

CLASES ESPEJO  
*y coil*



# “Uso de la metagenómica para el descubrimiento de arbovirus en garrapatas”

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2. Metagenómica o SNG.
3. Los arbovirus y clasificación e importancia.
4. Vectores: garrapatas.
5. ¿Qué estamos haciendo y que encontramos?

# Introducción

La secuenciación de nueva generación (NGS) representa un hito histórico en la investigación genética y la biología molecular. Antes de su aparición en la década del 2000, la secuenciación (tipo Sanger) de ADN era un proceso costoso, lento y laborioso que se limitaba a la lectura de fragmentos relativamente cortos del genoma.

La NGS revolucionó este panorama al introducir una capacidad de secuenciación a gran escala y alta velocidad.

 **NIH Public Access**  
**Author Manuscript**  
*Nature*. Author manuscript; available in PMC 2006 September 15.

Published in final edited form as:  
*Nature*. 2005 September 15; 437(7057): 376–380.

**Genome Sequencing in Open Microfabricated High Density Picoliter Reactors**

Marcel Margulies<sup>1,\*</sup>, Michael Egholm<sup>1,\*</sup>, William E. Altman<sup>1</sup>, Said Attiya<sup>1</sup>, Joel S. Bader<sup>1</sup>, Lisa A. Bembgen<sup>1</sup>, Jan Berka<sup>1</sup>, Michael S. Braverman<sup>1</sup>, Yi-Ju Chen<sup>1</sup>, Zhoutao Chen<sup>1</sup>, Scott B. Dewell<sup>1</sup>, Lei Du<sup>1</sup>, Joseph M. Fierro<sup>1</sup>, Xavier V. Gomes<sup>1</sup>, Brian C. Goodwin<sup>1</sup>, Wen He<sup>1</sup>, Scott Helgesen<sup>1</sup>, Chun He Ho<sup>1</sup>, Gerard P. Irzyk<sup>1</sup>, Szilveszter C. Jando<sup>1</sup>, Maria L.I. Alenquer<sup>1</sup>, Thomas P. Jarvie<sup>1</sup>, Kshama B. Jirage<sup>1</sup>, Jong-Bum Kim<sup>1</sup>, James R. Knight<sup>1</sup>, Janna R. Lanza<sup>1</sup>, John H. Leamon<sup>1</sup>, Steven M. Lefkowitz<sup>1</sup>, Ming Lei<sup>1</sup>, Jing Li<sup>1</sup>, Kenton L. Lohman<sup>1</sup>, Hong Lu<sup>1</sup>, Vinod B. Makhijani<sup>1</sup>, Keith E. McDade<sup>1</sup>, Michael P. McKenna<sup>1</sup>, Eugene W. Myers<sup>3</sup>, Elizabeth Nickerson<sup>1</sup>, John R. Nobile<sup>1</sup>, Ramona Plant<sup>1</sup>, Bernard P. Puc<sup>1</sup>, Michael T. Ronan<sup>1</sup>, George T. Roth<sup>1</sup>, Gary J. Sarkis<sup>1</sup>, Jan Fredrik Simons<sup>1</sup>, John W. Simpson<sup>1</sup>, Maithreyan Srinivasan<sup>1</sup>, Karrie R. Tartaro<sup>1</sup>, Alexander Tomasz<sup>4</sup>, Kari A. Vogt<sup>1</sup>, Greg A. Volkmer<sup>1</sup>, Shally H. Wang<sup>1</sup>, Yong Wang<sup>1</sup>, Michael P. Weiner<sup>2</sup>, Pengguang Yu<sup>1</sup>, Richard F. Begley<sup>1</sup>, and Jonathan M. Rothberg<sup>1</sup>

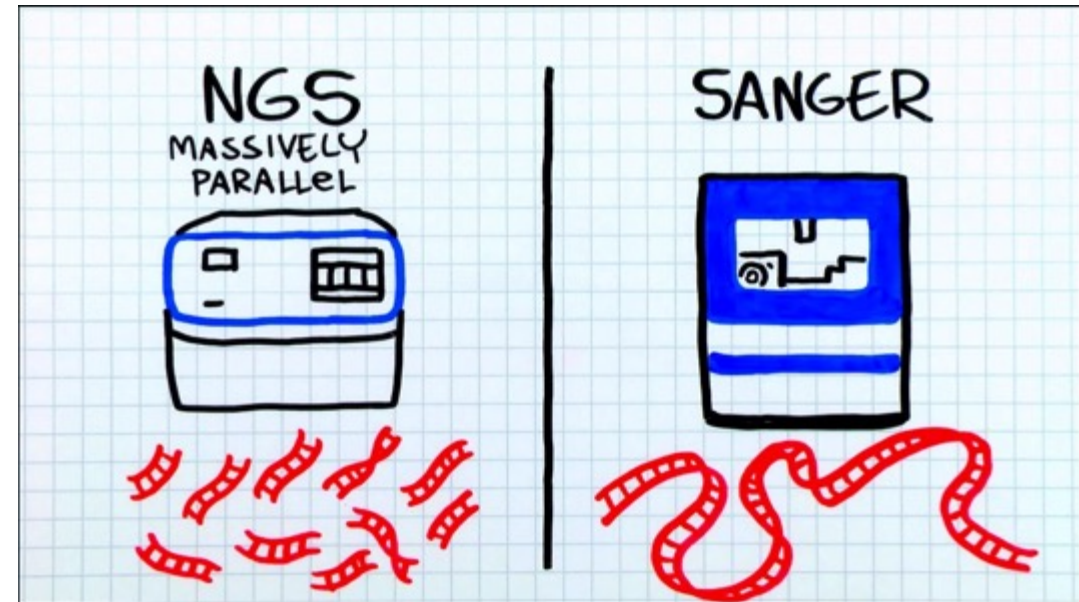
1 454 Life Sciences Corp., 20 Commercial St., Branford, CT 06405, USA.

Es un sistema de secuenciación que supera en rendimiento a lo tradicional. Utiliza una placa de fibra óptica con millones de pequeños pozos y puede secuenciar grandes cantidades de ADN con alta precisión y corto tiempo. Este sistema demostró ser muy efectivo y preciso al secuenciar y ensamblar el genoma del *Mycoplasma genitalium*.



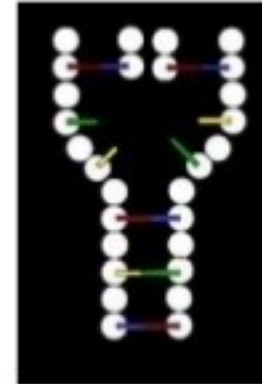
# Metagenómica

La secuenciación de nueva generación (NGS-Next Generation Sequencing) es una tecnología que permite determinar la secuencia de ADN y ARN con alta velocidad y a gran escala. Esto significa que puede leer miles o millones de secuencias de nucleótidos simultáneamente, lo que la hace muy eficiente para analizar genomas completos y grandes cantidades de datos genéticos.

