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A revised version of the international code of virus classification and nomenclature

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Foreword

The classification of viruses and the assignment of names to taxa are the responsibility of the International Committee on Taxonomy of Viruses (ICTV). The activities of ICTV are governed by Statutes agreed by the Virology Division of the International Union of Microbiological Societies and are guided by an International Code [2]. This Code is revised occasionally to conform with accepted virological practice and to make the Rules as readily comprehensible as possible (e.g. [1]).

Recently some changes to the Rules were proposed by the Executive Committee of the ICTV and subsequently ratified by the full membership of the ICTV. This article records these changes and also presents a new format for the Code, based in part on the International Code of Nomenclature of Bacteria [3].

The new Rules in the Code are the following:

(1) A replacement of old rule 24 (new Rule 3.24) that does not explicitly ban the use of higher taxon names in a species name, while at the same time avoiding encouraging this practice.
(2) New Rules (3.35 to 3.36) to regulate the activities of the ICTV in classifying sub-viral agents, as has in fact been done for several years.
(3) Changes to the Rules regarding orthography, so that the new Rule 3.40 replaces the old Rules 36 and 37. This Rule extends italicization of taxa to apply to species names that were previously exempted from the Rule as applied to other taxa.

The changes to the format of the Code are the introduction of brief sections that describe the statutory basis for the ICTV (Section 1), the principles of nomenclature (Section 2) and the Rules (Section 3). These are laid out such that explanatory comments now follow the Rule to which they refer, and contain more examples. The new Code is presented on the following page.

References

1. Mayo MA (1996) Recent revisions of the rules of virus classification and nomenclature. Arch Virol 141: 2479–2484
2. Murphy FA, Fauquet CM, Bishop DHL, Ghabrial SA, Jarvis AW, Martelli GP, Mayo MA, Summers MD (1995) Virus Taxonomy. Classification and Nomenclature of Viruses. Sixth Report of the International Committee on Taxonomy of Viruses. Springer, Wien New York (Arch Virol [Suppl] 10)
3. Sneath PHA (1992) International Code of Nomenclature of Bacteria: BACTERIOLOGICAL CODE. American Society for Microbiology, Washington DC

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The international code of virus classification and nomenclature

1. Statutory basis for the International Committee on Taxonomy of Viruses (ICTV)

1.1 The International Committee on Taxonomy of Viruses (ICTV) is a committee of the Virology Division of the International Union of Microbiological Societies. ICTV activities are governed by Statutes agreed with the Virology Division.

1.2 The Statutes define the objectives of the ICTV. These are:

(i) To develop an internationally agreed taxonomy for viruses
(ii) To develop internationally agreed names for virus taxa, including species and sub-viral agents.
(iii) To communicate taxonomic decisions to the international community of virologists.
(iv) To maintain an index of virus names.

1.3 The Statutes also state that classification and nomenclature will be subject to Rules set out in an International Code.

2. Principles of nomenclature

2.1 The essential principles of virus nomenclature are:

(i) To aim for stability.
(ii) To avoid or reject the use of names which might cause error or confusion.
(iii) To avoid the unnecessary creation of names.

2.2 Nomenclature of viruses and sub-viral agents is independent of other biological nomenclature. Virus and virus taxon nomenclature are recognized to have the status of exceptions in the proposed International Code of Bionomenclature (*BioCode*).

2.3 The primary purpose of naming a taxon is to supply a means of referring to the taxon, rather than to indicate the characters or the history of the taxon.

2.4 The application of names of taxa is determined, explicitly or implicitly, by means of nomenclatural types.

2.5 The name of a taxon has no status until it has been approved by the ICTV.

3. Rules of classification and nomenclature

I. General rules

The universal scheme

3.1 Virus classification and nomenclature shall be international and shall be universally applied to all viruses.

3.2 The universal virus classification system shall employ the hierarchical levels of Order, Family, Subfamily, Genus, and Species.
Comments

It is not obligatory to use all levels of the taxonomic hierarchy. The primary classification is of viruses into species. Most species are classified into genera and most genera are classified into families. Species not assigned to a genus will be "unassigned" in a family (see Rule 3.6) and genera not classified in families have the status of "unassigned" (sometimes referred to as "floating"). Some families are classified together into Orders, but for many, the family is the highest level taxon in use. Also, families are not necessarily divided into subfamilies. This taxon is to be used only when it is needed to solve a complex hierarchical problem (see Rule 3.29).

