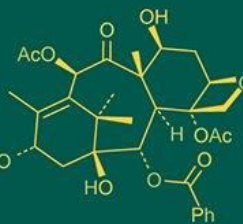
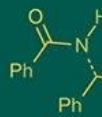
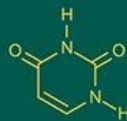
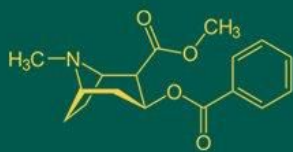


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2025; SP-9(4): 760-764
www.biochemjournal.com
Received: 09-01-2025
Accepted: 11-02-2025

Dr Asheera Banu Sangli
Department of Zoology, MES
College of Arts, Commerce and
Science, Malleshwara 15th
Cross, Bengaluru, Karnataka,
India

Climate change and viruses

Asheera Banu Sangli

DOI: <https://www.doi.org/10.33545/26174693.2025.v9.i4Si.4258>

Abstract

Climate change is one of the biggest problems faced throughout the world due to which abnormal seasonal changes, weather pattern, changes in the precipitation, rise in earth's atmospheric temperature leading to extreme weather conditions causing flood or drought. Flood causes stagnation of water and lead to vector breeding sites like mosquitoes and other insects. The increase in global temperature by 1°C affects both vectors and pathogens physiology and may result in increase in the population of vectors and pathogens. In India flood and drought has caused the increase in the breeding of insect vectors, During drought and flood drinking water problems are caused and affect human and animals. Different virus pathogens enter into the human body and lessen the immunity to fight and cause viral diseases in human and multiplication of viruses will be fast during this period, Few of the disease causing viruses are Influenza (Flu), Respiratory Syncytial Virus (RSV), Rhinoviruses (Common Cold), Human Parainfluenza Virus (HPV) infection. Human Metapneumovirus (HMPV) infection. Measles. Coxsackie virus, Viral hepatitis, chikungunya, dengue, enteric fever caused by rotavirus norovirus, chicken pox, Japanese encephalitis, West Nile disease, and acute respiratory infection.

Keywords: Climate change, virus, vectors

Introduction

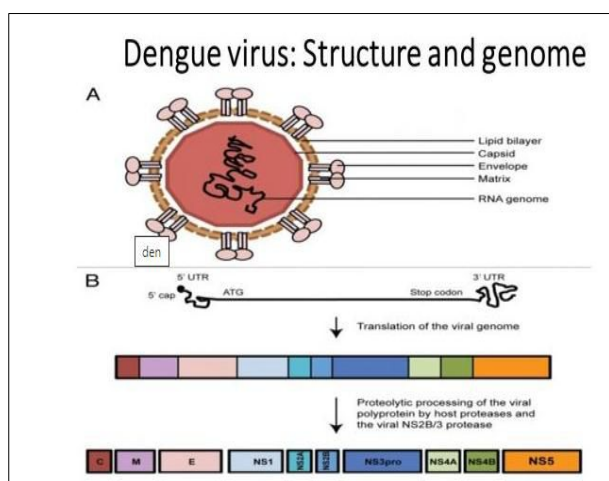
Climate is long term average of the weather condition in a given place which includes type, frequency, duration, intensity of weather and seasonal variations. Climate change develops over longer periods from decades to centuries. (APHA., 2024) ^[1]. International Panel on Climate Change has reported that drought, flood, melting of glaciers occurs and will affect human health and death., Greenhouse effect caused by green gases leads to Global warming. (Anubha Kaushik and C.P. Kaushik 2010) ^[2] Increased temperature on the earth surface led to Global warming (Melissa Denchak 2017) ^[3]. Warming temperature affects behavior, physiological characteristics and life history of both vectors and pathogens, behavior of reservoir and definitive hosts, And lower temperature increases the reproduction of vectors and transmission of viruses to the host. Here are some of the viruses which cause disease in human and disease are related with the climatic changes.