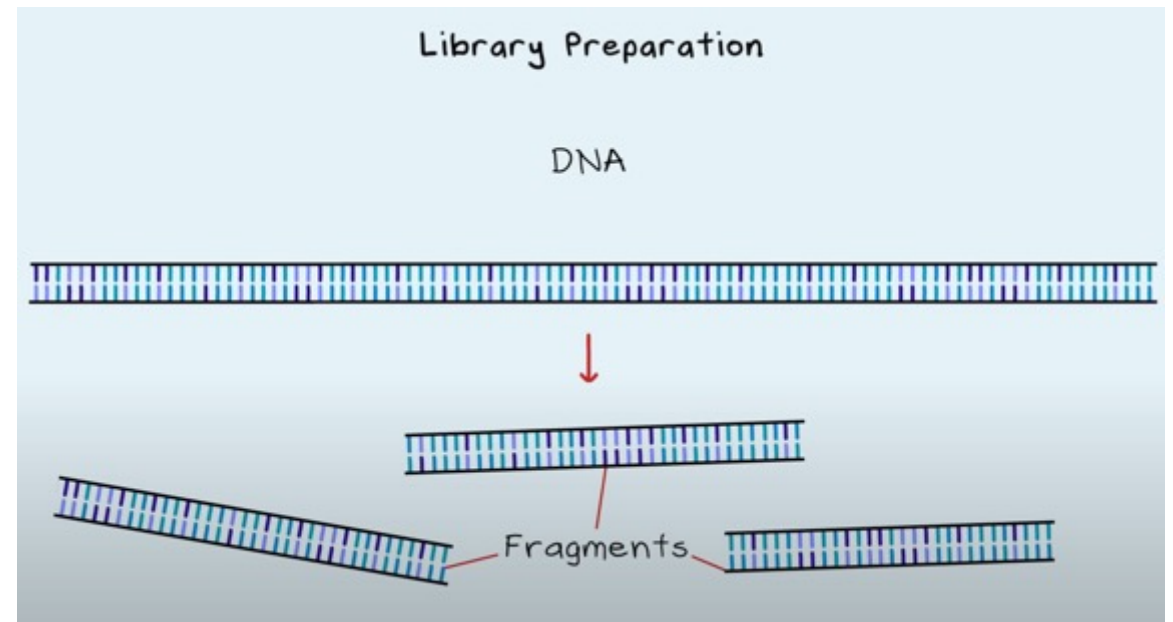
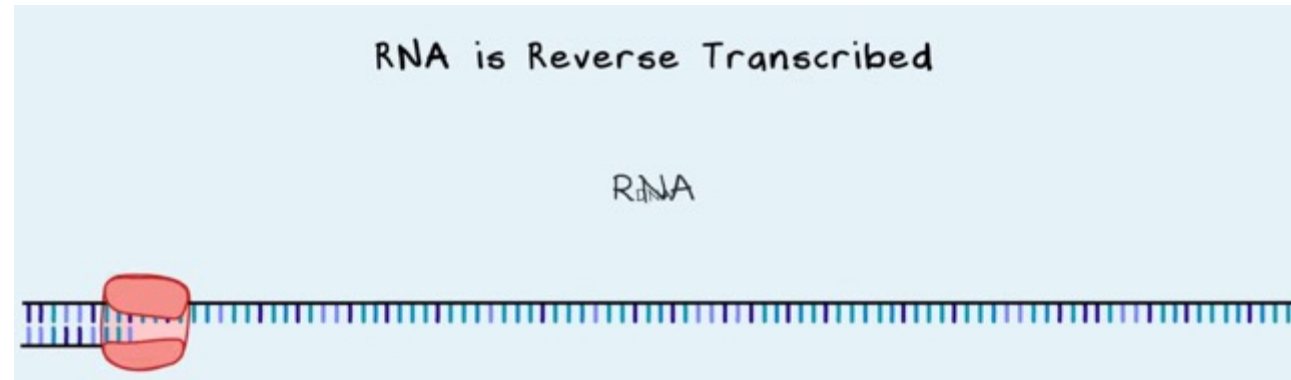
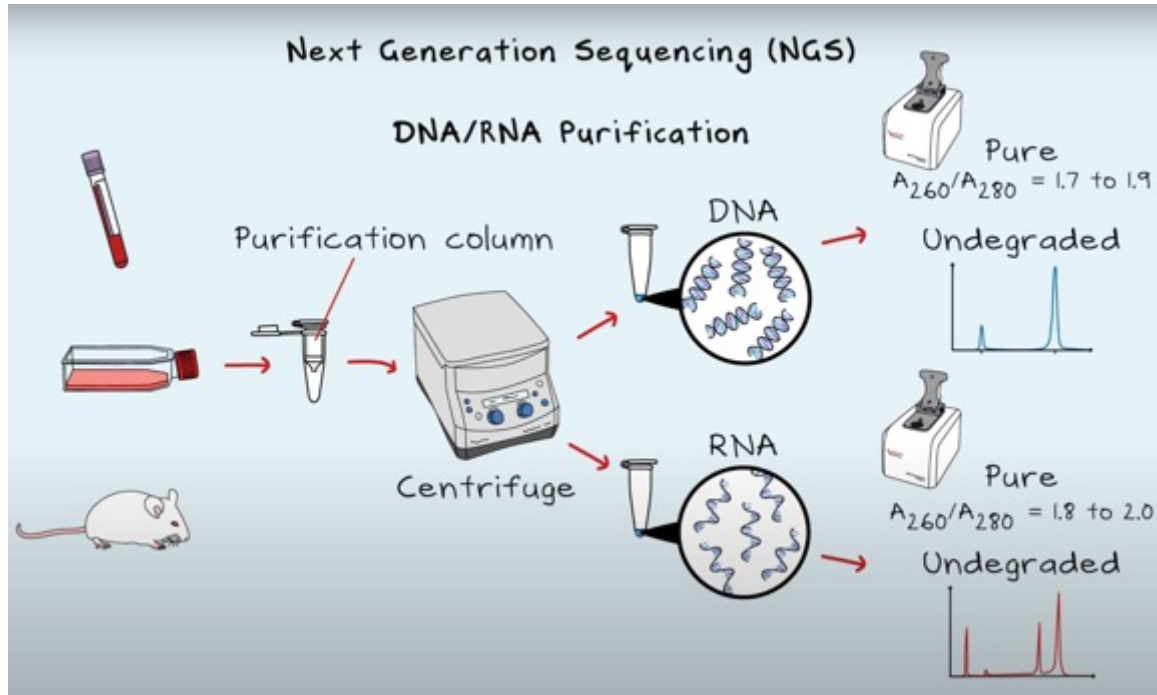


# SANGERS Vs. NGS

Features	Sanger	NGS
Sequencing Samples	Clones, PCR	DNA Libraries
Preparation Steps	Few, Sequencing reactions clean up	Many, Complex procedures
Data Collection	Samples in plates : 96, 384	Samples on slides 1-16+
Data	1 Read/ Sample	Thousands & Millions of Reads/ Samples.

