



## Taxonomy of the family *Arenaviridae* and the order *Bunyavirales*: update 2018

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## Abstract

In 2018, the family *Arenaviridae* was expanded by inclusion of 1 new genus and 5 novel species. At the same time, the recently established order *Bunyavirales* was expanded by 3 species. This article presents the updated taxonomy of the family *Arenaviridae* and the order *Bunyavirales* as now accepted by the International Committee on Taxonomy of Viruses (ICTV) and summarizes additional taxonomic proposals that may affect the order in the near future.

## Introduction

The family *Arenaviridae* was established in 1976 to accommodate predominantly murid viruses with bisegmented, ambisense single-stranded RNA genomes that form enveloped particles with a “sandy” appearance [7]. Until recently, the family was monogeneric, including the single genus *Arenavirus*, with a steadily increasing number of species. The taxonomy of the family was substantially amended and emended [22] following the discovery of several distinct arenaviruses in alethinophidian snakes [4, 10, 24]. In particular, the genus *Arenavirus* was renamed *Mammarenavirus*, and a second genus, *Reptarenavirus*, was established in 2014 for several of the newly discovered snake viruses. A non-Linnean binomial species nomenclature was adopted for the entire family *Arenaviridae* [22] (ICTV TaxoProps [taxonomic proposals] 2014.011a-dV and 2014.012aV). Since then, the genus *Mammarenavirus* has been extended by 8 species for novel murid viruses discovered in Africa and Asia [3, 8, 11, 15, 21, 25] (TaxoProps 2014.013aV.A.v3. *Mammarenavirus\_2sp*, 2015.001aM, 2016.014aM and 2016.019aM.A.v2. *Mammarenavirus\_sp*).

The order *Bunyavirales* was established in 2017 to accommodate related viruses with segmented, linear, single-stranded, negative-sense or ambisense RNA genomes distributed among nine families (TaxoProp 2016.030a-vM). In particular, the then existing family *Bunyaviridae* was elevated to the rank of order. The three established bunyaviral genera *Hantavirus*, *Nairovirus*, and *Tospovirus* were renamed *Orthohantavirus*, *Orthonairovirus*, and *Orthotospovirus* and included in the newly established families *Hantaviridae*, *Nairoviridae*, and *Tospoviridae*, respectively (TaxoProp 2016.030a-vM). The genus *Orthonairovirus* was expanded by five species [13] (TaxoProp 2016.026a,bM). The family *Peribunyaviridae* was created to include the established bunyaviral genus *Orthobunyavirus* and a new genus, *Herbevirus*, for bunyaviruses discovered in invertebrates [14, 17] (TaxoProps 2016.024a-dM and 2016.030a-vM). The family *Phenuiviridae* was created to accommodate the established bunyaviral genus *Phlebovirus*, the previously “free-floating” plant virus genus *Tenuivirus*, and two new genera, *Goukovirus* and *Phasivirus*, for novel invertebrate bunyaviruses [16] (TaxoProps 2016.022a-dM and 2016.027a-dM). Three new families, *Feraviridae*, *Jonviridae*, and *Phasmaviridae*, were established for newly discovered invertebrate bunyaviruses [2, 14, 18] (TaxoProps 2016.021a-dM, 2016.025a-dM and 2016.028a-dM).

In addition, the family *Fimoviridae* was created to accommodate the previously “free-floating” plant virus genus *Emaravirus*, which was expanded by three species for newly discovered plant viruses [5, 6, 26] (TaxoProps 2016.016aP, 2016.017aP, 2016.018aP, and 2016.030a-vM). Finally, a non-Linnean binomial species nomenclature was adopted for the entire family (TaxoProps 2016.020aM, 2016.023a-cM, 2016.026a,bM, 2016.029aM.A.v2. *Tenuivirus\_spre*n, and 2016.030a-vM).

After the establishment of the order *Bunyavirales*, the ICTV Study Groups responsible for the taxonomy of *Arenaviridae* and *Bunyavirales* assigned unclassified viruses to existing or novel taxa and continued streamlining order nomenclature in collaboration with other virus experts. Here we present the changes to both taxa that were proposed via official TaxoProps at <http://www.ictvonline.org/> in 2017 and that were accepted by the ICTV Executive Committee. These changes are official ICTV taxonomy as of March 2018.

## Family *Arenaviridae*

### Taxonomic changes at the family rank

In 2018, the family was extended by addition of a novel genus, *Hartmanivirus*, for Haartman Institute snake virus (HISV) isolated from a captive boa constrictor in Finland [9, 10] (TaxoProp 2017.001M.A.v1. *Hartmanivirus.zip*). The genus *Mammarenavirus* was extended by addition of two novel species for Ryukyo virus (RYKV) and souris virus (SOUV) discovered in mice in China and Cameroon, respectively (TaxoProps 2017.002M.A.v2. *Mammarenavirus\_sp* and 2017.003M.A.v1. *Mammarenavirus\_sp*). Five *mammarenavirus* species were renamed due to the ICTV decision to disallow diacritic marks in taxon names (TaxoProp 2017.001G.A.v2.43spren): *Amaparí mammarenavirus*, *Junín mammarenavirus*, *Paraná mammarenavirus*, *Pichindé mammarenavirus*, and *Sabiá mammarenavirus* were renamed *Serra do Navio mammarenavirus*, *Argentinian mammarenavirus*, *Paraguyan mammarenavirus*, *Cali mammarenavirus*, and *Brazilian mammarenavirus*, respectively, whereas the member virus names remained unchanged (TaxoProp 2017.001G.A.v2.43spren). Finally, the three *reptarenavirus* species names *Alethinophid 1 reptarenavirus*, *Alethinophid 2 reptarenavirus*, and *Alethinophid 3 reptarenavirus* were renamed *Golden reptarenavirus*, *California reptarenavirus*, and *Rotterdam reptarenavirus*. Two new

reptarenavirus species were created for tavallinen suomalainen mies virus 2 (TSMV-2) and University of Giessen viruses 1–3 (UGV-1–3) discovered in captive boa constrictors; several newly sequenced reptarenaviruses were assigned to existing species [9] (TaxoProp 2017.015M.A.v1. Reptarenavirus\_2sp3ren).

## Order *Bunyvirales*

### Taxonomic changes at the order rank

In 2018, no changes were made at the order rank.

### Taxonomic changes at the family rank

#### *Feraviridae*

In 2018, no changes were made at the family rank.

#### *Fimoviridae*

In 2018, no changes were made at the family rank.

#### *Hantaviridae*

In 2018, no changes were made at the family rank.

#### *Jonviridae*

In 2018, no changes were made at the family rank.

#### *Nairoviridae*

The family *Nairoviridae* was expanded in 2018 by addition of two new species for the long-known but previously unsequenced Artashat virus (ARTSV) and Chim virus (CHIMV), both originally isolated from ticks. In addition, the species *Burana orthonairovirus* was renamed *Tamdy orthonairovirus* to better reflect the discovery history of species members, and several newly sequenced nairoviruses were classified into existing species [1] (TaxoProp 2017.008M.A.v1.Orthonairovirus\_2sp1ren).

