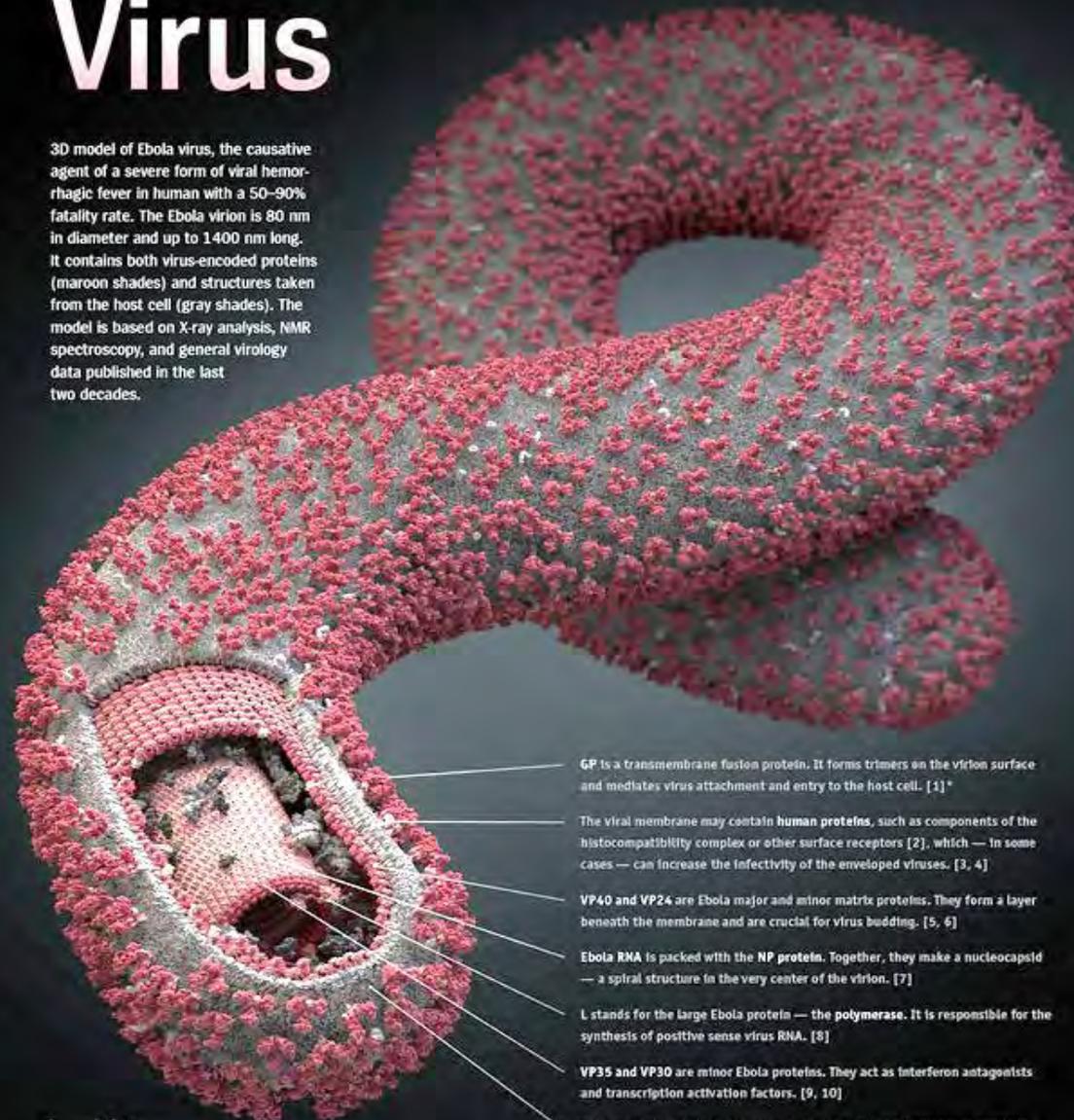


# The Ebola Virus

VIRAL PARK  
Project of Visual Science

3D model of Ebola virus, the causative agent of a severe form of viral hemorrhagic fever in human with a 50–90% fatality rate. The Ebola virion is 80 nm in diameter and up to 1400 nm long. It contains both virus-encoded proteins (maroon shades) and structures taken from the host cell (gray shades). The model is based on X-ray analysis, NMR spectroscopy, and general virology data published in the last two decades.



GP is a transmembrane fusion protein. It forms trimers on the virion surface and mediates virus attachment and entry to the host cell. [1]\*

The viral membrane may contain human proteins, such as components of the histocompatibility complex or other surface receptors [2], which — in some cases — can increase the infectivity of the enveloped viruses. [3, 4]

VP40 and VP24 are Ebola major and minor matrix proteins. They form a layer beneath the membrane and are crucial for virus budding. [5, 6]

Ebola RNA is packed with the NP protein. Together, they make a nucleocapsid — a spiral structure in the very center of the virion. [7]

L stands for the large Ebola protein — the polymerase. It is responsible for the synthesis of positive sense virus RNA. [8]

VP35 and VP30 are minor Ebola proteins. They act as interferon antagonists and transcription activation factors. [9, 10]

The budding viral particle is wrapped in the lipid membrane taken from the human cell. [11]

10 nm

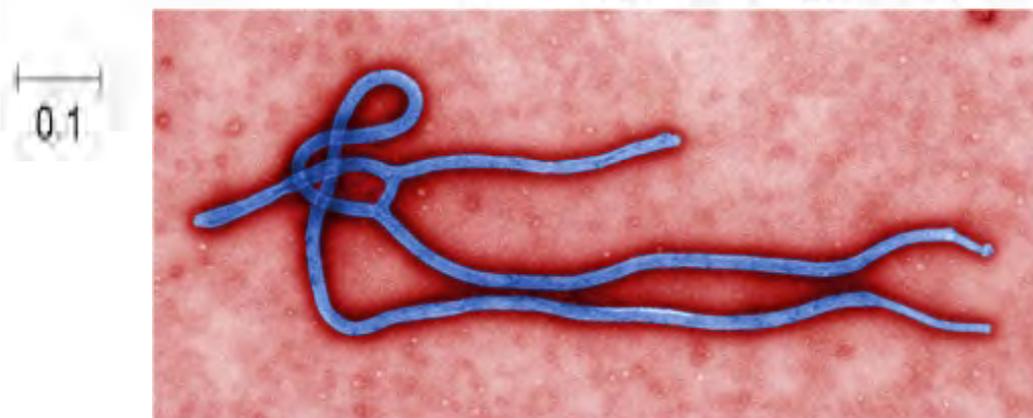
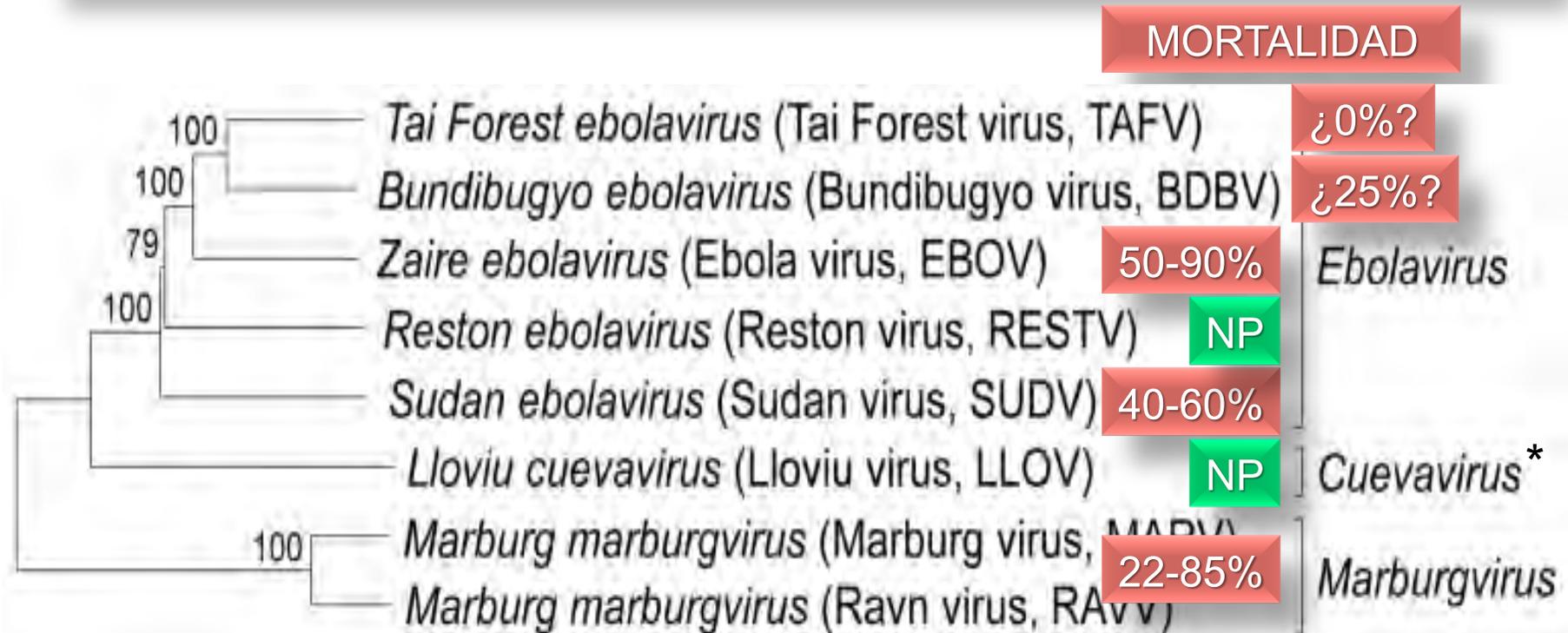
This model contains accurate models of 11 types of Ebola and human proteins, 18900 nucleotides of genomic RNA and more than 2.5 million lipid molecules.

