

# PANDEMICS

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**SOCIAL**



**ECONOMIC**

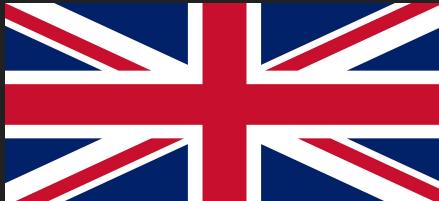


**POLITICAL**



# COVID-19 ( SARS-CoV-2)

H1N1 2009



# One of the reasons COVID-19 is so severe is due to its high transmission rate



$R_0 =$

The average number of secondary transmissions from one infected person to another [1].

More Contagious



Hepatitis C (2)



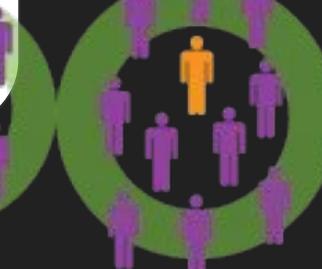
Ebola (2)



HIV (4)



SARS (4)



Mumps (10)



Measles (18)

	SARS-CoV-2	SARS-CoV	Pandemic influenza 1918	Pandemic influenza 2009	Interpretation
Transmissibility, $R_0$	2.5	2.4	2.0	1.7	SARS-CoV-2 has the highest average $R_0$
Incubation period, days	4–12	2–7	Unknown	2	Longer incubation period; SARS-CoV epidemics form slower

## 'Comparing SARS-CoV-2 with SARS-CoV and influenza pandemics' Esklid .P. et. al

	High	Low	High	High	Facilitates undetected transmission
Proportion with mild illness	High	Low	High	High	Facilitates undetected transmission
Proportion of patients requiring hospitalisation	Few (20%)	Most (>70%)	Few	Few	Concern about capacity in the health sector
Proportion of patients requiring intensive care	1/16 000	Most (40%)	Unknown	1/104 000	Concern about capacity in the health sector
Proportion of deaths in people younger than 65 years out of all deaths	0.6–2.8%	Unknown	95%	80%	SARS-CoV-2 might cause as many deaths as the 1918 influenza pandemic, but fewer years of life lost and disability-adjusted life-years, as deaths are in the older population with underlying health conditions
Risk factors for severe illness	Age, comorbidity	Age, comorbidity	Age (<60 years)	Age (<60 years)	--

Data from the following references.<sup>2,3,10–12</sup> MERS-CoV=Middle East respiratory syndrome coronavirus. SARS-CoV=severe acute respiratory syndrome coronavirus. SARS-CoV-2=severe acute respiratory syndrome coronavirus 2.

Table 1: Characteristics of SARS-CoV-2, SARS-CoV, and pandemic influenza

# HYPOTHESIS:

- COVID-19 has a higher transmission rate than H1N1.
- We will test this hypothesis through various statistical analyses using pandmeic datasets found on Kaggle .

# QUESTIONS AND REASONS

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# 1. COVID-19/H1N1: What is the trend for the “Rate of Cases” of each country?

- By comparing COVID-19 ‘Cases over Time’ in different countries we can determine who is currently doing ‘better’ or ‘worse’ during the pandemic.
- By evaluating H1N1 ‘Cases over Time’ for the SAME countries we can see if they show similar trends to our current COVID-19 pandemic.
- Based on this information future studies can evaluate why some countries might be doing better than others.
- We selected only 6 countries due to limited data in both data sets.

## 2. COVID-19/H1N1: What is the trend for the death rates of each country?

- By comparing COVID-19 death rates in different countries we can better understand who is currently doing ‘better’ or ‘worse’ during the pandemic allowing future studies to further research and understand why there might be more deaths in one country vs. the other.
- By comparing H1N1 death rates for the SAME countries we can now understand which virus lead to greater mortalities than the other.

### 3. COVID-19/H1N1: Is there a correlation between pandemic cases and deaths??

- We use the linear regression to model the relationship between cases vs deaths for COVID-19 and for H1N1.
- This will allow us to see if there is a strong or weak positive or negative correlation between pandemic cases and deaths.
- The  $R^2$  value will show that the value% of variation in one variable may be explained by the other.
- We believe that there will be a strong correlation and relationship between pandemic cases and deaths.

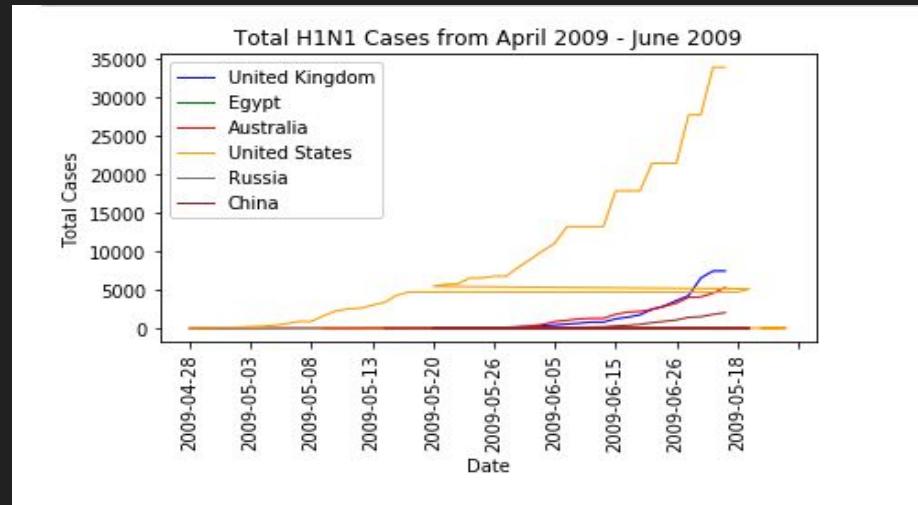
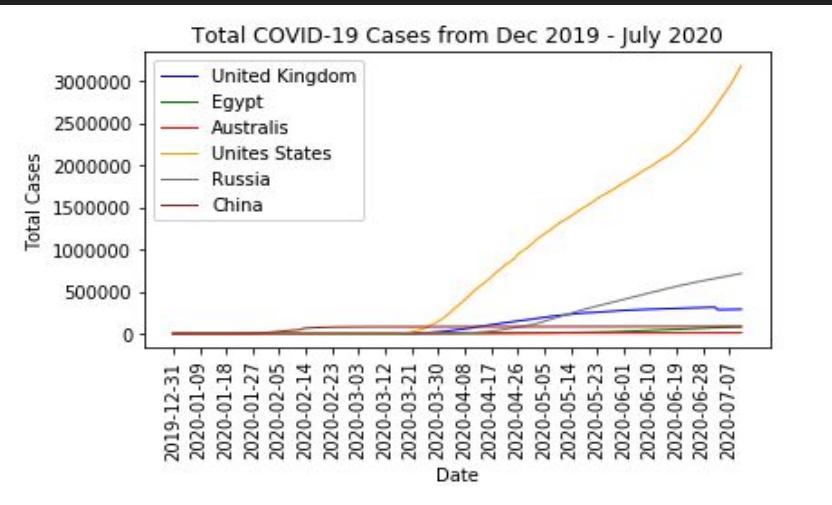
#### 4. COVID-19: Will countries with higher diabetes prevalences show greater trends for increased COVID-19 Cases?