#### *Peribunyaviridae*

The family *Peribunyaviridae* was expanded in 2018 by addition of a novel species for Wolkberg virus (WBV) discovered in wingless bat flies (*Eucampsipoda africana*) in South Africa [12] (TaxoProp 2017.007M.A.v1.Orthobunyavirus\_sp).

#### *Phasmaviridae*

In 2018, no changes were made at the family rank.

#### *Phenuiviridae*

In 2018, no changes were made at the family rank.

#### *Tospoviridae*

In 2018, no changes were made at the family rank.

## Outlook

The taxonomy of viruses of the family *Arenaviridae* and the order *Mononegavirales* remains in flux, and additional important changes are likely forthcoming. Indeed, in 2017, two additional taxonomic proposals that would affect the family *Arenaviridae* and the order *Mononegavirales* were debated during the most recent ICTV EC meeting in Singapore. TaxoProp 2017.006M.U.v2.Negarnaviricota proposes the

- establishment of a phylum for negative-sense RNA viruses that is subdivided into two subphyla; and
- establishment of a class including the order *Bunyvirales*, to be assigned to one of the subphyla.

TaxoProp 2017.012M.U.v2.Bunyvirales\_rev proposes

- dissolution of the families *Feraviridae*, *Jonviridae*, and *Tospoviridae* and absorption of their genera into remaining families;
- the creation of three new bunyaviral families for novel invertebrate viruses [19, 20, 23];
- the inclusion of the family *Arenaviridae* in the order; and
- the creation of 19 new bunyaviral genera. These genera are planned to accommodate novel, mostly invertebrate, viruses [14, 23], but some of them are deemed necessary for reclassification of certain hantaviruses and phleboviruses.

These two proposals failed to find unanimous approval at a final ICTV EC vote in fall of 2017 and were deferred to the 2018 ICTV EC meeting, at which a simple majority vote would suffice for approval of the original proposals.

## Summary

Summaries of the current, ICTV-accepted taxonomies of the family *Arenaviridae* and the order *Bunyvirales* are presented in Tables 1 and 2, respectively. These tables also

**Table 1** ICTV-accepted taxonomy of the family *Arenaviridae* as of 2018. Listed are all arenaviruses that have been classified into species

| Genus                 | Species <sup>a</sup>                      | Virus (abbreviation) <sup>a</sup>            |
|-----------------------|---|--|
| <i>Hartmanivirus</i>  | <i>Haartman hartmanivirus</i>             | Haartman Institute snake virus (HISV)        |
| <i>Mammarenavirus</i> | <i>Allpahuayo mammarenavirus</i>          | Allpahuayo virus (ALLV)                      |
|                       | <i>Argentinian mammarenavirus</i>         | Junín virus (JUNV)                           |
|                       | <i>Bear Canyon mammarenavirus</i>         | Bear Canyon virus (BCNV)                     |
|                       | <i>Brazilian mammarenavirus</i>           | Sabiá virus (SBAV)                           |
|                       | <i>Chapare mammarenavirus</i>             | Chapare virus (CHAPV)                        |
|                       | <i>Cupixi mammarenavirus</i>              | Cupixi virus (CUPXV)                         |
|                       | <i>Flexal mammarenavirus</i>              | Flexal virus (FLEV)                          |
|                       | <i>Gairo mammarenavirus</i>               | Gairo virus (GAIV)                           |
|                       | <i>Guanarito mammarenavirus</i>           | Guanarito virus (GTOV)                       |
|                       | <i>Ippy mammarenavirus</i>                | Ippy virus (IPPYV)                           |
|                       | <i>Lassa mammarenavirus</i>               | Lassa virus (LASV)                           |
|                       | <i>Latino mammarenavirus</i>              | Latino virus (LATV)                          |
|                       | <i>Loei River mammarenavirus</i>          | Loei River virus (LORV)                      |
|                       | <i>Lujo mammarenavirus</i>                | Lujo virus (LUJV)                            |
|                       | <i>Luna mammarenavirus</i>                | Luna virus (LUAV)                            |
|                       |   | Luli virus (LULV)                            |
|                       |   | Lunk virus (LNKV)                            |
|                       |   | lymphocytic choriomeningitis virus (LCMV)    |
|                       |   | Machupo virus (MACV)                         |
|                       |   | Mariental virus (MRLV)                       |
|                       |   | Merino Walk virus (MRWV)                     |
|                       |   | mobala virus (MOBV)                          |
|                       |   | Mopeia virus (MPOV)                          |
|                       |   | Morogoro virus (MORV)                        |
|                       |   | Okahandja virus (OKAV)                       |
|                       |   | Oliveros virus (OLVV)                        |
|                       |   | Paraná virus (PRAV)                          |
|                       |   | Pichindé virus (PICHV)                       |
|                       |   | Pirital virus (PIRV)                         |
|                       |   | Ryukyu virus (RYKV)                          |
|                       |   | Amaparí virus (AMAV)                         |
|                       |   | Solwezi virus (SOLV)                         |
|                       |   | souris virus (SOUV)                          |
|                       | Tacaribe virus (TCRV)                     |  |
|                       | Tamiami virus (TMMV)                      |  |
|                       | Wēnzhōu virus (WENV)                      |  |
|                       | Big Brushy Tank virus (BBRTV)             |  |
|                       | Catarina virus (CTNV)                     |  |
|                       | Skinner Tank virus (SKTV)                 |  |
|                       | Tonto Creek virus (TTCV)                  |  |
|                       | Whitewater Arroyo virus (WWAV)            |  |
| <i>Reptarenavirus</i> | <i>California reptarenavirus</i>          | CAS virus (CASV)                             |
|                       | <i>Giessen reptarenavirus</i>             | University of Giessen virus 1 (UGV-1)        |
|                       |   | University of Giessen virus 2 (UGV-2)        |
|                       |   | University of Giessen virus 3 (UGV-3)        |
|                       | <i>Golden reptarenavirus</i> <sup>b</sup> | Golden Gate virus (GOGV)                     |
|                       | <i>Ordinary reptarenavirus</i>            | tavallinen suomalainen mies virus 2 (TSMV-2) |
|                       | ROUT virus (ROUTV)                        |  |
|                       | University of Helsinki virus 1 (UHV-1)    |  |

<sup>a</sup>Please note that viruses are real objects that are assigned to concepts that are called taxa. Species, genera, families, and orders are taxa. Taxon names are always italicized and always begin with a capital letter. Virus names, on the other hand, are not italicized and are not capitalized, except if the name or a name component is a proper noun. This column lists the virus names with their correct (lack of) capitalization

