**Health events in the network:**

Ebolavirus: 2014

Dengue virus 2: 2007-2011 LARGE outbreak.

Dengue virus 1: 2007-2011 LARGE outbreak.

Dengue virus 3: 2007-2011 LARGE outbreak.

West Nile virus: 2009-2011 LARGE outbreak.

Hepacivirus C: 1992-1996. 2000-2006 small growing increase.

Hepatitis C: 2006-2008 LARGE outbreak.

Hepatits B: middling but consistent prevalence

Zika: 2015-2017 LARGE outbreak.

Hepatitis E: 1992-93. 2000-2006 small growing increase.

**Focus areas:**

dengue outbreak 2007-2011

West Nile 2008 – 2012 outbreak

Zika outbreak

**Subfocuses**

Scholarly Communication Events (eg conferences)

Scientific Innovation Events

Public Awareness

Policy Events (funding, etc)

**Points:**

How does the network react when an outbreak occurs? What factors lead to different levels of change?

Does collaboration increase or decrease?

How reliable is network activity in reflecting outbreaks?

Why, when outbreaks occur, does research on certain major pervasive viruses (HIV) significantly decrease when other times it does not? (See Dengue)

**OVERARCHING QUESTIONS**

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I’ll start here with the worldwide Dengue outbreak observed from 2005 to about 2010 (it’s worth noting that Dengue incidence has been dramatically increasing, with a 30fold increase over the last 30 years. Notably in 2007, there were a total of 232,000 cases of Dengue in an outbreak so significant it’s identified by the year. We see a dramatic surge in publications and submissions on all three Dengue virus subtypes between 2007-2010/2011. Already established, some of the largest outbreaks right before this period were the 2005 outbreak in Singapore, the 2006 outbreaks in India + Pakistan, the 2008 Rio de Janeiro outbreak (50k+ cases) and the 2009 Bolivian outbreak. It’s safe to say this time period saw a marked global outbreak of Dengue. I believe this surge in the network shows that the virus community is quite capable of having high reactivity to outbreaks, jumping to study their viruses when they occur. What triggered the increase in network activity however, deeper than the outbreaks themselves? Were rich western countries more likely to fund their research teams, or be heard in their pleas for international aid? And in this, who is doing the research?

In the Singapore outbreak, a significant number of citizens became infected with Dengue virus 3 – a brand new strain of the virus. This absolutely could lead to an increase in research soon after this period. Singapore had a great and efficient national response to the virus, similar to how they handled SARS a few years prior. They even cracked down on mosquito breeding sites, in events they called Blitzes. Singapore life-science startup created DNA and RNA based diagnostic kits for Dengue, but I can’t find much info on virus research.

50 million dengue cases occur each year worldwide causing 2.1 billion in economic damage, making research on its viruses a priority for top research groups such as NIH’s NIAID

**Dengue Outbreak (primarily virus 2) 2007-2011**

<https://en.wikipedia.org/wiki/2005_dengue_outbreak_in_Singapore>

[https://en.wikipedia.org/wiki/2006\_de ngue\_outbreak\_in\_India](https://en.wikipedia.org/wiki/2006_de%20ngue_outbreak_in_India)

<https://en.wikipedia.org/wiki/2006_dengue_outbreak_in_Pakistan>

<https://en.wikipedia.org/wiki/2009_Bolivian_dengue_fever_epidemic>

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5506197/

While we see in the data, a very large increase in scientific activity under all 3 Dengue viruses between 2007-2011, this is traceable to a large worldwide Dengue outbreak in Singapore, India, Pakistan, and Bolivia. These outbreaks were significant – Bolivia requested foreign aid for “the worst outbreak in the country’s history.” At the time of the 2006 Pakistan outbreak, it was its worst on record. The 2005 outbreak in Singapore was its worst disease outbreak since SARS. These comprise the major Dengue fever outbreaks in the past 20 years. From the visualization, we see that scientific activity began (eg papers were finished, submitted, and published which is a reasonable timeline) about one year after these outbreaks began. **This suggests that a large portion of scientific virus research is reactive to public health outbreaks. As viruses can appear or surge at any given time with little predictability, this makes intuitive sense that the virus community jumps on outbreaks, as they pose the greatest imminent risk to the public AND they comprise the greatest scientific interest points.**

An important note is that HIV research, during this outbreak, was overshadowed greatly by the increase in the Dengue activity.

**Hep C 2006-2008 outbreak**

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5079374/>

<https://en.wikipedia.org/wiki/Hepatitis_C#Epidemiology>

<https://www.hhs.gov/hepatitis/learn-about-viral-hepatitis/data-and-trends/index.html>

https://www.cdc.gov/hepatitis/outbreaks/HCVOutbreaks-PWID.htm

We see a massive increase in scientific activity around Hepatitis C virus between 2006 and 2008, while there is little activity before this point. Hepatitis C is a massive global problem, where an estimated 143 million people suffer chronically. Upon investigation, we see a general and steady increase in Hep. C cases from 2006. This corresponds to the height and progression of the Opioid crisis in the United States (according to the CDC, the highest reported severe incidence of Hep. C in the US is among 20-29 year olds – those most likely to inject drugs, as Hepatitis is spread by bodily fluid / sex / other physical contact.)

HIV activity did not decrease, unlike during the Dengue outbreak. I believe this may be because Hep. C is so widespread, that like HIV, the importance of the research stays more constant than something like Zika. However, after this given period, Hep. C activity substantially decreases, so I’m unsure about this hypothesis. Perhaps there was a policy event (eg governmental funding, opioid addiction policy) that led to this spike?

**Zika outbreak 2015-2017**

<https://www.who.int/news-room/fact-sheets/detail/zika-virus>

https://www.who.int/news-room/feature-stories/detail/the-history-of-zika-virus

As many people know, around the time of the 2016 FIFA World Cup, there was a Zika outbreak in more than 20 countries significant enough to create significant international travel concern, and for the WHO to declare Zika as a Public Health Emergency of International Concern. Before 2015, there were little to no papers on the Zika virus – its emergence onto the world stage was new in 2015**. This is another solid case of the scientific community reacting to the latest and newest public health outbreaks.** Activity ceases after 2017, in part because our data ends in 2018, but this corresponds to the end of local transmission of the virus in many of the affected countries. Brazil was the source of this major outbreak, beginning in March 2015. It spread around South and Central America (and to 80+ other nations) but was most prolific in S/C Americas.

**West Nile:**

There appears to be a worldwide outbreak of West Nile virus between 2008-2012. This primarily was located in the United States – who in this case contribute a vast majority of research. Notably, the 2012 outbreak: https://www.ecdc.europa.eu/en/news-events/epidemiological-update-2012-west-nile-virus-outbreak-usa-30-august-2012