- Patients with diabetes are often treated with ARB and ACE inhibitors [2]. With the inhibition of ACE Enzymes the amount of ACE receptors automatically increase and become readily available. Many researchers suspect that COVID-19 uses ACE2 receptors to enter the lungs in a similar mechanism to that of SARS-CoV [3]. Thus, using these drugs can potentially lead to a higher risk of contracting COVID-19.
- We use bar graphs to show the diabetes prevalence in each country and suspect that countries with higher diabetes prevalence will show greater trends in COVID-19 cases.
- By looking at the line graphs we can see which country shows a greater trend in cases.

FINDINGS

Findings

# 1. COVID-19/H1N1: What is the trend for the “Rate of Cases” of each country?



- The only countries that are plateauing are **China** and the **UK** while the rest of the countries are showing trends of increasing cases.
- The countries with the highest peaks are the **U.S.** and the **UK** at 300,000 cases in June.
- Australia was the country with the lowest peak at **9000** cases in July.

- Similar to COVID-19 the peaks were in June and July with Egypt and the U.S. having the highest peaks.
- Unlike COVID-19 number of cases were much lower.

# 1. COVID-19/H1N1: What is the trend for “Rate of Cases” of each country?

## FOR COVID-19:

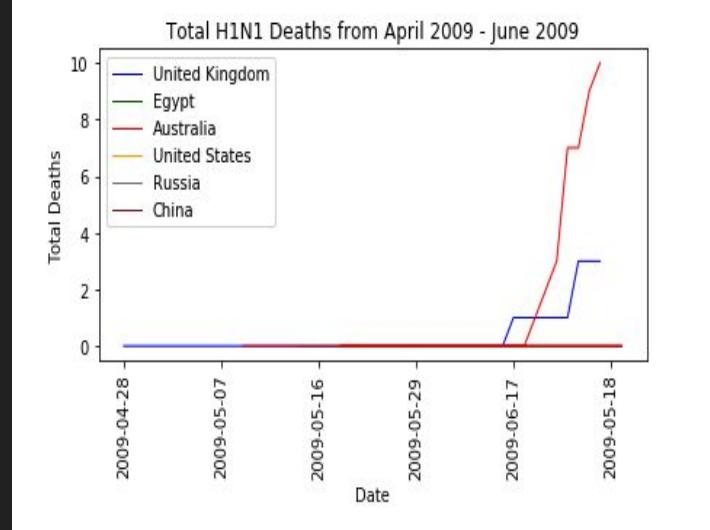
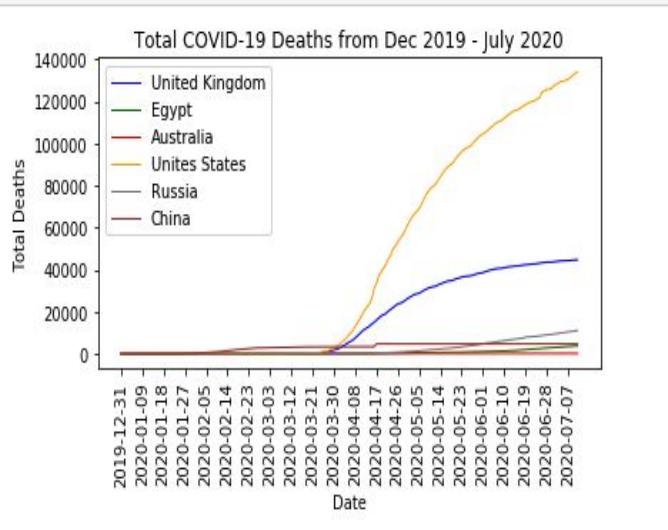
- The only countries that are plateauing are **China** and the **UK** while the rest of the countries are showing trends of increasing cases.  
**What are the UK and China doing that is driving the amount of COVID-19 cases to halt?**
- The countries with the highest peaks are the **U.S** and the **UK** at 300,000 cases in June. **Why were the highest peaks in the UK and the US similar in amount and time frame? Especially considering that the U.S population is 5 times greater than the UK ?**
- Australia was the country with the lowest peak at **9000** cases in July.  
**We need to consider that Australia has the smallest population compared to the other countries.**

# 1. COVID-19/H1N1: What is the trend for the rate of cases of each country?

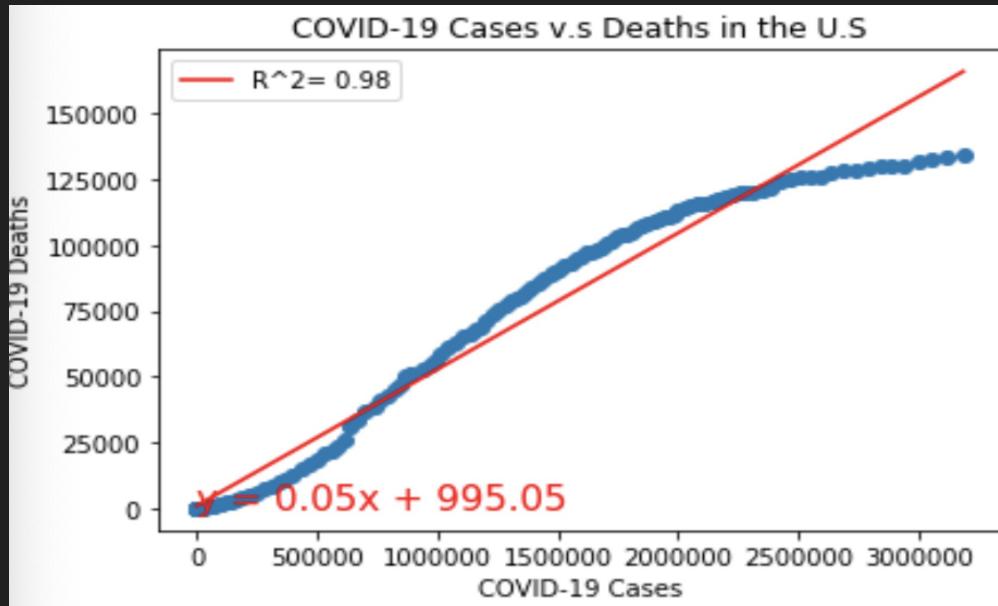
## FOR H1N1:

- Similar to COVID-19 the peaks were in June and July with **Egypt** and the **U.S** having the highest.  
*If the peaks for COVID-19 and H1N1 were during the same months of the year is there a relationship with season? Why is the U.S still having a higher peak compared to the other countries?*
- Unlike COVID-19 number of cases were much lower.  
*This supports that so far COVID-19 can potentially have a higher transmission rate than H1N1.*