<sup>b</sup>Type species

**Table 2** ICTV-accepted taxonomy of the order *Bunyavirales* as of 2018. Listed are all bunyaviruses that have been classified into species

| Genus                      | Species <sup>a</sup>   | Virus (abbreviation) <sup>a</sup>                        |
|----------------------------|--|--|
| Family <i>Feraviridae</i>  |  |  |
| <i>Orthoferavirus</i>      | <i>Ferak orthoferavirus</i> <sup>b</sup>                                 | ferak virus (FERV)                                       |
| Family <i>Fimoviridae</i>  |  |  |
| <i>Emaravirus</i>          | <i>Actinidia chlorotic ringspot-associated emaravirus</i>                | Actinidia chlorotic ringspot-associated virus (AcCRaV)   |
|                            | <i>European mountain ash ringspot-associated emaravirus</i> <sup>b</sup> | European mountain ash ringspot-associated virus (EMARaV) |
|                            | <i>Fig mosaic emaravirus</i>   | fig mosaic virus (FMV)                                   |
|                            | <i>High Plains wheat mosaic emaravirus</i>                               | High Plains wheat mosaic virus (HPWMoV)                  |
|                            | <i>Pigeonpea sterility mosaic emaravirus 1</i>                           | pigeonpea sterility mosaic virus (PPSMV)                 |
|                            | <i>Pigeonpea sterility mosaic emaravirus 2</i>                           | pigeonpea sterility mosaic virus 2 (PPSMV-2)             |
|                            | <i>Raspberry leaf blotch emaravirus</i>                                  | raspberry leaf blotch virus (RLBV)                       |
|                            | <i>Redbud yellow ringspot-associated emaravirus</i>                      | redbud yellow ringspot-associated virus (RYRaV)          |
|                            | <i>Rose rosette emaravirus</i>   | rose rosette virus (RRV)                                 |
| Family <i>Hantaviridae</i> |  |  |
| <i>Orthohantavirus</i>     | <i>Amga orthohantavirus</i>  | Amga virus (MGAV) <sup>c</sup>                           |
|                            | <i>Andes orthohantavirus</i>   | Andes virus (ANDV)                                       |
|                            |  | Castelo dos Sonhos virus (CASV)                          |
|                            |  | Lechiguanas virus (LECV = LECHV)                         |
|                            |  | Orán virus (ORNV)  |
|                            | <i>Asama orthohantavirus</i>   | Asama virus (ASAV)                                       |
|                            | <i>Asikkala orthohantavirus</i>  | Asikkala virus (ASIV)                                    |
|                            | <i>Bayou orthohantavirus</i>   | bayou virus (BAYV)                                       |
|                            |  | Catacamas virus (CATV)                                   |
|                            | <i>Black Creek Canal orthohantavirus</i>                                 | Black Creek Canal virus (BCCV)                           |
|                            | <i>Bowe orthohantavirus</i>  | Bowé virus (BOWV)  |
|                            | <i>Bruges orthohantavirus</i>  | Bruges virus (BRGV)                                      |
|                            | <i>Cano Delgadito orthohantavirus</i>                                    | Caño Delgadito virus (CADV)                              |
|                            | <i>Cao Bang orthohantavirus</i>  | Cao Bằng virus (CBNV)                                    |
|                            |  | Liánghé virus (LHEV)                                     |
|                            | <i>Choclo orthohantavirus</i>  | Choclo virus (CHOV)                                      |
|                            | <i>Dabieshan orthohantavirus</i>   | Dàbiéshān virus (DBSV)                                   |
|                            | <i>Dobrava-Belgrade orthohantavirus</i>                                  | Dobrava virus (DOBV)                                     |
|                            |  | Kurkino virus (KURV)                                     |
|                            |  | Saaremaa virus (SAAV)                                    |
|                            |  | Sochi virus  |
|                            | <i>El Moro Canyon orthohantavirus</i>                                    | Carrizal virus (CARV)                                    |
|                            |  | El Moro Canyon virus (ELMCV)                             |
|                            |  | Huitzilac virus (HUIV)                                   |
|                            | <i>Fugong orthohantavirus</i>  | Fúgōng virus (FUGV)                                      |
|                            | <i>Fusong orthohantavirus</i>  | Fūsōng virus (FUSV)                                      |
|                            | <i>Hantaan orthohantavirus</i> <sup>b</sup>                              | Amur virus (AMRV)  |
|                            |  | Hantaan virus (HTNV)                                     |
|                            |  | Soochong virus (SOOV)                                    |
|                            | <i>Imjin orthohantavirus</i>   | Imjin virus (MJNV)                                       |
|                            | <i>Jeju orthohantavirus</i>  | Jeju virus (JJUV)  |
|                            | <i>Kenkeme orthohantavirus</i>   | Kenkeme virus (KKMV)                                     |
|                            | <i>Khabarovsk orthohantavirus</i>  | Khabarovsk virus (KHAV)                                  |
|                            |  | Topografov virus (TOPV)                                  |

Table 2 (continued)