Climate Change and Dengue: Nearly 390 million of dengue cases in 100 countries are reported, El Nino has caused increase in dengue fever in Asian countries (Andrew K. Githeko *et al.*, 2000) ^[4] Dengue is an Arthropod borne virus belongs to family Flaviviridae and Genus Flavivirus. Dengue virus is transmitted between people by female mosquito of *Aedes aegypti* and *Aedes albopictus* bite which are found throughout the tropical and sub-tropical regions. (Gaurab Karki., 2017) ^[5]. Dengue virus causes diseases and death of human.

Climate change is one of the greatest threats to human health by the World Health Organization. Dengue is rapidly spreading 30-fold increase in global incidence over the past 50 years and an estimated 100-390 million dengue infections reported worldwide. The impact on health is dependent on the socio-economic environment and can influence the resilience of the population. Poor health, poverty, and conflict are also contributing factors to the impact of drought. The stagnation of water during flood help in breeding and increasing of mosquito population and high temperature also is desirable for the mosquito and they can survive from 25 to 40 °C. During rainy season as the people stay at home in a congested place and mosquito bites spread very fast in these areas and become epidemic in the whole

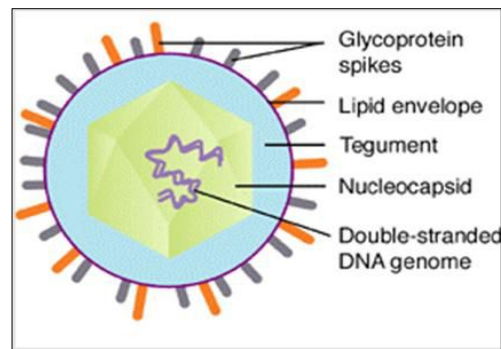
Corresponding Author:
Dr Asheera Banu Sangli
Department of Zoology, MES
College of Arts, Commerce and
Science, Malleshwara 15th
Cross, Bengaluru, Karnataka,
India

area. There are 5 dengue virus serotypes like DENV-1, DENV-2, DENV-3, DENV-4 and DENV-5. Four serotypes are found among the population of India. Karnataka state in the year 2024 was declared epidemic as the number of dengue cases has increased rapidly and caused death of 9 and suspected cases of 306257 in Karnataka and Bengaluru city alone is 77315 as on September 2024. Symptoms include mild infection high fever of 104°F, severe headache, pain behind eyes, muscle and joint pain, nausea, swollen glands, rashes, and in severe dengue symptoms include severe abdominal pain, persistent vomiting, bleeding gums and nose, feeling thirsty, feeling pale and cold skin weakness. (WHO, 2024). Dengue virus is spherical enveloped viruses with 40-60 nm in diameter. Dengue virus has single-stranded Positive-sense RNA genome of about 11 Kbp long, surrounded by a nucleocapsid and covered by a lipid envelope that contains the viral glycoproteins. and its Genome is given in the picture. given below,



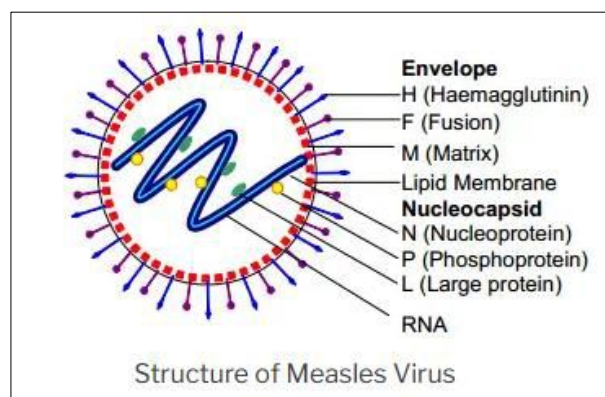
Structure of dengue virus picture was taken from Gaurav Karki 2017 [5]