## 2. COVID-19/H1N1: What is the trend for the “Death Rates” of each country?

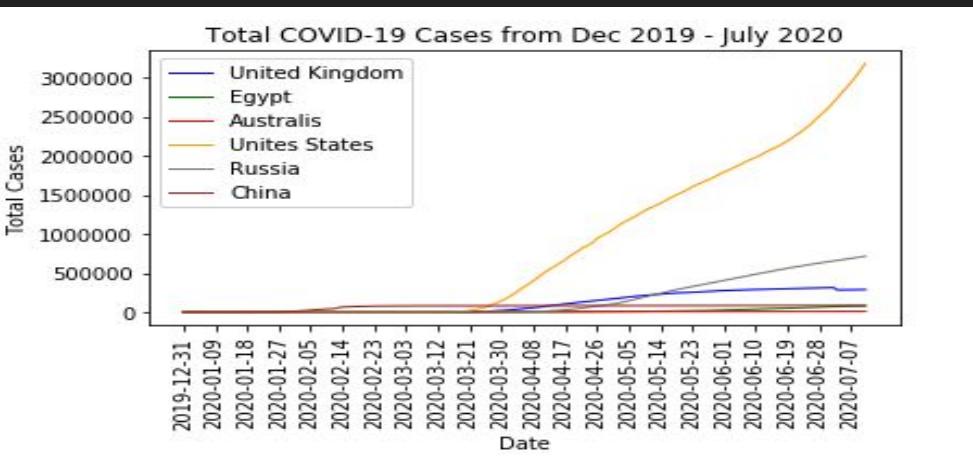


### 3. COVID-19/H1N1: Is there a correlation between pandemic cases and deaths??

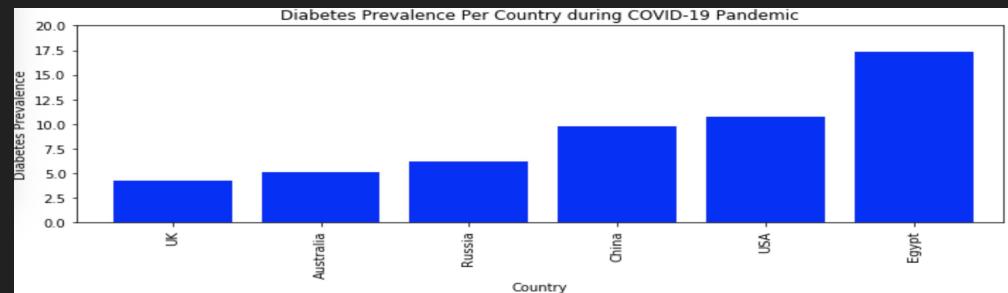


98% of the variation in one variable may be explained by the other. This is showing that there is a strong positive correlation.

## 4. COVID-19: Will countries with higher diabetes prevalences show greater trends for increased COVID-19 Cases?

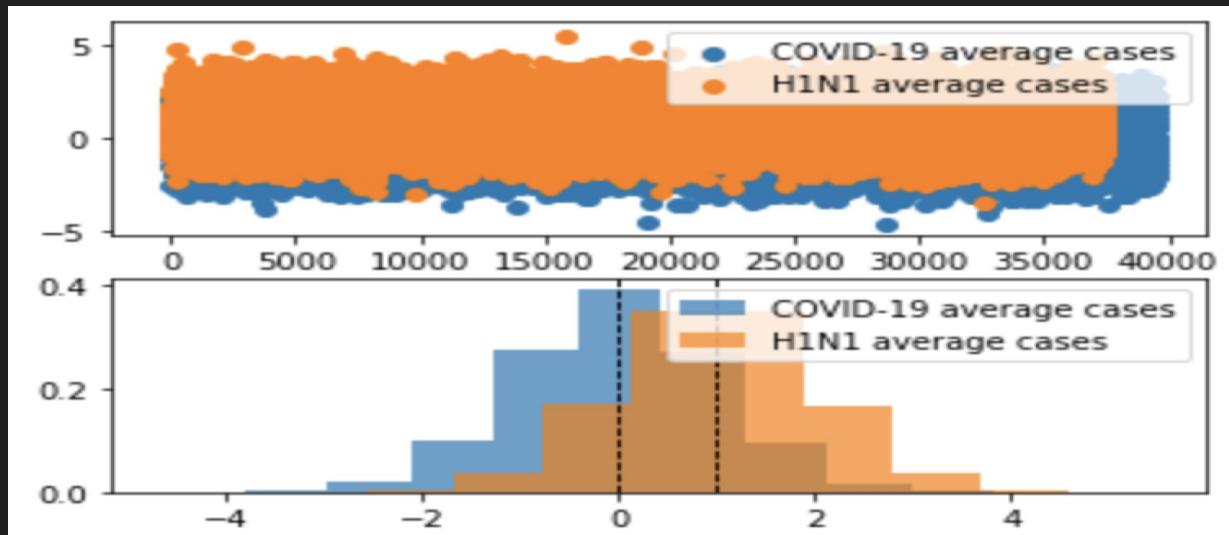


- The countries with the highest peaks are the **U.S** and the **UK** at 300,000 cases in June.
- The **U.S** and **Egypt** are the only countries increasing in death rates



# Hypothesis Testing

- COVID-19 has a higher transmission rate than H1N1.
- The Null Hypothesis is that COVID-19 does not have a higher transmission rate than H1N1.
- We test this hypothesis by comparing the average cases of COVID-19 and H1N1 in the independent T-test.
- Our P value=0 therefore we can reject the null.



```
Ttest_indResult(statistic=-138.85211566745224, pvalue=0.0)
```

# Data Cleanup & Exploration

	iso_code	continent	location	date	total_cases	new_cases	total_deaths	new_deaths	total_cases_per_million	new_case
0	AFG	Asia	Afghanistan	2019-12-31	0.0	0.0	0.0	0.0	0.0	0.0
1	AFG	Asia	Afghanistan	2020-01-01	0.0	0.0	0.0	0.0	0.0	0.0
2	AFG	Asia	Afghanistan	2020-01-02	0.0	0.0	0.0	0.0	0.0	0.0
3	AFG	Asia	Afghanistan	2020-01-03	0.0	0.0	0.0	0.0	0.0	0.0
4	AFG	Asia	Afghanistan	2020-01-04	0.0	0.0	0.0	0.0	0.0	0.0

```
Index(['iso_code', 'continent', 'location', 'date', 'total_cases', 'new_cases',
       'total_deaths', 'new_deaths', 'total_cases_per_million',
       'new_cases_per_million', 'total_deaths_per_million',
       'new_deaths_per_million', 'total_tests', 'new_tests',
       'total_tests_per_thousand', 'new_tests_per_thousand',
       'new_tests_smoothed', 'new_tests_smoothed_per_thousand', 'tests_units',
       'stringency_index', 'population', 'population_density', 'median_age',
       'aged_65_older', 'aged_70_older', 'gdp_per_capita', 'extreme_poverty',
       'cvd_death_rate', 'diabetes_prevalence', 'female_smokers',
       'male_smokers', 'handwashing_facilities', 'hospital_beds_per_thousand',
       'life_expectancy'],
      dtype='object')
```

Covid19 datasets vs. H1N1 datasets

	Date	Country	Cumulative no. of cases	Cumulative no. of deaths	Link
0	2009-04-24	Mexico	18	0	<a href="https://www.who.int/csr/don/2009_04_24/en/">https://www.who.int/csr/don/2009_04_24/en/</a>
1	2009-04-24	United States of America	7	0	<a href="https://www.who.int/csr/don/2009_04_24/en/">https://www.who.int/csr/don/2009_04_24/en/</a>
2	2009-04-26	Mexico	18	0	<a href="https://www.who.int/csr/don/2009_04_24/en/">https://www.who.int/csr/don/2009_04_24/en/</a>
3	2009-04-26	United States of America	20	0	<a href="https://www.who.int/csr/don/2009_04_24/en/">https://www.who.int/csr/don/2009_04_24/en/</a>
4	2009-04-27	Canada	6	0	<a href="https://www.who.int/csr/don/2009_04_24/en/">https://www.who.int/csr/don/2009_04_24/en/</a>

# Data Cleanup & Exploration

## Clean data

- Load the data
- Extract the countries we need to form new dataframe
- Select columns we are interested in