| Genus                      | Species <sup>a</sup>                                   | Virus (abbreviation) <sup>a</sup>   |
|----------------------------|--|---|
|                            | <i>Laguna Negra orthohantavirus</i>                    | Laguna Negra virus (LANV)<br>Maripa virus (MARV)<br>Río Mamoré virus (RIOMV)  |
|                            | <i>Laibin orthohantavirus</i>                          | Láibín virus (LBV)  |
|                            | <i>Longquan orthohantavirus</i>                        | Lóngquán virus (LQUV)   |
|                            | <i>Luxi orthohantavirus</i>                            | Lúxǐ virus (LUXV)   |
|                            | <i>Maporal orthohantavirus</i>                         | Maporal virus (MAPV)  |
|                            | <i>Montano orthohantavirus</i>                         | Montaño virus (MTNV)  |
|                            | <i>Necocli orthohantavirus</i>                         | Necocli virus (NECV)  |
|                            | <i>Nova orthohantavirus</i>                            | Nova virus (NVAV)   |
|                            | <i>Oxbow orthohantavirus</i>                           | Oxbow virus (OXBV)  |
|                            | <i>Prospect Hill orthohantavirus</i>                   | Prospect Hill virus (PHV)   |
|                            | <i>Puumala orthohantavirus</i>                         | Hokkaido virus (HOKV)<br>Muju virus (MUJV)<br>Puumala virus (PUUV)  |
|                            | <i>Quezon orthohantavirus</i>                          | Quezon virus (QZNV)   |
|                            | <i>Rockport orthohantavirus</i>                        | Rockport virus (RKPV)   |
|                            | <i>Sangassou orthohantavirus</i>                       | Sangassou virus (SANGV)   |
|                            | <i>Seoul orthohantavirus</i>                           | gōu virus (GOUV)<br>Seoul virus (SEOV)  |
|                            | <i>Sin Nombre orthohantavirus</i>                      | New York virus (NYV) <sup>d</sup><br>sin nombre virus (SNV)   |
|                            | <i>Thailand orthohantavirus</i>                        | Anjzorobe virus<br>Serang virus (SERV) <sup>e</sup><br>Thailand virus (THAIV)   |
|                            | <i>Thottapalayam orthohantavirus</i>                   | Thottapalayam virus (TPMV)  |
|                            | <i>Tula orthohantavirus</i>                            | Adler virus (ADLV)<br>Tula virus (TULV)   |
|                            | <i>Yakeshi orthohantavirus</i>                         | Yákèshí virus (YKSV)  |
| Family <i>Jonviridae</i>   |  |   |
| <i>Orthojonvirus</i>       | <i>Jonchet orthojonvirus</i> <sup>b</sup>              | jonchet virus (JONV)  |
| Family <i>Nairoviridae</i> |  |   |
| <i>Orthonairovirus</i>     | <i>Artashat orthonairovirus</i>                        | Artashat virus (ARTSV)  |
|                            | <i>Chim orthonairovirus</i>                            | Chim virus (CHIMV)  |
|                            | <i>Crimean-Congo hemorrhagic fever orthonairovirus</i> | Crimean-Congo hemorrhagic fever virus (CCHFV)   |
|                            | <i>Dera Ghazi Khan orthonairovirus</i>                 | Abu Hammad virus (AHV) <sup>f</sup><br>Abu Mina virus (AMV)<br>Dera Ghazi Khan virus (DGKV)<br>Sapphire II virus (SAPV)       |
|                            | <i>Dugbe orthonairovirus</i> <sup>b</sup>              | Dugbe virus (DUGV)<br>kupe virus (KUPEV)  |
|                            | <i>Hazara orthonairovirus</i>                          | Hazara virus (HAZV)<br>Tofla virus (TFLV)   |
|                            | <i>Hughes orthonairovirus</i>                          | Caspiy virus (CASV)<br>Farallon virus (FARV)<br>Great Saltee virus (GRSV)<br>Hughes virus (HUGV)<br>Punta Salinas virus (PSV) |

Table 2 (continued)

| Genus                          | Species <sup>a</sup>                         | Virus (abbreviation) <sup>a</sup>               |
|--------------------------------|--|---|
|                                |  | Raza virus (RAZAV)                              |
|                                |  | Soldado virus (SOLV)                            |
|                                |  | Zirqa virus (ZIRV)                              |
|                                | <i>Kasokero orthonairovirus</i>              | Kasokero virus (KASV = KASOV)                   |
|                                |  | Leopards Hill virus (LPHV)                      |
|                                |  | Yogue virus (YOGV)                              |
|                                | <i>Keterah orthonairovirus</i>               | Gossas virus (GOSV)                             |
|                                |  | Issyk-kul virus (ISKV)                          |
|                                |  | Keterah virus (KTRV) <sup>g</sup>               |
|                                |  | Uzun-Agach virus (UZAV)                         |
|                                | <i>Nairobi sheep disease orthonairovirus</i> | Nairobi sheep disease virus (NSDV) <sup>h</sup> |
|                                | <i>Qalyub orthonairovirus</i>                | Bandia virus (BDAV)                             |
|                                |  | Geran virus (GERV)                              |
|                                |  | Qalyub virus (QYBV)                             |
|                                | <i>Sakhalin orthonairovirus</i>              | Avalon virus (AVAV)                             |
|                                |  | Clo Mor virus (CMV = CLMV)                      |
|                                |  | Sakhalin virus (SAKV)                           |
|                                |  | Taggert virus (TAGV)                            |
|                                |  | Tillamook virus (TILLV)                         |
|                                | <i>Tamdy orthonairovirus</i>                 | Burana virus (BURV)                             |
|                                |  | Huángpí tick virus 1 (HpTV-1)                   |
|                                |  | Tamdy virus (TAMV)                              |
|                                |  | Táchéng tick virus 1 (TcTV-1)                   |
|                                |  | Wēnzhōu tick virus (WzTV)                       |
|                                | <i>Thiafora orthonairovirus</i>              | Erve virus (ERVEV)                              |
|                                |  | Thiafora virus (TFAV)                           |
| Family <i>Peribunyaviridae</i> |  |   |
| <i>Herbevirus</i>              | <i>Herbert herbevirus</i> <sup>b</sup>       | Herbert virus (HEBV)                            |
|                                | <i>Kibale herbevirus</i>                     | Kibale virus (KIBV)                             |
|                                | <i>Shuangao insect herbevirus 1</i>          | Shuāngào insect virus 1 (SgIV-1)                |
|                                | <i>Tai herbevirus</i>                        | Tāi virus (TAIV)                                |
| <i>Orthobunyavirus</i>         | <i>Acara orthobunyavirus</i>                 | Acará virus (ACAV)                              |
|                                |  | Moriche virus (MORV)                            |
|                                | <i>Akabane orthobunyavirus</i>               | Akabane virus (AKAV)                            |
|                                |  | Sabo virus (SABOV)                              |
|                                |  | Tinaroo virus (TINV)                            |
|                                |  | Yaba-7 virus (Y7V)                              |
|                                | <i>Alajuela orthobunyavirus</i>              | Alajuela virus (ALJV)                           |
|                                |  | Brus Laguna virus                               |
|                                |  | San Juan virus (SJV)                            |
|                                | <i>Anopheles A orthobunyavirus</i>           | Anopheles A virus (ANAV)                        |
|                                |  | Arumateua virus (ARTV)                          |
|                                |  | Caraipé virus (CPEV)                            |
|                                |  | Las Maloyas virus (LMV)                         |
|                                |  | Lukuni virus (LUKV)                             |
|                                |  | Trombetas virus (TRMV)                          |
|                                |  | Tucuruí virus (TUCV)                            |

Table 2 (continued)