\*For more information and references visit [www.visualsciencecompany.com/ebola](http://www.visualsciencecompany.com/ebola)

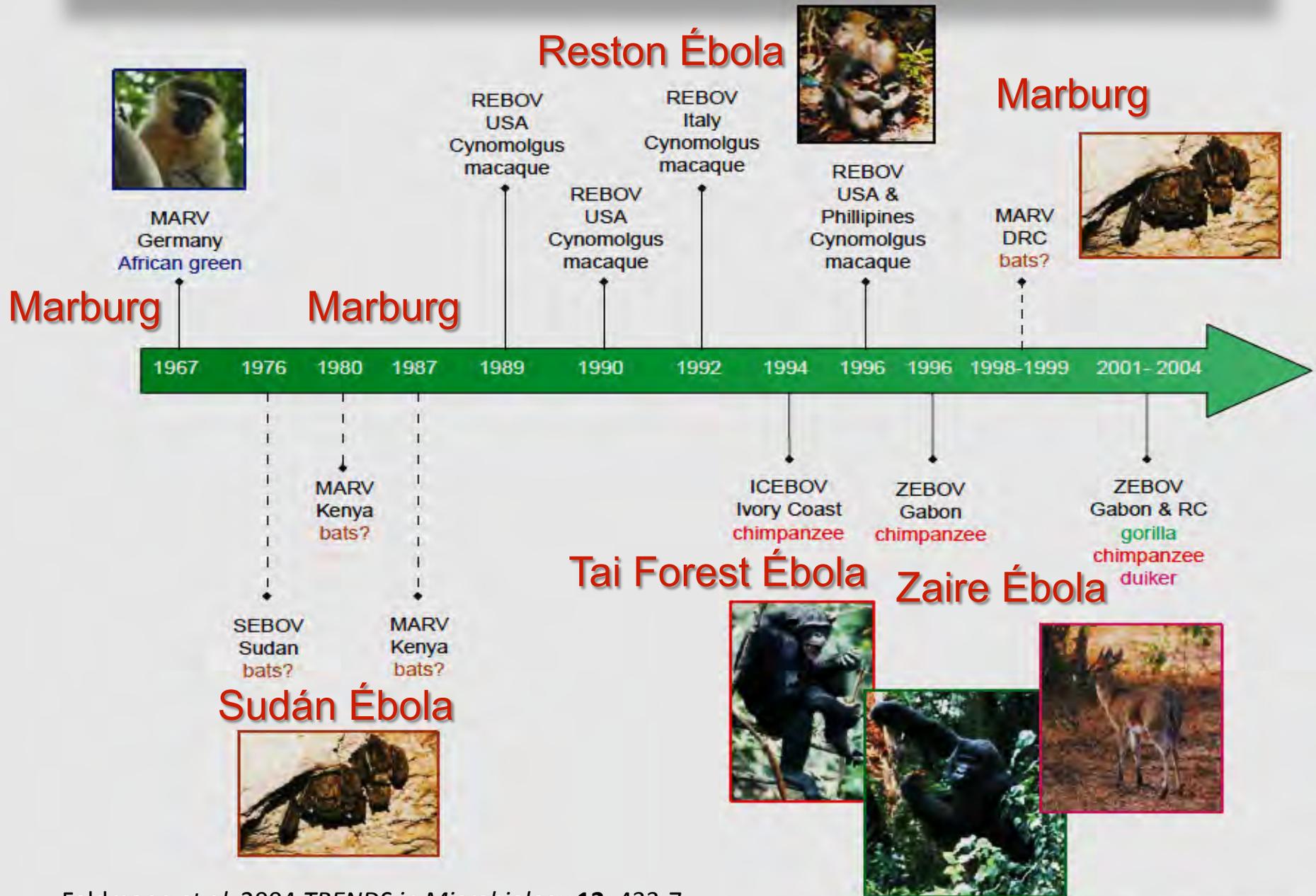


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# Clasificación de los Filovirus

