>
<td></td>
<td>Spirochaetal</td>
<td></td>
</tr>
</tbody>
</table>

* Not to be confused with Bacillus the genus.
† Most common example for sexually transmitted pathogens, that is, Treponema pallidum. Alternative forms are vibrio and spirillum.

ADVICE FOR AUTHORS
Editors and production staff at Sexually Transmitted Infections have come up with some guidance for authors (tables 1, 2 and 3). This combines published conventions for scientific nomenclature, summarised by the journal Emerging Infectious Diseases,18 and the opinions of the editors. We try to cover spelling and abbreviations of both organisms and conditions for the most common sexually transmitted infections (table 2).

We have posted the guidance in our Instructions for Authors on the submission website (http://sti.bmj.com/site/about/guidelines.xhtml) and we hope you find it useful. Please follow our guidance for all your future submissions.

Answers: all are incorrect (see table 2 for the correct spelling).

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