Chikungunya vaccine 2014 – A current view


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Abstract
A virus is a small parasite that cannot reproduce by itself. Once it infects a susceptible cell, however, a virus can direct the cell machinery to produce more viruses. The most common type of viral disease is the common cold, which is caused by a viral infection of the upper respiratory tract (nose and throat). Chikungunya disease is mostly confined to people living in tropical Africa and Asia and is characterized by a sudden and severe fever, skin rash and joint and muscle pain. Infection with the virus, spread by two mosquito species, typically is not fatal but can cause debilitating symptoms including fever, headache and severe joint pain lasting weeks or months. There is no current treatment and no licensed vaccine to prevent it. Scientists at the National Institute of Allergy and Infectious Diseases, Texas branch of Purdue University have developed a working vaccine for Chikungunya. Several vaccine candidates have reached the stage of human clinical trials. The progress achieved so far suggests that the development of a safe and effective CHIK vaccine is within reach.

Key words: Chikungunya, Chickenpox, Picornaviruses, Haematophagous.

INTRODUCTION

Virus
A virus is a small parasite that cannot reproduce by itself. Once it infects a susceptible cell, however, a virus can direct the cell machinery to produce more viruses. Most viruses have either RNA or DNA as their genetic material. The nucleic acid may be single or double stranded. The entire infectious virus particle, called a version, consists of the nucleic acid and an outer shell of protein. The simplest viruses contain only enough RNA or DNA to encode four proteins. The most complex can encode 100 – 200 proteins [1].

The classification based on nucleic acid
DNA viruses
- Viruses possess double-stranded DNA. Viruses that cause chickenpox and herpes are found here.
- Viruses possess single-stranded DNA.

Fig 2. Structure of DNA virus

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Table 1. Different types of DNA virus

<table>
<thead>
<tr>
<th>Virus family</th>
<th>Examples (common names)</th>
<th>Virion naked/enveloped</th>
<th>Nucleic acid type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenoviridae</td>
<td>Adenovirus, infectious canine hepatitis virus</td>
<td>Naked</td>
<td>ds</td>
</tr>
<tr>
<td>Papovaviridae</td>
<td>Papillomavirus, polyomaviridae, simian vacuolating virus</td>
<td>Naked</td>
<td>ds circular</td>
</tr>
<tr>
<td>Parvoviridae</td>
<td>Parvovirus B19, canine parvovirus</td>
<td>Naked</td>
<td>ss</td>
</tr>
<tr>
<td>Herpesviridae</td>
<td>Herpes simplex virus, varicella-zoster virus, cytomegalovirus, Epstein–Barr virus</td>
<td>Enveloped</td>
<td>ds</td>
</tr>
<tr>
<td>Poxviridae</td>
<td>Smallpox virus, cow pox virus, sheep pox virus, orf virus, monkey pox virus, vaccinia virus</td>
<td>Complex coats</td>
<td>ds</td>
</tr>
<tr>
<td>Hepadnaviridae</td>
<td>Hepatitis B virus</td>
<td>Enveloped</td>
<td>circular, partially ds</td>
</tr>
<tr>
<td>Anelloviridae</td>
<td>Torque teno virus</td>
<td>Naked</td>
<td>ss circular</td>
</tr>
</tbody>
</table>

RNA viruses
- Viruses possess double-stranded RNA genomes, e.g. rotavirus.
- Viruses possess positive-sense single-stranded RNA genomes. Many well known viruses are found in this group, including the picornaviruses (which is a family of viruses that includes well-known viruses like Hepatitis A virus, enteroviruses, rhinoviruses, poliovirus, and foot-and-mouth virus), hepatitis C virus, yellow fever virus, and rubella virus.
- Viruses possess negative-sense single-stranded RNA genomes. The deadly Ebola and Marburg viruses are well known members of this group, along with influenza virus, measles, mumps and rabies [2].