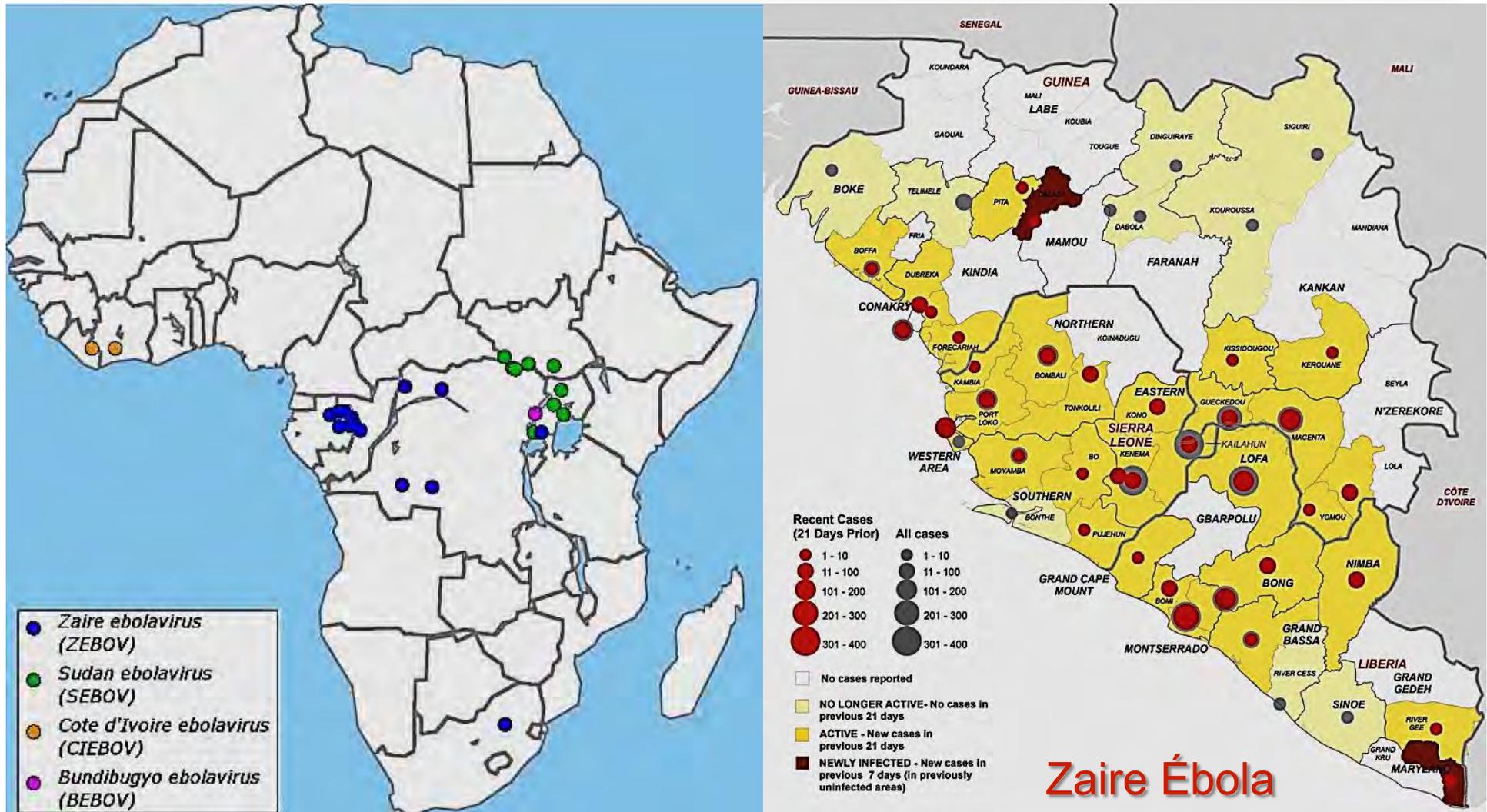


# Descubrimiento de los Filovirus

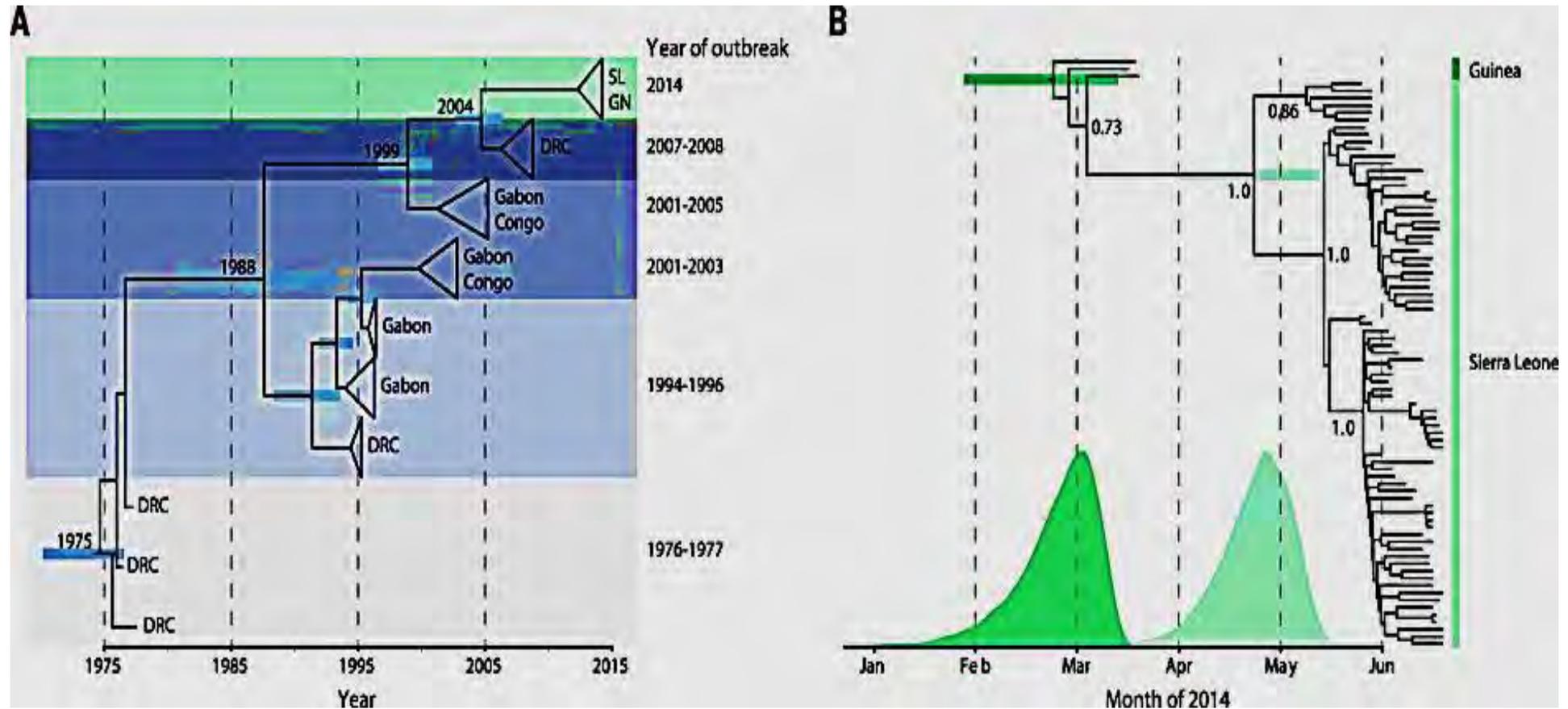


Feldmann et al. 2004 *TRENDS in Microbiology* **12**: 433-7.

# Virus Ébola en África



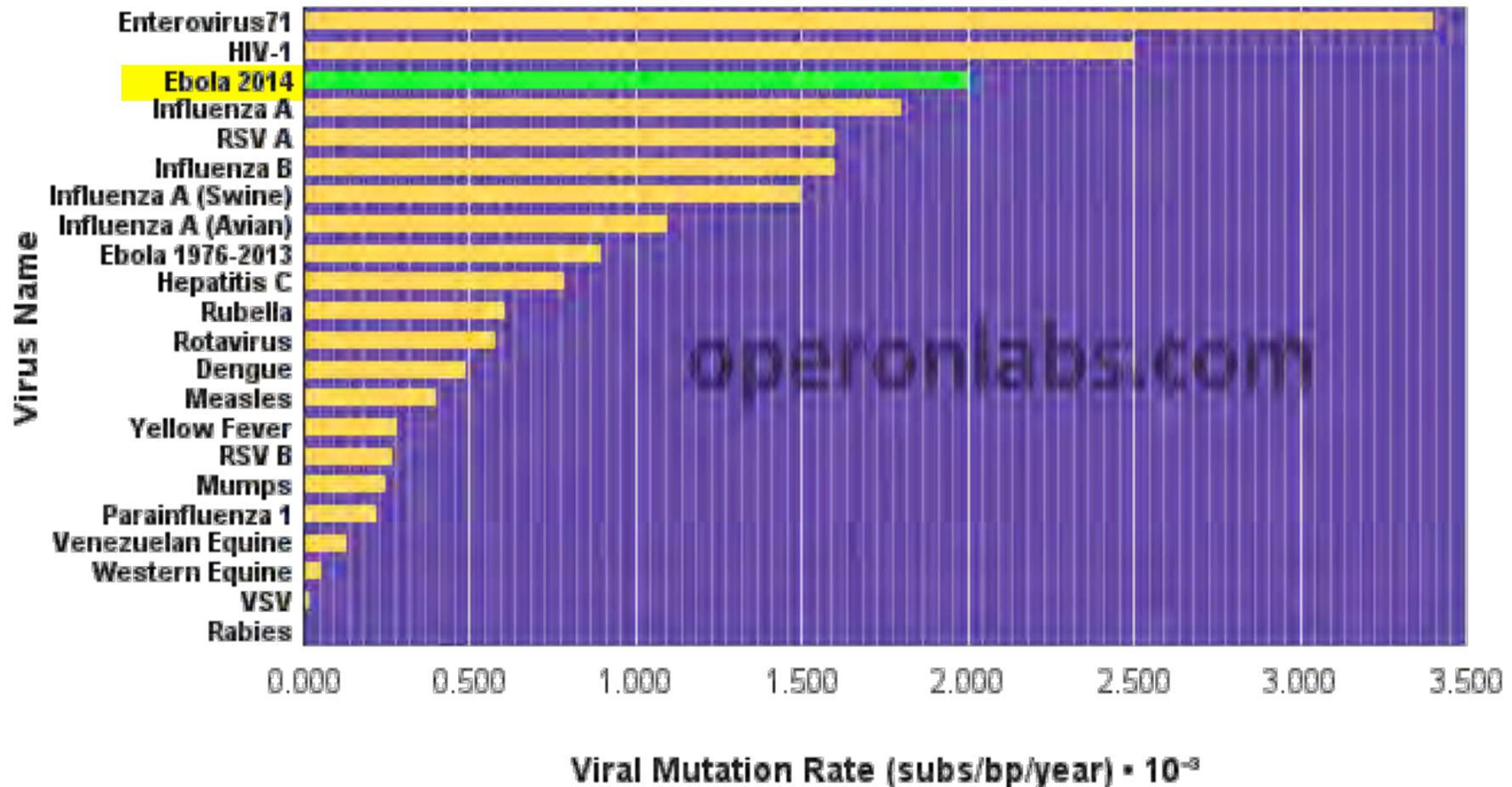
# Evolución del virus Ébola Zaire



Gire *et al.* 2014. *Science* **345**: 1369-72

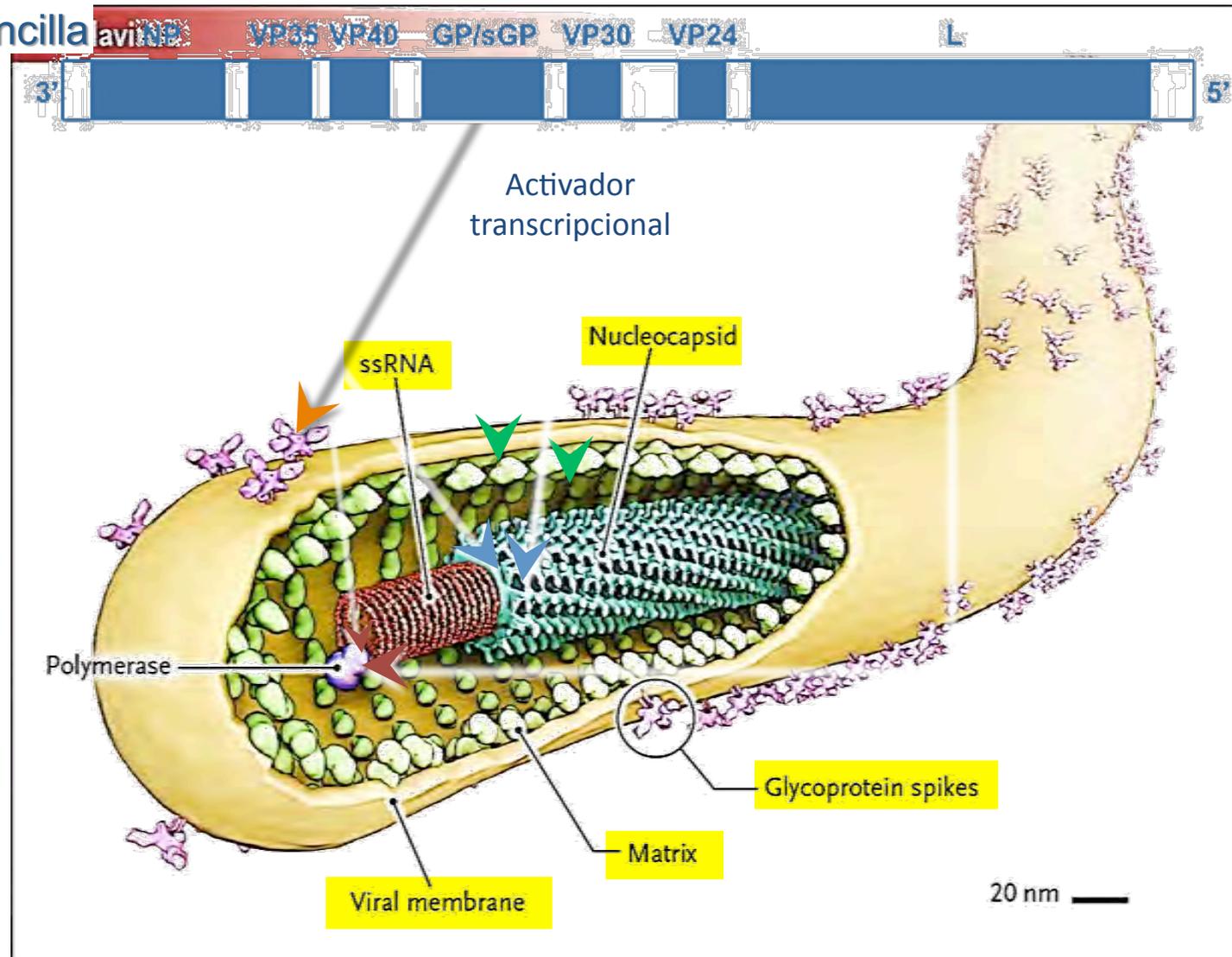
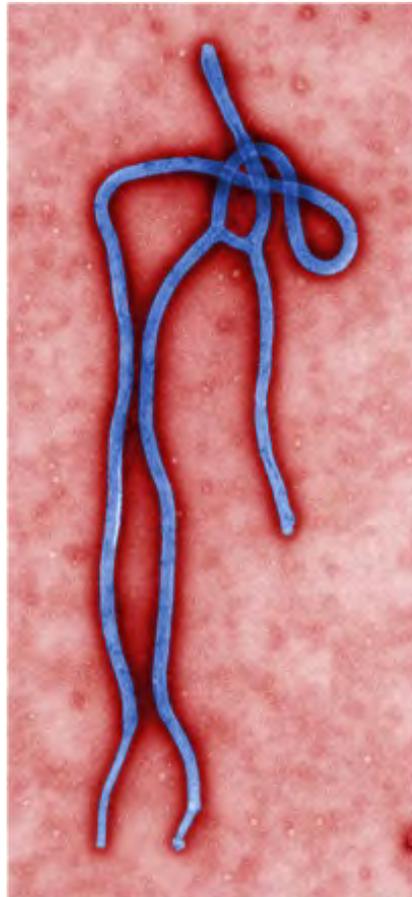
# Evolución del virus Ébola Zaire