Climate change and Chicken pox virus: Chicken pox viral cases are reported in several Asian countries including India. In Japan it has been reported that the factors like temperature, relative humidity and rainfall are responsible for the bimodal cycle of virus and transmission of virus rapidly. (K. Hari Gane *et al* 2015). The study revealed that the 6-10 age groups children were most vulnerable, and, with peak infection between November and February. The disease is generally more common during the colder and spring months. In India recorded outbreaks were seen among the children in Anganwadis, play schools, and schools and gathering locations. (Vikram Khan *et al.*, 2023) [21] Symptoms include itching skin rash, small blisters, mild fever, bumps filled with milky water. Varicella-Zoster virus (VZV) is an alpha Herpes virus subfamily Herpes simplex virus (HSV) 1 and 2. It is a member of varicella virus genus. The virion is spherical in shape with icosahedral symmetry measuring 159-200nm. The icosahedral protein capsid with average diameter 100 nm consists of 162 hollow hexagonal and pentagonal capsomeres with an electron-dense core containing the double-stranded DNA genome with 125240 kbp nucleotides together forming the nucleocapsid. The nucleocapsid is surrounded by an envelope which is lipoprotein in nature.



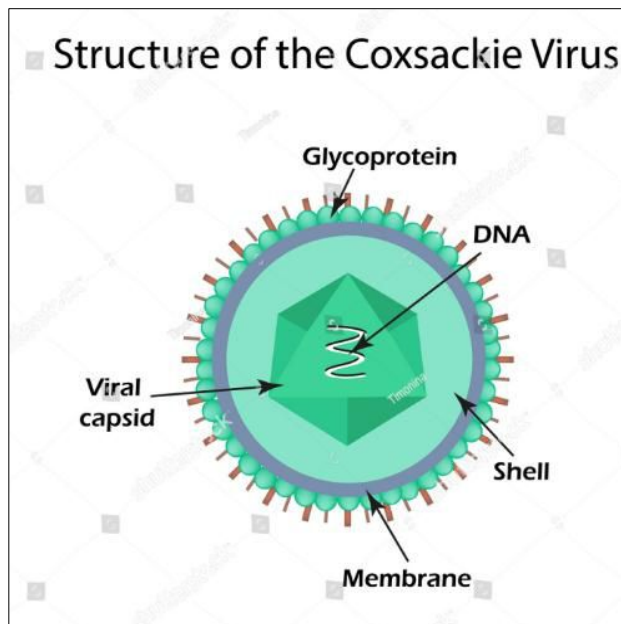
Varicella Zoster Virus structure picture taken from Sagar Aryal 2022 [8].

Climate change and Measles: The measles infection occurs between February and May and second infection occurs between September and December. Measles outbreak was seen in Maharashtra state as reported by Sunil R Vaidya., 2016 [23]. Measles virus infections is peak in late winter and early spring in temperate climates, and during the dry season in tropical climates. If the tropical regions do not receive rainfall the infections are more likely. Measles virus is a single-stranded RNA member of the Paramyxoviridae family, subfamily Paramyxovirinae. It is a large spherical enveloped virus with a diameter of 100 to 250 nm. There are six structural proteins. Three nucleoprotein P protein, L protein and M protein. Infected humans have symptoms like high fever, cough, runny nose and rashes over the body.



Measles virus: Structure taken by Acharya Tankeshwara 2025 [22]