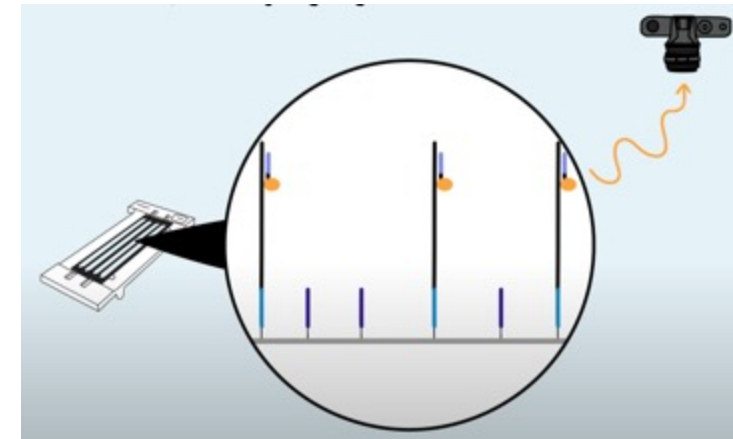
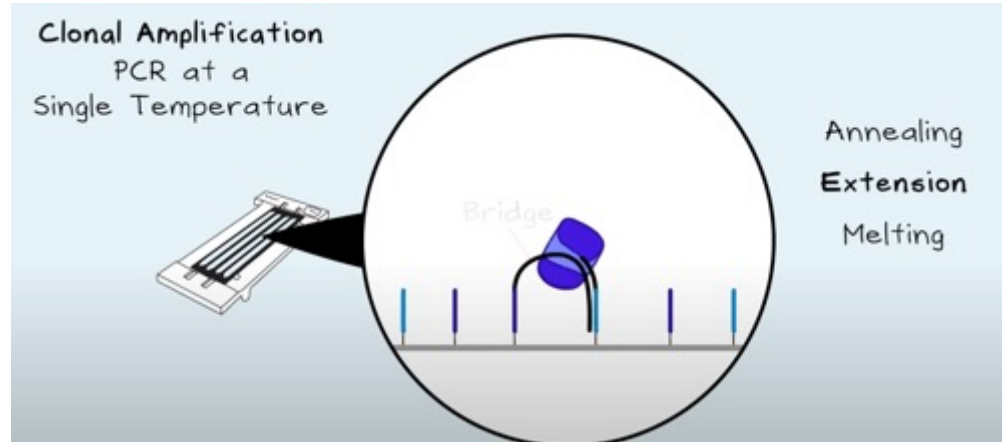
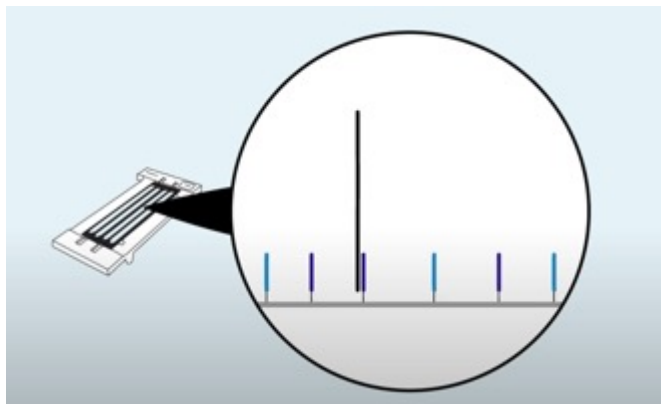
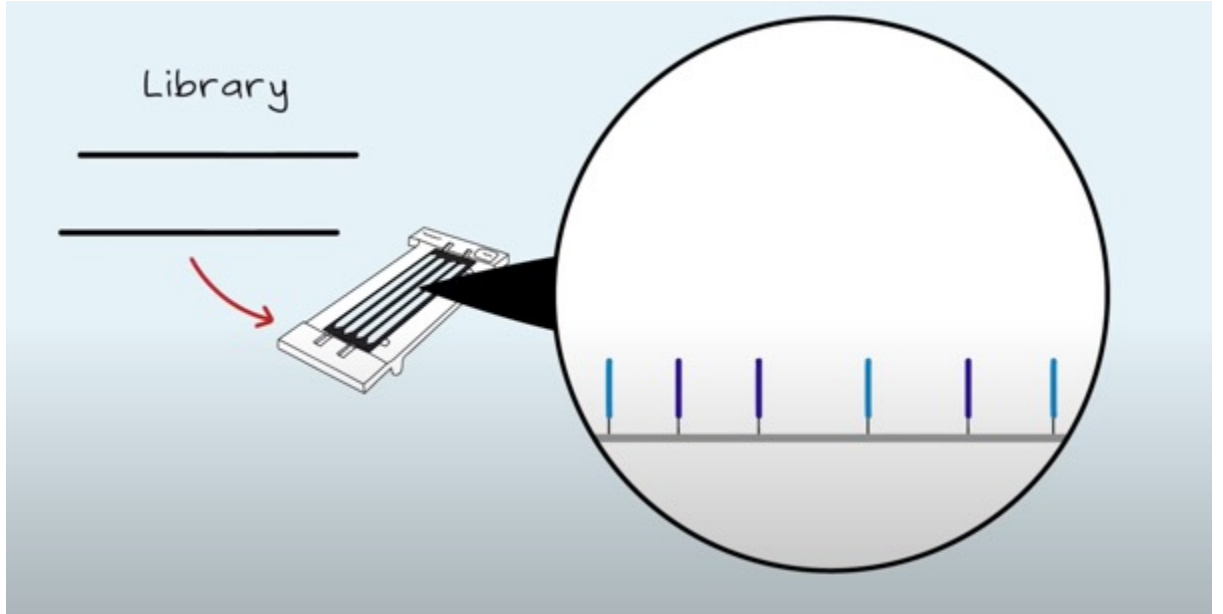
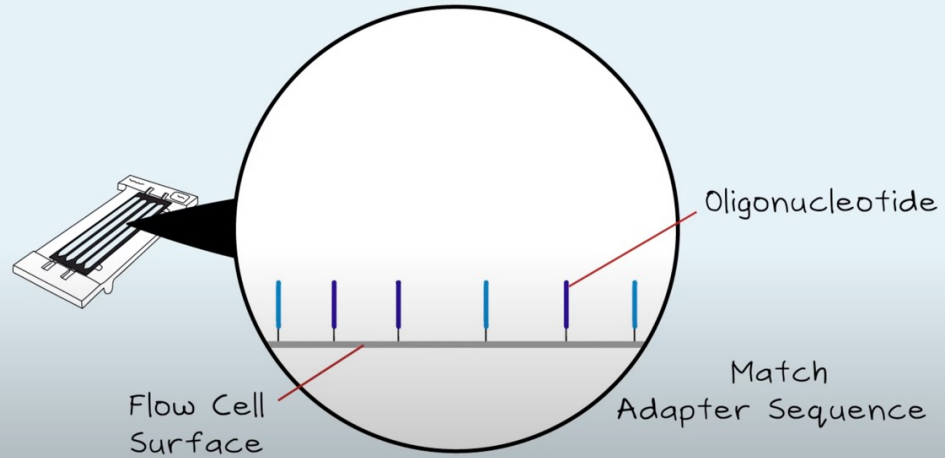
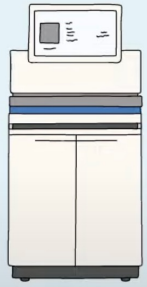


# Metagenómica: ¿Cómo funciona?



# Next Generation Sequencing (NGS) Sequencing by Synthesis (SBS)

# ILLUMINA



## DNA

### — DNA Sequencing, individual tube format

SERVICE	INTERNAL	EXTERNAL
Standard sequencing rxn, and cap run, full service	\$ 6.45	\$ 11.00
Standard sequencing rxn, and cap run, no redo	\$ 4.30	\$ 8.35
BAC/lambda sequencing rxn, and cap run	\$ 8.70	\$ 12.00
Sequencing capillary run (only)	\$ 1.85	\$ 3.50

Sanger

!!!