RNA Virus Mutation Rates



# El virus Ébola: Filovirus

RNA cadena sencilla



PI: 8-10 días (rango: 2-21)

Inmunosupresión

Necrosis hepática,  
↓ factores de coagulación

Necrosis adrenocortical,  
↓ esteroides

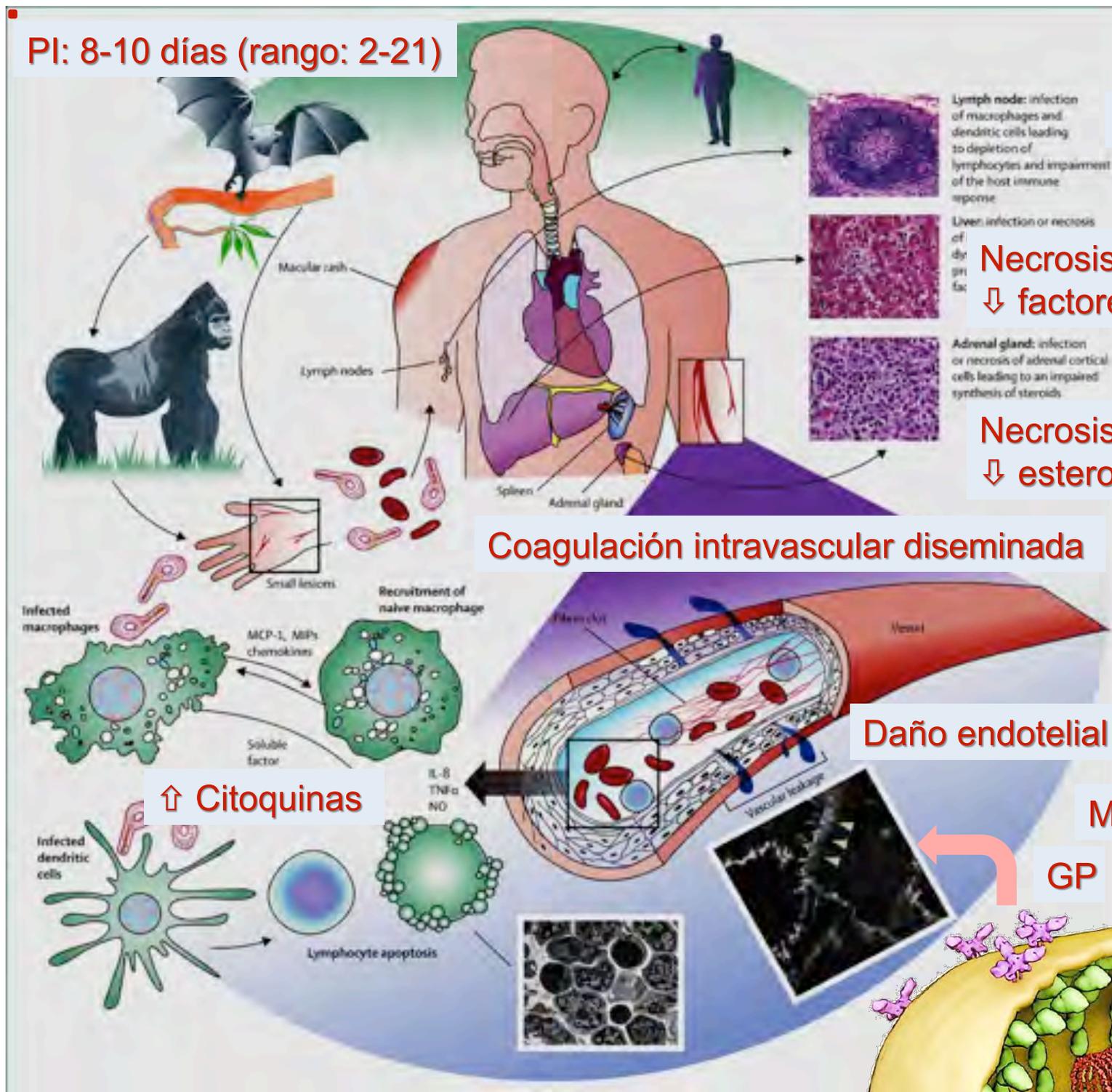
Coagulación intravascular diseminada

Daño endotelial

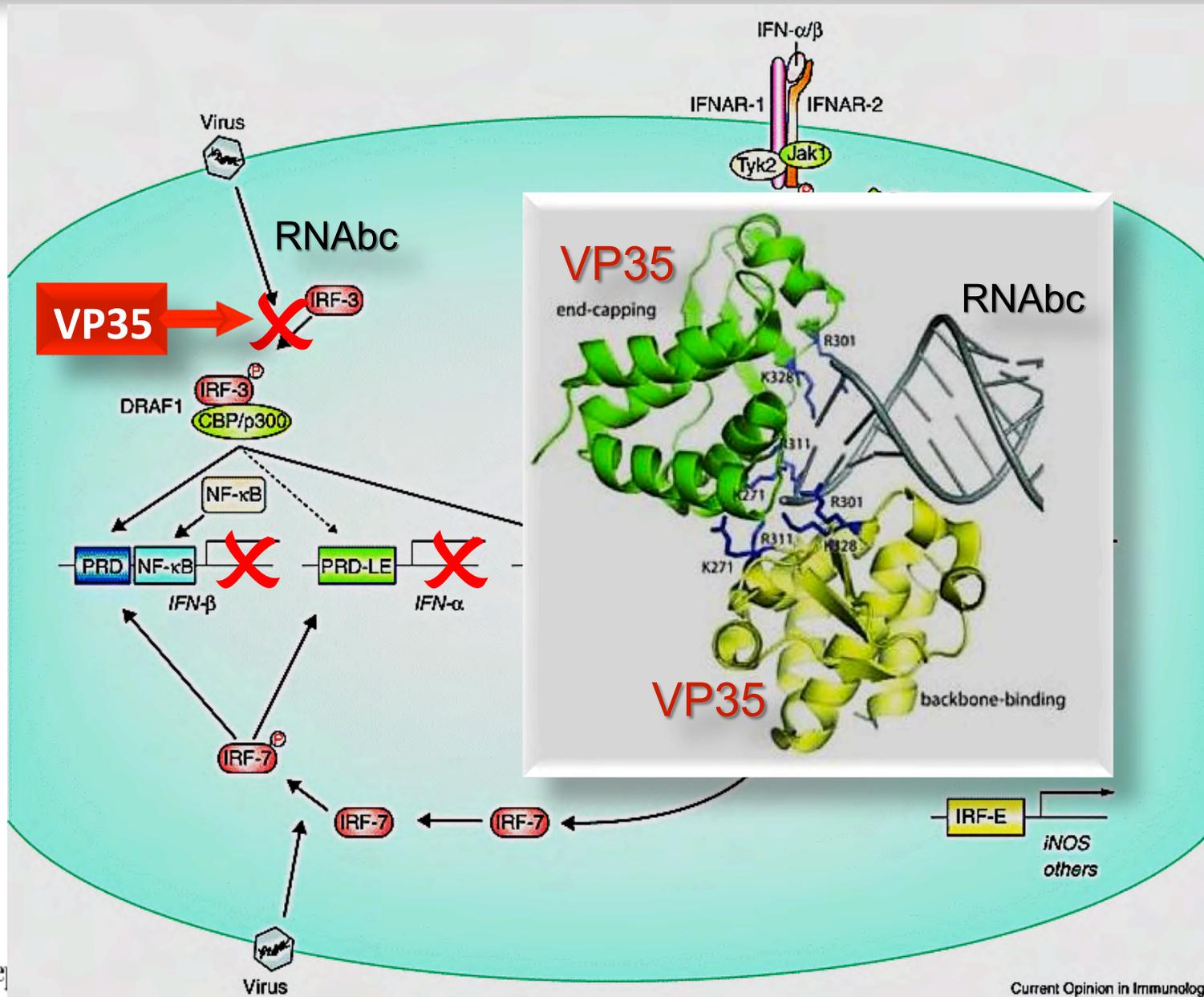
Muerte: días 6-14

GP

Feldmann &  
Geisbert, 2011.  
*Lancet* 377:  
849-62.