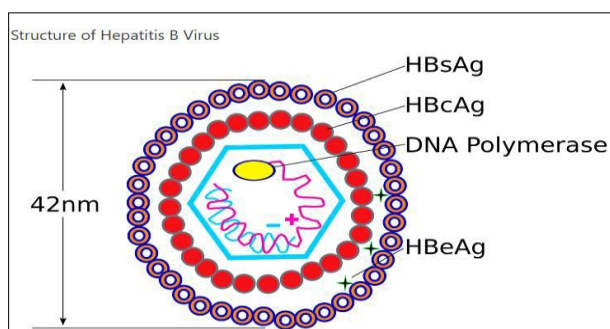
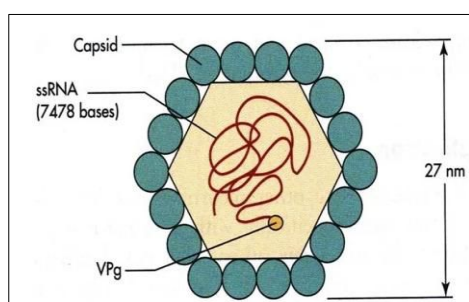
Climate change and Coxsackie virus is a Enterovirus, it belong to the Picornaviridae family, genus Enterovirus,. They contain a single plus-strand of RNA protected by an icosahedral capsid exclusively constituted of proteins. The viral particle contains no enzyme and no envelope. Its size is 22-30 nm. Coxsackieviruses are divided into two subgroups: coxsackievirus A (CA) with 23 serotypes 1-24 (23 is missing) and coxsackievirus B (CB) with six serotypes 1-6. (Bruno Pozzetto and Odette G Gaudin 2007) [13]. The Coxsackievirus circulate in the summer months having warmer weather and transmission is seen in warmer places and high humidity. less rainfall is likely for more infections. The symptoms include poor appetite, runny nose and sore throat can appear three to five days after exposure. A blister-like rash on the hands, feet and in the mouth The viruses can spread from person to person, usually on unwashed hands and surfaces contaminated by faeces.



Picture is taken from shutter stock

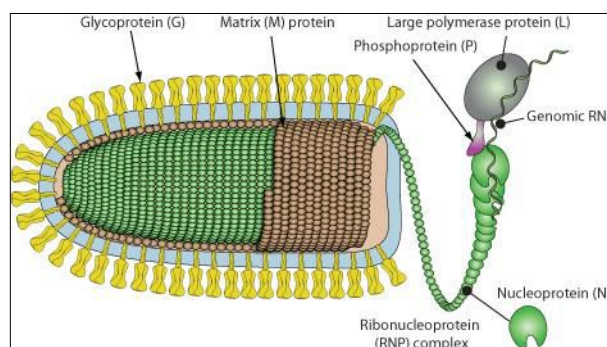
Climate change and Viral hepatitis

Hepatitis A is a disease that increases due climate change, it is related to water, continuous rain which causes flooding. The impact of extreme weather changes in the water characteristics, viral population, duration of the hepatitis A virus in the water which affects human population and contribute to public health. The climate change causes the frequency, intensity and duration of the infection. Excessive rainfall rain, storms, floods, and droughts the infection is more (Adiben *et al.*, 2021) The hepatitis B virus is a DNA virus belonging to the *Hepadnaviridae* family causing hepatitis B in humans. Hepatitis B is a viral infection that attacks the liver and cause both acute and chronic disease. They have diameter of 22 to 42 nm and are spherical, filamentous, particle. Hepatitis is a liver related disease and the air and water pollution makes the liver susceptible for viral infections and cause disease.



Structure of Hepatitis A Virus by Nazuk Gupta Hepatitis B Virus by Sagar Arya 2022 ^[28]

