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Paper

Hepatitis

Introduction:

The Hepatitis virus is a significant concern for human health. In the last decade, scientists noticed highly diverse viruses related to human hepatitis in animals. There are five hepatitis variants, but I will discuss 4 in this paper. Hepatitis kills approximately 1.3 million people a year annually. The death rate for hepatitis B exceeds hepatitis A, C, and D. This paper will focus on the prevalence of high mutation rates in Hepatitis B being more prevalent than Hepatitis C.

Acute viral hepatitis is one of the most common infectious diseases, and hepatitis A is the most common form. Hepatitis A affects children without producing any symptoms, but in adults, patients will experience jaundice. Unlike the others, Chronic liver disease is linked to Hepatitis A. Hepatitis A is usually found in the stool and blood of infected people (*Hepatitis A - Faqs, Statistics, Data, & Guidelines,2020*) . Hepatitis is very contagious; most people contract the virus by close personal contact with an infected individual or through eating contaminated food/drink. People with hepatitis A do not have a chronic, lasting illness; a vaccine is also available to prevent contracting the disease.

Hepatitis B (*Hepatitis B - Faqs, Statistics, Data, & Guidelines,2023*) is a preventable liver infection by vaccination. Hepatitis B is contagious when blood, semen, or another body fluid is passed from an infected individual to an unaffected individual. According to (cdc.gov) about 9

out of 10 infants who become infected go on to develop a life-long chronic illness. Hepatitis B's age is a variable in determining if the disease will become chronic.

The Hepatitis C virus causes a liver infection known as Hepatitis C Hepatitis. According to (*Hepatitis C - Faqs, Statistics, Data, & Guidelines,2020*) Hepatitis C is spread through blood contact and sharing needles or equipment to prepare and inject drugs. Unlike hepatitis A, hepatitis B C does not have a vaccine to prevent the virus, but the only way to prevent Hepatitis C is to avoid the behaviors that can spread the disease.

The Hepatitis D virus is a liver infection that causes Hepatitis. Hepatitis D is only possible with people who currently have hepatitis B. Hepatitis B is spread by blood and bodily fluid contact. Hepatitis D can cause severe symptoms and chronic liver damage, potentially leading to death. No vaccine for hepatitis D has been discovered, but the best way to prevent hepatitis D is to take the vaccine for hepatitis B, and it will also prevent hepatitis D. (*Hepatitis D - Faqs and Laboratory Testing Requests,2020*)

Methods:

To test the hypothesis, data was collected from “*The Centers for disease control and Prevention, viral hepatitis*” When observing the data, it was intriguing how high the mutation rate was due to its replicative strategy, which will ultimately lead to many variants. The Data gathered contained states, mutation rates by age, ethnicity, country, year, and death rates. Each sample collected was out of a population of 100,000 individuals. To test the hypothesis, each data set was put in individually to show the correlation between hepatitis B vs. hepatitis C.

"Information from the Centers for Disease Control and Prevention" showed the mutation rates by state, illustrated in Figure 3.

Data analysis:

A T-test was performed, sampling the mutation rate from 2016 and the mutation rate in 2020 to indicate the t-value equals -0.4812, the degrees of freedom was 65.435, and the p-value equals 0.632 to indicate that there isn't a big difference in viral rates. Another Cor test was done at a 95% confidence interval to see the correlation between Hepatitis B and Hepatitis C rates in 2020; the results were t -value was 0.097746, the degrees of freedom was 40, the p-value = 0.922, while the Cor value was 0.0154532; indicating that the two data sets were different. R studio was used to make the graphs below to help explain the results. Ggplot, Us_map, gppubr, and phytol functions were used in this paper.

Phylogeny

In this paper, data for the phylogeny was found (*Sali, Shahnaz, et al., 2019*). R studio was used to construct this phylogeny, using the function "vert. tree" in the package (phytools).