Table 2. Different types of RNA virus

<table>
<thead>
<tr>
<th>Virus Family</th>
<th>Examples (common names)</th>
<th>Capsid naked/enveloped</th>
<th>Nucleic acid type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reoviridae</td>
<td>Reovirus, rotavirus</td>
<td>Naked</td>
<td>ds</td>
</tr>
<tr>
<td>Picornaviridae</td>
<td>Enterovirus, rhinovirus, hepatovirus, cardiovirus, aphthovirus, poliovirus, parechovirus, erbovirus, kobuvirus, teschovirus, coxsackie</td>
<td>Naked</td>
<td>ss</td>
</tr>
<tr>
<td>Caliciviridae</td>
<td>Norwalk virus</td>
<td>Naked</td>
<td>ss</td>
</tr>
<tr>
<td>Togaviridae</td>
<td>Rubella virus, alphavirus (Chikungunya)</td>
<td>Enveloped</td>
<td>ss</td>
</tr>
<tr>
<td>Arenaviridae</td>
<td>Lymphocytic choriomeningitis virus</td>
<td>Enveloped</td>
<td>ss(-)</td>
</tr>
<tr>
<td>Flaviviridae</td>
<td>Dengue virus, hepatitis C virus, yellow fever virus</td>
<td>Enveloped</td>
<td>ss</td>
</tr>
<tr>
<td>Orthomyxoviridae</td>
<td>Influenzavirus A, influenza B, influenza C, isavirus, thogotovirus</td>
<td>Enveloped</td>
<td>ss(-)</td>
</tr>
<tr>
<td>Paramyxoviridae</td>
<td>Measles virus, mumps virus, respiratory syncytial virus, Rinderpest virus, canine distemper virus</td>
<td>Enveloped</td>
<td>ss(-)</td>
</tr>
<tr>
<td>Bunyaviridae</td>
<td>California encephalitis virus, hantavirus</td>
<td>Enveloped</td>
<td>ss(-)</td>
</tr>
<tr>
<td>Rhabdoviridae</td>
<td>Rabies virus</td>
<td>Enveloped</td>
<td>ss(-)</td>
</tr>
<tr>
<td>Filoviridae</td>
<td>Ebola virus, Marburg virus</td>
<td>Enveloped</td>
<td>ss(-)</td>
</tr>
<tr>
<td>Coronaviridae</td>
<td>Corona virus</td>
<td>Enveloped</td>
<td>ss</td>
</tr>
<tr>
<td>Astroviridae</td>
<td>Astrovirus</td>
<td>Naked</td>
<td>ss</td>
</tr>
<tr>
<td>Bornaviridae</td>
<td>Borna disease virus</td>
<td>Enveloped</td>
<td>ss(-)</td>
</tr>
<tr>
<td>Arteriviridae</td>
<td>Arterivirus, equine arteritis virus</td>
<td>Enveloped</td>
<td>ss</td>
</tr>
<tr>
<td>Hepeviridae</td>
<td>Hepatitis E virus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Diseases due to virus
The most common type of viral disease is the common cold, which is caused by a viral infection of the upper respiratory tract (nose and throat). Other common viral diseases include:

- Chickenpox
- Flu (influenza)
- Herpes
- Human immunodeficiency virus (HIV/AIDS)
- Human papilloma virus (HPV)
- Infectious mononucleosis
- Mumps, measles and rubella
- Shingles
- Viral gastroenteritis (stomach flu)
- Viral hepatitis
- Viral meningitis
- Viral pneumonia [3]

Mode of transmission of virus
Viruses are mainly transmitted to human mainly from animals, the cycle are as follows

CHIKUNGUNYA
Chikungunya fever is also known as CHIK fever, it is a mosquito borne illness of humans caused by chikungunya virus. The virus is currently causing one of the largest reported outbreaks of CHIK fever in last 40 years. The virus, first reported in 1952 in Tanzania, has been attributed to many outbreaks in a number of countries.

Chikungunya disease is mostly confined to people living in tropical Africa and Asia and is characterized by a sudden and severe fever, skin rash and joint and muscle pain. The mosquitoes that cause infection due to the Chikungunya virus in Africa and Asia are the same mosquitoes that cause yellow fever and dengue fever in many parts of the world [4].

Caused organism for Chikungunya virus
Recent epidemics have revealed Chikungunya virus as a dangerous, important, emerging arbo virus. The virus is one of 29 distinct species in the family Togaviridae, genus Alphavirus. It is transmitted by haematophagous arthropod vectors, particularly Aedes aegypti or Aedes albopictus mosquitoes. The virus was discovered in the mid-1950s from the serum of a febrile patient during a dengue fever-like epidemic in Tanzania. Indeed, CHIKV causes an acute fever arthralgia syndrome that can evolve into chronic arthritis. Most infected individuals show symptoms; only about 5% of cases of asymptomatic CHIKV infection have been reported. The resurgence and global spread of CHIKV infection in recent years have provided opportunities for greater knowledge of its clinical features.