## Problems and insights in exploration:

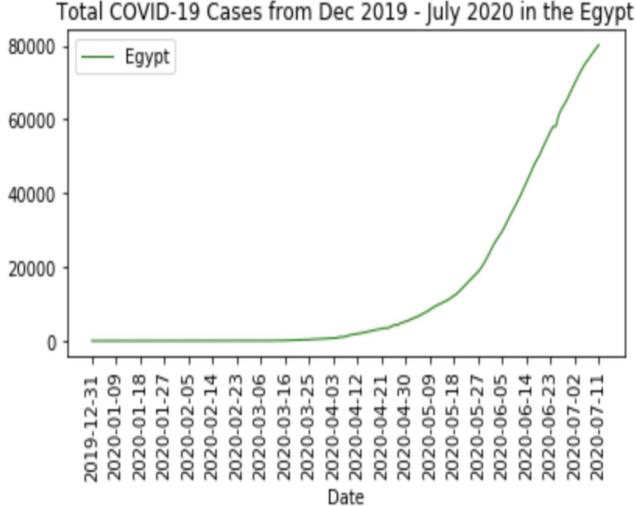
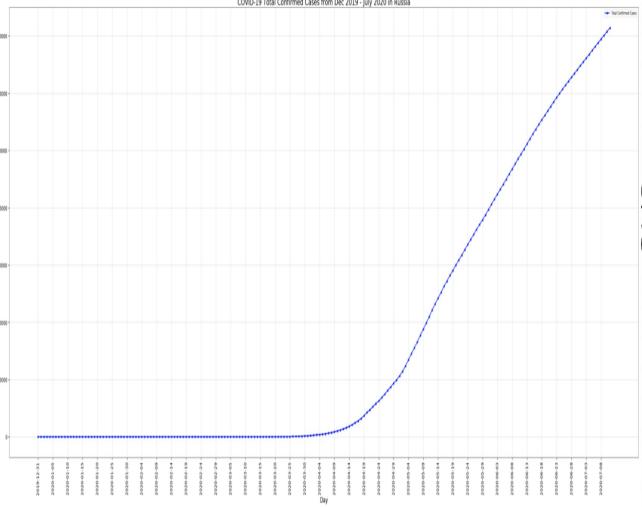
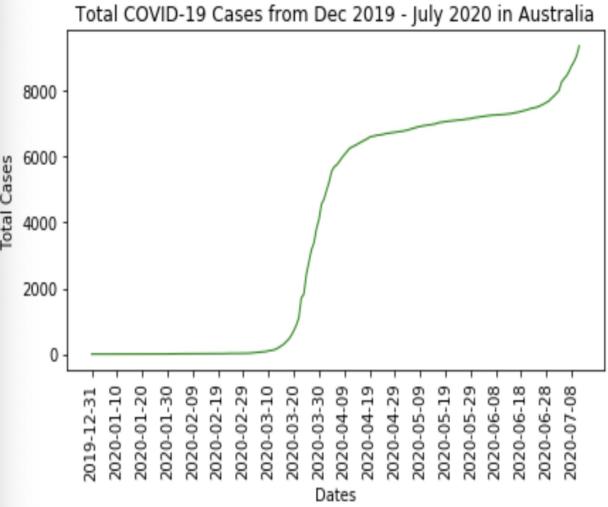
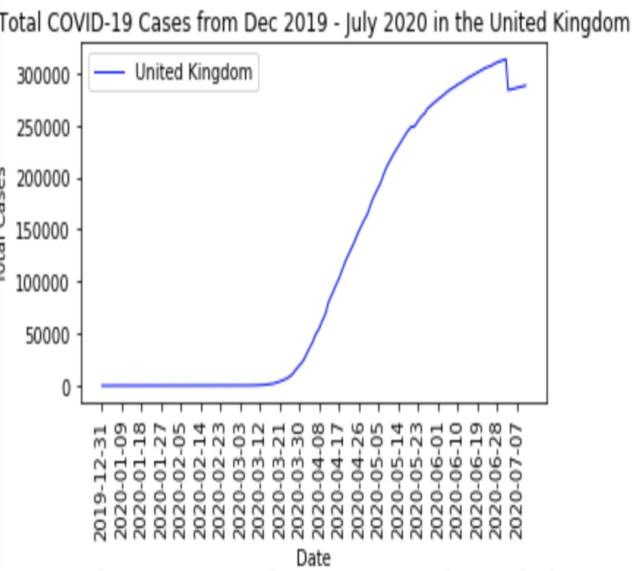
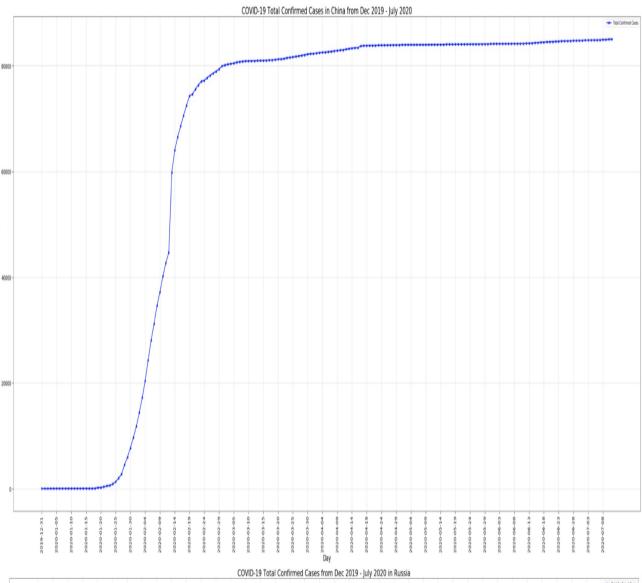
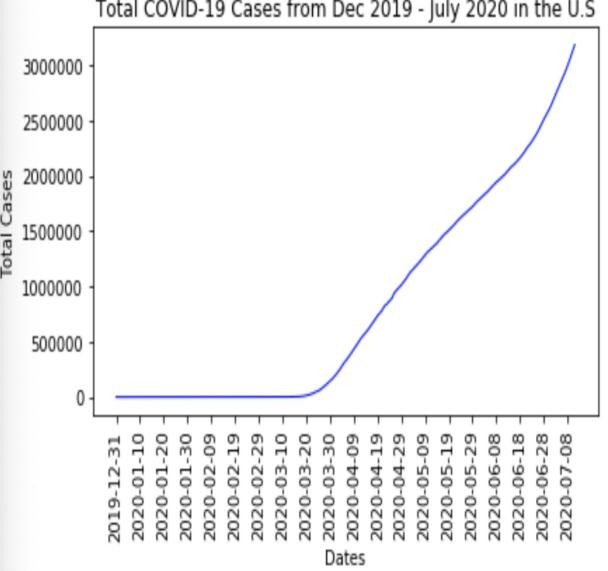
- Economic data is hard to fit in because it is based on seasons and not updated (we could not have current GDP data)
- Some data are not available to do analysis on (e.g. new tests/total tests)
- Some datasets are not complete (H1N1 deaths)
- We find data of diabetes prevalence and decide we could do analysis on it
- H1N1 dataset is less detailed than Covid19