### — Cluster Generation and Sequencing, NovaSeq 6000

SERVICE	INTERNAL	EXTERNAL
100-Cycle Single Read NovaSeq 6000 SP Flow Cell Sequencing, per lane	\$ 1,855.00	\$ 2,179.00
100-Cycle Single Read NovaSeq 6000 SP Flow Cell Sequencing, per flow cell	\$ 3,272.00	\$ 3,798.00
100-Cycle Paired End NovaSeq 6000 SP Flow Cell Sequencing, per lane	\$ 2,385.00	\$ 2,785.00
100-Cycle Paired End NovaSeq 6000 SP Flow Cell Sequencing, per flow cell	\$ 4,333.00	\$ 4,999.00

NGS





La NGS ha revolucionado la forma en cómo se identifican y estudian microorganismos como bacterias, virus, hongos y otros agentes infecciosos. Algunos ejemplos de uso con patógenos incluyen:

- **Diagnóstico de enfermedades infecciosas.**
- **Epidemiología molecular.**
- **Identificación de nuevos patógenos.**
- **Estudio de microbiomas.**
- **Investigación de vectores y reservorios.**



## Chapter 15 - Next-Generation Sequencing for Pathogen Detection and Identification

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Commentaries and Points of View

Molecular epidemiology of viral diseases in the era of next generation sequencing 

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OPEN ACCESS Freely available online



## Next Generation Sequencing Uncovers Unexpected Bacterial Pathogens in Ticks in Western Europe

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# Arbovirus

## William C Reeves

A leading authority on the spread and control of mosquito-borne diseases

William C Reeves was only 25 years old when he and William M Harmon led the research team that isolated the western equine and St Louis encephalitis viruses from the *Culex tarsalis* mosquito.

Originally trained as an entomologist, Dr Reeves became interested in arboviruses (a term he coined for arthropod borne viruses) before going on to earn his PhD in medical entomology and parasitology in 1943 at the University of California at Berkeley, where he also earned a master's degree in epidemiology in 1949.

In a captivating series of oral history interviews in 1990, Dr Reeves said that he developed an interest in insects while growing up on a ranch in rural California. His interest was so keen that childhood friends called him "Billy Bugs Reeves."

While working for the Alameda County











Reeves (on left) created "a roadmap for understanding West Nile virus"

UNIVERSITY OF CALIFORNIA AT BERKELEY

El término "**arbovirus**" fue acuñado por el virólogo estadounidense William C. Reeves en la década de 1950. Se definen como un grupo de virus que se transmiten a vertebrados principalmente a través de la picadura/mordedura de artrópodos, como los mosquitos, garrapatas y otros insectos.

Estos virus pertenecen a 8 diferentes familias y varios géneros. En México, han sido descritos más de 10 arbovirus que han causado problemas en salud pública.

Virus Family	Viral Genus	Virus		Vector Species
Bunyaviridae	Orthobunyavirus	California serogroup viruses		Mosquito (Aedes sp.)
	Phlebovirus	Rift Valley Fever virus		Mosquito (various)
	Phlebovirus	Toscana virus		Sandfly (Phelbotomus sp.)
	Phlebovirus	Phlebotomus fever virus		Sandfly (phelbotomus)
	Phlebovirus	Sandfly Fever Naples virus		Sandfly (phelbotomus)
	Phlebovirus	Sandfly Fever Sicilian virus		Sandfly (phelbotomus)
	Phlebovirus	Heartland virus		Tick (A. americanum)
	Phlebovirus	Severe fever with thrombocytopenia syndrome virus		Tick (H. longicornis)
	Nairovirus	Crimean Hemorrhagic Fever virus		Tick (Hyalomma sp.)
Flaviviridae	Flavivirus	Dengue Virus		Mosquito (Aedes sp.)
	Flavivirus	Zika virus		Mosquito (Aedes sp.)
	Flavivirus	Yellow fever virus		Mosquito (Aedes sp.)
	Flavivirus	West Nile Virus		Mosquito (Culex sp.)
	Flavivirus	St. Louis Encephalitis virus		Mosquito (Culex sp.)
	Flavivirus	Japanese encephalitis virus		Mosquito (Culex sp.)
	Flavivirus	Murray Valley encephalitis virus		Mosquito (Culex sp.)
	Flavivirus	Usutu		Mosquito (various)
	Flavivirus	Omsk Hemorrhagic fever virus		Tick (dermacentor)
	Flavivirus	Kyasanur Forest Disease virus		Tick (Haemaphysalis sp.)
	Flavivirus	Tick-borne encephalitis virus		Tick (Ixodes and Haemaphysalis sp.)
	Flavivirus	Powassan virus		Tick (Ixodes sp.)
	Orthomyxoviridae	Thogotovirus		Bourbon virus
Reoviridae	Coltivirus	Colorado tick fever		Tick (dermacentor)
Rhabdoviridae	Vesiculovirus	Vesicular Stomatitis (New Jersey) virus		Sandflies (Lutz. Sp)   Mosquitos (various)
	Vesiculovirus	Chandipura		Sandfly (Phlebotomus Sp.)
Togaviridae	Alphavirus	Barmah Forest Virus		Mosquito (Aedes and Culex sp.)
	Alphavirus	Chikungunya virus		Mosquito (Aedes sp.)
	Alphavirus	Venezuelan equine encephalitis virus		Mosquito (Culex sp.)
	Alphavirus	Sindbis virus		Mosquito (Culex sp.)
	Alphavirus	Equine encephalitis virus		Mosquito (Culex sp.)
	Alphavirus	Mayaro virus		Mosquito (Haemagogus sp.)



## Detection of Antibodies to Lokern, Main Drain, St. Louis Encephalitis, and West Nile Viruses in Vertebrate Animals in Chihuahua, Guerrero, and Michoacán, Mexico

Stephaine Viridiana Laredo-Tiscareño,<sup>1</sup> Javier A. Garza-Hernandez,<sup>2</sup> Carlos A. Rodríguez-Alarcón,<sup>3,1</sup> Jaime R. Adame-Gallegos,<sup>4</sup> Diana M. Beristain-Ruiz,<sup>3</sup> Ignacio Netzahualcoyotl Barajas-López,<sup>5</sup> Rodolfo González-Peña,<sup>4</sup> David Baylon-Jaquez,<sup>3</sup> Adriana Camacho-Perea,<sup>5</sup> Alfonso Vega-Durán,<sup>3</sup> Ezequiel Rubio-Tabares,<sup>3</sup> Ramón Rivera-Barreno,<sup>3</sup> Carolina Montelongo-Ponce,<sup>3</sup> Chandra S. Tangudu,<sup>1</sup> and Bradley J. Blitvich<sup>1</sup>

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## Surveillance for Flaviviruses Near the Mexico–U.S. Border: Co-circulation of Dengue Virus Serotypes 1, 2, and 3 and West Nile Virus in Tamaulipas, Northern Mexico, 2014–2016

S. Viridiana Laredo-Tiscareño,<sup>1,2,3</sup> Javier A. Garza-Hernandez,<sup>4</sup> Ma Isabel Salazar,<sup>5</sup> Erick J. De Luna-Santillana,<sup>6</sup> Chandra S. Tangudu,<sup>3</sup> Rosa C. Cetina-Trejo,<sup>2</sup> Gloria L. Doria-Cobos,<sup>7</sup> Santos Daniel Carmona-Aguirre,<sup>8</sup> Julian E. Garcia-Rejon,<sup>2</sup> Carlos Machain-Williams,<sup>2</sup> Bradley J. Blitvich,<sup>3\*</sup> and Mario Alberto Rodríguez Pérez<sup>1</sup>

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## Journal of Vector Borne Diseases

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### RESEARCH ARTICLE

Ahead of Print

#### Host-seeking *Aedes aegypti* linked to dengue seropositive households at northeastern Mexico

Mario A Rodríguez-Perez<sup>1</sup>, Monsuru A Adeleke<sup>2</sup>, Tanya L Russell<sup>3</sup>, Omar Olguin-Rodríguez<sup>1</sup>, Stephanie V Laredo-Tiscareño<sup>1</sup>, Javier A Garza-Hernandez<sup>4</sup>, Filiberto Reyes-Villanueva<sup>1</sup>

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# Garrapatas

Grupo de artrópodos arácnidos del orden Ixodida, que se dividen en Ixodidae y Argasidae. A nivel mundial existen más de 900 especies. Son de importancia en la salud humana y animal y actualmente se ha incrementado su estuio ya que han ampleado sus nichos, hospederos, distribución.