Fig 3. Structure of RNA virus

Fig 4. Mode of transmission of virus
patients who contract Chikungunya virus infection develop chronic joint symptoms. There is no antiviral drug or medicine specifically for Chikungunya. But since Chikungunya is cured by immune system in almost all cases there is no need to worry [5].

**Symptoms of Chikungunya**

Symptoms of Chikungunya includes debilitating arthralgia (joint pain), swelling of joints, stiffness of joints, myalgia (muscular pain), headache, fatigue (weakness), nausea, vomiting and rash and fever. The incubation period (time from infection to illness) can be 2-12 days, but is usually 3-7 days. Silent CHIKV infections (infections without illness) do occur; but how commonly this happens is not yet known. Acute chikungunya fever typically lasts a few days to a couple of weeks, but some patients have prolonged fatigue lasting several weeks. Additionally, some patients have reported incapacitating joint pain, or arthritis which may last for weeks or months. No deaths, neuro-invasive cases, hemorrhagic cases related to CHIKV infection have been conclusively documented in the scientific literature. CHIKV infection (whether clinical or silent) is thought to confer life-long immunity [6].

**Diagnosis**

A number of methods are used for diagnosing CHIKV infection. The type of test performed typically depends on the timing and volume of samples available.79 Virus isolation and nucleic acid detection are possible from serum specimens collected during the first 7 days of illness. IgM antibodies are detectable after about a week of illness and these persist for several weeks.

**CHIKUNGUNYA VACCINE**

**Data 1**

Currently there are no vaccines available in the market for preventing Chikungunya disease. However scientists all over the world are conducting experiments to develop a vaccine for Chikungunya virus. A number of experimental vaccines were found to be effective in monkeys and mice. Scientists at the National Institute of Allergy and Infectious Diseases, Texas branch of Purdue University have developed a working vaccine for Chikungunya. It was successfully tested on monkeys. The next step for this vaccine is human testing [7].

**Data 2**

A Phase II clinical vaccine trial, sponsored by the US Government in 2000, used a live, attenuated virus, developing viral resistance in 98% of those tested after 28 days and 85% still showed resistance after one year. However, live Chikungunya vaccines are still questionable as there could be a risk of a live vaccine possibly inducing chronic rheumatism.

DNA vaccination is a technique for protecting an organism against disease by injecting it with genetically engineered DNA to produce an immunological response. Nucleic acid vaccines are still experimental, and have been applied to a number of viral, bacterial and parasitic models of disease, as well as to several tumour models. DNA vaccines have a number of advantages over conventional vaccines, including the ability to induce a wider range of immune response types. A recent study supports a novel consensus-based approach to vaccine design for chikungunya virus employing a DNA vaccine strategy [8].

**Fig 6. Phase II clinical vaccine trial**

**Data 3 (Experimental Vaccine for Chikungunya Passes First Test)**

Scientists have taken the first steps to developing a vaccine for chikungunya an emerging mosquito-borne virus that has infected more than a half million people in the Western Hemisphere this year. About 600 Americans have brought the virus to 43 states.

The study was small: Only 25 people were given the experimental vaccine. But the findings are promising. They demonstrate that the vaccine is safe and that it triggers a strong response from the immune system, scientists reported Friday in the *Lancet* journal.
Chikungunya virus, endemic in Africa and Asia and transmitted via the bites of infected mosquitoes, has now spread into the Americas. No vaccine or specific therapy is currently available. A virus like particle (VLP) based Chikungunya vaccine has been shown to elicit neutralizing antibodies and protect nonhuman primates from infection and illness. To assess immunogenicity and safety in humans, investigators conducted a phase I trial of a VLP Chikungunya vaccine in healthy adults. The vaccine was administered intramuscularly at weeks 0, 4, and 20 in three dosage groups (10 µg, n=5; 20 µg, n=10; and 20 µg, n=10). Twenty-three of the 25 participants received all three doses. Neutralizing antibodies were present in all participants 4 weeks after the second dose and were boosted after the third dose; no significant differences among the group mean titers were noted after the third dose. Antibodies were found against an outbreak strain as well as the vaccine strain (West African strain 37997) and persisted in participants in all groups 6 months after the third dose [9].

The vaccine was well tolerated. Seven mild to moderate adverse events occurred, including transient liver enzyme elevations and transient neutropenia.