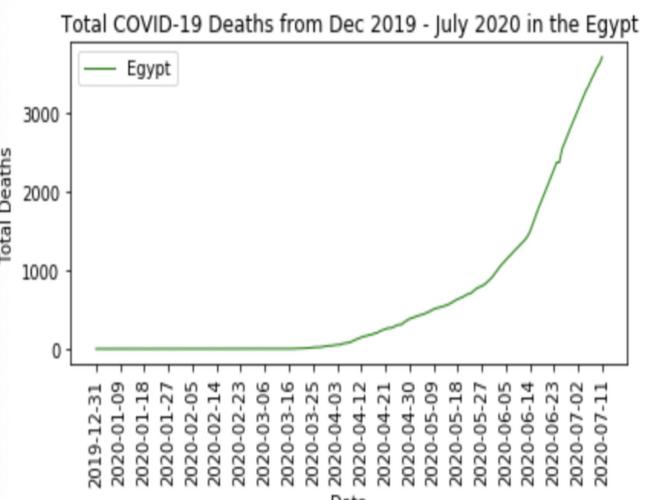
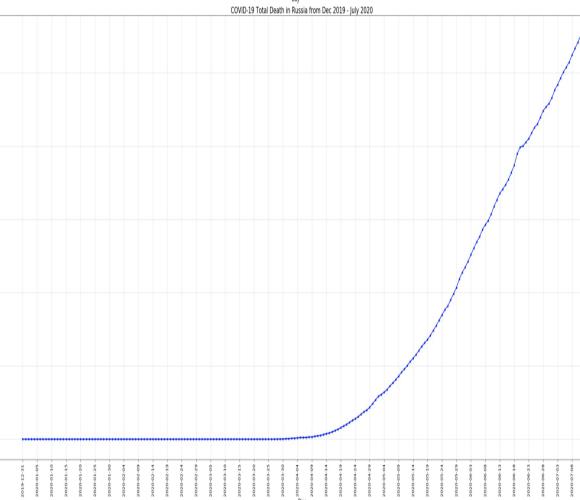
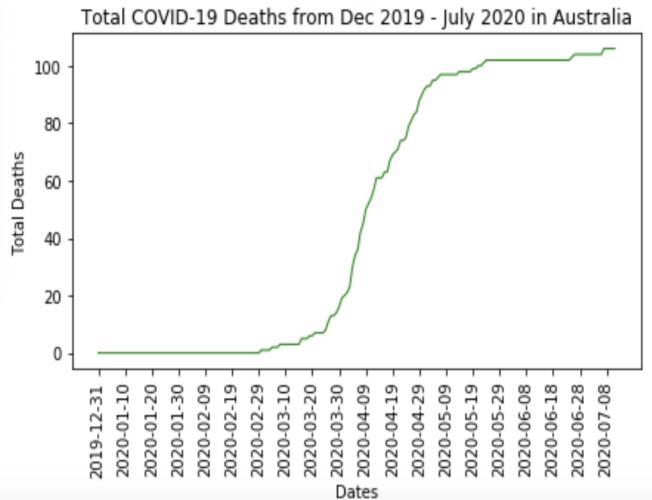
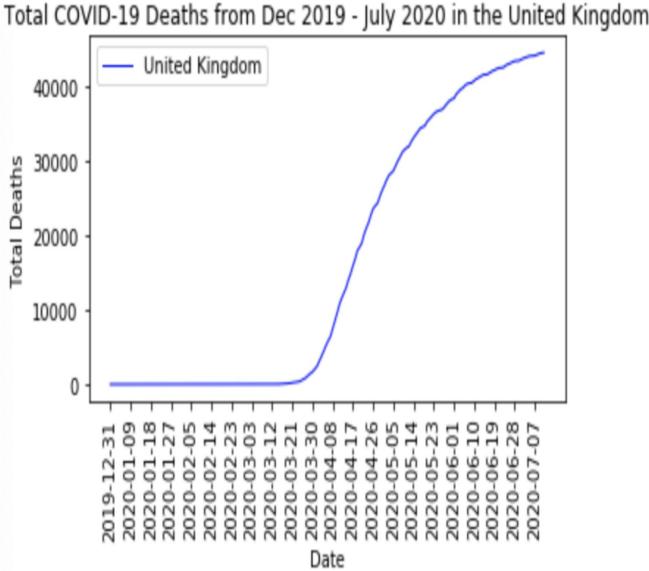
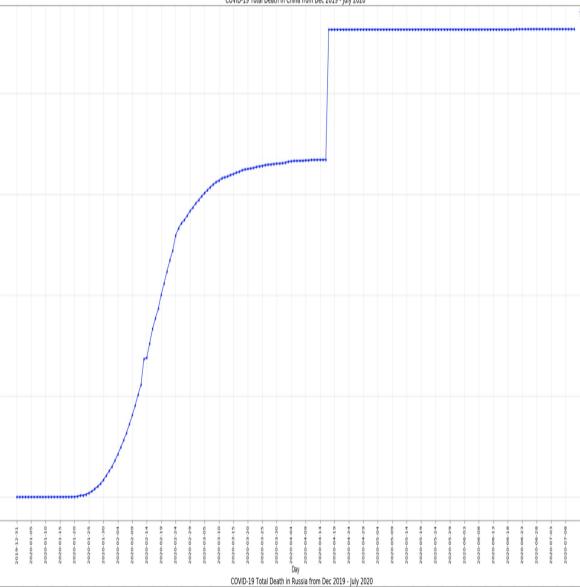
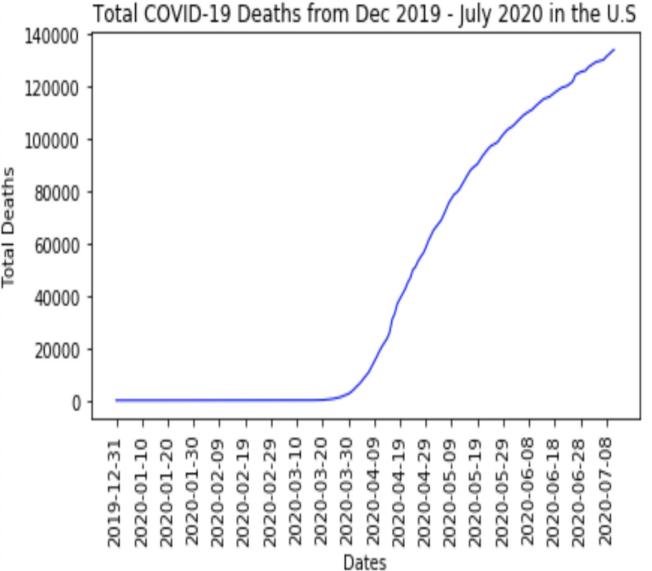
# Data analysis