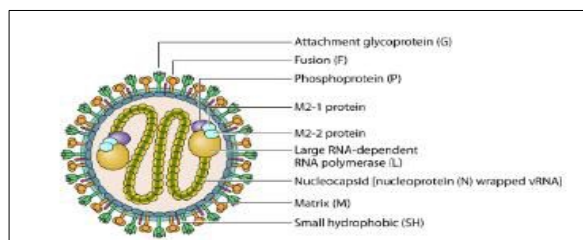
Climate change and Chandipura virus (CHPV) was identified in 1950, The fever was first found in Chandipura village in northern Maharashtra near Nagpur district, The virus belong to families of arbovirus include Toga viridae (Alpha viruses), Flaviviridae, Bunya viridae and Rebo viridae. infection is caused by virus loaded female *Aedes aegypti* and Sand flies (*Phlebotomus papatasi*, *Phlebotomus argentipes* or *Sergentomyia* spp.) and ticks bite. The virus is a tropical pathogen (Sunil Menghani *et al.*, 2012) ^[11] with massive outbreak in 2003-2004 in Maharashtra, Telangana and Gujarat with 55 to 75% fatality among children and they found out that the infection is due to climatological factors or human genetic factor or a combination of both. (A.B. Sudeep *et al* 2019) ^[14] The infection again occurred in the month of June to August 2024 in the children below 15 years of age (Morgan E Brises and Hinh Ly 2024) ^[29], The manifestation of CHPV starts as an influenza-like illness, associated with abdominal pain, vomiting, altered consciousness, and impaired neurologic functions (Peiris *et al.*, 2008). It causes encephalitis, a diffuse or focal inflammatory process of the brain parenchyma associated with brain dysfunction. The pathology of encephalitis can be broadly divided into two major categories: infection-related encephalitis and auto-immune mediated encephalitis (Domingues, 2009). It has a rod-shaped structure, which is characteristic of the family Rhabdo viridae. The outer envelope consists of glycoprotein (G) and host-derived lipid membrane. The viral RNA and envelope are connected through the matrix protein (M). Neurodegeneration and neuronal death and virus are seen in cerebrospinal fluid. the structure of Chandipura virus rod shaped, belongs to the family Rhabdo viridae, a member of genus *Vesiculo virus*. The outer envelope consists of glycoprotein (G) and host-derived lipid membrane. The viral RNA and envelope are connected through the matrix protein (M). The genome is a single-stranded RNA having a negative helical turn. The RNA genome is associated with three other viral proteins known as nucleoprotein (N), phosphoprotein (P) and large protein (L) forming the ribonucleoprotein complex (2012 Li J, Zhang Y, Sourish Ghosh 2017) ^[10, 9] this virus has to manipulate the cellular machineries of its hosts at molecular levels through specific protein-protein interactions for its survival, replication, subsequent spread and infection. (Sreejith Raja Sekharan *et al.*, 2013) ^[6] the vectors were killed using pesticides in Gujrat and Rajasthan because of many children were affected.(WHO 2024)



Structure of Chandipura virus Picture from Sourish Ghosh 2017 ^[9]

Climate change and Human Meta Pneumo Virus (HMPV) HMPV infects individuals of 5 years and adults of 65years of age, The immune compromised individuals, are susceptible populations. Disease severity increase as the

immunity decreases. and infants of 5 months with prolonged stays in the intensive care unit (ICU) are susceptible they show severe respiratory infections: Cough., Fever., Runny or stuffy nose., Sore throat. wheezing, rashes on the body. HMPV spreads through direct contact with someone who has it or from touching things contaminated with the virus Coughing and sneezing. Shaking hands, hugging or kissing. Touching surfaces or objects like phones, door handles, keyboards or toys. younger than 5) or older than 65 week with weakened immune. (Cleveland Clinic 2023) [17].

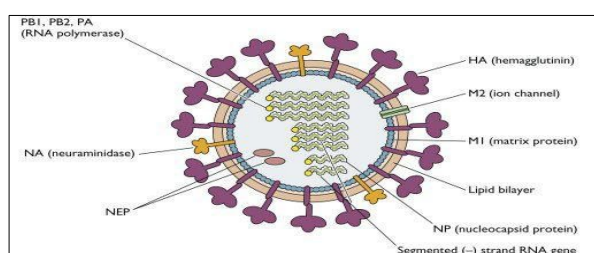


Human Metapneumovirus structure by Pablo F Cespedes *et al* 2016 [31]