## The *Amblyomma* (Acari: Ixodida: Ixodidae) of Mexico: Identification Keys, Distribution and Hosts

CARMEN GUZMÁN-CORNEJO<sup>1</sup>, RICHARD G. ROBBINS<sup>2</sup>, ALBERTO A. GUGLIELMONE<sup>3</sup>,  
GRISELDA MONTIEL-PARRA<sup>4</sup> & TILA MARÍA PÉREZ<sup>4</sup>

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## The *Ixodes* (Acari: Ixodidae) of Mexico: parasite-host and host-parasite checklists

CARMEN GUZMÁN-CORNEJO<sup>1</sup>, RICHARD G. ROBBINS<sup>2</sup> & TILA M. PÉREZ<sup>1</sup>

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<sup>2</sup>DPMIAC/AFPMB, Walter Reed Army Medical Center, Washington, DC 20307-5001.

## Potential Species Distribution and Richness of Ixodidae Ticks Associated with Wild Vertebrates from Michoacán, Mexico

Margarita Vargas-Sandoval<sup>1\*</sup>, Angel G. Priego-Santander<sup>2</sup>, Alejandra Larrazábal<sup>2</sup>,  
Carolina G. Sosa-Gutiérrez<sup>3</sup>, Blanca Lara-Chávez<sup>1</sup>, Teresita Avila-Val<sup>1</sup>





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# A review of hard ticks (Acari: Ixodidae) in Colombia: The risk of tick-borne diseases

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## ABSTRACT

This paper reviews the ixodid tick species that are present in Colombia. The different databases reported 50 species of ticks, of which 29 belong to *Amblyomma*: *A. auricularium*, *A. cajennense sensu lato (s.l.)*; for Colombia *A. calcaratum*, *A. coelebs*, *A. crassum*, *A. dissimile*, *A. geayi*, *A. goeldii*, *A. humerale*, *A. longirostre*, *A. maculatum*, *A. tigrinum*, *A. triste*, *A. mixtum*, *A. multipunctum*, *A. naponense*, *A. neumanni*, *A. nodosum*, *A. oblongoguttatum*, *A. ovale*, *A. pacae*, *A. pecarium*, *A. patinoi*, *A. rotundatum*, *A. sabanerae*, *A. scalpturatum*, *A. tapirellum*, *A. varium*, *A. incisum*, *A. parvum*; two *Haemaphysalis* species: *H. juxtakochi*, *H. leporispalustris*, two *Rhipicephalus* species: *R. (Boophilus) microplus*, *R. sanguineus s.s.*, two *Dermacentor* species: *Anocentor (D.) nitens*, *D. imitans*, and 15 species of *Ixodes*: *I. affinis*, *I. andinus*, *I. auritulus*, *I. bocatorensis*, *I. boliviensis*, *I. brunneus*, *I. fuscipes*, *I. lasallei*, *I. loricatus*, *I. luciae*, *I. montoyanus*, *I. pararicinus*, *I. tapirus*, *I. tropicalis*, *I. venezuelensis*. Some of these species need to be validated, their presence confirmed, and their role as a risk for human and animal health studied. Therefore, a countrywide survey of Ixodidae ticks would be of great value to update the information presented in this work.

**KEY WORDS:** America; biodiversity; checklist; health; Ixodida; vector.



# Arbovirus transmitidos por garrapatas

## Tick-borne viruses

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### SUMMARY

At least 38 viral species are transmitted by ticks. Virus-tick-vertebrate host relationships are highly specific and less than 10% of all tick species (Argasidae and Ixodidae) are known to play a role as vectors of arboviruses. However, a few tick species transmit several (e.g. *Ixodes ricinus*, *Amblyomma variegatum*) or many (*I. uriae*) tick-borne viruses. Tick-borne viruses are found in six different virus families (Asfarviridae, Reoviridae, Rhabdoviridae, Orthomyxoviridae, Bunyaviridae, Flaviviridae) and at least 9 genera. Some as yet unassigned tick-borne viruses may belong to a seventh family, the Arenaviridae. With only one exception (*African swine fever virus*, family Asfarviridae) all tick-borne viruses (as well as all other arboviruses) are RNA viruses. Tick-borne viruses are found in all the RNA virus families in which insect-borne members are found, with the exception of the family Togaviridae. Some tick-borne viruses pose a significant threat to the health of humans (*Tick-borne encephalitis virus*, *Crimean-Congo haemorrhagic fever virus*) or livestock (*African swine fever virus*, *Nairobi sheep disease virus*). Key challenges are to determine the molecular adaptations that allow tick-borne viruses to infect and replicate in both tick and vertebrate cells, and to identify the principal ecological determinants of tick-borne virus survival.

Key words: Arboviruses, tick-borne viruses, ticks, vectors.

Ejemplos:

- Crimean-Congo hemorrhagic fever virus.
- Kyasanur Forest disease virus.
- Powassan virus.
- African swine fever virus.



# International Committee on Taxonomy of Viruses: ICTV

## Official Taxonomic Resources



[ICTV Taxonomy Browser](#)  
Find taxa and browse the virus taxonomy



[Master Species List](#)  
MSL: Spreadsheet of all current species



[Virus Metadata Resource](#)  
VMR: Virus exemplars for every species

Home About Taxonomy Report Information Forums Help [Log in](#)

Home > Master Species Lists

## Master Species Lists

### The Master Species List: A Spreadsheet of Current Taxonomy

The most recent Master Species List (MSL) below provides access to the official, current virus taxonomy approved by the ICTV. A new MSL will be uploaded whenever a new, revised taxonomy ratified by the ICTV membership. These Master Species Lists (MSL) provide the complete ICTV taxonomy as a downloadable spreadsheet. MSL files are available for each release of the virus taxonomy since 2008.

[Download Current Master Species List \(MSL\)](#)

To download folders and files in bulk, select the checkbox next to the desired downloads and then click on the "Download archive" button to receive a .zip file of your requested files.