Contrasting examples of full classifications of some negative strand RNA viruses are: (1) species *Mumps virus*; genus *Rubulavirus*; subfamily *Paramyxovirinae*; family *Paramyxoviridae*; order *Mononegavirales*, and (2) species *Rice stripe virus*; genus *Tenuivirus* (see also Rule 3.41).

Scope of the classification

3.3 The ICTV is not responsible for classification and nomenclature of virus taxa below the rank of species. The classification and naming of serotypes, genotypes, strains, variants and isolates of virus species is the responsibility of acknowledged international specialist groups.

Comments
Particular virus isolates may be regarded as strains, variants, clusters or other sub-specific entities that, together with other entities, constitute a species. Classification of such isolates is not the responsibility of the ICTV but is the responsibility of international speciality groups. It is the responsibility of ICTV Study Groups to decide if an isolate or a group of isolates should constitute a species.

Deciding the names of serotypes, genotypes, strains, variants or isolates of virus species is not the responsibility of the ICTV. However, it is recommended that new names not be the same as, or closely similar to, names already in use (Rule 3.14 for taxa). When a particular virus isolate is designated to represent a species, the decision as to which name will be adopted for the species for formal taxonomic purposes will be the responsibility of the ICTV, initially of a particular Study Group working on behalf of the ICTV. The Study Group will be expected to consult widely so as to ensure the acceptability of names, subject to the Rules in the Code. The policy of the ICTV is that as far as is possible, taxonomic and nomenclatural decisions should reflect the majority view of the appropriate virological constituency.

3.4 Artificially created viruses and laboratory hybrid viruses will not be given taxonomic consideration. Their classification will be the responsibility of acknowledged international specialist groups.

Comments
Naturally occurring isolates that have genomes formed from parts of the genomes of different strains of a virus, either by recombination between the genome nucleic acids or by re-assortment of separate genome parts, will be classified either as species or sub-specific entities in the same way that other isolates are classified. Neither

artificial variants made by recombination or re-assortment, nor mutant viruses, are subject to the Rules in the Code.

Limitations

3.5 Taxa will be established only when representative member viruses are sufficiently well characterized and described in the published literature so as to allow them to be identified unambiguously and the taxon to be distinguished from other similar taxa.

3.6 When it is uncertain how to classify a species into a genus but its classification in a family is clear, it will be classified as an unassigned species of that family.

Comments

A species can be classified as an unassigned member of a family when no genus has been devised. For example, *Bimbo virus* is a rhabdovirus of vertebrates but is not a member of any of the currently recognized genera in the family *Rhabdoviridae*. Likewise, *Groundnut rosette assistor virus* resembles viruses in the family *Luteoviridae* but is not classified in any of the genera in that family. These viruses are each classified as an unassigned member of their respective families.

3.7 Names will only be accepted if they are linked to taxa at the hierarchical levels described in Rule 2 and which have been approved by the ICTV.

Comments

Taxa above the rank of species must be approved before a name is assigned to them. Proposals for the creation of taxa shall be accompanied by proposals for names. A decision to create a taxon can thus be followed immediately by a decision about the name for the taxon. Species will be approved together with their names as a single taxonomic act.

The following example is of a proposal concerning an imaginary virus with the vernacular name of "beta gamma virus" that is related to another virus, "alpha beta virus".

Proposal 1. Approve *Beta gamma virus* as a species containing strains known as "beta gamma virus" and "alpha beta virus".
Proposal 2. Create a genus to contain species resembling *Beta gamma virus*.
Proposal 3. Name the genus created by Proposal 2, *Betavirus*.
Proposal 4. Nominate *Beta gamma virus* as the type species of the genus *Betavirus*.
Proposal 5. Create a family to contain genus *Betavirus* and similar genera.
Proposal 6. Name the family created by Proposal 5, *Betaviridae*.
Proposal 7. Assign species X, Y and Z to genus *Betavirus* (such a proposal should include a listing of the parameters for discriminating between species in the genus *Betavirus*).

II. Rules about naming taxa

Status of names

3.8 Names proposed for taxa are "valid names" if they conform to the Rules set out in the Code and they pertain to established taxa. Valid names are "accepted names" if they are recorded as approved International Names in the 6th Report of the ICTV (Springer-Verlag, 1995) or become "accepted names" by an ICTV vote of approval for a taxo-

nomic proposal.

Comments
A valid name is one that has been published, one that is associated with descriptive material, and one that is acceptable in that it conforms to the Rules in the Code. Accepted names will be kept in an "Index" by the ICTV.

