Load files

In [1]:

```
import pandas as pd
import warnings
warnings.filterwarnings('ignore')

covid = pd.read_csv('covid.csv')
covid = pd.DataFrame(covid)
datewise = pd.read_csv('datewise.csv')
datewise = pd.DataFrame(datewise)
countrywise = pd.read_csv('countrywise.csv')
countrywise = pd.DataFrame(countrywise)
```

In [2]:

```
covid.head()
```

Out[2]:

	Unnamed: 0	Province/State	Country/Region	Last Update	Confirmed	Deaths	Recovered	Obs
0	0	Anhui	Mainland China	1/22/2020 17:00	1.0	0.0	0.0	
1	1	Beijing	Mainland China	1/22/2020 17:00	14.0	0.0	0.0	
2	2	Chongqing	Mainland China	1/22/2020 17:00	6.0	0.0	0.0	
3	3	Fujian	Mainland China	1/22/2020 17:00	1.0	0.0	0.0	
4	4	Gansu	Mainland China	1/22/2020 17:00	0.0	0.0	0.0	

In [3]:

```
datewise.head()
```

Out[3]:

	ObservationDate	Confirmed	Recovered	Deaths	Days Since	WeekOfYear	Mortalit Rat
0	2020-01-22	555.0	28.0	17.0	0 days 00:00:00.000000000	4	3.06306
1	2020-01-23	653.0	30.0	18.0	1 days 00:00:00.000000000	4	2.75650
2	2020-01-24	941.0	36.0	26.0	2 days 00:00:00.000000000	4	2.76301
3	2020-01-25	1438.0	39.0	42.0	3 days 00:00:00.000000000	4	2.92072
4	2020-01-26	2118.0	52.0	56.0	4 days 00:00:00.000000000	4	2.64400

In [4]:

```
countrywise.index = countrywise['Country/Region']
countrywise = countrywise.drop(columns=['Country/Region'])
countrywise.head()
```

Out[4]:

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
US	2590651.0	705203.0	126140.0	4.869046	27.221073	1759308.0	831343.0
Brazil	1368195.0	757811.0	58314.0	4.262112	55.387646	552070.0	816125.0
Russia	640246.0	402778.0	9152.0	1.429451	62.909882	228316.0	411930.0
India	566840.0	334822.0	16893.0	2.980206	59.068167	215125.0	351715.0
United Kingdom	313470.0	1368.0	43659.0	13.927649	0.436405	268443.0	45027.0

In [5]:

```
grouped_country = covid.groupby(["Country/Region", "ObservationDate"]).agg(
    {"Confirmed":'sum',"Recovered":'sum',"Deaths":'sum'})
grouped_country["Active Cases"] = grouped_country[
    "Confirmed"]-grouped_country["Recovered"]-grouped_country["Deaths"]

import numpy as np
grouped_country["log_confirmed"] = np.log(grouped_country["Confirmed"])
grouped_country["log_active"] = np.log(grouped_country["Active Cases"])
```

In [6]:

```
grouped_country.head()
```

Out[6]:

Country/Region	ObservationDate	Confirmed	Recovered	Deaths	Active Cases	log_confirmed	log_
Azerbaijan	2020-02-28	1.0	0.0	0.0	1.0	0.0	
Afghanistan	2020-02-24	1.0	0.0	0.0	1.0	0.0	
	2020-02-25	1.0	0.0	0.0	1.0	0.0	
	2020-02-26	1.0	0.0	0.0	1.0	0.0	
	2020-02-27	1.0	0.0	0.0	1.0	0.0	

Clustering of Countries

The Clustering of countries can be done considering different features. Here I'm trying to cluster different countries based on the Mortality and Recovery rate of indivisual country.

As we all are well aware that COVID-19 has different Mortality Rate among different countries based on different factors and so is the Recovery Rate because of pandemic controlling practices followed by the individual country. Also Mortality Rate and Recovery Rate both together takes into account all types of cases Confirmed, Recovered and Deaths.

Let's checkout how these clusters look like!

In [7]:

```
from sklearn.preprocessing import StandardScaler

std = StandardScaler()
X = countrywise[['Mortality', 'Recovery']]
# Standard Scaling since K-Means Clustering is a distance based alogrithm
X = std.fit_transform(X)
```

In [8]:

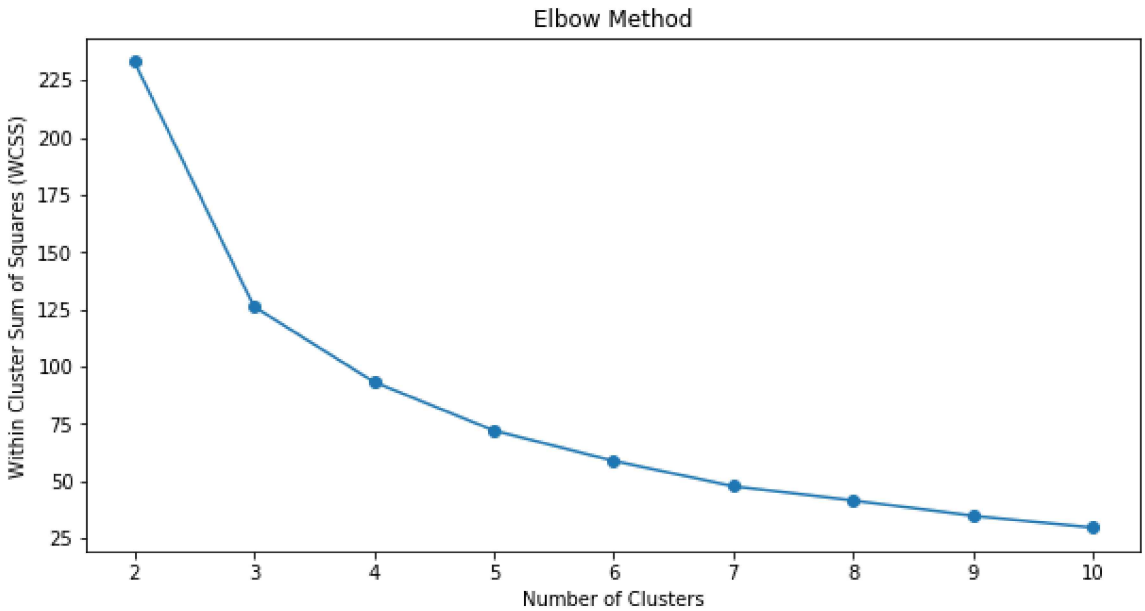
```
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score, silhouette_samples

wcss=[]
sil=[]

for i in range(2, 11):
    clf=KMeans(n_clusters=i, init='k-means++', random_state=42)
    clf.fit(X)
    labels=clf.labels_
    centroids=clf.cluster_centers_
    sil.append(silhouette_score(X, labels, metric='euclidean'))
    wcss.append(clf.inertia_)
```

In [10]:

```
import matplotlib.pyplot as plt

x = np.arange(2, 11)
plt.figure(figsize=(10, 5))
plt.plot(x, wcss, marker='o')
plt.xlabel('Number of Clusters')
plt.ylabel('Within Cluster Sum of Squares (WCSS)')
plt.title('Elbow Method')
```

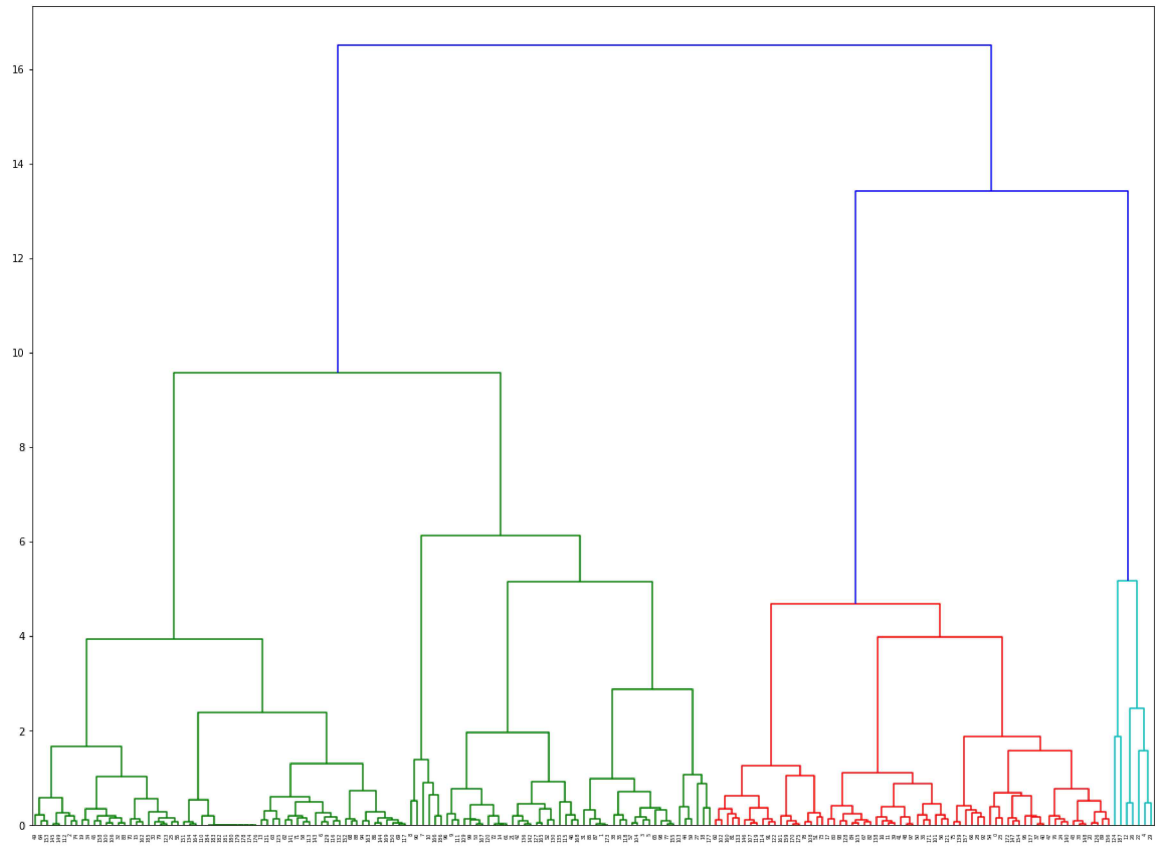
Out[10]:

```
Text(0.5, 1.0, 'Elbow Method')
```



