

The Threat of Arbovirus Diseases: Current Status and Mitigation Efforts

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High Profile Human Infectious Disease Epidemics, 1990- Present

- Dengue, 1970-2023
- Human Immunodeficiency Virus, 1980-2023
- Venezuelan equine encephalitis, 1992
- Pneumonic plague, 1994
- Avian influenza, 1997-2010
- Rift Valley Fever, 1998
- Nipah encephalitis, 1998-1999
- West Nile, 1999-2005
- SARS, 2003
- Zika, 2007-2016
- Swine origin H1N1 influenza, 2009-2010
- MERS-CoV, 2012 -2018
- Chikungunya, 2004-2015
- Ebola, 2014
- Yellow fever, 2016-2018
- SARS-CoV-2, 2019-2022
- Monkey Pox, 2022-2023
- Respiratory syncytial virus, 2022-2023

Pandemic Infectious Diseases in the New Millennium

- **Dengue – 1970-2020**
- HIV – 1981-2020
- H1N1 Influenza – 2009
- **Chikungunya -- 2014**
- **Zika -- 2016**
- COVID-19 – 2019
- **Monkey Pox -- 2022**

Potential Pandemic Infectious Diseases, 1990-Present

- **Venezuelan Equine Encephalitis, 1992***
- **Plague, 1994***
- **H1N5 avian influenza, 1997**
- **Rift Valley Fever, 1998***
- **West Nile encephalitis, 1999***
- **SARS, 2003**
- **Yellow Fever, 2016***

*- Vector-borne

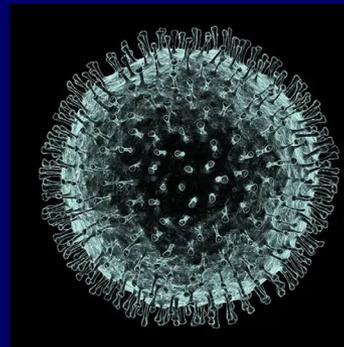
Pandemic Threats to Health



DISEASES
TRANSMITTED
THROUGH
RESPIRATORY
DROPLETS



DISEASES
TRANSMITTED
BY URBAN
MOSQUITOES



MAINLY
VIRUSES

Arbovirus Outbreaks Reported in 2023

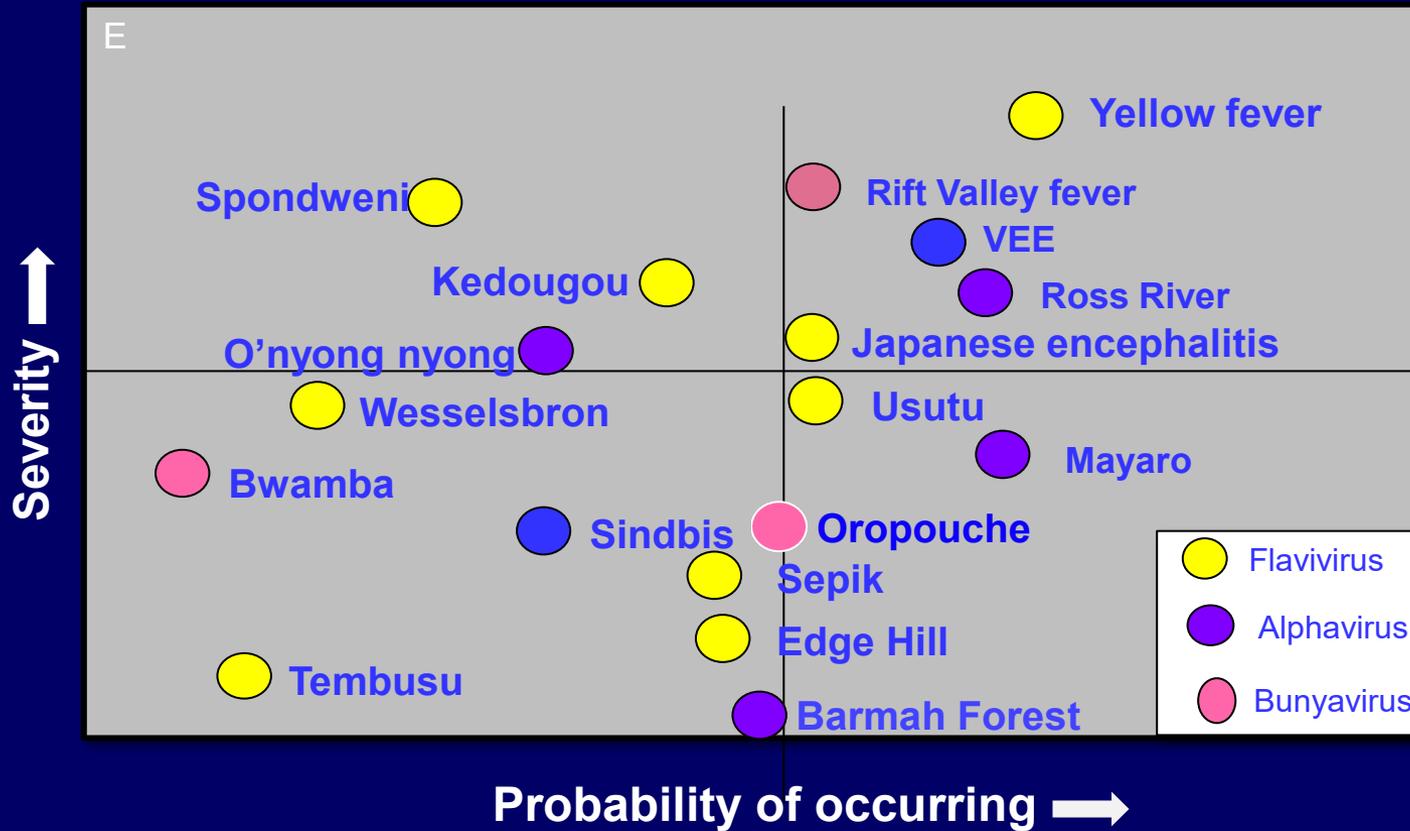
- Dengue*
- Zika*
- Yellow Fever*
- Japanese Encephalitis*
- West Nile*
- St Louis Encephalitis*
- Murray Valley Encephalitis*
- Usutu*
- Powassan
- Tick-borne Encephalitis
- Chikungunya*
- Venezuelan Equine Encephalitis*
- Eastern Equine Encephalitis
- Western Equine Encephalitis
- Getah Virus
- Rift Valley Fever*
- Toscana Virus
- Blue Tongue*
- Crimean Congo Hemorrhagic Fever
- Vesicular Stomatitis Virus
- Jamestown Canyon Virus
- Cache Valley Virus