Data 4 (Experimental Chikungunya vaccine shows promise in first human trials)
An experimental vaccine being developed by U.S. government scientists to prevent the painful mosquito-borne viral disease Chikungunya has shown promise in its first human trials but remains years away from approval for widespread use. In a study published on Thursday in the Lancet medical journal, National Institutes of Health scientists said the vaccine elicited an impressive immune response in all 25 adult volunteers who took part and caused no worrisome side effects.

Infection with the virus, spread by two mosquito species, typically is not fatal but can cause debilitating symptoms including fever, headache and severe joint pain lasting weeks or months. There is no current treatment and no licensed vaccine to prevent it. It showed up for the first time in the Americas late last year. In the United States, locally transmitted infections - as opposed to infections in Americans traveling abroad - have been reported for the first time this year.

The early-stage clinical trial involved 25 healthy American volunteers ages 18 to 50 years old, who were given one of three dosage levels of the vaccine in three injections over a 20-week period. The volunteers were not exposed to the Chikungunya virus, but their immune response was measured in the form of neutralizing antibodies - proteins produced by a special type of white blood cell that defends a person from an invading virus. An immune response was seen in most of the volunteers after the first vaccination. Following the second, all exhibited high levels of antibodies. There was a significant increase in antibodies after the third injection. The antibodies lasted a long time and were present in all of the volunteers six months following their final shot.

This was a so-called Phase I trial testing the safety of a vaccine and looking at dosage ranges. Before securing regulatory approval, the vaccine would need to go through a Phase II trial using a larger group of people to test potential effectiveness and further evaluate safety. Next would be a Phase III trial with large numbers of people to confirm effectiveness and safety [10].

The list of vaccine currently under design and ongoing trials are
Deliberate Attenuation of Chikungunya Virus by Adaptation to Heparan Sulfate-Dependent Infectivity: A Model for Rational Arboviral Vaccine Design
Chikungunya virus (CHIKV) is an emerging mosquito-borne alphavirus indigenous to tropical Africa and Asia. Acute illness is characterized by fever, arthralgias, conjunctivitis, rash, and sometimes arthritis. Relatively little is known about the antigenic targets for immunity, and no licensed vaccines or therapeutics are currently available for the pathogen. While the Aedes aegypti mosquito is its primary vector, recent evidence suggests that...
other carriers can transmit CHIKV thus raising concerns about its spread outside of natural endemic areas to new countries including the U.S. and Europe. Considering the potential for pandemic spread, understanding the development of immunity is paramount to the development of effective counter measures against CHIKV. In this study, we isolated a new CHIKV virus from an acutely infected human patient and developed a defined viral challenge stock in mice that allowed us to study viral pathogenesis and develop a viral neutralization assay. We then constructed a synthetic DNA vaccine delivered by *in vivo* electroporation (EP) that expresses a component of the CHIKV envelope glycoprotein and used this model to evaluate its efficacy. Vaccination induced robust antigen-specific cellular and humoral immune responses, which individually were capable of providing protection against CHIKV challenge in mice. Furthermore, vaccine studies in rhesus macaques demonstrated induction of nAb responses, which mimicked those induced in convalescent human patient sera. These data suggest a protective role for nAb against CHIKV disease and support further study of envelope-based CHIKV DNA vaccines [11].