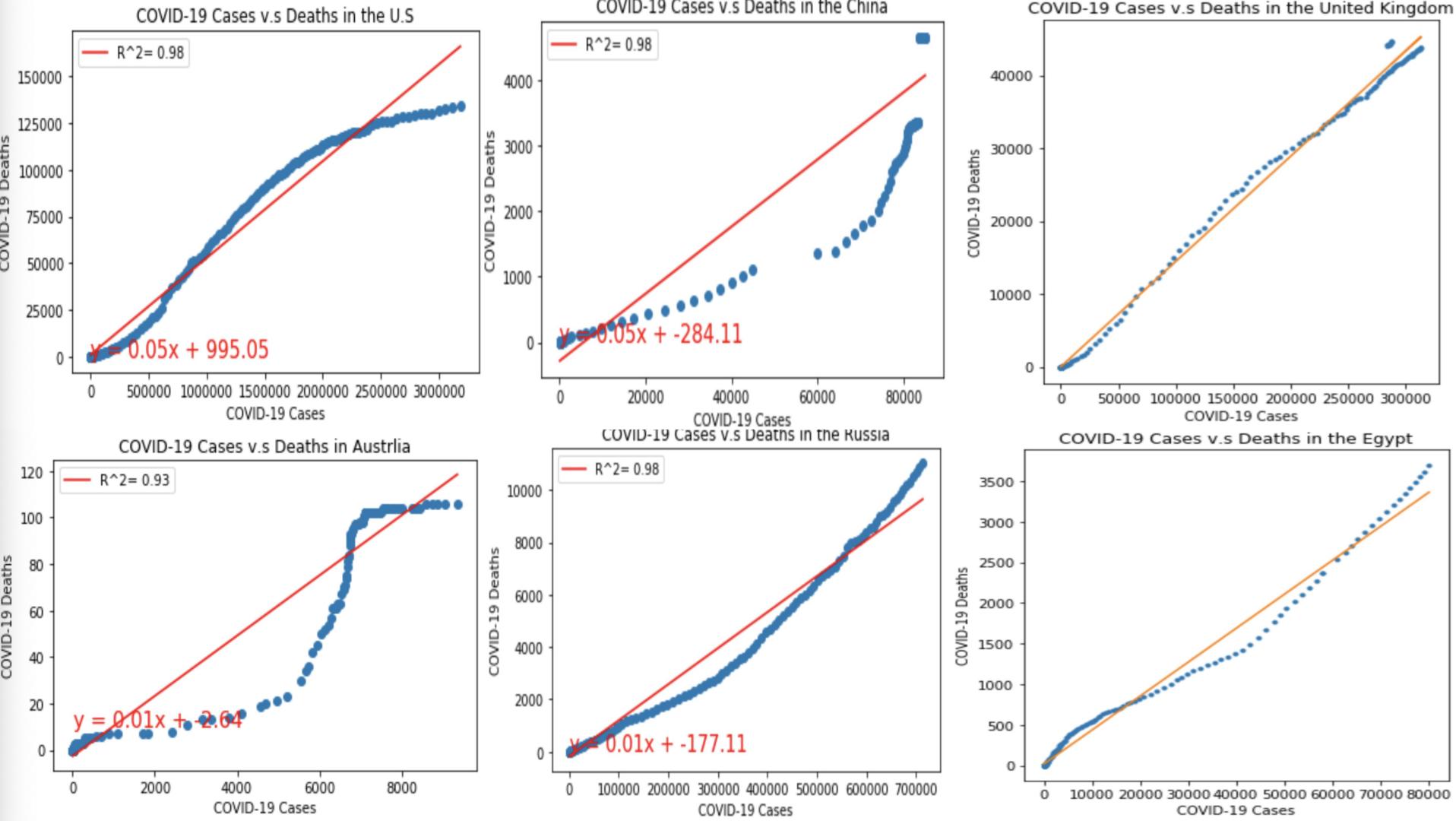
1. To answer the trend of cases and deaths of each country
  - a. Line graphs of each country's cases and deaths based on date
  - b. Since H1N1 data only has cumulative data, we chose to focus on total cases and deaths
2. To answer question of correlation
  - a. Plot the scatter plot of the total cases and deaths
  - b. Add linear regression equation to better visualize the correlation
  - c. Calculate the r and p values
3. To answer question of diabetes
  - a. Since the data is based on diabetes prevalence, we chose bar graph to better visualize the prevalence of each country
  - b. We also plot GDP per capita graph to compare it with diabetes

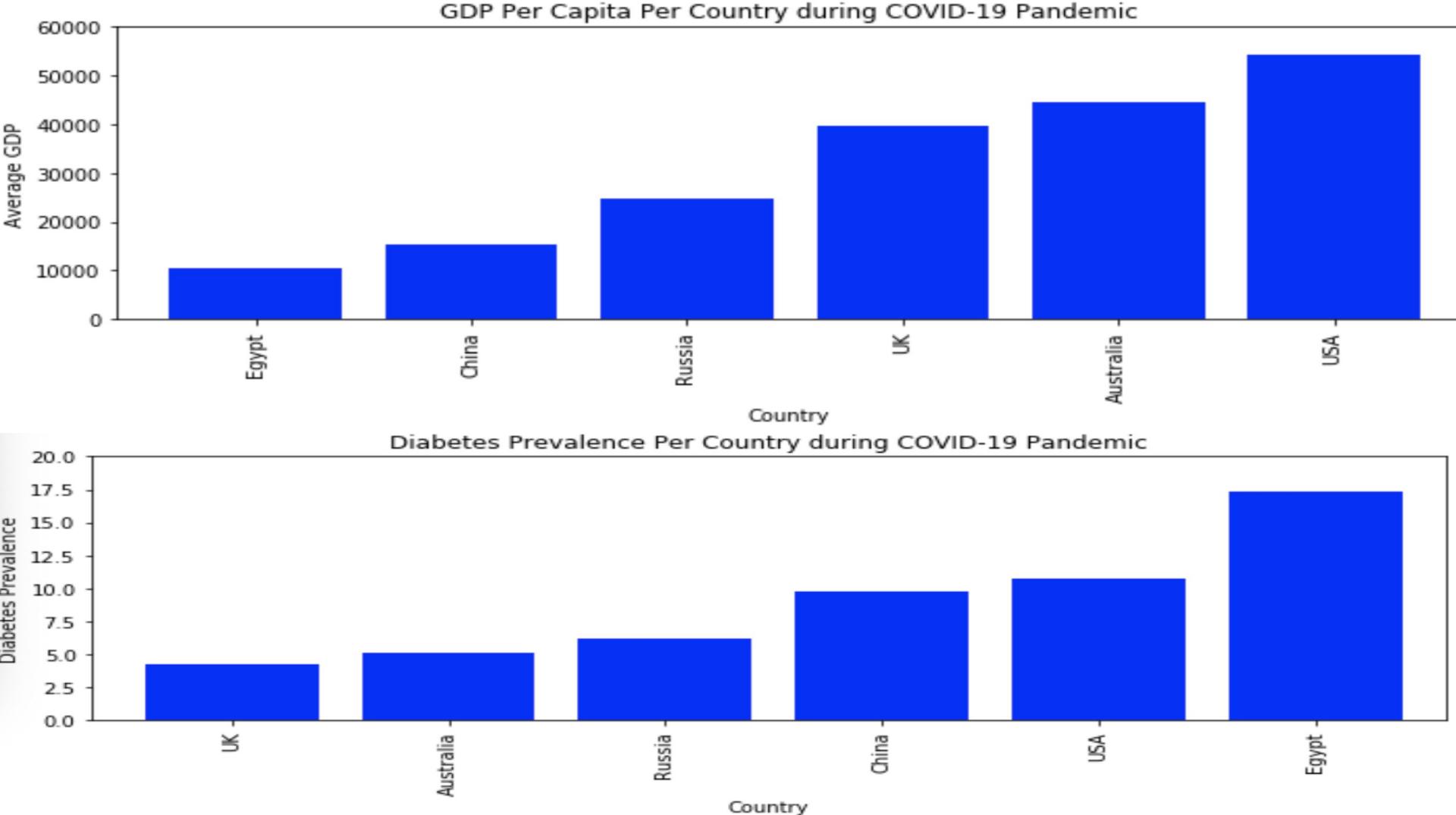
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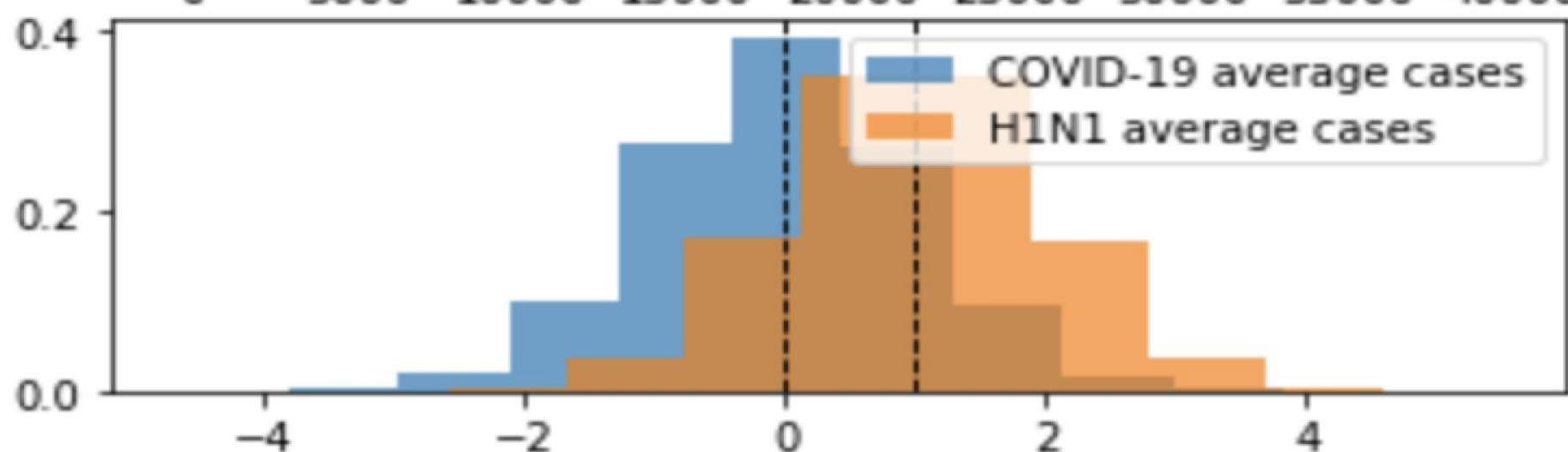
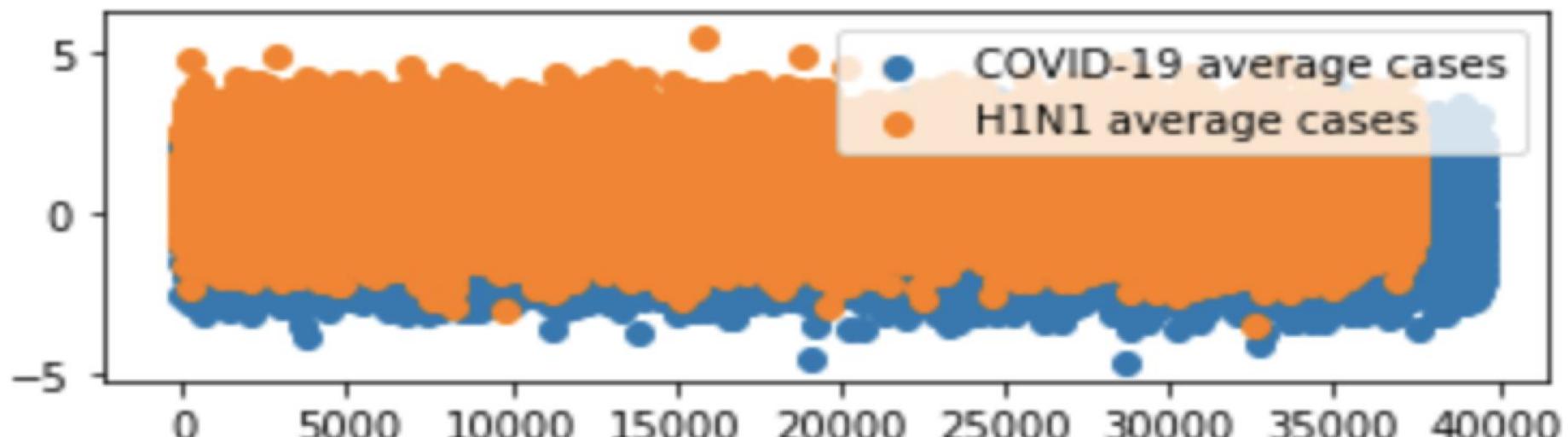
4. To compare the differences of H1N1 and Covid19
  - a. We use T test to compare the means of H1N1 and Covid19 to find out the difference of transmission rate
  - b. Along with the literature we searched, try to explain why the trend is different