HMPV relatively new member of the Paramyxoviridae family paramyxovirinae subfamily, and belongs to the genus Metapneumovirus hMPV is a pleomorphic, spherical, enveloped virus with a mean diameter of 209 nm, The nucleocapsid has a varying length from 200 to 1000 nm and a 17 nm diameter. The genome of hMPV is negative-sense, single-stranded, nonsegmented RNA that is about 13,000 nucleotides in length and consists of eight genes and nine proteins N, P, M, F, M2, I and M2-2, SH, G, L polymerase proteins and envelope of glycolipid. The HMPV viruses are transmitted due to climate change changing of host by virus and transmission occurs very easily due the colder season as humans will not go out due to dip in temperature.

Climate change and Influenza virus attack human usually during winter and people are aware of it and usually avoid going out doors and infected people but because of climate change seasonal variations occurs and found throughout the year especially in developing countries. There are 3-5 million cases of severe illness and 290 000 to 650 000 respiratory deaths in developing countries. Symptoms begin 1-4 days after infection and usually last around a week. (October 2023 WHO). There are 4 types of influenza viruses, types A, B, C and D. Influenza A and B viruses circulate and cause seasonal epidemics of disease.

Influenza A viruses are further classified into subtypes according to the combinations of the proteins on the surface of the virus. In humans subtype A(H1N1) and A(H3N2) influenza viruses. The A(H1N1) caused the pandemic in 2009. Influenza D affect cattle and affect human. Symptoms are sudden onset of fever, cough, headache, muscle and joint pain, severe malaise (feeling unwell), sore throat, runny nose

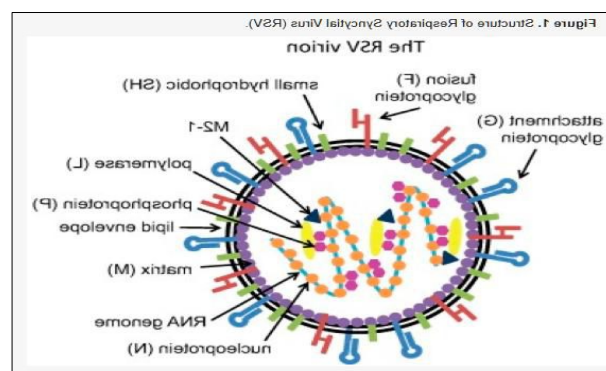


Structure of influenza virus is from Vincent Racaniello 2009 [32]

Climate change and Pneumonia: Seasonal influenza is an acute respiratory infection caused by influenza viruses which circulate in all parts of the world. It represents a year-round disease burden. It causes illnesses that range in severity and sometimes lead to hospitalization and death.

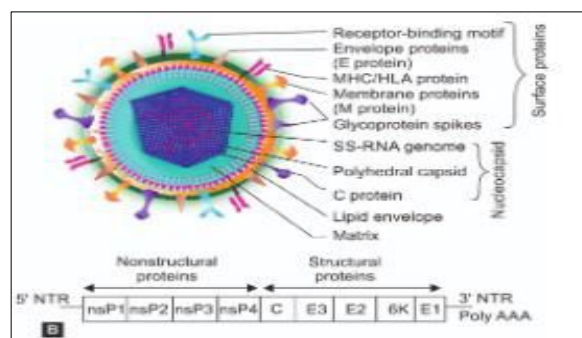
Most people recover from fever and other symptoms within a week without requiring medical attention. However, influenza can cause severe illness or death, particularly among high risk groups including the very young, the elderly, pregnant women, health workers and those with serious medical conditions.

In temperate climates, seasonal epidemics occur mainly during winter, while in tropical regions, influenza may occur throughout the year, causing outbreaks more irregularly.