Recently described tick-borne viruses

- Severe Fever with Thrombocytopenia Syndrome
- Heartland Virus
- Bourbon Virus
- Echarate Virus
- Jingmen Virus
- Alongastran Virus
- Oz Virus
- Haseki Virus
- Mogiana Tick Virus
- Tacheng Tick Virus
- Songling Virus
- Oya Virus

* Most likely to cause large epidemics based on past history

Arboviruses with Potential for Urban Emergence



Why have we seen such a dramatic increase in epidemic arboviral diseases?

- Complacency
- Lack of Political Will
- Policy Changes
- Deterioration in Public Health
- Changing Lifestyles/Behavior
- Microbial Adaptation
- Technology
- Intent to Harm
- Climate Change*

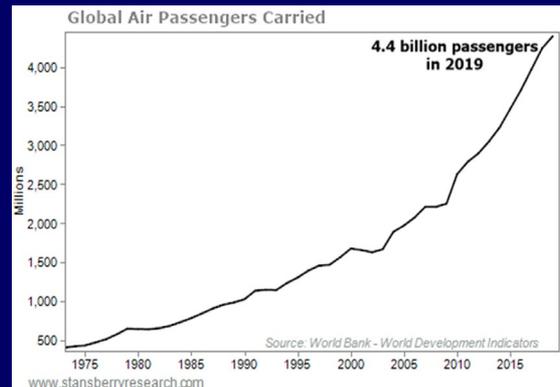
Why have we seen such a dramatic increase in epidemic arboviral diseases??

Major Drivers

- Demographic Changes
 - Population growth
 - Migration patterns
- Environmental Change
 - Unprecedented urban growth
 - Changing lifestyles
 - Agricultural/animal husbandry practices
- Technology
 - Modern Transportation (Globalization)
Increased movement of people, animals, commodities and pathogens
- Inadequate Public Health Infrastructure