# Conclusions and Lessons Learned

## Conclusions

- COVID-19 has a higher transmission rate than H1N1 supported by total cases and total deaths
- Countries with high death rates also have high diabetes prevalence

## Difficulties

- Using one comprehensive dataset on COVID-19 proved to be advantageous but comparing another limited H1N1 dataset was challenging
- Timeframes were not consistent between historic pandemic information and datasets used in analysis
- There were some technical issues with data cleaning and merging repositories

## Additional questions and next steps

- What other parameters are impactful in pandemics other than transmission rate?
  - GDP, unemployment rate, treatment options, healthcare system, government action, political climate, social distancing measures, travel restrictions

# Reference Slides

# References cited

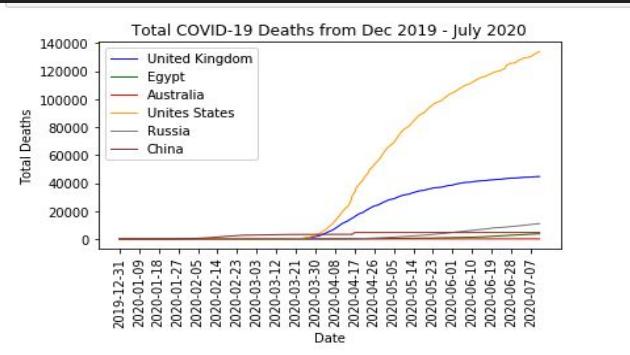
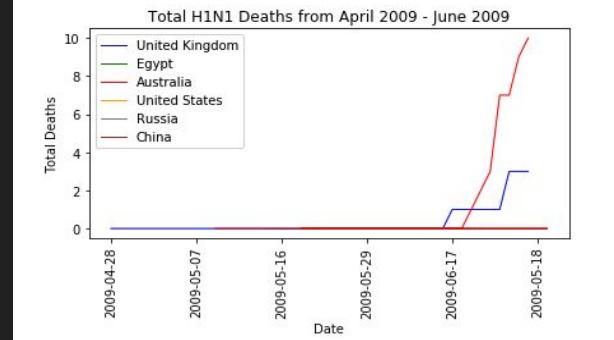
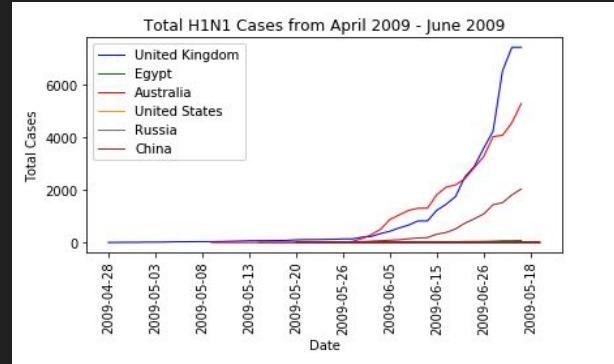
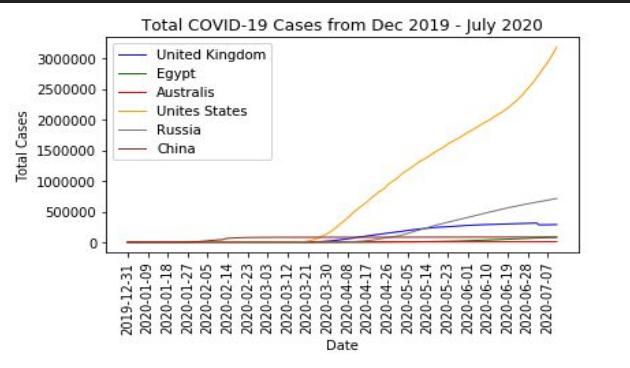
1. Esklid .P. et. al, 2020, 'Comparing SARS-CoV-2 with SARS-CoV and influenza pandemics ', [https://doi.org/10.1016/S1473-3099\(20\)30484-9](https://doi.org/10.1016/S1473-3099(20)30484-9)
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3. Juan .M. et. al, 2020, 'Outcomes in Patients with COVID-19 Infection Taking ACEI/ARB', <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7154066/>