| Genus | Species <sup>a</sup>                           | Virus (abbreviation) <sup>a</sup>   |
|-------|--|---|
|       | <i>Anopheles B orthobunyavirus</i>             | Anopheles B virus (ANBV)  |
|       | <i>Bakau orthobunyavirus</i>                   | Boracéia virus (BORV)<br>Bakau virus (BAKV)<br>Ketapang virus (KETV)<br>Nola virus (NOLAV)<br>Tanjong Rabok virus (TRV)<br>Telok Forest virus (TFV)   |
|       | <i>Batama orthobunyavirus</i>                  | Batama virus (BMAV)   |
|       | <i>Benevides orthobunyavirus</i>               | Benevides virus (BVSV)  |
|       | <i>Bertioga orthobunyavirus</i>                | Bertioga virus (BERV)<br>Cananéia virus (CNAV)<br>Guaratuba virus (GTBV)<br>Itimirim virus (ITIV)<br>Mirim virus (MIRV)   |
|       | <i>Bimiti orthobunyavirus</i>                  | bimiti virus (BIMV)   |
|       | <i>Botambi orthobunyavirus</i>                 | Botambi virus (BOTV)  |
|       | <i>Bunyamwera orthobunyavirus</i> <sup>b</sup> | Anadyr virus (ANADV)<br>Batai virus (BATV) <sup>i</sup><br>Birao virus (BIRV)<br>Bozo virus (BOZOV)<br>Bunyamwera virus (BUNV)<br>Cache Valley virus (CVV)<br>Fort Sherman virus (FSV)<br>Germiston virus (GERV)<br>Ilesha virus (ILEV)<br>Lokern virus (LOKV)<br>Maguari virus (MAGV)<br>Mboké virus (MBOV)<br>Ngari virus (NRIV) <sup>j</sup><br>Northway virus (NORV)<br>Playas virus (PLAV)<br>Potosi virus (POTV)<br>Santa Rosa virus (SARV)<br>Shokwe virus (SHOV)<br>Stanfield virus (STAV)<br>Tensaw virus (TENV)<br>Tlacotalpan virus (TLAV)<br>Xingu virus (XINV) |
|       | <i>Bushbush orthobunyavirus</i>                | Benfica virus (BENV)<br>Bushbush virus (BSBV)<br>Juan Díaz virus (JDV)  |
|       | <i>Bwamba orthobunyavirus</i>                  | Bwamba virus (BWAV)<br>Pongola virus (PGAV)   |
|       | <i>California encephalitis orthobunyavirus</i> | Achiote virus (ACHOV)<br>California encephalitis virus (CEV)<br>infirmatus virus (INFV)<br>Inkoo virus (INKV)<br>Jamestown Canyon virus (JCV)   |



Table 2 (continued)

| Genus | Species <sup>a</sup>               | Virus (abbreviation) <sup>a</sup>   |
|-------|------------------------------------|-------------------------------------|
|       |                                    | Jerry Slough virus (JSV)            |
|       |                                    | Keystone virus (KEYV)               |
|       |                                    | Khatanga virus (KHATV) <sup>k</sup> |
|       |                                    | La Crosse virus (LACV)              |
|       |                                    | Lumbo virus (LUMV)                  |
|       |                                    | Melao virus (MELV)                  |
|       |                                    | Morro Bay virus (MBV)               |
|       |                                    | San Angelo virus (SAV)              |
|       |                                    | Serra do Navio virus (SDNV)         |
|       |                                    | snowshoe hare virus (SSHV)          |
|       |                                    | South River virus (SORV)            |
|       |                                    | Ťahyňa virus (TAHV)                 |
|       |                                    | trivittatus virus (TVTV)            |
|       | <i>Capim orthobunyavirus</i>       | Capim virus (CAPV)                  |
|       | <i>Caraparu orthobunyavirus</i>    | Apeú virus (APEUV)                  |
|       |                                    | Bruconha virus (BRUV)               |
|       |                                    | Caraparú virus (CARV)               |
|       |                                    | El Huayo virus                      |
|       |                                    | Itaya virus (ITYV)                  |
|       |                                    | Ossa virus (OSSAV)                  |
|       |                                    | Vinces virus (VINV)                 |
|       | <i>Catu orthobunyavirus</i>        | Catú virus (CATUV)                  |
|       | <i>Estero Real orthobunyavirus</i> | Estero Real virus (ERV)             |
|       | <i>Gamboa orthobunyavirus</i>      | Calchaquí virus (CQIV)              |
|       |                                    | Gamboa virus (GAMV)                 |
|       |                                    | Pueblo Viejo virus (PVV)            |
|       |                                    | Soberanía virus                     |
|       | <i>Guajara orthobunyavirus</i>     | Guajará virus (GJAV)                |
|       | <i>Guama orthobunyavirus</i>       | Ananindeua virus (ANUV)             |
|       |                                    | Guamá virus (GMAV)                  |
|       |                                    | Mahogany Hammock virus (MHV)        |
|       |                                    | Moju virus (MOJUV)                  |
|       | <i>Guaroa orthobunyavirus</i>      | Guaroa virus (GROV)                 |
|       | <i>Kaeng Khoi orthobunyavirus</i>  | Kaeng Khoi virus (KKV)              |
|       | <i>Kairi orthobunyavirus</i>       | Kairi virus (KRIV)                  |
|       | <i>Koongol orthobunyavirus</i>     | koongol virus (KOOV)                |
|       |                                    | wongal virus (WONV)                 |
|       | <i>Madrid orthobunyavirus</i>      | Madrid virus (MADV)                 |
|       | <i>Main Drain orthobunyavirus</i>  | Main Drain virus (MDV)              |
|       | <i>Manzanilla orthobunyavirus</i>  | Buttonwillow virus (BUTV)           |
|       |                                    | Cát Quế virus (CQV)                 |
|       |                                    | Ingwavuma virus (INGV)              |
|       |                                    | Inini virus (INIV)                  |
|       |                                    | Manzanilla virus (MANV)             |
|       |                                    | Mermet virus (MERV)                 |
|       | <i>Marituba orthobunyavirus</i>    | Gumbo Limbo virus (GLV)             |
|       |                                    | Marituba virus (MTBV)               |
|       |                                    | Murutucú virus (MURV)               |
|       |                                    | Nepuyo virus (NEPV)                 |

Table 2 (continued)