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<input type="checkbox"/>		Name	Created	Size
<input type="checkbox"/>		<a href="#">ICTV_Master_Species_List_2022_MSL38.v3.xlsx</a>	09/11/2023 - 11:17	1.91 MB
<input type="checkbox"/>		<a href="#">ICTV_Master_Species_List_2022_MSL38.v2.xlsx</a>	06/07/2023 - 14:42	1.35 MB
<input type="checkbox"/>		<a href="#">ICTV_Master_Species_List_2022_MSL38.v1.xlsx</a>	04/08/2023 - 08:53	1.25 MB
<input type="checkbox"/>		<a href="#">ICTV_Master_Species_List_2021_v3.xlsx</a>	11/01/2023 - 12:01	898.14 KB
<input type="checkbox"/>		<a href="#">ICTV_Master_Species_List_2021_v2.xlsx</a>	06/28/2022 - 12:52	895.99 KB

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## Guidelines for public database submission of uncultivated virus genome sequences for taxonomic classification



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Short communication

# Field samplings of *Ixodes ricinus* ticks from a tick-borne encephalitis virus micro-focus in Northern Zealand, Denmark

Andreas Petersen<sup>a b c</sup>  , Maiken Worsøe Rosenstjerne<sup>b</sup>, Morten Rasmussen<sup>b</sup>, Kurt Fuursted<sup>c</sup>, Henrik Vedel Nielsen<sup>c</sup>, Lee O'Brien Andersen<sup>c</sup>, René Bødker<sup>d</sup>, Anders Fomsgaard<sup>b e</sup>

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<https://doi.org/10.1016/j.ttbdis.2019.05.005>

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## Abstract

In 2008–2009 a tick-borne encephalitis virus (TBEV) micro-focus was detected in Northern Zealand, Denmark. No new cases of TBE with an epidemiological link to Northern Zealand has been reported since. Here we undertook to investigate *Ixodes ricinus* ticks from this endemic micro-focus in 2016 and 2017. In addition to TBEV, *I.*



## Virome Analysis of *Amblyomma americanum*, *Dermacentor variabilis*, and *Ixodes scapularis* Ticks Reveals Novel Highly Divergent Vertebrate and Invertebrate Viruses

Rafal Tokarz, Simon Hedley Williams, Stephen Sameroff, Maria Sanchez Leon, Komal Jain, W. Ian Lipkin  
Center for Infection and Immunity, Mailman School of Public Health, Columbia University, New York, New York, USA

### ABSTRACT

A wide range of bacterial pathogens have been identified in ticks, yet the diversity of viruses in ticks is largely unexplored. In the United States, *Amblyomma americanum*, *Dermacentor variabilis*, and *Ixodes scapularis* are among the principal tick species associated with pathogen transmission. We used high-throughput sequencing to characterize the viromes of these tick species and identified the presence of Powassan virus and eight novel viruses. These included the most divergent nairovirus described to date, two new clades of tick-borne phleboviruses, a mononegavirus, and viruses with similarity to plant and insect viruses. Our analysis revealed that ticks are reservoirs for a wide range of viruses and suggests that discovery and characterization of tick-borne viruses will have implications for viral taxonomy and may provide insight into tick-transmitted diseases.

# Detection of multiple novel viruses in Argasidae and Ixodidae ticks in Mexico

S. Viridiana Laredo-Tiscareño<sup>1</sup>, Javier A. Garza-Hernandez<sup>2</sup>, Chandra S. Tangudu<sup>1</sup>, Carlos A. Rodríguez-Alarcón<sup>3</sup>, Rodolfo Gonzalez-Peña<sup>4</sup>, Jaime R. Adame-Gallegos<sup>5</sup>, Diana M. Beristain-Ruiz<sup>3</sup>, Ignacio Netzahualcoyotl Barajas-López<sup>6</sup>, Alissa M. Hargett<sup>1</sup>, Ulrike G. Munderloh<sup>7</sup>, Bradley J. Blitvich<sup>1\*</sup> [\(accepted Ticks & tick-borne diseases\)](#)

# Colecta de las garrapatas

Figure 1B

## Chiapas

1. Acacoyagua



## Chihuahua

1. Buenaventura
2. Guadalupe
3. Juárez



## Guerrero

1. La Unión de Isidro Montes de Oca

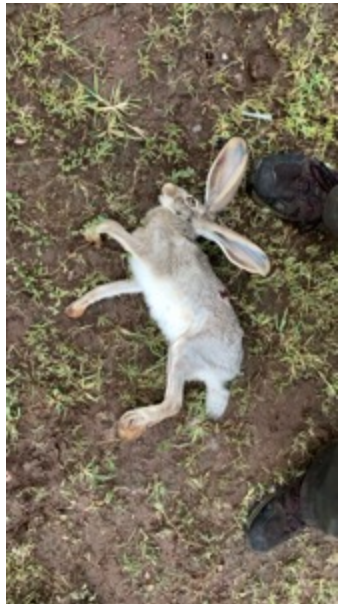
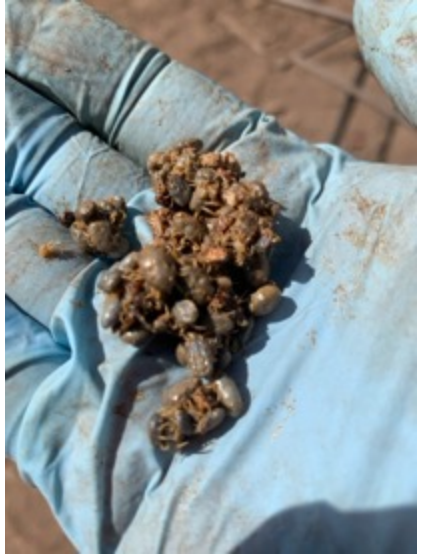