Influenza virus structure Sonia Bianchini *et al* 2020 [16]

Climate change and Chikungunya: Chikungunya is caused by a virus found in Africa, the Americas, Asia, Europe, India and Pacific Oceans. The virus belongs to a group of viruses called alphaviruses. Other alphaviruses causing a similar disease include Mavaro virus and Ross River virus. People are infected with chikungunya virus when mosquitoes feed on another infected person and then bite them. People infected with chikungunya virus have high enough levels of virus in their blood (viremia) during the first few days of illness to transmit the virus to mosquitoes. Prevent getting infected with chikungunya virus by preventing mosquito bites and getting vaccinated before travel. Spread can occur through Blood transfusion, Handling infected blood in the laboratory, Drawing blood from an infected patient. The virus is not spread from person-to-person and is not spread through coughing, sneezing, or touching. Pregnancy and breastfeeding, Rarely the infection can be spread from a pregnant person to their unborn baby, mostly during the second trimester, through the bites of infected *Culex* species mosquitoes, particularly *Culex tritaeniorhynchus* bronchiolitis or respiratory syncytial virus, rhinovirus or parainfluenza virus caused during rainy or winter seasons.



Structure of chikungunya by Srijan Singh, *et al* 2021 [20]

According to a Council on Energy, Environment and Water (CEEW) study, Eighty percent of the population in India live in districts that are highly vulnerable to extreme weather events and population do not have adequate adaptive capacities, India does not have the capability and skills to make its people climate-resilient because of its diverse structural challenges including inadequate infrastructure, low literacy rates, and poor disaster management planning. (Abhinash Mohanty and Shreya Wadhawan October 2021) ^[15] and climate change has impact on disease outbreak.

Conclusion

Viral disease outbreak, viral multiplication, viral infection, viral transmission from human to human or through vectors to human are due to climate change causing pandemic or epidemic leading to the death of human population. . .