# El virus Ébola inhibe el sistema del interferón



Current Opinion in Immunology

# Diagnóstico de la fiebre por Ébola

- Epidemiología
- Síntomas inespecíficos
- Linfopenia, trombocitopenia
- ↑ Transaminasas
- **RT-PCR**
  - **Sangre, fluidos...**
  - **+ a los 3-10 días post-síntomas.**
- **IgM**

Descartar fiebre de Lassa, malaria, fiebre tifoidea, dengue, Chikungyunga...

## INTERIM GUIDANCE FOR Specimen Collection, Transport, Testing, and Submission for Patients with Suspected Infection with Ebola Virus Disease

### NOTIFICATION & CONSULTATION

their state and/or local health department procedures for notification for Ebola testing requests before contacting CDC.

specimens without prior consultation.

FOR CONSULTATION, CALL THE CDC  
EMERGENCY OPERATIONS CENTER AT

**770-488-7100**



### SHOULD BE COLLECTED FOR EBOLA TESTING

Ebola virus is detected in blood only after the onset of symptoms, usually fever. It may take up to 3 days after symptoms appear for the virus to reach detectable levels. Virus is generally detectable by real-time RT-PCR from 3-10 days after



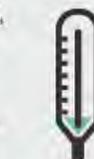
Inactivar con isotiocianato de guanidina

asymptomatic patient reports to a health care provider about Ebola exposure. However, if the patient may be needed to completely rule-out Ebola virus, if the first specimen tests negative.

### PREFERRED SPECIMENS FOR EBOLA TESTING

milliliters of whole blood preferred but whole blood containing ethylenediamine tetraacetate (EDTA) or polyanethol sulfonate (SPS), or heparin can be submitted for

Shipped at 2-8°C or frozen. Do not submit specimens in heparin tubes.



**2-8°C**

Specimens other than blood may be submitted upon consult with CDC.

Standard labeling should be applied for each specimen. The requested test needs to be identified only on the requisition and CDC specimen submission forms.



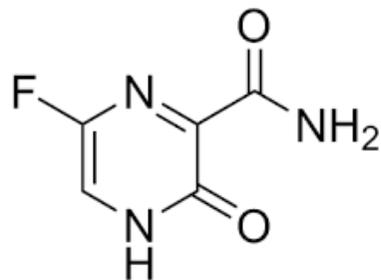
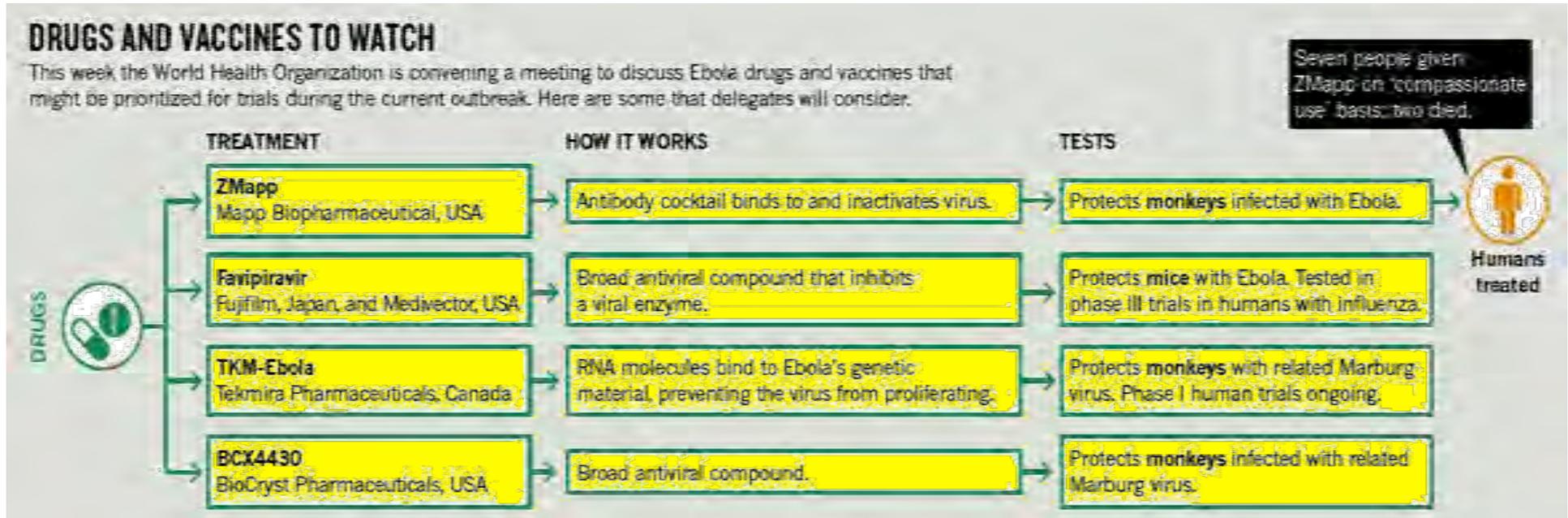
### TESTING FOR EBOLA PERFORMED AT CDC

Several diagnostic tests are available for detection of Ebola virus disease. Acute infections will be confirmed using a real-time RT-PCR assay (CDC test directory code CDC -10309 Ebola Identification) in a CLIA-accredited laboratory. Virus isolation may also be attempted. Serologic testing for IgM and IgG antibodies will be completed for certain specimens and to monitor the immune response in confirmed Ebola virus disease patients (#CDC-10310 Ebola Serology).

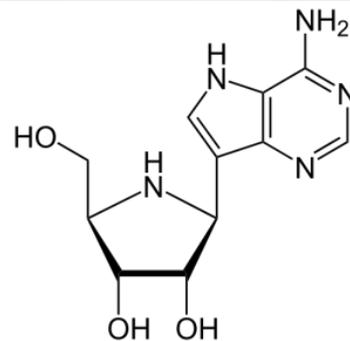
Lassa fever is also endemic in certain areas of West Africa and may show symptoms similar to early Ebola virus disease. Diagnostic tests available at CDC include but are not limited to RT-PCR, antigen detection, and IgM serology, all of which

# Tratamiento

## Rehidratación, rNAPc2, proteína C-activada (PCA)...



Favipiravir (T-507)



BCX4430

(análogo de adenosina)



# Prevención

VACCINES

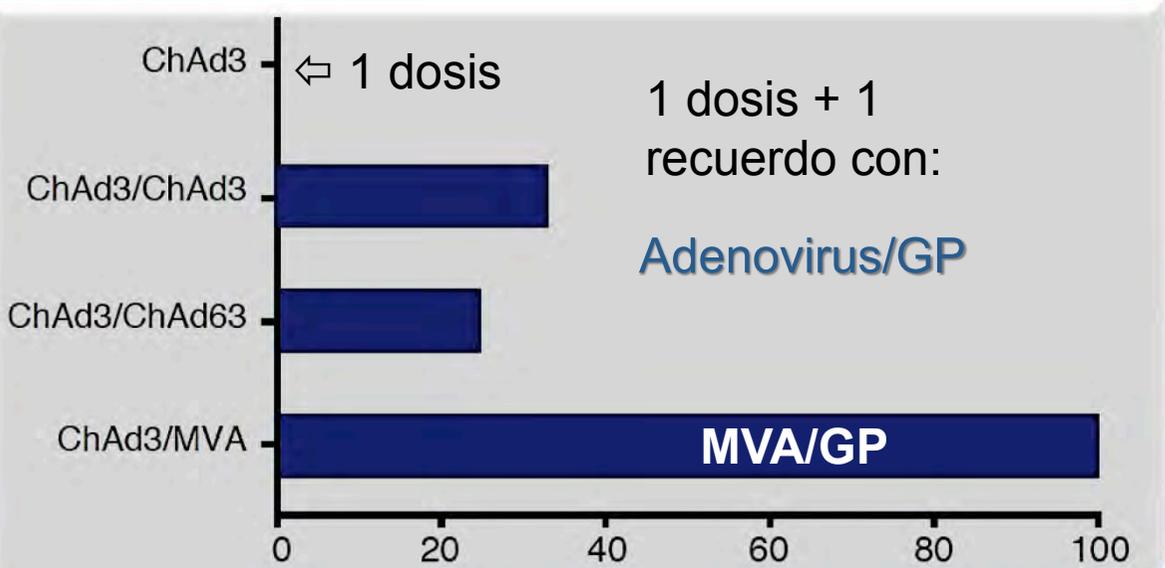


**NIAID/GSK Ebola vaccine**  
US National Institute of Allergy and Infectious Diseases and GlaxoSmithKline, UK

Chimpanzee virus delivers segments of genetic material from two Ebola virus species.