## Michoacán

1. Lázaro Cárdenas







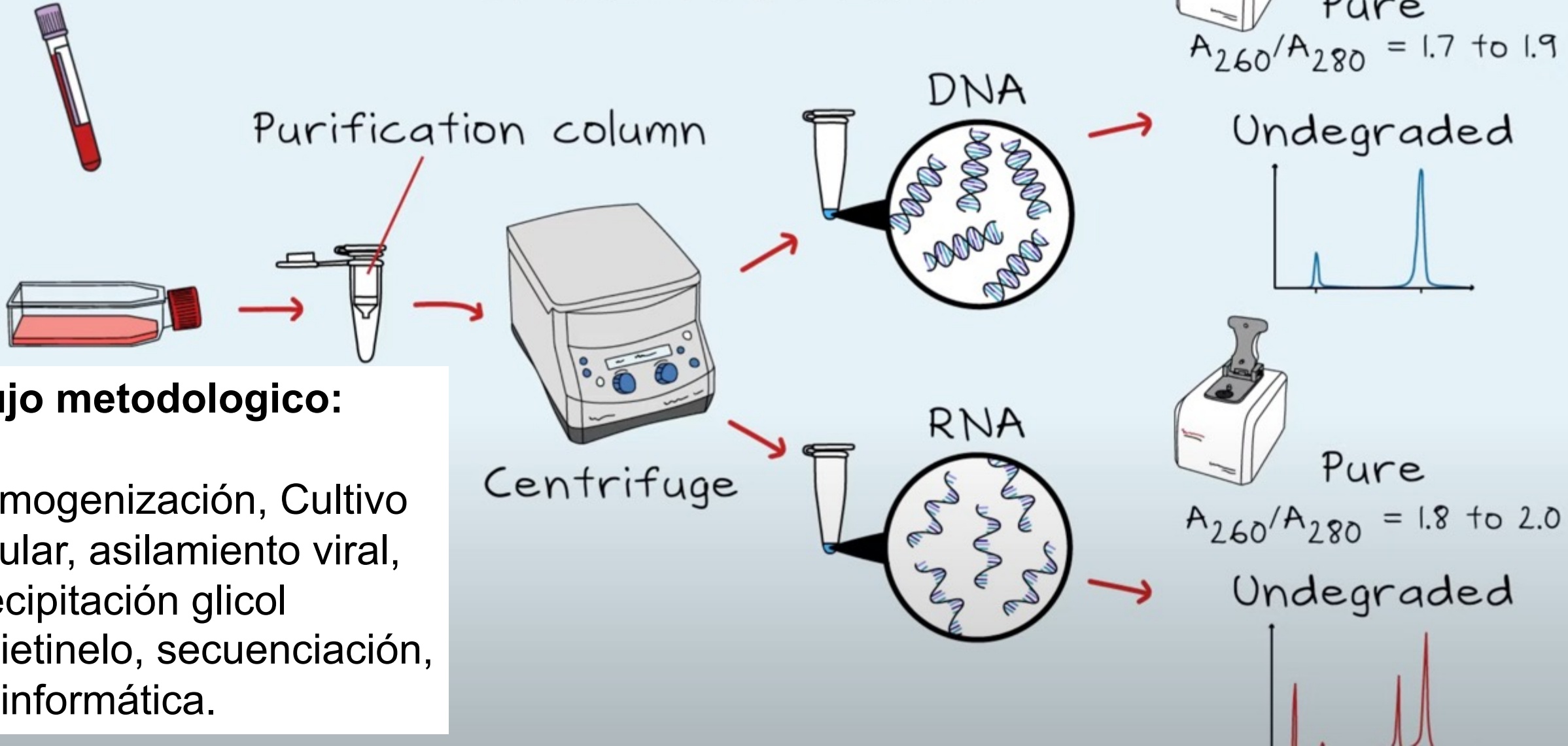






# Next Generation Sequencing (NGS)

## DNA/RNA Purification



### Flujo metodológico:

Homogenización, Cultivo celular, asilamiento viral, precipitación glicol polietileno, secuenciación, bioinformática.