3.9 Existing names of taxa and viruses shall be retained whenever feasible.

Comment
A stable nomenclature is one of the principal aims of taxonomy and therefore changes to names that have been accepted will only be considered in exceptional circumstances, and then only because of serious conflict with the Rules.

3.10 The rule of priority in naming taxa and viruses shall not be observed.

Comments
The earlier of candidate names for a taxon may be chosen as a convenience to virologists, but the Rule ensures that it is not possible to invalidate a name in current use by claiming priority for an older name that has been superseded.

3.11 No person's name shall be used when devising names for new taxa.

Comments
New taxon names shall not be made by adopting a person's name, by adding a formal ending to a person's name or by using part of a person's name to create a stem for a name. When existing names of species incorporate a person's name (for example, *Shope papilloma virus*) continued usage of this name, in agreement with Rule 2.3 and 3.9, is in general preferable to the creation of a new name.

3.12 Names for taxa shall be easy to use and easy to remember. Euphonious names are preferred.

Comments
In general, short names are desirable and the number of syllables should be kept to a minimum.

3.13 Subscripts, superscripts, hyphens, oblique bars and Greek letters may not be used in devising new names.

Comments
The Rule is intended to make text unambiguous and easy to manipulate and its application should often make names more pronouncable, in agreement with Rule 3.12. Existing names of some species violate this Rule (e.g. coliphage λ), but international names of genera and families do not.

3.14 New names shall not duplicate approved names. New names shall be chosen such that they are not closely similar to names that are in use currently or have been in use in the recent past.

Comments
The name selected for a new taxon should not sound indistinguishable from the name of another taxon at any rank or from any taxon. For example, the existence of the genus *Iridovirus* means that forms of new name such as "irodovirus" or "iridivirus"

are unacceptable as they are too easily confused with an approved name. Confusion can also be between species and genus names as both end in "virus". Thus, for example, the name selected for a genus typified by a species "Omega virus" would not be named "Omegavirus" because species and genus would then be too readily confused.

3.15 Sigla may be accepted as names of taxa, provided that they are meaningful to virologists in the field, normally as represented by Study Groups.

Comments
Sigla are names comprising letters and/or letter combinations taken from words in a compound term. The name of the genus *Comovirus* has the sigla stem "Co-" from cowpea and "-mo-" from mosaic; the name of the genus *Reovirus* has the sigla stem "R" from "Respiratory, "e" from "enteric" and "o" from "orphan".

Decision making

3.16 In the event of more than one candidate name being proposed, the relevant Subcommittee will make a recommendation to the Executive Committee of the ICTV, which will then decide among the candidates as to which to recommend to ICTV for acceptance.

Comments
When there is more than one candidate name for the same taxon, the decision as to which will be accepted shall be made on the basis of the Code and, if necessary, thereafter on the basis of likely acceptability to the majority of virologists.

3.17 If no suitable name is proposed for a taxon, the taxon may be approved and the name will be left undecided until the adoption of an acceptable international name when one is proposed to and accepted by the ICTV.

Comments
When genera have not been named this is indicated by quotation marks. For example, *Soybean chlorotic mottle virus* is a species in an as yet un-named genus in the family *Caulimoviridae*. Until the genus is named, it is designated as "soybean chlorotic mottle-like viruses". This designation is regarded as temporary as it is an inconvenience to most virologists.

3.18 New names shall be selected such that they, or parts of them, do not convey a meaning for the taxon which would either (1) seem to exclude viruses which lack the character described by the name but which are members of the taxon being named, or (2) seem to exclude viruses which are as yet undescribed but which might belong to the taxon being named, or (3) appear to include within the taxon viruses which are members of different taxa.

3.19 New names shall be chosen with due regard to national and/or local sensitivities. When names are universally used by virologists in published work, these or derivatives shall be the preferred basis for creating names, irrespective of national origin.

Procedures for naming taxa

3.20 Proposals for new names, name changes, establishment of taxa and taxonomic placement of taxa shall be submitted to the Executive Committee of the ICTV in the form of taxonomic proposals. All relevant subcommittees and study groups of the ICTV will be consulted prior to a decision being taken.

Comments
For example, taxonomic proposals concerned with the family *Partitiviridae* would be considered by the Fungal Virus Subcommittee and one of its Study Groups but because some genera in the family contain viruses of plants, proposals affecting the family would also be considered by the Plant Virus Subcommittee.