Results:

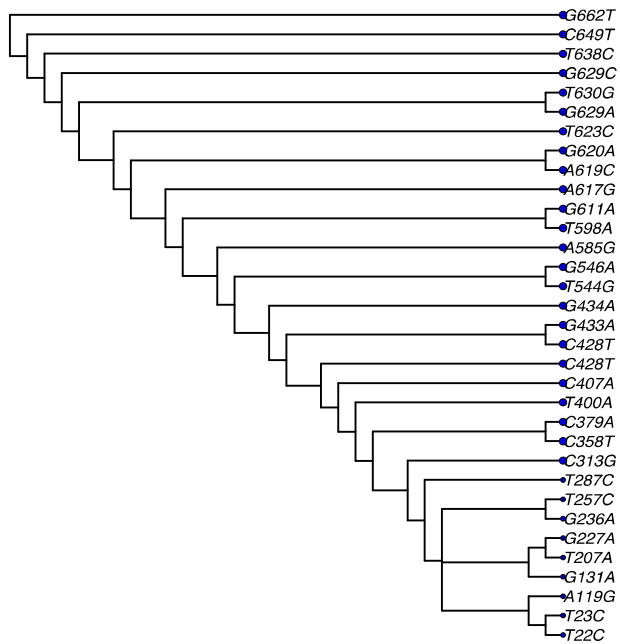


Figure 1 Mutation's in Hepatitis B

Figure 1: This phylogeny tree of Hepatitis B S-gene sequences uses 26 isolated sequences. Branch lengths are proportional to sequence divergence. The above phylogeny is used to investigate the evolutionary development of these mutations in the S-region.

2016 Hepatitis B rates by state

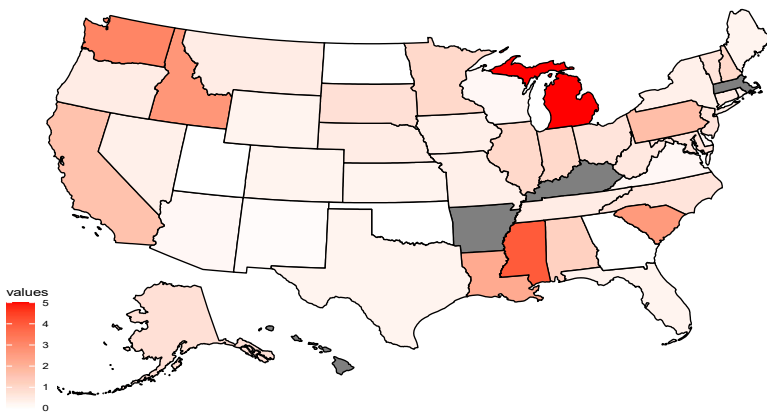


Figure 2 Hepatitis B rate in 2016

Figure 2 shows the prevalence rate of mutation on the S-gene for hepatitis B in the United States of America. In the year 2016, compared to 2020, as illustrated in Figure 3 will show states like West Virginia, Maine, and Tennessee have little to no rates for hepatitis B, while shown in Figure 3 is almost the exact opposite; states like West Virginia, Tennessee, Maine has the highest prevalence rates in the United States of America.