| Genus | Species <sup>a</sup>                | Virus (abbreviation) <sup>a</sup> |
|-------|-------------------------------------|-----------------------------------|
|       |                                     | Restan virus (RESV)               |
|       |                                     | Zungarococha virus (ZUNV)         |
|       | <i>Minatitlan orthobunyavirus</i>   | Minatitlán virus (MNTV)           |
|       |                                     | Palestina virus (PLSV)            |
|       | <i>MPoko orthobunyavirus</i>        | M <sup>o</sup> Poko virus (MPOV)  |
|       |                                     | Yaba-1 virus (Y1V)                |
|       | <i>Nyando orthobunyavirus</i>       | Nyando virus (NDV)                |
|       |                                     | Eretmapodites virus (ERETV)       |
|       | <i>Olifantsvlei orthobunyavirus</i> | Bobia virus (BIAV)                |
|       |                                     | Dabakala virus (DABV)             |
|       |                                     | Olifantsvlei virus (OLIV)         |
|       |                                     | Oubi virus (OUBIV)                |
|       | <i>Oriboca orthobunyavirus</i>      | Itaquí virus (ITQV)               |
|       |                                     | Oriboca virus (ORIV)              |
|       | <i>Oropouche orthobunyavirus</i>    | Facey's paddock virus (FPV)       |
|       |                                     | Iquitos virus (IQTV) <sup>d</sup> |
|       |                                     | Madre de Dios virus (MDDV)        |
|       |                                     | Oropouche virus (OROV)            |
|       |                                     | Perdões virus (PDEV)              |
|       |                                     | Pintupo virus (PINTV)             |
|       |                                     | Utinga virus (UTIV)               |
|       |                                     | Utivé virus (UVV = UTVEV)         |
|       | <i>Patois orthobunyavirus</i>       | Abras virus (ABRV)                |
|       |                                     | Babahoya virus (BABV)             |
|       |                                     | Pahayokee virus (PAHV)            |
|       |                                     | Patois virus (PATV)               |
|       |                                     | Shark River virus (SRV)           |
|       | <i>Sathuperi orthobunyavirus</i>    | Douglas virus (DOUV)              |
|       |                                     | Sathuperi virus (SATV)            |
|       | <i>Shamonda orthobunyavirus</i>     | Peaton virus (PEAV)               |
|       |                                     | Sango virus (SANV)                |
|       | <i>Shuni orthobunyavirus</i>        | Shamonda virus (SHAV)             |
|       |                                     | Aino virus (AINOV)                |
|       |                                     | Kaikalur virus (KAIV)             |
|       |                                     | Shuni virus (SHUV)                |
|       | <i>Simbu orthobunyavirus</i>        | Simbu virus (SIMV)                |
|       |                                     | Oya virus (OYAV)                  |
|       | <i>Tacaiuma orthobunyavirus</i>     | Tacaiuma virus (TCMV)             |
|       |                                     | CoAr 1071 virus (CA1071V)         |
|       |                                     | CoAr 3627 virus (CA3626V)         |
|       |                                     | Virgin River virus (VRV)          |
|       | <i>Tete orthobunyavirus</i>         | Bahig virus (BAHV)                |
|       |                                     | Matruh virus (MTRV)               |
|       |                                     | Tete virus (TETE V)               |
|       |                                     | Tsuruse virus (TSUV)              |
|       |                                     | Weldona virus (WELV)              |
|       | <i>Thimiri orthobunyavirus</i>      | Thimiri virus (THIV)              |
|       | <i>Timboteua orthobunyavirus</i>    | Timboteua virus (TBTV)            |

**Table 2** (continued)

| Genus                   | Species <sup>a</sup>                                  | Virus (abbreviation) <sup>a</sup>  |
|-------------------------|---|--|
|                         | <i>Turlock orthobunyavirus</i>                        | Lednice virus (LEDV)<br>Turlock virus (TURV)<br>Umbre virus (UMBV)   |
|                         | <i>Wolkberg orthobunyavirus</i>                       | Wolkberg virus (WBV)   |
|                         | <i>Wyeomyia orthobunyavirus</i>                       | Anhemi virus (AMBV)<br>BeAr 328208 virus (BAV)<br>Cachoeira Porteira virus (CPOV)<br>Iaco virus (IACOV)<br>Macauã virus (MCAV)<br>Rio Pracupi virus<br>Sororoca virus (SORV)<br>Taiassui virus (TAIAV)<br>Tucunduba virus (TUCV)<br>Wyeomyia virus (WYOV)  |
|                         | <i>Zegla orthobunyavirus</i>                          | Zegla virus (ZEGV)   |
| Family Phasmaviridae    |   |  |
| <i>Orthophasmavirus</i> | <i>Kigluaik phantom orthophasmavirus</i> <sup>b</sup> | Kigluaik phantom virus (KIGV)  |
|                         | <i>Nome phantom orthophasmavirus</i>                  | Nome phantom virus (NOMV)  |
|                         | <i>Shuangao insect orthophasmavirus 2</i>             | Shuāngào insect virus 2 (SgIV-2)   |
|                         | <i>Wuchang cockroach orthophasmavirus 1</i>           | Wūchāng cockroach virus 1 (WcCV-1)   |
|                         | <i>Wuhan mosquito orthophasmavirus 1</i>              | Wūhàn mosquito virus 1 (WhMV-1)  |
|                         | <i>Wuhan mosquito orthophasmavirus 2</i>              | Wūhàn mosquito virus 2 (WhMV-2)  |
| Family Phenuiviridae    |   |  |
| <i>Goukovirus</i>       | <i>Cumuto goukovirus</i>                              | Cumuto virus (CUMV)  |
|                         | <i>Gouleako goukovirus</i> <sup>b</sup>               | Gouléako virus (GOLV)  |
|                         | <i>Yichang insect goukovirus</i>                      | Yíchāng insect virus (YcIV)  |
| <i>Phasivirus</i>       | <i>Badu phasivirus</i> <sup>b</sup>                   | Badu virus (BADUV)   |
|                         | <i>Phasi Charoen-like phasivirus</i>                  | Phasi Chaeron-like virus (PCLV)  |
|                         | <i>Wuhan fly phasivirus</i>                           | Wūhàn fly virus 1 (WhFV-1)   |
|                         | <i>Wutai mosquito phasivirus</i>                      | Wūtái mosquito virus (WtMV)  |
| <i>Phlebovirus</i>      | <i>Bujaru phlebovirus</i>                             | Bujaru virus (BUJV)<br>Munguba virus (MUNV)  |
|                         | <i>Candiru phlebovirus</i>                            | Alenquer virus (ALEV)<br>Ariquemes virus (ARQV)<br>Candiru virus (CDUV)<br>Itaituba virus (ITAV)<br>Jacundá virus (JCNV)<br>Maldonado virus (MLOV)<br>Morumbi virus (MR(M)BV)<br>Mucura virus (MCRV/MRAV)<br>Nique virus (NIQV)<br>Oriximiná virus (ORXV)<br>Serra Norte virus (SRNV)<br>Turuna virus (TUAV) |
|                         | <i>Chilibre phlebovirus</i>                           | Cacao virus (CACV)<br>Chilibre virus (CHIV)  |
|                         | <i>Frijoles phlebovirus</i>                           | Frijoles virus (FRIV)<br>Joá virus (JOAV)  |
|                         | <i>Punta Toro phlebovirus</i>                         | Buenaventura virus (BUEV)<br>Campana virus (CMAV)  |

