

Recently agreed changes to the International Code of Virus Classification and Nomenclature

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Introduction

The International Committee on Taxonomy of Viruses (ICTV; <http://www.ictvonline.org/>) is a committee of Virology Division of the International Union of Microbiological Societies, and its operation is governed by Statutes agreed with Virology Division. The classification and nomenclature of viruses is then subject to rules formalized into a Code (required by Statute 8.1).

The need for a review of the Statutes and Code became clear during editorial work involved in production of the Ninth ICTV Report [1]. Changes to these documents require the approval of the ICTV Executive Committee (EC) and the full ICTV membership. Changes to the Statutes also require the agreement of Virology Division.

The changes described in this article were discussed and agreed by the ICTV EC over a period of more than two years. Notification of a ballot was sent via email on 14 January 2013

to the 165 members of ICTV, namely the ICTV EC Members, Life Members, ICTV Subcommittee Members and ICTV National Representatives. Members were then requested to vote on whether or not to ratify the proposals (voting closed on 14 February 2013). The return rate of votes was approximately 41%, and all proposed changes were accepted, mostly unanimously. The only significant exception was the proposed change to the species definition in Rule 3.21 (Rule 3.20 in the latest version of the code) which was approved by 45:21 with two abstentions.

In this article, we present the new version of the Code, highlighted in bold to show those parts that have recently been changed. Those changes are then explained in the sections that follow. It should be noted that some rules were deleted and that some renumbering of sections has therefore taken place. In recent years, the Code has been published with some explanatory Comments from the EC, and the opportunity has been taken to revise and update these where necessary.

The changes to the Statutes are the subject of a separate article [2].

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Complete International Code of Virus Classification and Nomenclature (February 2013)

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; (iii) to communicate taxonomic decisions to the international community of virologists; (iv) to maintain an Index of agreed names of virus taxa.

1.3

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

Comment: Ratified changes will be published in Virology Division News in Archives of Virology, and in subsequent ICTV Reports.

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 is independent of other biological nomenclature. Virus taxon nomenclature is recognized as an exception 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 history of the taxon.

2.4

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

Comment: see Section 3.8

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.

Comment: 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 into orders, but often 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 3.26).

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*.

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.

Comment: A variety of subspecific entities may be identified within a single virus species. These may be described as viruses (e.g. peanut stripe virus, which is classified in the species *Bean common mosaic virus*, genus *Potyvirus*, family *Potyviridae*) or as serotypes, genotypes, strains, variants, isolates, etc. Naming of such entities is not the responsibility of the ICTV but of international specialty groups. It is the responsibility of ICTV Study Groups to consider how these entities may best be classified into species.

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.

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.

Comment: A species can be classified as unassigned within a family when no genus has been devised. For example, *Groundnut rosette assistor virus* is classified in the family *Luteoviridae* but not within any of the current genera of that family.

3.7

Names will only be accepted if they are linked to taxa at the hierarchical levels described in Rule 3.2 and which have been approved by the ICTV.

Comment: Taxa above the rank of species must be approved before a name is assigned to them. Proposals for the creation of taxa must 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 porcine gamma virus that is related to another virus, porcine beta virus.

- Proposal 1. Approve *Beta gamma virus* as a species containing strains known as porcine gamma virus and porcine beta virus.
- Proposal 2. Create a genus to contain *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 8th ICTV Report or have subsequently become “accepted names” by an ICTV vote of approval for a taxonomic proposal.

Comment: A valid taxon 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 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 if the accepted

name conflicts with the Rules or if a change is necessary to remove ambiguities or confusion.

3.10

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

Comment: 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.

Comment: New taxon names shall not be created 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, *Mason-Pfizer monkey 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.

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

3.13

Subscripts, superscripts, oblique bars and non-Latin letters may not be used in taxon names. Hyphens should not be used when attaching numbers or letters to the end of a series of species names and should never be used in names of genera, subfamilies, families or orders.

Comment: The Rule is intended to make text unambiguous and easy to sort electronically; its application should often make names more pronounceable, in agreement with Rule 3.12.

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.

Comment: 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 new names such as “irodovirus” or “iridivirus” are unacceptable, as they are too easily confused with an approved name. Confusion can also occur between species and genus names, as both end in “virus”. Thus, for example, a genus typified by the imaginary 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.

Comment: 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 family *Reoviridae* 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.

Comment: When there is more than one candidate name for the same taxon, the choice of name to be approved will usually be based on the recommendations 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, decisions on questions of taxonomy and nomenclature should reflect the majority view of the appropriate virological constituency.

3.17

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.