2020 Hepatitis B rates by state

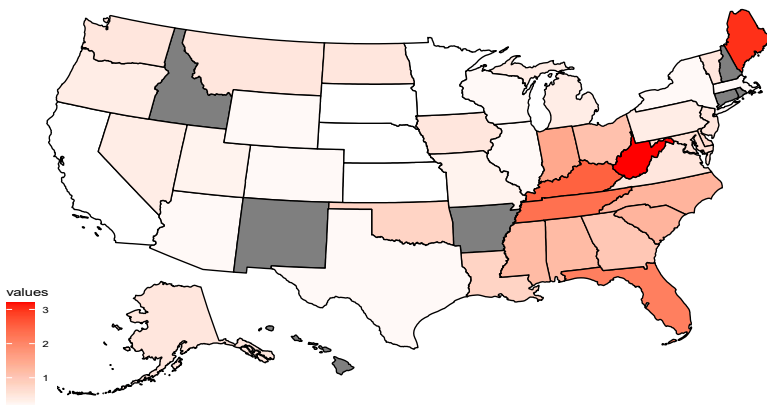


Figure 3 2020 Hepatitis B rates by state

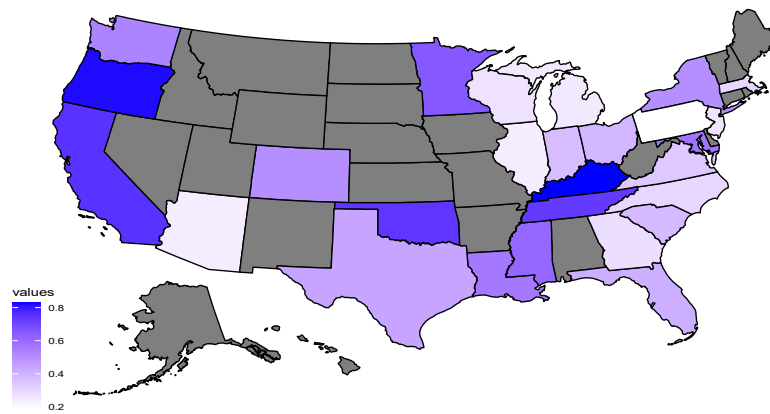
Figure 3 shows the S-gene mutation rate in states for hepatitis B in the United States of America. West Virginia and Maine had the highest mutation rate in 2020, while the other states had little to no rate of mutation for hepatitis B in the year 2020. Michigan had a high prevalence rate in 2016, but in 2020 has a \geq one prevalence rate.

Figure 3 illustrates mutation rates for Hepatitis C in 2019. West Virginia has a ≥ 4 -mutation rate at the S-gene region, while Figure 4 shows West Virginia and Indiana are \geq a 4-mutation rate. The state of Utah is ≥ 3.0 . Tennessee, Florida, South Dakota, Louisiana, and Kentucky all have a low mutational rate on the s-gene. Texas, Nebraska, and Iowa in 2019 had a 0 mutational rate in the S-region for Hepatitis C. Important to note that the states illustrated in the grey did not have any data for that specific year for hepatitis C.

Figure 4 2020 Hepatitis C rates by state

Figure 4 shows the change from 2019 to 2020. West Virginia in 2019 had a ≥ 4 out of 100,000 people, but in 2020 as illustrated dropped significantly. Maine in 2019 was ≥ 3 out of 100,000 people, but in 2020 increased the mutational rate to about ≥ 9 of 100,000 people. States that went from a little mutational rate in 2019 to 0 mutational rates in 2020 are Texas, California, Idaho, New Mexico, Colorado, Kansas, Missouri, Iowa, Virginia, South Carolina, Vermont, and Connecticut. The only state that has increased in the mutational rate from 2019 to 2020 is Maine; the remaining states decreased mutational rates or remained the same.

2020 Hepatitis B death rates



2020 Hepatitis C rates by state

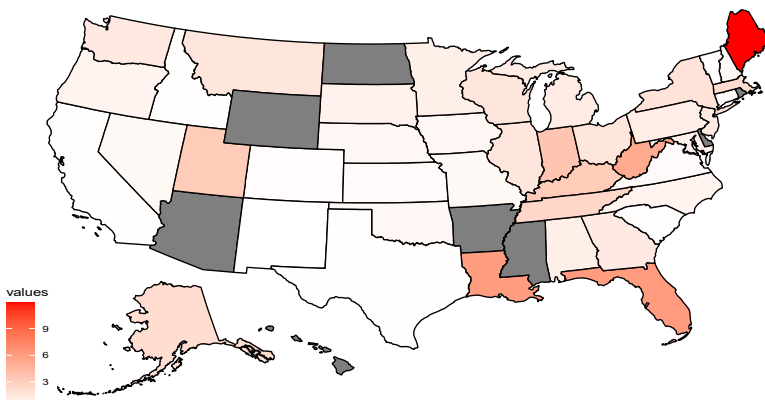


Figure 5 2020 Hepatitis B death rates

Figure 5 shows that California, Oregon, Minnesota, Kentucky, and Oklahoma all had ≥ 0.8 deaths per 100,000 people. While Texas, Colorado, Washington, Florida, Ohio, Illinois, South Carolina, and New York had ≥ 0.4 deaths per 100,000 people. The grey states were not reported in the data.