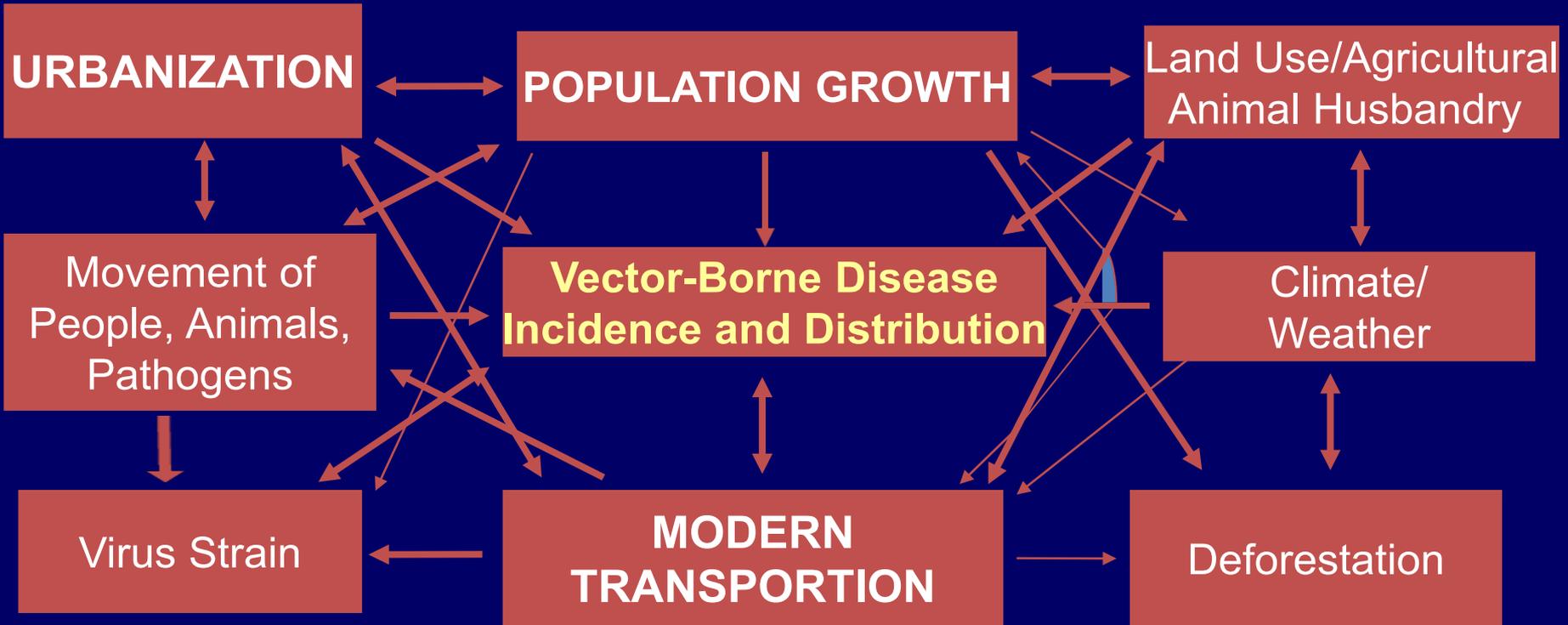
Risk Factors for Urban Arboviral Disease Epidemics

- Unprecedented urban growth & migration
- Crowded tropical urban centers provide ideal ecological conditions to maintain viruses and mosquito vectors
- Globalization and modern transportation provides ideal mechanism to move viruses and mosquito vectors among population centers
- 2023 >5 billion people will travel by air, 100s of millions to endemic areas
- Increased encroachment on sylvatic virus cycles



The Complexity of Arboviral Transmission Dynamics

Ecological/Environmental/Demographic Factors that Influence the Geographic Distribution and Incidence of Arboviral Diseases*



* Adapted from Sutherst, Clin. Micro. Rev., Jan. 2004.

Lessons Learned from Past Epidemics

- Unplanned urban growth
- Epidemic Cycles
- “Out of site-out of mind” mentality
- Political/administrative changes
- Emergency response plans
- Communication and community outreach
- Media and panic/fear driven response
- Politicization of public health
- Crisis-oriented society

Can We Reverse the Trend of Emergent Arboviral Diseases?

- Get serious about prevention vs reactive control
- Coordinated global funding
- Operational and Response plans with automatic triggers
- Intersectoral community partnerships
- Communication to all segments of society
- Laboratory-based proactive surveillance
- Adequate sustainable funding by countries
- Urban renewal
- Lancet Commission on ATVDs
- Research

Gaps in Available Intervention Tools

- Mosquito Control
- Vaccines
- Therapeutics
- Diagnostics
- Insecticides
- Surveillance
- Political commitment
- Community outreach
- Long-term planning
- Funding

Global Threat of Epidemic Arboviral Diseases

SUMMARY/CONCLUSIONS

- Risk of epidemic arboviral diseases is highest in history
- Over 500 known viruses of animals; many more will likely be discovered
- Responsible global trends will not reverse anytime soon
- We can expect emergence of more epidemic viruses in tropical urban areas
- Prevention, control and possibly containment may be possible

What is the Cost of Inaction?

- Increased Frequency & Magnitude of Arbovirus Epidemics/Pandemics
- Threat to Global Public Health and Economic Security