In [11]:

```
import scipy.cluster.hierarchy as sch

plt.figure(figsize=(20, 15))
dendogram = sch.dendrogram(sch.linkage(X, method='ward'))
```



All methods namely Elbow Method and Hierarchical Clustering shows K=3 will correct number of clusters.

In [12]:

```
clf_final = KMeans(n_clusters=3, init = 'k-means++', random_state=6)
clf_final.fit(X)
```

Out[12]:

```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
       n_clusters=3, n_init=10, n_jobs=None, precompute_distances='auto',
       random_state=6, tol=0.0001, verbose=0)
```

In [13]:

```
countrywise['Clusters']=clf_final.predict(X)
```

Summary of Clusters

In [14]:

```
cluster_summary = pd.concat([countrywise[countrywise['Clusters']==1].head(15),
                             countrywise[countrywise['Clusters']==2].head(15),
                             countrywise[countrywise['Clusters']==0].head(15)])
cluster_summary.style.background_gradient(cmap='Reds')
```

Out[14]:

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
United Kingdom	313470	1368	43659	13.9276	0.436405	268443	45027
Spain	248970	150376	28346	11.3853	60.3992	70248	178722
Italy	240436	189196	34744	14.4504	78.6887	16496	223940
Mexico	220657	170147	27121	12.291	77.1093	23389	197268
France	201522	76124	29816	14.7954	37.7745	95582	105940
Belgium	61361	16941	9732	15.8602	27.6087	34688	26673
Netherlands	50433	186	6126	12.1468	0.368806	44121	6312
Hungary	4145	2685	585	14.1134	64.7768	875	3270
Yemen	1128	432	304	26.9504	38.2979	392	736
Bahamas	104	87	11	10.5769	83.6538	6	98
Western Sahara	10	8	1	10	80	1	9
MS Zaandam	9	0	2	22.2222	0	7	2
Russia	640246	402778	9152	1.42945	62.9099	228316	411930
Chile	275999	236154	5575	2.01993	85.5634	34270	241729
Iran	225205	186180	10670	4.73791	82.6713	28355	196850
Turkey	198613	171809	5115	2.57536	86.5044	21689	176924
Germany	195042	177770	8976	4.60209	91.1445	8296	186746
Saudi Arabia	186436	127118	1599	0.857667	68.1832	57719	128717
Canada	105830	68698	8628	8.1527	64.9135	28504	77326
Qatar	95106	80170	113	0.118815	84.2954	14823	80283
Mainland China	84780	79619	4641	5.47417	93.9125	520	84260
Belarus	61790	45213	387	0.626315	73.172	16190	45600
United Arab Emirates	48246	37076	314	0.650831	76.8478	10856	37390
Kuwait	45524	36313	350	0.768825	79.7667	8861	36663
Singapore	43661	37985	26	0.0595497	86.9998	5650	38011
Portugal	41912	27205	1568	3.74117	64.9098	13139	28773
Switzerland	31652	29100	1962	6.19866	91.9373	590	31062
US	2.59065e+06	705203	126140	4.86905	27.2211	1.75931e+06	831343
Brazil	1.3682e+06	757811	58314	4.26211	55.3876	552070	816125
India	566840	334822	16893	2.98021	59.0682	215125	351715
Peru	282365	171159	9504	3.36586	60.6162	101702	180663
Pakistan	209337	98503	4304	2.05601	47.0547	106530	102807
South Africa	144264	70614	2529	1.75304	48.9478	71121	73143
Bangladesh	141801	57780	1783	1.2574	40.7472	82238	59563