Table 2 (continued)

| Genus                      | Species <sup>a</sup>                              | Virus (abbreviation) <sup>a</sup>                         |
|----------------------------|---|---|
|                            |   | Capira virus (CAPIV)                                      |
|                            |   | Coclé virus (CCLV)  |
|                            |   | Leticia virus (LTCV)                                      |
|                            |   | Punta Toro virus (PTV)                                    |
|                            | <i>Rift Valley fever phlebovirus</i> <sup>b</sup> | Rift Valley fever virus (RVFV)                            |
|                            | <i>Salehabad phlebovirus</i>                      | Adana virus (ADAV)  |
|                            |   | Adria virus (ADRV)  |
|                            |   | Alcube virus  |
|                            |   | Arbia virus (ARBV)  |
|                            |   | Arumowot virus (AMTV)                                     |
|                            |   | Medjerda Valley virus                                     |
|                            |   | Odrénisrou virus (ODRV)                                   |
|                            |   | Olbia virus (OLBV)  |
|                            |   | Salehabad virus (SALV)                                    |
|                            |   | Bregalaka virus (BREV)                                    |
|                            |   | Zaba virus (ZABAV)  |
|                            | <i>Sandfly fever Naples phlebovirus</i>           | Arrábida virus (ARRV)                                     |
|                            |   | Balkan virus (BALKV)                                      |
|                            |   | Fermo virus (FERV)  |
|                            |   | Gordil virus (GORV)                                       |
|                            |   | Granada virus (GRV = GRAV)                                |
|                            |   | Massilia virus (MASV)                                     |
|                            |   | Punique virus (PUNV)                                      |
|                            |   | Saddaguia virus (SADV)                                    |
|                            |   | Saint-Floris virus (SAFV)                                 |
|                            |   | sandfly fever Naples virus (SFNV)                         |
|                            |   | Tehran virus (THEV)                                       |
|                            |   | Toscana virus (TOSV)                                      |
|                            |   | Zerdali virus (ZERV)                                      |
|                            | <i>SFTS phlebovirus</i>                           | severe fever with thrombocytopenia syndrome virus (SFTSV) |
|                            | <i>Uukuniemi phlebovirus</i>                      | Chizé virus (CHZV)  |
|                            |   | EgAN 1825-61 virus (EGAV)                                 |
|                            |   | Fin V 707 virus (FINV)                                    |
|                            |   | Oceanside virus (OCV = OCEV)                              |
|                            |   | Pontevès virus (PTVV)                                     |
|                            |   | St. Abbs Head virus (SAHV)                                |
|                            |   | Uukuniemi virus (UUKV)                                    |
|                            |   | Zaliv Terpenyia virus (ZTV)                               |
| <i>Tenuivirus</i>          | <i>Echinochloa hoja blanca tenuivirus</i>         | Echinochloa hoja blanca virus (EHBV)                      |
|                            | <i>Iranian wheat stripe tenuivirus</i>            | Iranian wheat stripe virus (IWSV)                         |
|                            | <i>Maize stripe tenuivirus</i>                    | maize stripe virus (MStV = MSpV)                          |
|                            | <i>Rice grassy stunt tenuivirus</i>               | rice grassy stunt virus (RGSV)                            |
|                            | <i>Rice hoja blanca tenuivirus</i>                | rice hoja blanca virus (RHBV)                             |
|                            | <i>Rice stripe tenuivirus</i> <sup>b</sup>        | rice stripe virus (RSV = RStV)                            |
|                            | <i>Urochloa hoja blanca tenuivirus</i>            | Urochloa hoja blanca virus (UHBV)                         |
| Family <i>Tospoviridae</i> |   |   |
| <i>Orthospovirus</i>       | <i>Groundnut bud necrosis orthospovirus</i>       | groundnut bud necrosis virus (GBNV) <sup>1</sup>          |

**Table 2** (continued)

| Genus | Species <sup>a</sup>                                    | Virus (abbreviation) <sup>a</sup>               |
|-------|---|---|
|       | <i>Groundnut ringspot orthotospovirus</i>               | groundnut ringspot virus (GRSV)                 |
|       | <i>Groundnut yellow spot orthotospovirus</i>            | groundnut yellow spot virus (GYSV) <sup>m</sup> |
|       | <i>Impatiens necrotic spot orthotospovirus</i>          | impatiens necrotic spot virus (INSV)            |
|       | <i>Iris yellow spot orthotospovirus</i>                 | iris yellow spot virus (IYSV)                   |
|       | <i>Polygonum ringspot orthotospovirus</i>               | Polygonum ringspot virus (PoRSV)                |
|       | <i>Tomato chlorotic spot orthotospovirus</i>            | tomato chlorotic spot virus (TCSV)              |
|       | <i>Tomato spotted wilt orthotospovirus</i> <sup>b</sup> | tomato spotted wilt virus (TSWV)                |
|       | <i>Watermelon bud necrosis orthotospovirus</i>          | watermelon bud necrosis virus (WBNV)            |
|       | <i>Watermelon silver mottle orthotospovirus</i>         | watermelon silver mottle virus (WSMoV)          |
|       | <i>Zucchini lethal chlorosis orthotospovirus</i>        | zucchini lethal chlorosis virus (ZLCV)          |

<sup>a</sup>Please note that viruses are real objects that are assigned to concepts that are called taxa. Species, genera, families, and orders are taxa. Taxon names are always italicized and always begin with a capital letter. Virus names, on the other hand, are not italicized and are not capitalized, except if the name or a name component is a proper noun. This column lists the virus names with their correct (lack of) capitalization. Lists of viruses within a given species are provisional at this point and will likely be amended in the near future

<sup>b</sup>Type species

<sup>c</sup>Synonym: Artybash virus (ARTV)

<sup>d</sup>Synonym: New York 1 virus (NY-1V)

<sup>e</sup>Synonym: Jurong virus

<sup>f</sup>Includes the strain previously referred to as Tunis virus (TUNV)

<sup>g</sup>Includes the strain previously referred to as soft tick bunyavirus (STBV)

<sup>h</sup>Includes the strain previously referred to as Ganjam virus (GANV)

<sup>i</sup>Synonyms: Čalovo virus (CVOV), Chittoor virus (CHITV), Olkya virus, Olyka virus, UgMP-6830 virus

<sup>j</sup>Includes the strain previously referred to as Garissa virus

<sup>k</sup>Also mistakenly referred to in the literature as Chantanga virus (CHATV) and Chatanga virus (CHATV)

<sup>l</sup>Synonym: peanut bud necrosis virus (PDNV)

<sup>m</sup>Synonym: peanut yellow spot virus (PYSV)

include corrections and updates in virus name or abbreviation spelling.

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## Compliance with ethical standards

**Ethical approval** The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of

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## References

- Alkhovsky SV, Lvov DK, Shchetinin AM, Deriabina PG, Shchelkanov MY, Aristova VA, Morozova TN, Gitelman AK, Palacios GF, Kuhn JH (2017) Complete genome coding sequences of Artashat, Burana, Caspiy, Chim, Geran, Tamdy, and Uzun-Agach viruses (*Bunyavirales: Nairoviridae: Orthonairovirus*). *Genome Announc* 5:e01098-01017
- Ballinger MJ, Bruenn JA, Hay J, Czechowski D, Taylor DJ (2014) Discovery and evolution of bunyavirids in arctic