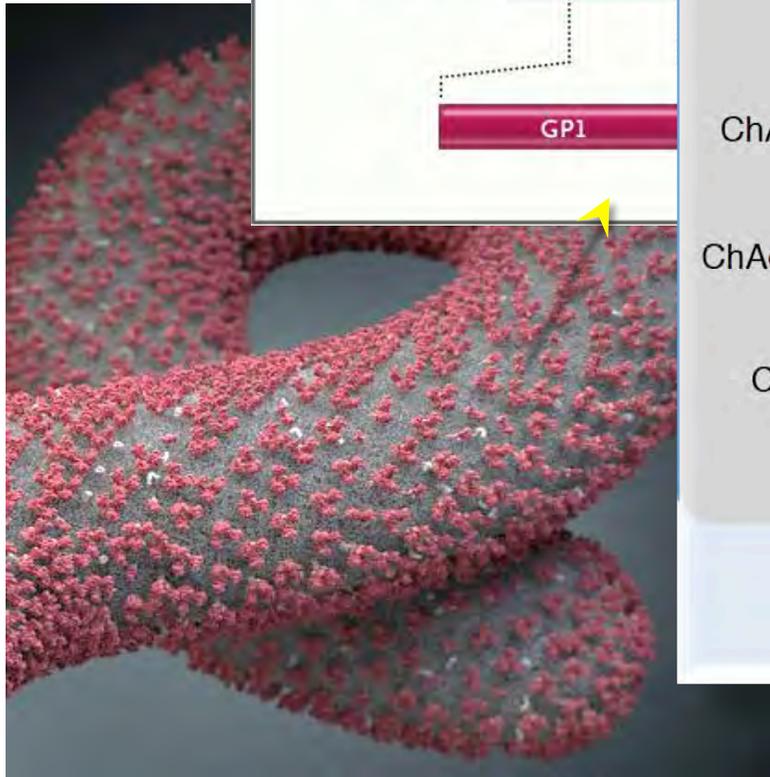
Phase I clinical trials imminent.

## B NIAID/GSK cAd3 Ebola vaccine

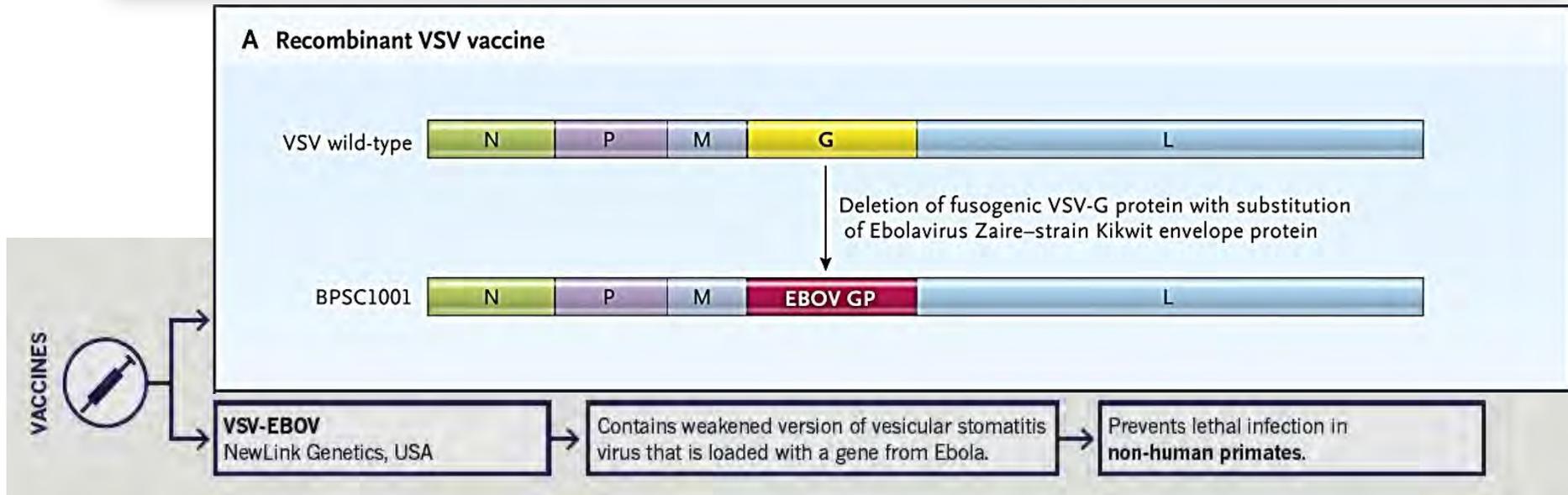


% supervivencia a los 10 meses de macacos (4/grupo), tras inoculación de 1000 UFP de Ébola Zaire

Stanley *et al.* 2014. *Nature Med.* **20**:1126-9



# Prevención



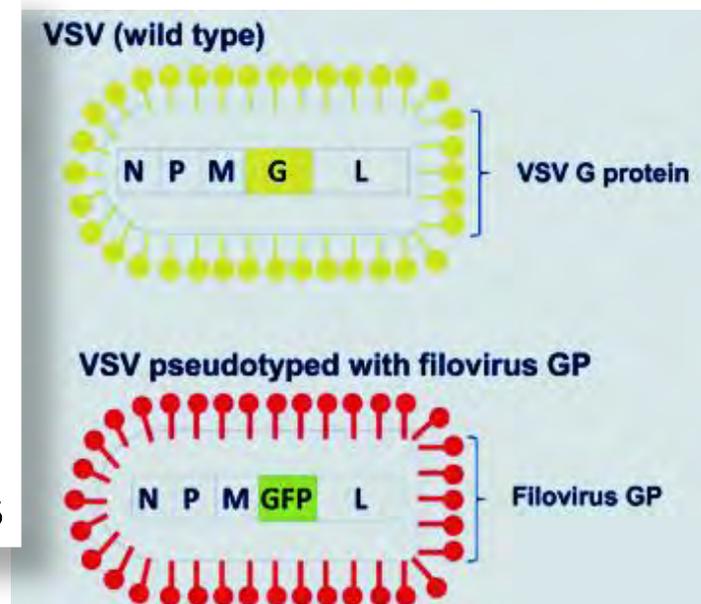
## 1 dosis:

- 100% protección al año (6 macacos inoculados con Marburg)
- Posible uso IM o intranasal

## 1 dosis post-exposición:

- 24h ~ 80%
- 48h ~ 30%

Mire *et al.* 2014. *PLoS ONE* 9(4): e94355



# Modelos animales



- **Ratón:**

- Cepa Zaire adaptada
- Zaire silvestre, sólo en ratones SCID
- No afecta coagulación



- **Cobaya:**

- Cepa Zaire adaptada
- Algunas alteraciones coagulación
- Mal modelo para estudios inmunitarios



- **Hamster sirio**

- Buen modelo de patogénesis
- Cepa adaptada a ratones
- Mal modelo para estudios inmunitarios



- **Primates (Macacos, Monos verdes, Babones)**

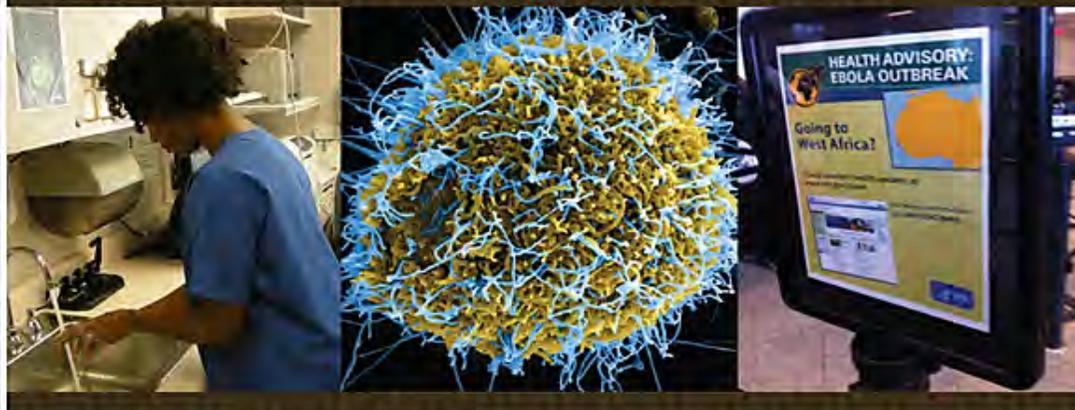
- Buen modelo de patogénesis
- 100% letalidad con cepas humanas
- Dosis letal:  $\geq 10$  ufp/IM-SC; 400 ufp/aerosol

## Enfermedad del Ébola (Enfermedad del virus del Ébola)

Recomendar Tweetear Compartir

Idioma: Español

### Qué debe saber sobre el Ébola



#### SIGNOS Y SÍNTOMAS

Los síntomas pueden aparecer entre 2 y 21 días de la exposición al virus del Ébola...

#### TRANSMISIÓN

Se propaga a través de los líquidos corporales de una persona con la enfermedad del Ébola o que ha muerto a causa de ella...

#### RIESGO DE EXPOSICIÓN

Durante los brotes de la enfermedad del Ébola, quienes corren mayor riesgo son los trabajadores del sector de la salud y los familiares...

#### PARA TRABAJADORES DEL SECTOR DE LA SALUD

Guía actualizada para controlar o prepararse para la enfermedad del Ébola en los EE. UU. y el exterior...

#### PREVENCIÓN

El personal de atención médica debe estar listo para tomar las precauciones de aislamiento...

#### DIAGNÓSTICO

Diagnosticar la enfermedad del Ébola en una persona que la ha contraído hace pocos días es difícil...

#### TRATAMIENTO

El tratamiento de la enfermedad del Ébola presenta

#### Brote en África Occidental en 2014

La epidemia 2014 de la enfermedad del Ébola es la más grande que se haya registrado y afecta a [varios países](#) de África Occidental. Dos casos importados, incluida una muerte, y dos casos de contagio a nivel local en trabajadores del sector de la salud se han [reportado en los Estados Unidos](#). Los CDC y organizaciones asociadas están tomando medidas para evitar la propagación de la enfermedad del Ébola dentro de los Estados Unidos.