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
Colombia	91995	38345	3256	3.53932	41.6816	50394	41601
Sweden	67667	0	5310	7.84725	0	62357	5310
Egypt	66754	17951	2872	4.30236	26.8913	45931	20823
Argentina	62268	21138	1280	2.05563	33.9468	39850	22418
Ecuador	55665	27430	4502	8.08767	49.2769	23733	31932
Indonesia	55092	23800	2805	5.09148	43.2005	28487	26605
Iraq	47151	22974	1839	3.90024	48.7243	22338	24813
Ukraine	44538	19679	1161	2.60676	44.1847	23698	20840

In [15]:

```
print('Average Mortality Rate of Cluster 0: ', countrywise[countrywise['Clusters']==0]['Mortality'].mean())
print('Average Recovery Rate of Cluster 0: ', countrywise[countrywise['Clusters']==0]['Recovery'].mean())
print('Average Mortality Rate of Cluster 1: ', countrywise[countrywise['Clusters']==1]['Mortality'].mean())
print('Average Recovery Rate of Cluster 1: ', countrywise[countrywise['Clusters']==1]['Recovery'].mean())
print('Average Mortality Rate of Cluster 2: ', countrywise[countrywise['Clusters']==2]['Mortality'].mean())
print('Average Recovery Rate of Cluster 2: ', countrywise[countrywise['Clusters']==2]['Recovery'].mean())
```

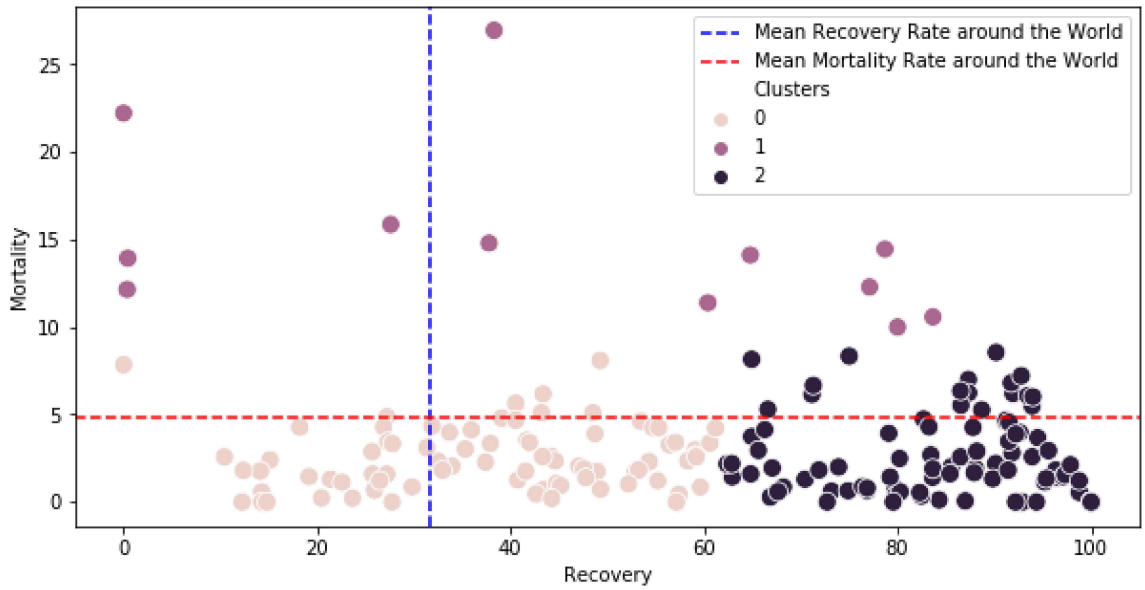
```
Average Mortality Rate of Cluster 0:  2.5046428205639253
Average Recovery Rate of Cluster 0:  38.570326586284374
Average Mortality Rate of Cluster 1:  14.893311251727345
Average Recovery Rate of Cluster 1:  45.75952305119821
Average Mortality Rate of Cluster 2:  2.549667336198441
Average Recovery Rate of Cluster 2:  85.00216396833275
```

In [16]:

```
import seaborn as sns

plt.figure(figsize=(10, 5))
sns.scatterplot(x=countrywise['Recovery'], y=countrywise['Mortality'],
                hue=countrywise['Clusters'], s=100)
plt.axvline(((datewise['Recovered']/datewise['Confirmed'])*100).mean(),
            color='blue', linestyle='--', label='Mean Recovery Rate around the World')
plt.axhline(((datewise['Deaths']/datewise['Confirmed'])*100).mean(),
            color='red', linestyle='--', label='Mean Mortality Rate around the World')
plt.legend()
```

Out[16]:

<matplotlib.legend.Legend at 0x14da36a9588>



In [17]:

```
print('Few Countries belonging to Cluster 0: ', list(countrywise[countrywise['Clusters']==0].hea
d(10).index))
print('Few Countries belonging to Cluster 1: ', list(countrywise[countrywise['Clusters']==1].hea
d(10).index))
print('Few Countries belonging to Cluster 2: ', list(countrywise[countrywise['Clusters']==2].hea
d(10).index))
```

```
Few Countries belonging to Cluster 0:  ['US', 'Brazil', 'India', 'Peru', 'Pakista
n', 'South Africa', 'Bangladesh', 'Colombia', 'Sweden', 'Egypt']
Few Countries belonging to Cluster 1:  ['United Kingdom', 'Spain', 'Italy', 'Mexic
o', 'France', 'Belgium', 'Netherlands', 'Hungary', 'Yemen', 'Bahamas']
Few Countries belonging to Cluster 2:  ['Russia', 'Chile', 'Iran', 'Turkey', 'Germ
any', 'Saudi Arabia', 'Canada', 'Qatar', 'Mainland China', 'Belarus']
```

Cluster 1 is a set of countries which have really High Mortality Rate and considerably Good Recovery Rate. Basically few countries among these clusters have seen already the worst of this pandemic but are now recovering with healthy Recovery Rate.

Cluster 2 is a set of countries which have Low Mortality Rate and really High Recovery Rate. These are the set of countries who has been able to control the COVID-19 by following pandemic controlling practices rigorously.

Cluster 0 is a set of countries which have Low Mortality Rate and really Low Recovery Rate. These countries need to pace up their Recovery Rate to get out it, Some these countries have really high nuber of Infected Cases but Low Mortality is positive sign out of it.

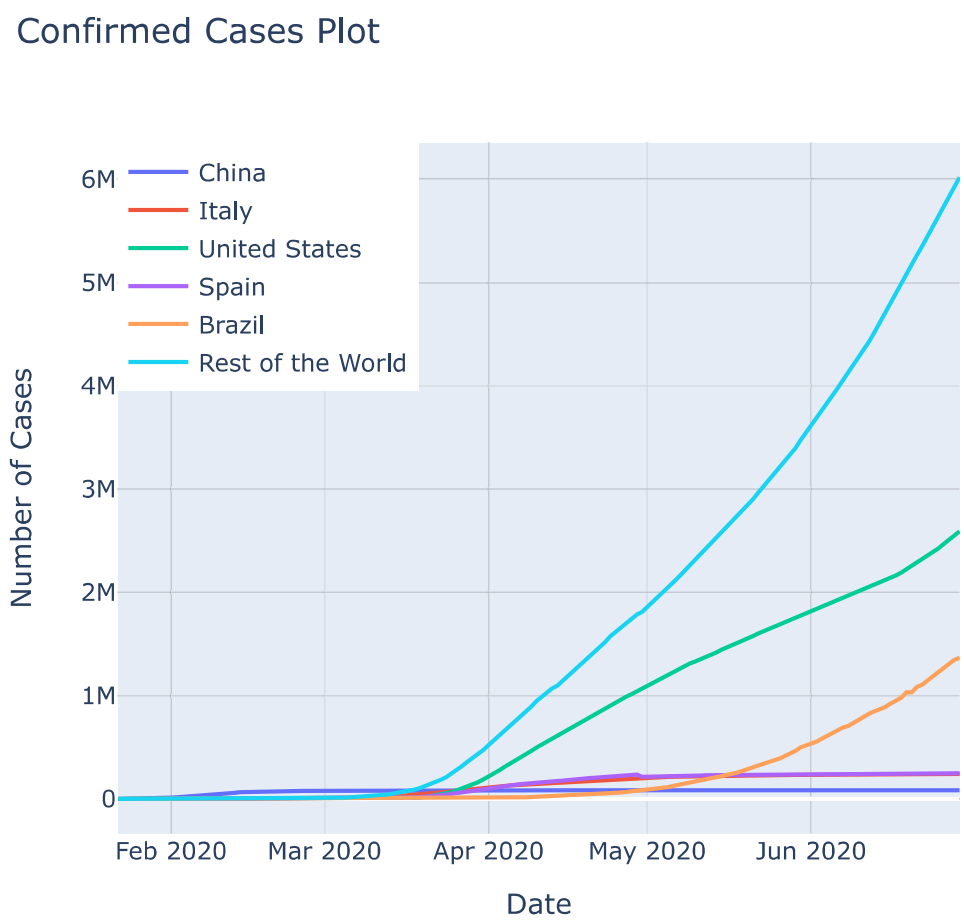
Comparison of China, Italy, US, Spain, Brazil and Rest of the World