- phantom midges and ancient bunyavirid-like sequences in insect genomes. *J Virol* 88:8783–8794
3. Blasdel KR, Duong V, Eloit M, Chretien F, Ly S, Hul V, Deubel V, Morand S, Buchy P (2016) Evidence of human infection by a new mammarena virus endemic to Southeastern Asia. *Elife* 5:e13135
  4. Bodewes R, Kik MJL, Raj VS, Schapendonk CME, Haagmans BL, Smits SL, Osterhaus ADME (2013) Detection of novel divergent arenaviruses in boid snakes with inclusion body disease in The Netherlands. *J Gen Virol* 94:1206–1210
  5. Di Bello PL, Laney AG, Druciarek T, Ho T, Gergerich RC, Keller KE, Martin RR, Tzanetakis IE (2016) A novel emaravirus is associated with redbud yellow ringspot disease. *Virus Res* 222:41–47
  6. Elbeaino T, Digiario M, Uppala M, Sudini H (2015) Deep sequencing of dsRNAs recovered from mosaic-diseased pigeonpea reveals the presence of a novel emaravirus: pigeonpea sterility mosaic virus 2. *Arch Virol* 160:2019–2029
  7. Fenner F (1976) Classification and nomenclature of viruses. Second report of the International Committee on Taxonomy of Viruses. *Intervirology* 7:1–115
  8. Gryseels S, Rieger T, Oestereich L, Cuypers B, Borremans B, Makundi R, Leirs H, Günther S, Goüy de Bellocq J (2015) Gairo virus, a novel arenavirus of the widespread *Mastomys natalensis*: genetically divergent, but ecologically similar to Lassa and Morogoro viruses. *Virology* 476:249–256
  9. Hepojoki J, Salmenperä P, Sironen T, Hetzel U, Korzyukov Y, Kipar A, Vapalahti O (2015) Arenavirus coinfections are common in snakes with boid inclusion body disease. *J Virol* 89:8657–8660
  10. Hetzel U, Sironen T, Laurinmäki P, Liljeroos L, Patjas A, Henttonen H, Vaheri A, Artelt A, Kipar A, Butcher SJ, Vapalahti O, Hepojoki J (2013) Isolation, identification, and characterization of novel arenaviruses, the etiologic agents of boid inclusion body disease. *J Virol* 87:10918–10935
  11. Ishii A, Thomas Y, Moonga L, Nakamura I, Ohnuma A, Hang'ombe BM, Takada A, Mweene AS, Sawa H (2012) Molecular surveillance and phylogenetic analysis of Old World arenaviruses in Zambia. *J Gen Virol* 93:2247–2251
  12. Jansen van Vuren P, Wiley MR, Palacios G, Storm N, Markotter W, Birkhead M, Kemp A, Paweska JT (2017) Isolation of a novel orthobunyavirus from bat flies (*Eucampsipoda africana*). *J Gen Virol* 98:935–945
  13. Kuhn JH, Wiley MR, Rodriguez SE, Bào Y, Prieto K, Travassos da Rosa APA, Guzman H, Savji N, Ladner JT, Tesh RB, Wada J, Jahrling PB, Bente DA, Palacios G (2016) Genomic characterization of the genus *Nairovirus* (family *Bunyaviridae*). *Viruses* 8:164
  14. Li C-X, Shi M, Tian J-H, Lin X-D, Kang Y-J, Chen L-J, Qin X-C, Xu J, Holmes EC, Zhang Y-Z (2015) Unprecedented genomic diversity of RNA viruses in arthropods reveals the ancestry of negative-sense RNA viruses. *Elife* 4:e05378
  15. Li K, Lin X-D, Wang W, Shi M, Guo W-P, Zhang X-H, Xing J-G, He J-R, Wang K, Li M-H, Cao J-H, Jiang M-L, Holmes EC, Zhang Y-Z (2015) Isolation and characterization of a novel arenavirus harbored by rodents and shrews in Zhejiang province, China. *Virology* 476:37–42
  16. Marklewitz M, Handrick S, Grasse W, Kurth A, Lukashev A, Drosten C, Ellerbrok H, Leendertz FH, Pauli G, Junglen S (2011) Gouléako virus isolated from West African mosquitoes constitutes a proposed novel genus in the family *Bunyaviridae*. *J Virol* 85:9227–9234
  17. Marklewitz M, Zirkel F, Rwego IB, Heidemann H, Trippner P, Kurth A, Kallies R, Briese T, Lipkin WI, Drosten C, Gillespie TR, Junglen S (2013) Discovery of a unique novel clade of mosquito-associated bunyaviruses. *J Virol* 87:12850–12865
  18. Marklewitz M, Zirkel F, Kurth A, Drosten C, Junglen S (2015) Evolutionary and phenotypic analysis of live virus isolates suggests arthropod origin of a pathogenic RNA virus family. *Proc Natl Acad Sci USA* 112:7536–7541
  19. Marzano S-YL, Domier LL (2016) Novel mycoviruses discovered from metatranscriptomics survey of soybean phyllosphere phytobiomes. *Virus Res* 213:332–342
  20. Marzano S-YL, Nelson BD, Ajayi-Oyetunde O, Bradley CA, Hughes TJ, Hartman GL, Eastburn DM, Domier LL (2016) Identification of diverse mycoviruses through metatranscriptomics characterization of the viromes of five major fungal plant pathogens. *J Virol* 90:6846–6863
  21. Palacios G, Savji N, Hui J, Travassos da Rosa A, Popov V, Briese T, Tesh R, Lipkin WI (2010) Genomic and phylogenetic characterization of Merino Walk virus, a novel arenavirus isolated in South Africa. *J Gen Virol* 91:1315–1324
  22. Radoshitzky SR, Bào Y, Buchmeier MJ, Charrel RN, Clawson AN, Clegg CS, DeRisi JL, Emonet S, Gonzalez J-P, Kuhn JH, Lukashevich IS, Peters CJ, Romanowski V, Salvato MS, Stenglein MD, de la Torre JC (2015) Past, present, and future of arenavirus taxonomy. *Arch Virol* 160:1851–1874
  23. Shi M, Lin X-D, Tian J-H, Chen L-J, Chen X, Li C-X, Qin X-C, Li J, Cao J-P, Eden J-S, Buchmann J, Wang W, Xu J, Holmes EC, Zhang Y-Z (2016) Redefining the invertebrate RNA virosphere. *Nature* 540:539–543
  24. Stenglein MD, Sanders C, Kistler AL, Ruby JG, Franco JY, Reavill DR, Dunker F, DeRisi JL (2012) Identification, characterization, and in vitro culture of highly divergent arenaviruses from boa constrictors and annulated tree boas: candidate etiological agents for snake inclusion body disease. *MBio* 3:e00180-00112
  25. Witkowski PT, Kallies R, Hoveka J, Auste B, Ithete NL, Šoltys K, Szemes T, Drosten C, Preiser W, Klempa B, Mfunke JKE, Kruger DH (2015) Novel arenavirus isolates from Namaqua rock mice, Namibia, Southern Africa. *Emerg Infect Dis* 21:1213–1216
  26. Zheng Y, Navarro B, Wang G, Wang Y, Yang Z, Xu W, Zhu C, Wang L, Di Serio F, Hong N (2017) Actinidia chlorotic ringspot-associated virus: a novel emaravirus infecting kiwifruit plants. *Mol Plant Pathol* 18:569–581

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