III. Rules about species

Definition of a virus species

3.21 A virus species is defined as a polythetic class of viruses that constitutes a replicating lineage and occupies a particular ecological niche.

Definition of "tentative" status

3.22 When an ICTV Subcommittee is uncertain about the taxonomic status of a new species or about the assignment of the new species to an established genus, the new species will be listed as a tentative species in the appropriate genus or family. Names of tentative species, as of taxa generally (Rule 14), shall not duplicate approved names and shall be chosen such that they are not closely similar to names that are in use currently, names that have been in use in the recent past, or names of definitive species.

Comments
Species classified as tentative are candidates for taxonomic decision by the appropriate Study Groups to resolve their tentative status.

Construction of a name

3.23 A species name shall consist of as few words as practicable but shall not consist only of a host name and the word "virus".

Comments
The styles used when virus names are devised differ according to the traditions of the particular fields of virology. For example, plant virus names are usually constructed as host + symptom + "virus" (e.g. tobacco necrosis virus) whereas, in contrast, viruses in the family *Bunyaviridae* are usually named after the location at which the virus was found + "virus" (e.g. Bunyamwera virus).

3.24 A species name must provide an appropriately unambiguous identification of the species.

3.25 Numbers, letters, or combinations thereof may be used as species epithets where such numbers and letters are already widely used. However, newly designated serial numbers, letters or combinations thereof are not acceptable alone as species epithets. If a number or letter series is in existence it may be continued.

IV. Rules about genera

3.26 A genus is a group of species sharing certain common characters.
3.27 A genus name shall be a single word ending in "… *virus*."
3.28 Approval of a new genus must be accompanied by the approval of a type species.

V. Rules about subfamilies

3.29 A subfamily is a group of genera sharing certain common characters. The taxon shall be used only when it is needed to solve a complex hierarchical problem.
3.30 A subfamily name shall be a single word ending in "… *virinae*."

VI. Rules about families

3.31 A family is a group of genera (whether or not these are organized into subfamilies) sharing certain common characters.
3.32 A family name shall be a single word ending in "… *viridae*."

VII. Rules about orders

3.33 An order is a group of families sharing certain common characters.
3.34 An order name shall be a single word ending in "… *virales*."

VIII. Rules about sub-viral agents

Viroids

3.35 Rules concerned with the classification of viruses shall also apply to the classification of viroids.

3.36 The formal endings for taxa of viroids are the word "viroid" for species, the suffix "-viroid" for genera, the suffix "-viroinae" for sub-families (should this taxon be needed) and "-viroidae" for families.

Comments
For example, the species *Potato spindle tuber viroid* is classified in genus *Pospiviroid*, and the family *Pospiviroidae*.

Other sub-viral agents

3.37 Retrotransposons are considered to be viruses in classification and nomenclature
3.38 Satellites and prions are not classified as viruses but are assigned an arbitrary classification as seems useful to workers in the particular fields.

IX. Rules for orthography

3.39 In formal taxonomic usage, the accepted names of virus Orders, Families, Subfamilies, and Genera are printed in italics and the first letters of the names are capitalized.

Comments
See Rule 3.8 for the definition of an "accepted" name.

3.40 Species names are printed in italics and have the first letter of the first word capitalized. Other words are not capitalized unless they are proper nouns, or parts of proper nouns.

Comments
When used formally, as labels for taxonomic entities, the names *Tobacco mosaic virus* and *Murray River encephalitis virus* are in the correct form and typographical style. Examples of incorrect forms are Aspergillus niger virus S (not italic), *Murray river encephalitis virus* (River is a proper noun) or tobacco mosaic virus (not capitalized or italic).

Taxa are abstractions and thus when their names are used formally, these are written distinctively using italicization and capitalization. In other senses, such as an adjectival form (e.g. the tobacco mosaic virus polymerase) italics and capital initial letters are not needed. Equally, these are not needed when referring to physical entities such as virions (e.g. a preparation or a micrograph of tobacco mosaic virus).
This Rule was introduced in 1998 and is in contradistinction to Rules in the Code published in the 6th Report of the ICTV (Springer-Verlag, 1995).

3.41 In formal usage, the name of the taxon shall precede the term for the taxonomic unit.

Comments
For example, the correct formal descriptions of various taxa are … the family *Herpesviridae* … the genus *Morbillivirus*, … the genus *Rhinovirus*, … the species *Tobacco necrosis virus*, and so on.

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