In [18]:

```
china = covid[covid['Country/Region']=='Mainland China']
Italy = covid[covid['Country/Region']=='Italy']
US = covid[covid['Country/Region']=='US']
spain = covid[covid['Country/Region']=='Spain']
brazil = covid[covid['Country/Region']=='Brazil']

rest = covid[(covid['Country/Region']!='Mainland China')&
             (covid['Country/Region']!='Italy')&
             (covid['Country/Region']!='US')&
             (covid['Country/Region']!='([Spain')&
             (covid['Country/Region']!='Brazil')]

datewise_china = china.groupby(['ObservationDate']).agg({"Confirmed":'sum',
                          "Recovered" : 'sum', "Deaths" : 'sum'})
datewise_Italy = Italy.groupby(['ObservationDate']).agg({"Confirmed":'sum',
                          "Recovered" : 'sum', "Deaths" : 'sum'})
datewise_US = US.groupby(['ObservationDate']).agg({"Confirmed":'sum',
                          "Recovered" : 'sum', "Deaths" : 'sum'})
datewise_spain = spain.groupby(['ObservationDate']).agg({"Confirmed":'sum',
                          "Recovered" : 'sum', "Deaths" : 'sum'})
datewise_brazil = brazil.groupby(['ObservationDate']).agg({"Confirmed":'sum',
                          "Recovered" : 'sum', "Deaths" : 'sum'})
datewise_rest = rest.groupby(['ObservationDate']).agg({"Confirmed":'sum',
                          "Recovered" : 'sum', "Deaths" : 'sum'})
```

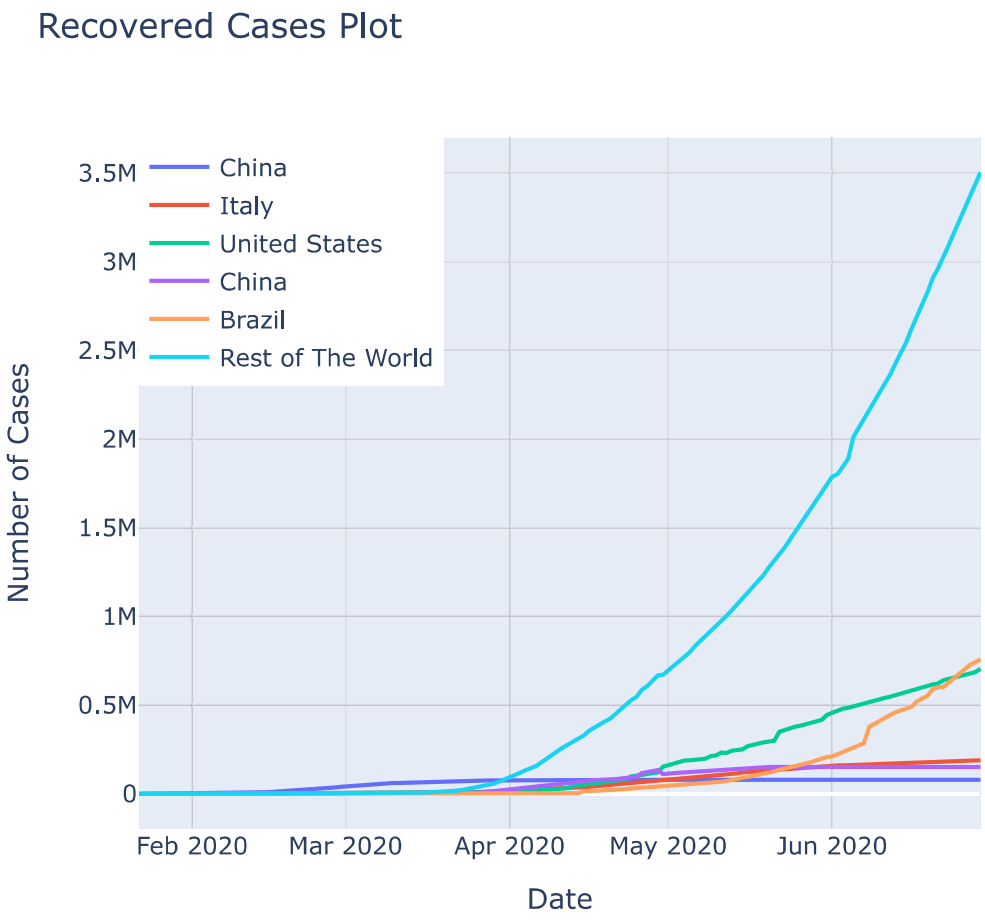
In [19]:

```
import plotly.graph_objects as go

fig=go.Figure()
fig.add_trace(go.Scatter(x=datewise_china.index, y=(datewise_china['Confirmed']),
                         mode='lines', name='China'))
fig.add_trace(go.Scatter(x=datewise_Italy.index, y=(datewise_Italy['Confirmed']),
                         mode='lines', name='Italy'))
fig.add_trace(go.Scatter(x=datewise_US.index, y=(datewise_US['Confirmed']),
                         mode='lines', name='United States'))
fig.add_trace(go.Scatter(x=datewise_spain.index, y=(datewise_spain['Confirmed']),
                         mode='lines', name='Spain'))
fig.add_trace(go.Scatter(x=datewise_brazil.index, y=(datewise_brazil['Confirmed']),
                         mode='lines', name='Brazil'))
fig.add_trace(go.Scatter(x=datewise_rest.index, y=(datewise_rest['Confirmed']),
                         mode='lines', name='Rest of the World'))


fig.update_layout(title='Confirmed Cases Plot',
                  xaxis_title='Date', yaxis_title='Number of Cases',
                  legend=dict(x=0, y=1, traceorder='normal'))
fig.show()
```