**Effective Chikungunya Virus-like Particle Vaccine Produced in Insect Cells**

The emerging arthritogenic, mosquito-borne chikungunya virus (CHIKV) causes severe disease in humans and represents a serious public health threat in countries where Aedes spp mosquitoes are present. This study describes for the first time the successful production of CHIKV virus-like particles (VLPs) in insect cells using recombinant baculo viruses. This well-established expression system is rapidly scalable to volumes required for epidemic responses and proved well suited for processing of CHIKV glycoproteins and production of enveloped VLPs. Herein we show that a single immunization with 1mg of non adjuvanted CHIKV VLPs induced high titer neutralizing antibody responses and provided complete protection against viraemia and joint inflammation upon challenge with the Reunion Island CHIKV strain in an adult wild-type mouse model of CHIKV disease. CHIKV VLPs produced in insect cells using recombinant baculo viruses thus represents as a new, safe, non-replicating and effective vaccine candidate against CHIKV infections.
develop a vaccine that is both well tolerated and highly protective. In this study, we describe the construction and characterization of a modified Vaccinia virus Ankara (MVA) virus expressing CHIKV E3 and E2 proteins (MVA-CHIK) that protected several mouse models from challenge with CHIKV. In particular mice were completely protected against viremia upon challenge with CHIKV after two doses of MVA-CHIK. Additionally, A129 mice were protected from viremia, footpad swelling, and mortality. While high anti-virus antibodies were elicited, low or undetectable levels of neutralizing antibodies were produced in both mouse models. However, passive transfer of MVA-CHIK immune serum to mice did not protect against mortality, suggesting that antibodies may not be the main effectors of protection afforded by MVA-CHIK. Furthermore, depletion of CD4+, but not CD8+ T-cells from vaccinated mice resulted in 100% mortality, implicating the indispensable role of CD4+ T-cells in the protection afforded by MVA-CHIK. The results presented herein demonstrate the potential of MVA to effectively express CHIKV proteins and generate protective immune responses. Our findings challenge the assumption that only neutralizing antibodies are effective in providing protection against CHIKV, and provides a framework for the development of novel, more effective vaccine strategies to combat CHIKV [12].

Recombinant Modified Vaccinia Virus Ankara Expressing Glycoprotein E2 of Chikungunya Virus Protects AG129 Mice against Lethal Challenge

Chikungunya virus (CHIKV) infection is characterized by rash, acute high fever, chills, headache, nausea, photophobia, vomiting, and severe polyarthralgia. There is evidence that arthralgia can persist for years and result in long-term discomfort. Neurologic disease with fatal outcome has been documented, although at low incidences. The CHIKV RNA genome encodes five structural proteins. The E1 spike protein drives the fusion process within the cytoplasm, while the E2 protein is believed to interact with cellular receptors and therefore most probably constitutes the target of neutralizing antibodies. We have constructed recombinant Modified Vaccinia Ankara expressing E3E2, 6KE1, or the entire CHIKV envelope polyprotein cassette E3E26KE1. MVA is an appropriate platform because of its demonstrated clinical safety and its suitability for expression of various heterologous proteins. After completing the immunization scheme, animals were challenged with CHIKV. Immunization of mice with MVAs expressing E2 elicited neutralizing antibodies in all animals and provided 100% protection against lethal disease. In contrast, 75% of the animals immunized with 6KE1 were protected against lethal infection. In conclusion, MVA expressing the glycoprotein E2 of CHIKV represents as an immunogenic and effective candidate vaccine against CHIKV infections [13].

Chimeric Alphavirus Vaccine Candidates For Chikungunya

Chikungunya virus (CHIKV) is an emerging alphavirus that has caused major epidemics in India and islands off the east coast of Africa since 2005. Importations into Europe and the Americas, including one that led to epidemic transmission in Italy during 2007, underscore the risk of endemic establishment elsewhere. Because there is no licensed human vaccine, and an attenuated Investigational New Drug product developed by the U.S. Army causes mild arthritis in some vaccines, we developed chimeric alphavirus vaccine candidates using either Venezuelan equine encephalitis attenuated vaccine strain TC-83, a naturally attenuated strain of eastern equine encephalitis virus (EEEV) as a backbone and the structural protein genes of CHIKV. All vaccine candidates replicated efficiently in cell cultures, and were highly attenuated in mice. All of the chimeras also produced robust neutralizing antibody responses, although the TC-83 and EEEV backbones appeared to offer greater immunogenicity. Vaccinated mice were fully protected against disease and viremia after CHIKV challenge [14].

A VLP vaccine for epidemic Chikungunya virus protects nonhuman primates against infection

Chikungunya virus (CHIKV) has infected millions of people in Africa, Europe, and Asia since its re-emergence in Kenya in 2004. The severity of disease and spread of this epidemic virus present a serious public health threat in the absence of vaccines or anti-viral therapies. Here, we describe a novel vaccine that protects against emerging CHIKV infection of non-human primates (NHP). We show that selective expression of viral structural proteins gives rise to virus-like particles (VLPs) in vitro that resemble replication-competent alpha viruses. Immunization with these VLPs elicited neutralizing
antibodies against envelope proteins from different CHIKV strains. Monkeys immunized with VLPs produced high titer neutralizing antibodies that protected against viremia after high dose challenge. We transferred these antibodies into immune deficient mice, where they protected against subsequent lethal CHIKV challenge, establishing a humoral mechanism of protection. Immunization with alpha virus VLP vaccines represents a strategy to contain the spread of CHIKV and related pathogenic viruses in humans.