2020 hepatitis C death rates

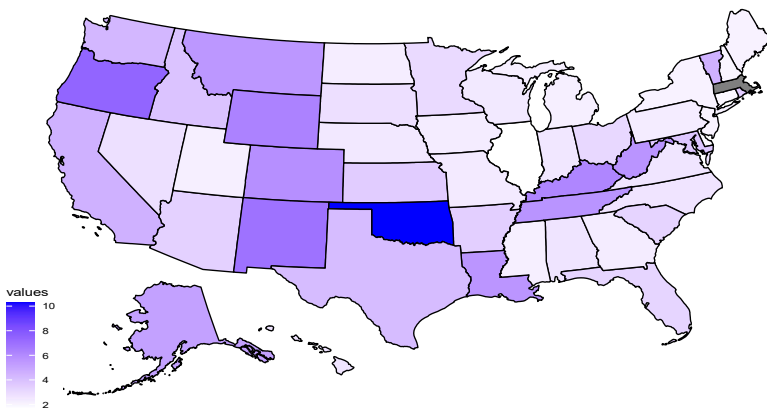


Figure 6 2020 Hepatitis C death rates

Figure 6 illustrates the death rates for each state in the United States. Oklahoma has ≥ 10 deaths per 100,000 people. Oregon has ≥ 8 deaths per 100,000 people. West Virginia, Tennessee, Kentucky, New Mexico, Kansas, Colorado, Wyoming, Montana, Vermont, and Louisiana all have ≥ 8 deaths per 100,000 people.

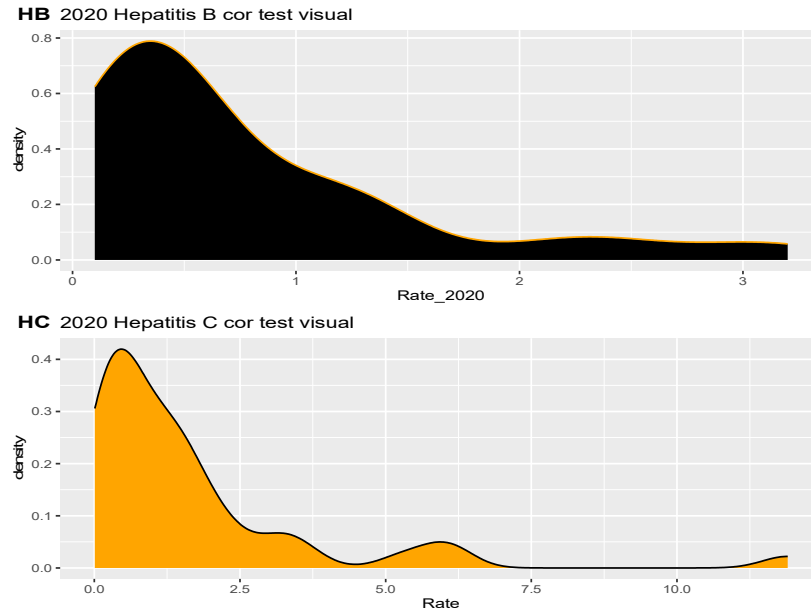


Figure 7 2020 Hepatitis B & C cor test visual rates.

Discussion:

Hepatitis B had higher mutational rates in the S-region and higher death rates the hepatitis C, but how can this be? Hepatitis C does not have a vaccine, while hepatitis B does, indicating that the vaccine isn't as effective or that there might be a higher percentage of individuals with hepatitis B.

Literature cited:

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