3.18

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

3.19

All relevant ICTV subcommittees and study groups will be consulted prior to a decision being taken on any taxonomic proposal submitted to the Executive Committee of the ICTV.

Comment: Proposals concerning a family containing genera of viruses that infect diverse types of hosts (e.g., plants and vertebrates, fungi and plants, and so on) must be considered by the Subcommittees responsible for viruses of each host type (i.e., Plant viruses, Vertebrate viruses, and

so on). 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*

3.20

Species shall be created in accordance with the following definition:

A species is the lowest taxonomic level in the hierarchy approved by the ICTV. A species is a monophyletic group of viruses whose properties can be distinguished from those of other species by multiple criteria.

Comment: The criteria by which different species within a genus are distinguished shall be established by the appropriate Study Group. These criteria may include, but are not limited to, natural and experimental host range, cell and tissue tropism, pathogenicity, vector specificity, antigenicity, and the degree of relatedness of their genomes or genes. The criteria used should be published in the relevant section of the ICTV Report and reviewed periodically by the Study Group.

Construction of a name

3.21

A species name shall consist of as few words as practicable but be distinct from names of other taxa. Species names shall not consist only of a host name and the word “virus”.

Comment: Species names normally comprise more than one word (e.g. *Bunyamwera virus*).

3.22

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

Comment: Species names should be distinctive. They should not be in a form that could be easily confused with the names of other taxa.

IV—Rules about Genera

3.23

A genus is a group of species sharing certain common characters.

Comment: It is acceptable for a genus to contain a single species.

3.24

A genus name shall be a single word ending in ...virus.

3.25

Approval of a new genus must be accompanied by the approval of a type species.

V—Rules about Subfamilies

3.26

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.

Comment: It is acceptable for a subfamily to contain a single genus.

3.27

A subfamily name shall be a single word ending in ...virinae.

VI—Rules about Families

3.28

A family is a group of genera (whether or not these are organized into subfamilies) sharing certain common characters.

Comment: It is acceptable for a family to contain a single genus.

3.29

A family name shall be a single word ending in ...viridae.

VII—Rules about Orders

3.30

An order is a group of families sharing certain common characters.

3.31

An order name shall be a single word ending in ...virales.

*VIII—Rules about sub-viral agents**Viroids*

3.32

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

3.33

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.

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

Other sub-viral Agents

3.34

Retrotransposons are considered to be viruses in classification and nomenclature

3.35

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

3.36

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.

Comment: See Rule 3.8 for the definition of an “accepted” name.

3.37

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.

Comment: The species names *Tobacco mosaic virus* and *Murray Valley encephalitis virus* are in the correct form and typographical style. Examples of incorrect forms are *Ustilago maydis virus H* (not italicized), *Murray valley encephalitis virus* (Valley is a proper noun) or tobacco mosaic virus (not capitalized or italicized).

When taxon names are used informally, italics and capital initial letters are not needed. This applies at all taxonomic levels; examples are: (1) “the tobacco mosaic virus polymerase”, when describing the properties of the polymerase in members of the species *Tobacco mosaic virus* and (2) “three pestiviruses”, to describe viruses that are members of the genus *Pestivirus*.

Changes made in 2013**Changes to rule 1.2**

Previous wording:

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 subviral agents. (iii) to communicate taxonomic decisions to the international community of virologists. (iv) to maintain an Index of virus names.

New wording:

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

(i) to develop an internationally agreed taxonomy for viruses (ii) To establish internationally agreed names for **virus taxa**. (iii) to communicate taxonomic decisions to the international community of virologists. (iv) to maintain an **Index of agreed names of virus taxa**.

Explanation:

This is to be consistent with changes to Statute 3.2. It removes the confusing apparent distinction between virus

taxa and virus species and changes the Index of 'virus names' because this phrase nowadays usually refers to names not regulated by ICTV but which are allocated to species (and higher taxa).

Changes to rule 2.2

Previous wording:

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

New wording:

Nomenclature of viruses is independent of other biological nomenclature. **Virus taxon nomenclature** is recognised as an exception in the proposed International Code of Bionomenclature (BioCode).

Explanation:

There is no need to specifically mention sub-viral agents, which (apart from viroids) are not formally classified by ICTV. The final sentence is simplified to remove the suggestion that ICTV might be involved in naming viruses (as opposed to species, genera and other taxa).

Removal of previous rule 2.4

Previous wording:

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

Explanation:

This rule does not appear to serve any current purpose.

Changes to rules 3.9 and 3.10

Previous wording:

3.9

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

3.10

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

New wording:

3.9

Existing names of taxa shall be retained whenever feasible.