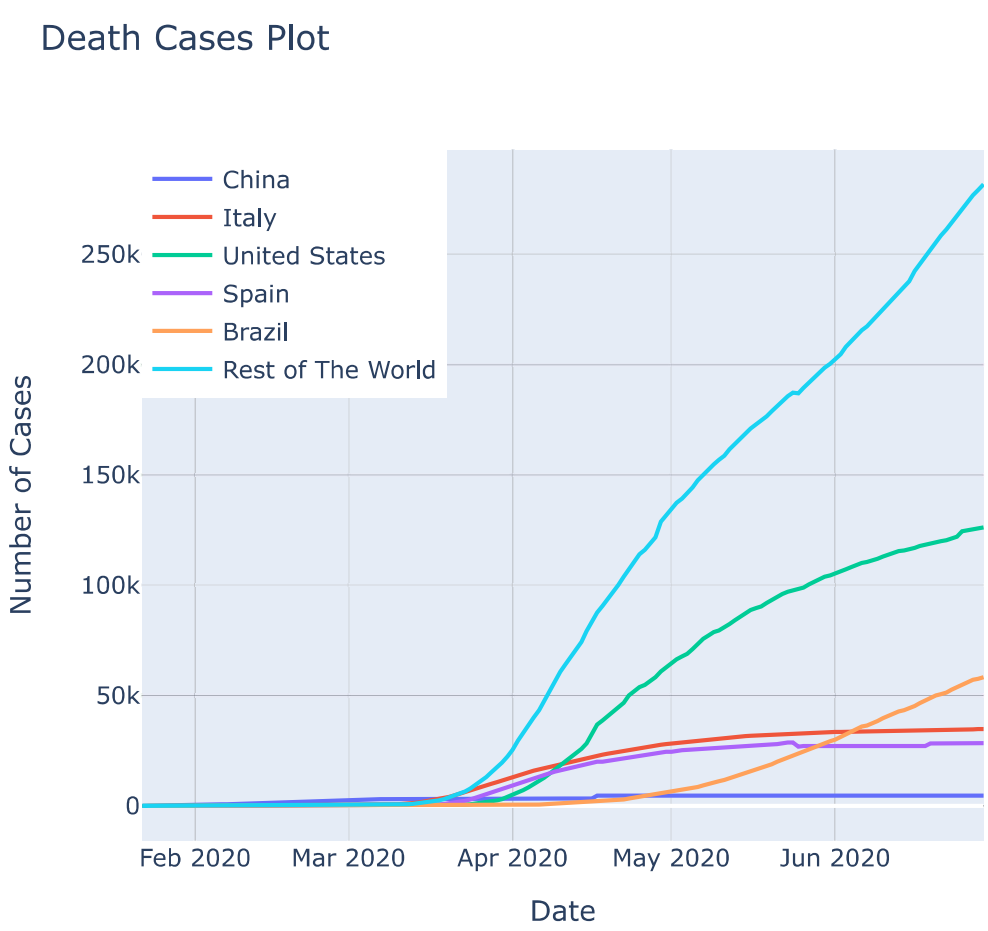
In [20]:

```
fig=go.Figure()
fig.add_trace(go.Scatter(x=datewise_china.index, y=(datewise_china['Recovered']),
                         mode='lines', name='China'))
fig.add_trace(go.Scatter(x=datewise_Italy.index, y=(datewise_Italy['Recovered']),
                         mode='lines', name='Italy'))
fig.add_trace(go.Scatter(x=datewise_US.index, y=(datewise_US['Recovered']),
                         mode='lines', name='United States'))
fig.add_trace(go.Scatter(x=datewise_spain.index, y=(datewise_spain['Recovered']),
                         mode='lines', name='China'))
fig.add_trace(go.Scatter(x=datewise_brazil.index, y=(datewise_brazil['Recovered']),
                         mode='lines', name='Brazil'))
fig.add_trace(go.Scatter(x=datewise_rest.index, y=(datewise_rest['Recovered']),
                         mode='lines', name='Rest of The World'))

fig.update_layout(title='Recovered Cases Plot',
                  xaxis_title='Date', yaxis_title='Number of Cases',
                  legend=dict(x=0, y=1, traceorder='normal'))
fig.show()
```