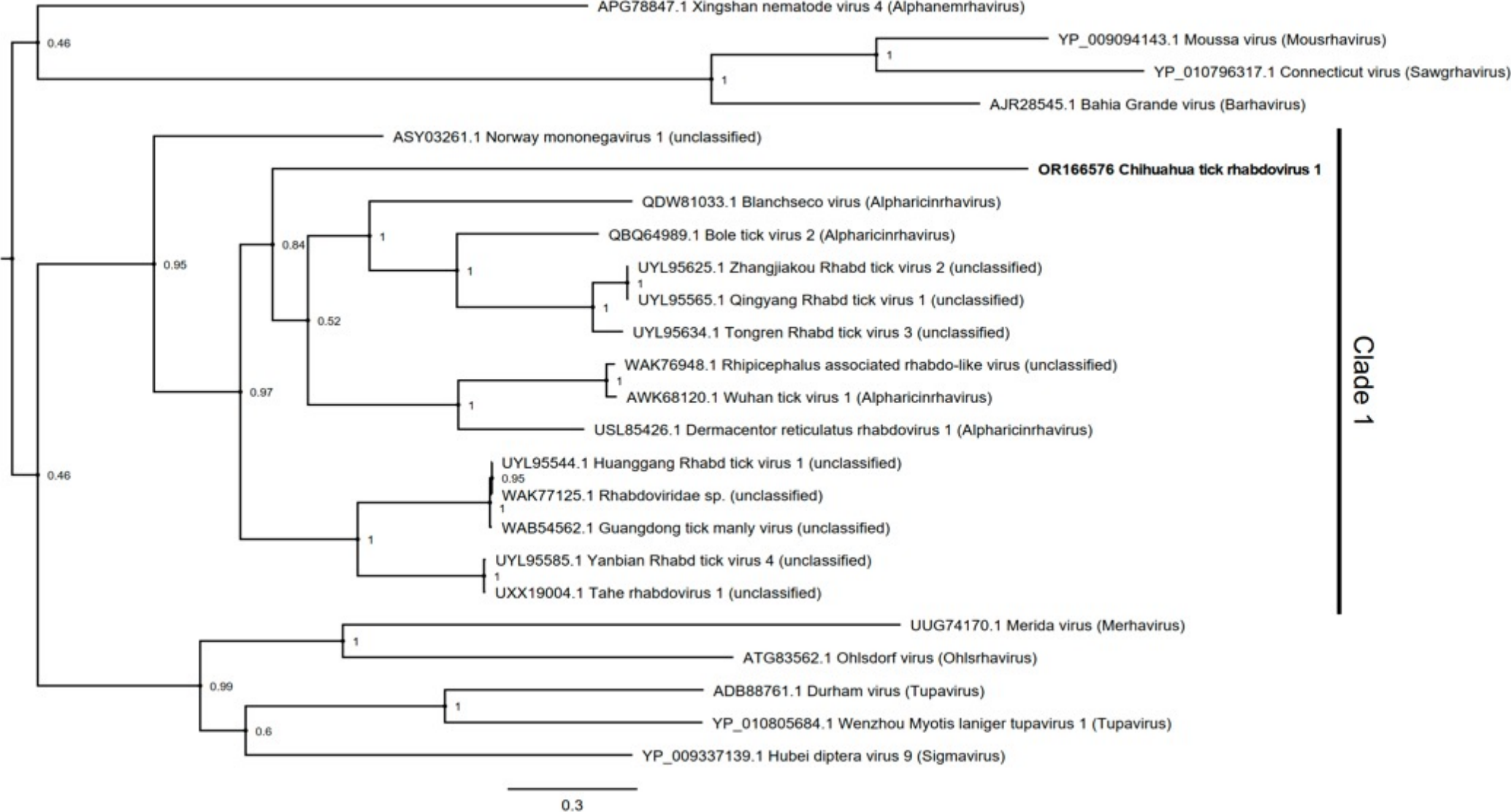


# Resultados

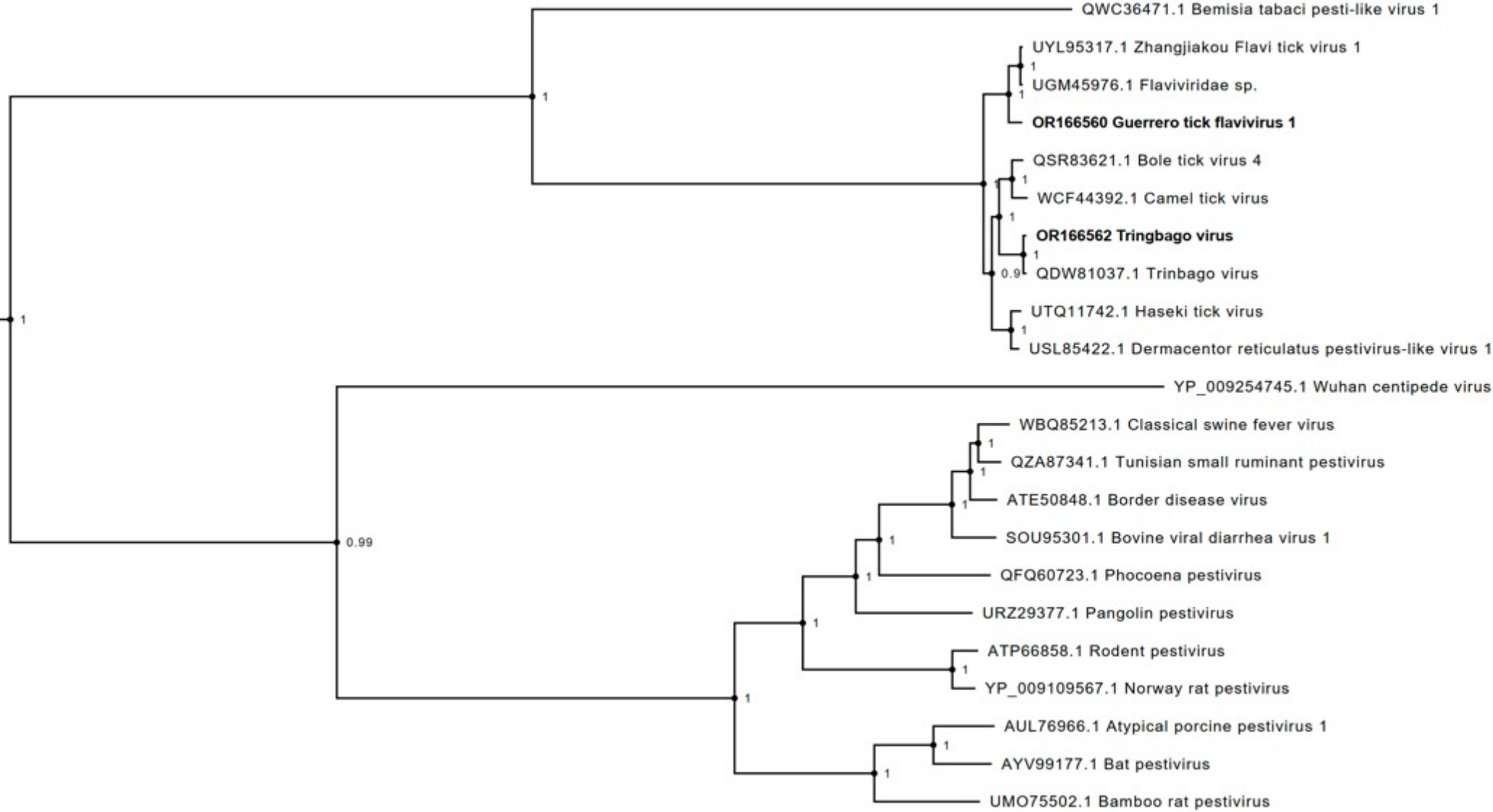
Colectamos para este estudio un total de 3131 garrapatas de animales domésticos en México entre 2019 y 2021. 5 especies de garrapatas duras y una especie de garrapata blanda.

Se detectaron siete virus nuevos y 12 virus reconocidos, en 7 familias: Totiviridae (virus que infectan protozoos y microhongos), Solemoviridae (virus que infectan plantas), Nyamiviridae (Tick-borne virus), Nodaviridae (virus que infectan animales), **Rhabdoviridae, Flaviviridae y Bunyavirales.**

# Filogenia de los nuevos Rhabdoviridae, Flaviviridae y Bunyavirales



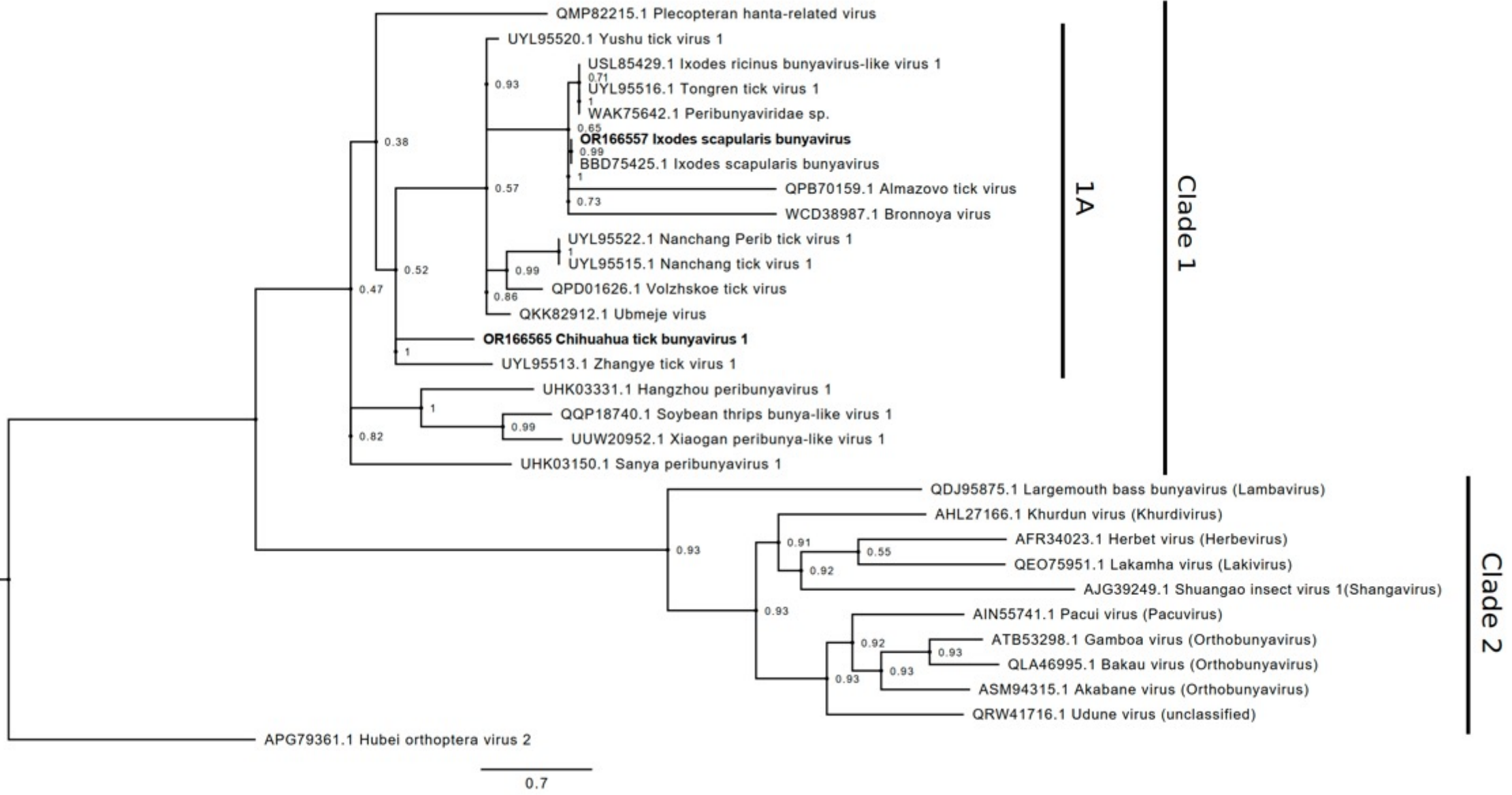
# Flaviviridae



0.7



# Bunyavirales



En resumen, gracias a este estudio identificamos una amplia variedad de virus, tanto conocidos como nuevos, en garrapatas argásidas e ixódidas que parasitan animales domésticos en México. Este hallazgo contribuye significativamente a nuestra comprensión del viroma presente en estos parásitos, respaldando investigaciones previas que ya habían señalado la diversidad taxonómica de los virus en garrapatas.