References

1. APHA. Climate, Health and Equity. 2024. Available from: www.apha.org-topics-and-issues
2. Kaushik A, Kaushik CP. Environmental Studies. New Delhi: New Age International Publishers; 2010.
3. Denchak M. Global Climate Change: What you need to know. NRDC; 2017 Feb 23. Available from: www.nrdc.com
4. Githeko AK, Lindsay SW, Confalonieri UE, Patz JA. Climate change and vector borne disease: a regional analysis. *Bull World Health Organ.* 2000;78(9):1136-47.
5. Karki G. Dengue Virus: Structure, Serotypes and Mode of Transmission. Online Biology Notes; 2017 Dec. Available from: www.onlinebiologynotes.com
6. Sekharan SR, Rana J, Gulati S, Sharma SK, Gupta V, Gupta S. Predicting the host protein interactors of Chandipura virus using a structural similarity-based approach. *Pathog Dis.* 2013;69(1):29-35. <https://doi.org/10.1111/2049-632X.12064>
7. Ministry of Health & Family Welfare. National Guidelines for Clinical Management of Dengue Fever. 2023. Available from: <https://ncvdbc.mohfw.gov.in/Doc/National%20Guidelines%20for%20Clinical%20>
8. Aryal S. Varicella Zoster Virus - An Overview. *Microbe Notes*; 2022 Apr 28.
9. Ghosh S, Basu A. Neuropathogenesis by Chandipura virus: An acute encephalitis syndrome in India. *Natl Med J India.* 2017;30(1).
10. Li J, Zhang Y. Methylation—From DNA, RNA and histones to diseases and treatment. In: *InTech*; 2012. Available from: <http://dx.doi.org/10.5772/54598>
11. Menghani S, Chikhale R, Raval A, Wadibhasme P, Khedekar P. Chandipura Virus: An emerging tropical pathogen. *Acta Trop.* 2012;124(1):1-106.
12. Structure of Coxsackie virus [Internet]. Shutterstock. Available from: <https://www.shutterstock.com/image-illustration/structure-coxsackie-virus-enterovirus-infographics-illustration-725446771>
13. Pozzetto B, Gaudin OG. Coxsackieviruses (Picornaviridae). In: *Encyclopedia of Virology.* 2004 Jun 17;305-11. <https://doi.org/10.1006/rwvi.1999.0057>
14. Sudeep AB, Gunjkar RS, Ghodke YS, Khutwad K, Sapkal KN. Temperature sensitivity and environmental stability of Chandipura virus. *VirusDisease.* 2019 Jan 19;30(2):214-8. <https://doi.org/10.1007/s13337-018-00511-4>
15. Mohanty A, Wadhawan S. Mapping India's Climate Vulnerability. CEEW; 2021 Oct.
16. Bianchini S, Silvestri E, Argentiero A, Fainardi V, Pisi G, Esposito S. Pneumonia. *Microorganisms.* 2020;8(12):2048. <https://doi.org/10.3390/microorganisms8122048>
17. Cleveland Clinic. Human Metapneumovirus (hMPV). 2023 Jun 20. Available from: <https://my.clevelandclinic.org/health/diseases/22443-human-metapneumovirus-hmpv>
18. World Health Organization. Influenza (seasonal) Fact Sheet. 2023 Oct. Available from: [https://www.who.int/news-room/fact-sheets/detail/influenza-\(seasonal\)](https://www.who.int/news-room/fact-sheets/detail/influenza-(seasonal))
19. Harigane K, Sumi A, Mise K, Kobayashi N. The role of temperature in reported chickenpox cases from 2000 to 2011 in Japan. *Epidemiol Infect.* 2015 Jan 14;143(12):2666-78.
20. Singh S, Amrit A, Mane S, Kasniya G, Rahman MM, Tekleab M, Maheshwari A. Newborn. 2023;2(1).
21. Khan V, Sanghai AA, Zala DB, Babariya MJ, Das VK. Congenital Chikungunya virus infections—a deep dive into chickenpox epidemiology and outbreaks: a retrospective study in a tribal-dominated district of Western India. *Indian J Med Sci.* 2023;76(1):36-42. https://doi.org/10.25259/IJMS_196_2023
22. Tankeshwar A. Measles virus: Structure, Pathogenesis, Lab Diagnosis. *Virology*; 2025.
23. Vaidya SR, Kamble MB, Choudhury DT, Neelakshi S, Kumbhar NS. Measles and Rubella outbreak in Maharashtra state, India. *Indian J Med Res.* 2016 Feb;143(2):227-31.
24. Adibin A, Aisnah, Indrawati, Sumriati, Tosepu R. Increased risk of hepatitis A due to weather changes: A review. *IOP Conf Ser Earth Environ Sci.* 2021;755:012085. <https://doi.org/10.1088/1755-1315/755/1/012085>
25. Ma R. Phospholipases in viral infection physiology and pathology. *Sci Direct, Academic Press.* 2023;7:63-73.
26. Sangli AB, Sangli S. Impact of climate change. *Ecology Res.* Bhumi Publishing. 2021;2:122-5.
27. Aya S. Hepatitis B Virus - Structure, Epidemiology, Symptoms, Pathogenesis, Diagnosis, Treatment and Vaccines. *Microbiologyinfo.com*; 2022 Aug 10.
28. Gupta N. Hepatitis A. Available from: <https://www.mdiss.edu.sg/blog/hepatitis-a/>
29. Brises ME, Ly H. Chandipura virus causing large viral encephalitis outbreaks in India. *Pathogens.* 2024;13(12):1110. <https://doi.org/10.3390/pathogens13121110>
30. World Health Organization. Acute encephalitis syndrome due to Chandipura virus, India. 2024 Aug 23. Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2024-DON529>
31. Cespedes PF, Alavecino CEP, Kalergis AM, Bueno S. [Title]. *Clin Microbiol Rev.* 2016 Oct;29(4):795-818. <https://doi.org/10.1128/CMR.00081-15>
32. Racaniello V. Structure of influenza virus. *Virology Blog*; 2000 Apr 30.