[Última información de los CDC sobre el brote](#)

Actualizado el 29 de octubre de 2014

Lo nuevo

29 de octubre de 2014: [Cantidad de casos actualizada](#)

28 de octubre de 2014: [Infographic: Is it Flu or Ebola?](#)

(PDF - 1 page)

27 de octubre de 2014: [Hoja informativa: Vigilancia de síntomas y control del movimiento para detener la propagación de la enfermedad del Ébola](#)

Actualizado el 27 de octubre de 2014: [Guía provisional para los EE. UU. sobre la vigilancia y el traslado de personas potencialmente expuestas al virus del Ébola](#)

Actualizado el 27 de octubre de 2014: [Definición de casos de la enfermedad del virus del Ébola \(EVE\)](#)

27 de octubre de 2014: [Factores de riesgo epidemiológico a considerar al evaluar a una persona con exposición al virus del Ébola](#)

25 de octubre de 2014: [Identificar, aislar, informar: evaluación y control del departamento de emergencias para pacientes que se presentan con posibilidades de enfermedad del virus del Ébola](#)

Lo nuevo (continuación) >



BROTOS



#StopEbola

“Hemos ayudado a sobrevivir a más de 1000 personas en esta epidemia de Ébola, la peor de la historia.

Y no vamos a descansar, porque las necesidades son enormes”

José Antonio Bastos  
Presidente de Médicos Sin Fronteras



Cuando saltaron las primeras alarmas por el brote de Ébola el pasado marzo, nuestros equipos acudieron de inmediato a los países afectados en África occidental.

En Médicos Sin Fronteras, contamos con una larga experiencia en la lucha contra el Ébola y otras fiebres hemorrágicas, ya que hemos intervenido en prácticamente todos los brotes de los últimos 20 años.

Actualmente, más de 3.000 profesionales de MSF trabajan en primera línea para contener esta epidemia sin precedentes. Desde el principio del brote, hemos ingresado a cerca de 5.000 pacientes, de los cuales 3.200 han dado positivo en las pruebas de Ébola: más de 1.000 se han curado tras recibir tratamiento en nuestros centros.

Pero no es suficiente. Millones de personas están amenazadas por el Ébola y la crisis médica y humanitaria que ha generado en África occidental. **Las necesidades son enormes y nuestros equipos están al límite de sus capacidades.** Pero no vamos a descansar. Vamos a seguir luchando, y por eso hoy te pedimos que te movilices para ayudarnos a detener la epidemia. Te pedimos que apoyes nuestra campaña #StopEbola.

Si puedes, haz un donativo.



Con 30 €

conseguiremos 30 litros de suero para la rehidratación intravenosa.



Con 89€

adquiriremos un traje completo de protección biológica.



Con 160€

tendremos un kit con todo lo necesario para tratar a un enfermo de Ébola durante cinco días.

Haz un donativo



Departamento de  
Microbiología II  
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<http://www.medscape.com/viewarticle/833907>

**Doffing PPE, PAPR Option** – PPE doffing should be performed in the designated PPE removal area.

**Engage Trained Observer:** The doffing process is conducted under the supervision of a trained observer, who reads aloud each step of the procedure and confirms visually that the PPE is removed properly. Prior to doffing PPE, the trained observer must remind the healthcare worker to avoid reflexive actions that may put them at risk, such as touching their face. Post this instruction and repeat it verbally during doffing. Although the trained observer should minimize touching the healthcare worker or the healthcare worker's PPE during the doffing process, the trained observer may assist with removal of specific components of PPE, as outlined below. The trained observer disinfects the outer-gloved hands immediately after handling any healthcare worker PPE.

**Inspect:** Inspect the PPE to assess for visible contamination, cuts, or tears before starting to remove. If any PPE is potentially contaminated, then disinfect using an EPA-registered disinfectant wipe.

**Disinfect Outer Gloves:** Disinfect outer-gloved hands with either an \*EPA-registered disinfectant wipe or ABHR, and allow to dry.

**Remove Apron (if used):** Remove and discard apron taking care to avoid contaminating gloves by rolling the apron from inside to outside.

**Inspect:** Following apron removal, inspect the PPE ensemble to assess for visible contamination or cuts or tears. If visibly contaminated, then disinfect affected PPE using an \*EPA-registered disinfectant wipe.

**Disinfect Outer Gloves:** Disinfect outer-gloved hands with either an \*EPA-registered disinfectant wipe or ABHR.

**Remove Boot or Shoe Covers:** While sitting down, remove and discard boot or shoe covers.

**Disinfect and Remove Outer Gloves:** Disinfect outer-gloved hands with either an \*EPA-registered disinfectant wipe or ABHR. Remove and discard outer gloves, taking care not to contaminate inner glove during removal process.

**Inspect and Disinfect Inner Gloves:** Inspect the inner gloves' outer surfaces for visible contamination, cuts, or tears. If an inner glove is visibly soiled, cut, or torn, then disinfect the glove with either an \*EPA-registered disinfectant wipe or ABHR. Then remove the inner gloves, perform hand hygiene with ABHR on bare hands, and don a clean pair of gloves. If no visible contamination, cuts, or tears are identified on the inner gloves, then disinfect the inner-gloved hands with either an \*EPA-registered disinfectant wipe or ABHR.

**Remove Respirator (PAPR)\*\*\*:**

If a PAPR with an external belt-mounted blower unit is used, then all components must be removed at this step.

Remove and discard disposable hood.

Disinfect inner gloves with either an \*EPA-registered disinfectant wipe or ABHR.

Remove headpiece, blower, tubing, and the belt and battery unit. This step might require assistance from the trained observer.

# Ebola Virus Disease (Ebola)

Algorithm for Evaluation of the Returned Traveler



**FEVER** (subjective or  $\geq 100.4^{\circ}\text{F}$  or  $38.0^{\circ}\text{C}$ ) or compatible Ebola symptoms\* in a patient who has resided in or traveled to a country with wide-spread Ebola transmission\*\* in the 21 days before illness onset

\* headache, weakness, muscle pain, vomiting, diarrhea, abdominal pain, or hemorrhage

NO

**Report** asymptomatic patients with high- or low-risk exposures (see below) in the past 21 days to the health department

YES

1. Isolate patient in single room with a private bathroom and with the door to hallway closed
2. Implement standard, contact, and droplet precautions
3. Notify the hospital Infection Control Program and other appropriate staff
4. Evaluate for any risk exposures for Ebola
5. IMMEDIATELY report to the health department

## HIGH-RISK EXPOSURE

Percutaneous (e.g., needle stick) or mucous membrane contact with blood or body fluids from an Ebola patient

OR

Direct skin contact with, or exposure to blood or body fluids of, an Ebola patient

OR

Processing blood or body fluids from an Ebola patient without appropriate personal protective equipment (PPE) or biosafety precautions

OR

Direct contact with a dead body (including during funeral rites) in a country with wide-spread Ebola transmission\*\* without appropriate PPE

## LOW-RISK EXPOSURE

Household members of an Ebola patient and others who had brief direct contact (e.g., shaking hands) with an Ebola patient without appropriate PPE

OR

Healthcare personnel in facilities with confirmed or probable Ebola patients who have been in the care area for a prolonged period of time while not wearing recommended PPE

## NO KNOWN EXPOSURE

Residence in or travel to a country with wide-spread Ebola transmission\*\* without HIGH- or LOW-risk exposure

## Review Case with Health Department Including:

- Severity of illness
- Laboratory findings (e.g., platelet counts)
- Alternative diagnoses

Ebola suspected

Ebola not suspected

## TESTING IS INDICATED

The health department will arrange specimen transport and testing at a Public Health Laboratory and CDC

The health department, in consultation with CDC, will provide guidance to the hospital on all aspects of patient care and management



U.S. Department of Health and Human Services  
Centers for Disease Control and Prevention

\*\* CDC Website to check current countries with wide-spread transmission:  
<http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/case-counts.html>

This algorithm is a tool to assist healthcare providers identify and triage patients who may have Ebola. The clinical criteria used in this algorithm (a single symptom consistent with Ebola) differ from the CDC case definition of a Person Under Investigation (PUI) for Ebola, which is more specific. Public health consultation alone does not imply that Ebola testing is necessary. More information on the PUI case definition: <http://www.cdc.gov/vhf/ebola/hcp/case-definition.html>

## TESTING IS NOT INDICATED

If patient requires in-hospital management:

- Decisions regarding infection control precautions should be based on the patient's clinical situation and in consultation with hospital infection control and the health department
- If patient's symptoms progress or change, re-assess need for testing with the health department

If patient does not require in-hospital management:

- Alert the health department before discharge to arrange appropriate discharge instructions and to determine if the patient should self-monitor for illness
- Self-monitoring includes taking their temperature twice a day for 21 days after their last exposure to an Ebola patient