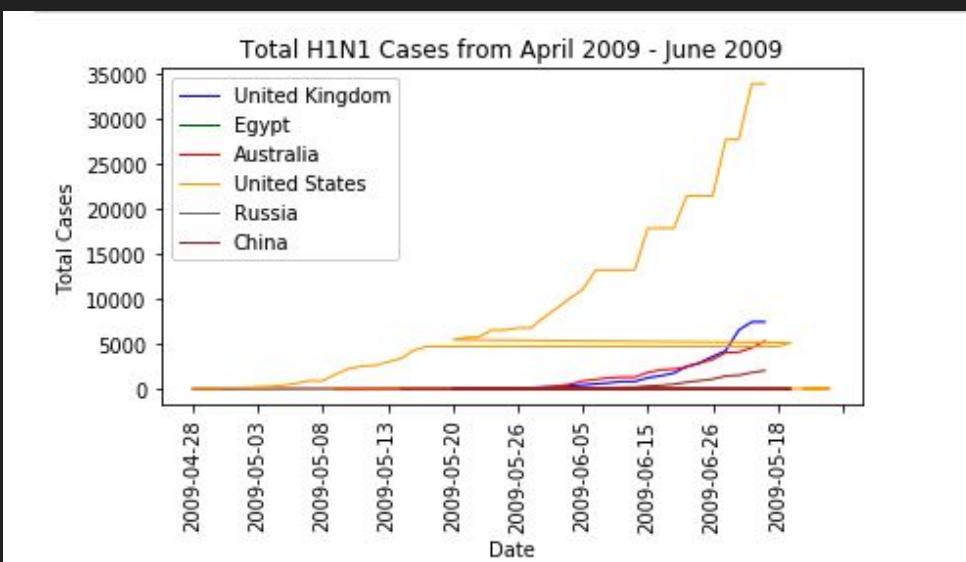
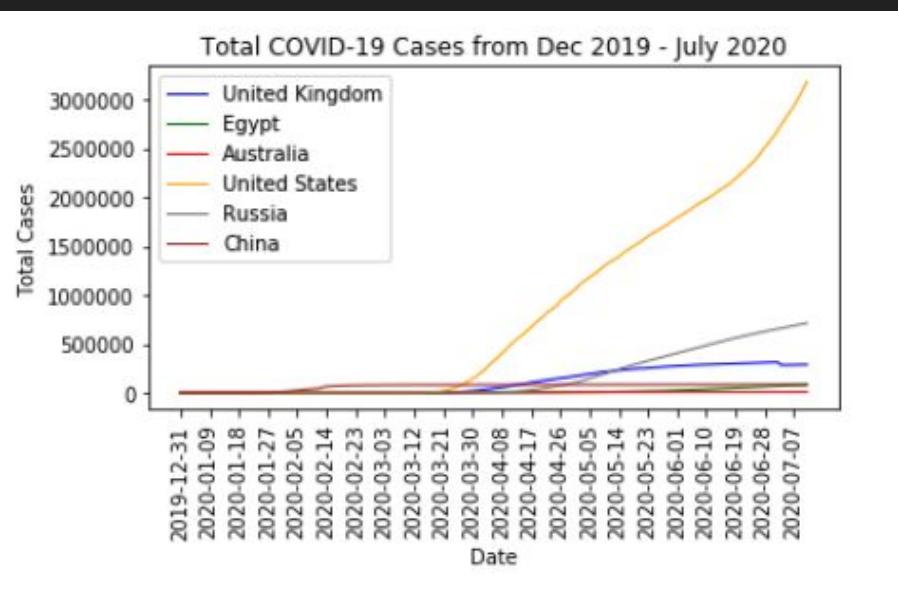
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## Images:

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4. [https://www.google.com/search?q=USA&tbm=isch&ved=2ahUKEwjr1JHv6drqAhUHAjQIHWNuCV0Q2-cCeqQIABAA&oq=USA&gs\\_lcp=CgNpbWcQAzIECAAQQzIFCAAQsQMyBAgAEEMyBAgAEEMyBQgAELEDmgUIABCxAzIECAAQQzIECAAQQzOCCAA6BwgAELEDEENQws0EWO7YBGDV2wRoAHAeACAACIAZICkqEBM5gBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=QAcVX-u0E1eE0PEP49yl6AU&bih=821&biw=1440&tbs=sur%3Afch&hl=en&hl=en#imgrc=cMIE1Razok6B4M](https://www.google.com/search?q=USA&tbm=isch&ved=2ahUKEwjr1JHv6drqAhUHAjQIHWNuCV0Q2-cCeqQIABAA&oq=USA&gs_lcp=CgNpbWcQAzIECAAQQzIFCAAQsQMyBAgAEEMyBAgAEEMyBQgAELEDmgUIABCxAzIECAAQQzIECAAQQzOCCAA6BwgAELEDEENQws0EWO7YBGDV2wRoAHAeACAACIAZICkqEBM5gBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=QAcVX-u0E1eE0PEP49yl6AU&bih=821&biw=1440&tbs=sur%3Afch&hl=en&hl=en#imgrc=cMIE1Razok6B4M)
5. [https://www.google.com/search?q=China&tbm=isch&ved=2ahUKEwjg7MqU6trqAhVqATQIHb3KAaqQ2-cCeqQIABAA&oq=China&gs\\_lcp=CgNpbWcQAzIHCAAQsQMQQzIHCAAQsQMQQzIECAAQQzIECAAQQzIFCAAQsQMyBAgAEEMyBAgAEEMyBAgAEENQxNsHWOrkB2CN5gdoAHAAeACAAWuIAdcDkgEDMy4ymAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&sclient=img&ei=jgcVX-rtMOqC0PEPvZWhwAo&bih=821&biw=1440&tbs=sur%3Afc&hl=en&hl=en#imgrc=axjQvWKDI6z7iM](https://www.google.com/search?q=China&tbm=isch&ved=2ahUKEwjg7MqU6trqAhVqATQIHb3KAaqQ2-cCeqQIABAA&oq=China&gs_lcp=CgNpbWcQAzIHCAAQsQMQQzIHCAAQsQMQQzIECAAQQzIECAAQQzIFCAAQsQMyBAgAEEMyBAgAEEMyBAgAEENQxNsHWOrkB2CN5gdoAHAAeACAAWuIAdcDkgEDMy4ymAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&sclient=img&ei=jgcVX-rtMOqC0PEPvZWhwAo&bih=821&biw=1440&tbs=sur%3Afc&hl=en&hl=en#imgrc=axjQvWKDI6z7iM)

# Pandemic Comparison





# All Countries: More Cases = More Deaths