A complex adenovirus vaccine against chikungunya virus provides complete protection against viraemia and arthritis

Chikungunya virus, a mosquito-borne alpha virus, recently caused the largest epidemic ever seen for this virus. Chikungunya disease primarily manifests as a painful and debilitating arthralgia/ arthritis, and no effective drug or vaccine is currently available. Here we describe a recombinant chikungunya virus vaccine comprising a non-replicating complex adenovirus vector encoding the structural polyprotein cassette of chikungunya virus. A single immunisation with this vaccine consistently induced high titres of anti-chikungunya virus antibodies that neutralised both an old Asian isolate and a Reunion Island isolate from the recent epidemic. The vaccine also completely protected mice against viraemia and arthritic disease caused by both virus isolates [15].

Table 3. Current strategies of chikungunya vaccine

<table>
<thead>
<tr>
<th>S. No</th>
<th>Approach</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inactivated vaccine</td>
<td>Phase I</td>
</tr>
<tr>
<td>2</td>
<td>Tween ether-inactivated chikungunya virus strains (African 168, Asian BAH-306, and Indian C-266) grown on Green monkey kidney cells</td>
<td>Preclinical</td>
</tr>
<tr>
<td>3</td>
<td>Formalin-inactivated 2006 Indian strain grown on Vero cells adjuvanted by Alhydrogel</td>
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</tr>
<tr>
<td>4</td>
<td>Live-attenuated vaccine</td>
<td>Preclinical</td>
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<tr>
<td>5</td>
<td>Live, chikungunya virus vaccine-infected with an attenuated strain, chikungunya 181/clone 25</td>
<td>Completed Phase II</td>
</tr>
<tr>
<td>6</td>
<td>Genetically engineered vaccines</td>
<td>Preclinical</td>
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<tr>
<td>7</td>
<td>CHIKV genes inserted into nonreplicating adenovirus vectors produce recombinant expressing structural sequence from Asian and genotype isolates</td>
<td>Preclinical</td>
</tr>
<tr>
<td>8</td>
<td>chikungunya - internal ribosome entry sequence: replacement of structural proteins for altering levels and host specific mechanism, chikungunya - internal ribosome entry sequence by Encephalo myocarditis virus - internal ribosome entry sequence</td>
<td>Preclinical</td>
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<tr>
<td>9</td>
<td>DNA vaccine: encoding C, E1, E2 genes of chikungunya virus by using three individual plasmids</td>
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</tr>
<tr>
<td>10</td>
<td>DNA vaccine encoding envelope glycoprotein by using single plasmid</td>
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<tr>
<td>11</td>
<td>Virus-like particles vaccine: selective expression of viral structural proteins gives to VLPs from 37997 and LR2006 OPY-1strains</td>
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<tr>
<td>12</td>
<td>siRNA: designing of siRNA against conserved region of nsP3 and E1 gene</td>
<td>Preclinical</td>
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</tbody>
</table>

Prevention of Chikungunya

The best way to avoid CHIKV infection is to prevent mosquito bites. In addition we strongly recommend having Homeopathic Genus Epidemicus for double protection.

Prevention tips

- Use mosquito repellent on exposed skin.
- Wear long sleeves shirts and pants.
- Have secure screens on windows and doors to keep mosquitoes out.
- Get rid of mosquito breeding sites by emptying standing water from flower pots, buckets and barrels. Change the water in pet dishes and replace the water in bird baths weekly. Drill holes in tire swings so water drains out.
- Additionally, a person with chikungunya fever should limit their exposure to mosquito bites in order to avoid further spreading the infection.
The person should stay indoors or under a mosquito net [16, 17].

CONCLUSION
Chikungunya fever is a global health problem and several outbreaks have occurred in the last 50 years in Asia and Africa. The newly re-emerged CHIKV is actually an old virus, which was localized in the tropics but has now become a global disease. Unique issues are related to CHIKV infection, such as the mysterious behavior of dramatic outbreaks interspersed by periods of prolonged absence, changes in viral genome leading to changes in virus vector adaption, chronic and recurrent arthralgia, and socioeconomic impacts. Currently, there is no consensus as to how an individual is protected from CHIK. Several vaccine candidates have reached the stage of human clinical trials. The progress achieved so far suggests that the development of a safe and effective CHIK vaccine is within reach.

REFERENCES