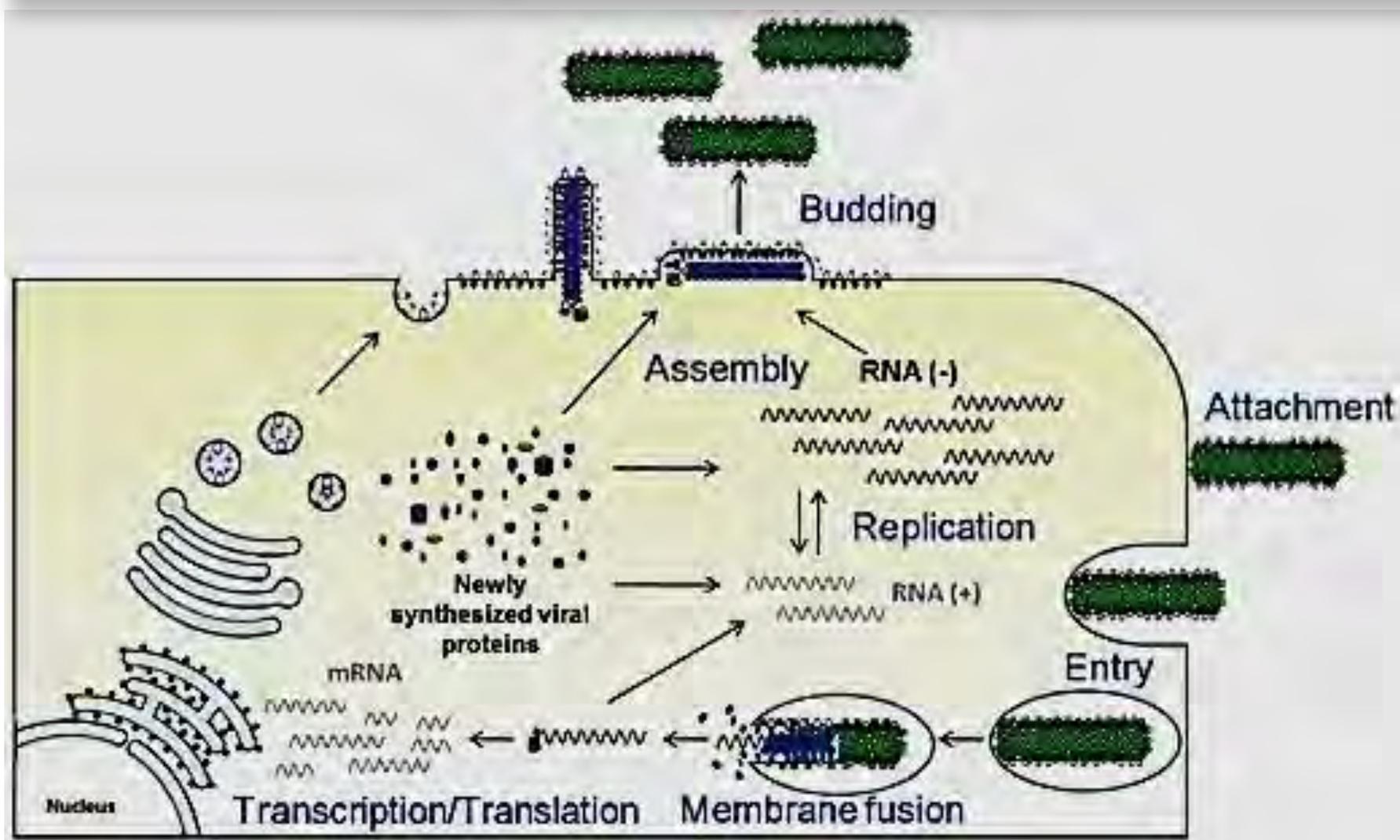
**Table 2 Case definition of Ebola Virus Disease (EVD) [23,34]**

Name	Definition
<b>Index case</b>	Very first case (probable or confirmed, see below) found to be the origin of the outbreak
<b>Alert case</b>	Any person with sudden onset of high fever or sudden death or bleeding or bloody diarrhea or blood in urine
<b>Suspect case</b> (person under investigation)	Any person, dead or alive, who present (or presented before the death):  (i) fever (>38.5°C or 101.5 °F) with additional symptoms (severe headache, muscle pain, vomiting, diarrhea, abdominal pain, or unexplained hemorrhage) and (ii) epidemiologic risk factors within the past 21 days before the onset of symptoms (close contact with body fluids of a suspect or probable case of EVD, or direct handling of bush animals from disease-endemic areas)
<b>Probable case</b>	Person with symptoms compatible with EVD, as evaluated by a clinician, or a dead person with an epidemiological link with a confirmed case
<b>Contacts</b>	Person without suggestive symptom of the disease, but who has been in contact with a suspect or probable case of EVD (living in the same house, provided care during the illness, participated in the burial rites etc.). It should be important to assess the risk level (see Table 3).  If laboratory samples are obtained at an appropriate time during the illness, the previous notification categories should be reclassified as "laboratory-confirmed" cases and "not a case"
<b>Confirmed case</b>	Case with positive laboratory response for either Ebola virus antigen or Ebola IgG antibody
<b>"Not a case"</b>	Person with no Ebola-specific detectable antibody or antigen

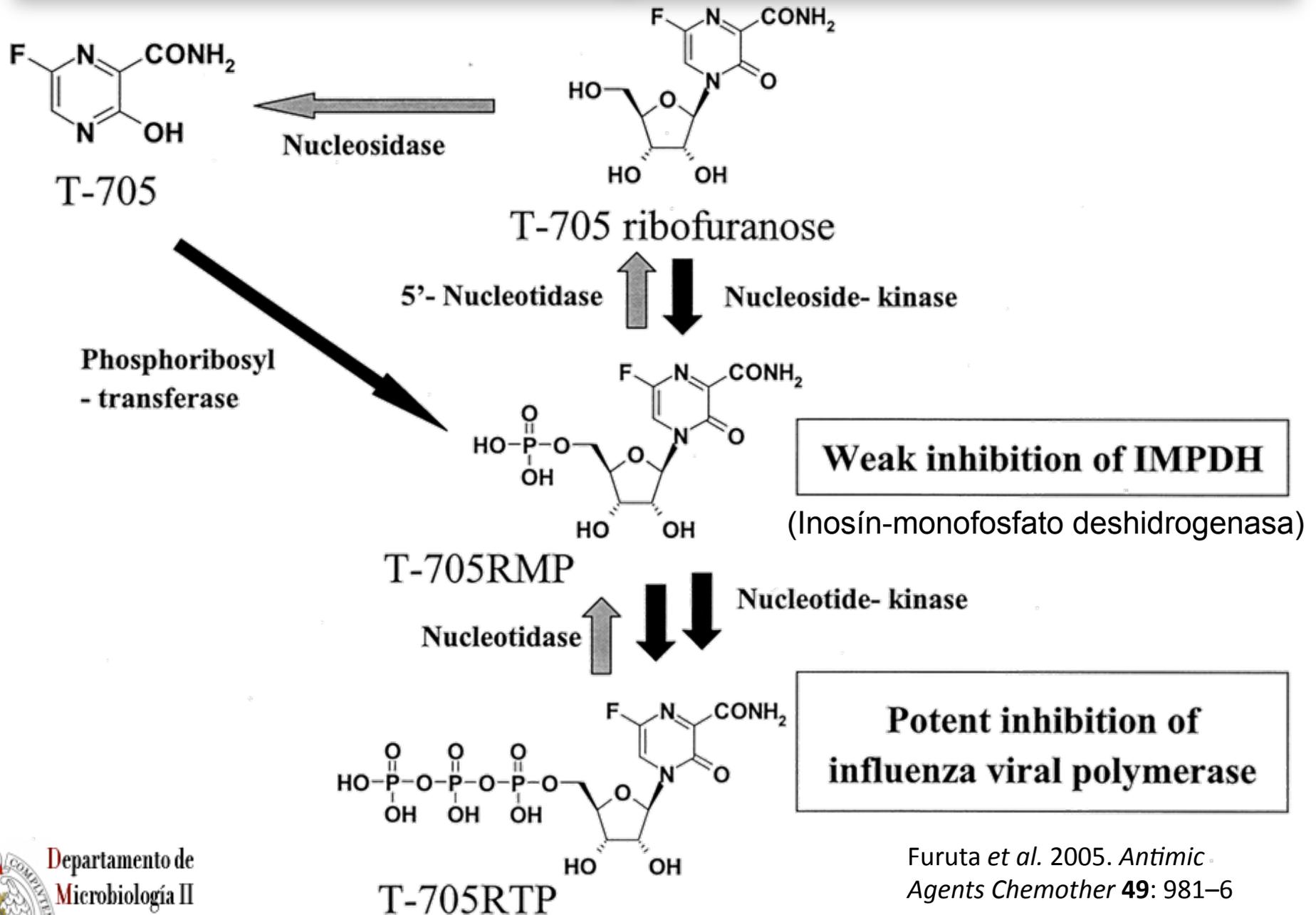
**Table 3 Definition and assessment of risk exposure [23,34-36]**

Risk level	Definition
<b>High-risk exposure</b>	<ul style="list-style-type: none"><li>• Percutaneous injury, e.g. needlestick, or mucous membrane exposure to body fluids of an EVD patient</li><li>• Direct care or exposure to body fluids of an EVD patient without appropriate personal protective equipment (PPE)</li><li>• Laboratory worker processing body fluids of confirmed EVD patients without appropriate PPE or standard biosafety precautions</li><li>• Participation in funeral rites that include direct contact with human remains in the geographic area where an outbreak is occurring without appropriate PPE</li></ul>
<b>Low-risk exposure</b>	<ul style="list-style-type: none"><li>• Household member or other casual contact<sup>1</sup> with an EVD patient</li><li>• Providing patient care or casual contact<sup>1</sup> without high-risk exposure with EVD patients in health care facilities in EVD outbreak affected countries</li></ul>
<b>No known exposure</b>	<p>Persons with no known exposure were present in an EVD outbreak affected country in the past 21 days with no low-risk or high-risk exposures</p> <p><sup>1</sup>Casual contact is defined as (i) being within approximately 3 feet (1 meter) or within the room or care area for a prolonged period of time (e.g. healthcare personnel, household members) while not wearing recommended personal protective equipment; or (ii) having direct brief contact (e.g., shaking hands) with an EVD case while not wearing recommended personal protective equipment</p>

# Ciclo de replicación del virus Ébola



# Favipiravir



Furuta *et al.* 2005. *Antimicrob Agents Chemother* **49**: 981-6