3.10

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

Explanation:

ICTV does not name viruses but only species, genera and higher taxa.

Changes to rule 3.13

Previous wording:

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

New wording:

Subscripts, superscripts, oblique bars and **non-Latin** letters may not be used in **taxon names**. **Hyphens should**

not be used when attaching numbers or letters to the end of a series of species names and should never be used in names of genera, subfamilies, families or orders.

Explanation:

Many species names contain hyphens (*Foot-and-mouth disease virus*) and need to contain them. All Greek letters were removed from species names several years ago, so the rule now applies to all names.

Removal of previous rule 3.17

Previous wording:

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 ICTV.

Explanation:

Temporary genus names were used for some years, particularly in some groups of phage. These have now all been replaced by valid names acceptable to the community, and it is neither necessary nor desirable to use this rule in the future.

Changes to previous rule 3.20 (now 3.19)

Previous wording:

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 ICTV subcommittees and study groups will be consulted prior to a decision being taken.

New wording:

All relevant ICTV subcommittees and study groups will be consulted prior to a decision being taken on any taxonomic proposal submitted to the Executive Committee of the ICTV.

Explanation:

The first sentence does not provide a comprehensive or understandable list of the types of proposal that might be made and was tautological.

Changes to previous rule 3.21 (now 3.20)

Previous wording:

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

New wording:

Species shall be created in accordance with the following definition:

A species is the lowest taxonomic level in the hierarchy approved by the ICTV. A species is a monophyletic group of viruses whose properties can be distinguished from those of other species by multiple criteria.

Comments: The criteria by which different species within a genus are distinguished shall be established by the appropriate Study Group. These criteria may include, but are not limited to, natural and experimental

host range, cell and tissue tropism, pathogenicity, vector specificity, antigenicity, and the degree of relatedness of their genomes or genes. The criteria used should be published in the relevant section of the ICTV Report and reviewed periodically by the Study Group.

Explanation:

“A species is the lowest taxonomic level”:

Species is the basic unit of taxonomy into which all viruses are to be grouped. Since there cannot be more than one “lowest” level, it follows that all species are at the same level and, therefore, no species can be contained, wholly or in part, within another species.

“...monophyletic group of viruses”:

A monophyletic group is one derived from a common ancestor. Monophyly establishes two key principles. (i) Species are discrete, non-overlapping groups of viruses, i.e. each species comprises only members of its defining lineage, and each defining lineage comprises only members of that species. (ii) The requirement for species to be monophyletic makes explicit what it is already the policy of the EC in reviewing taxonomic proposals, that a proper phylogenetic analysis is a fundamental requirement to justify the creation of new species. It is true that such analyses require interpretation and that judgments sometimes have to be made about the appropriate places for species ‘boundaries’ but, as the definition makes clear, species assignments do not rely exclusively on measures of genetic relatedness.

“...distinguished from those of other species by multiple criteria”:

This provision of the definition, together with the accompanying comments, makes it explicit that species should not be created on the basis of a single distinguishing criterion, whether that is host, symptomatology or some measure of genetic distance. The comments also explain how the criteria should be established and reviewed.

Removal of previous rule 3.22

Previous wording:

When an ICTV Subcommittee is uncertain about the taxonomic status of a new species or about assignment of a 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 3.14), 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.

Explanation:

The category of ‘Tentative Species’ was used to list viruses in many chapters (genera and families) in the 7th and 8th ICTV Reports. The terminology has proved

ambiguous in practice as the names were not names of species and did not require the approval of a taxonomic proposal. It seems best simply to abolish this definition. In the 9th Report, many chapters include lists of ‘Other related viruses which may be members of the genus/family but have not been approved as species’. These are included at the discretion of the authors, and it does not require a rule in the Code to continue such a practice.

Removal of previous rule 3.25

Previous wording:

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.

Explanation:

This rule had become out of touch with reality. In 2012, 693 of the 2285 species names ended in letters, numbers or a combination of both. ICTV has recently approved several sets of species names in which numbers are used at the end to indicate different species (e.g. in the genus *Alphatorquevirus*). According to this rule, that should not have been done, but it is difficult to know what alternative there is. With increasing numbers of environmental samples, etc., this is probably an issue that will continue to be important.

Removal of previous rule 3.41

Previous wording:

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 D*, and so on.

Explanation:

This rule is (1) unnecessary in a set of taxonomic rules, being purely stylistic; (2) not observed in practice and (3) is contradicted by the comment that is supposed to explain it. This change was the subject of a separate proposal [3].

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