In [21]:

```
fig=go.Figure()
fig.add_trace(go.Scatter(x=datewise_china.index, y=(datewise_china['Deaths']),
                         mode='lines', name='China'))
fig.add_trace(go.Scatter(x=datewise_Italy.index, y=(datewise_Italy['Deaths']),
                         mode='lines', name='Italy'))
fig.add_trace(go.Scatter(x=datewise_US.index, y=(datewise_US['Deaths']),
                         mode='lines', name='United States'))
fig.add_trace(go.Scatter(x=datewise_spain.index, y=(datewise_spain['Deaths']),
                         mode='lines', name='Spain'))
fig.add_trace(go.Scatter(x=datewise_brazil.index, y=(datewise_brazil['Deaths']),
                         mode='lines', name='Brazil'))
fig.add_trace(go.Scatter(x=datewise_rest.index, y=(datewise_rest['Deaths']),
                         mode='lines', name='Rest of The World'))

fig.update_layout(title='Death Cases Plot',
                  xaxis_title='Date', yaxis_title='Number of Cases',
                  legend=dict(x=0, y=1, traceorder='normal'))
fig.show()
```



China has been able to 'flatten the curve' looking at their graphs of Confirmed and Death Cases. With staggering Recovery Rate.

US seems to have good control on Deaths, but number of people affected is going way out of hand.

In [22]:

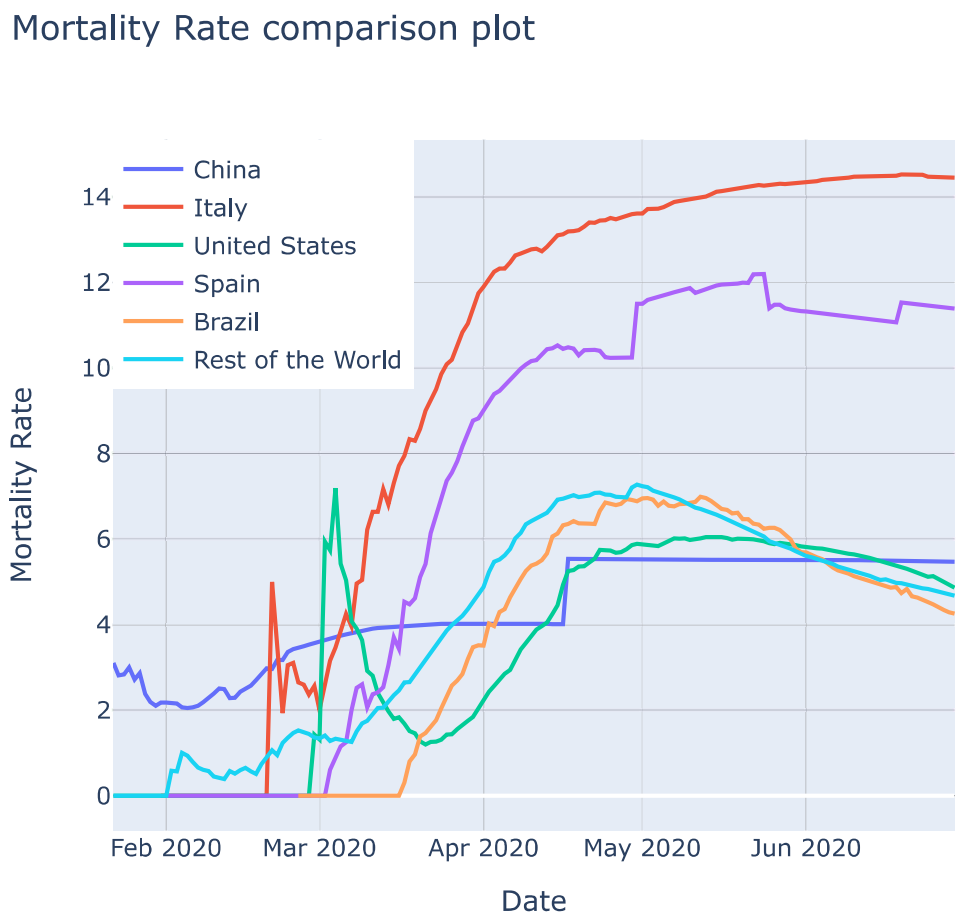
```
# View entire dataframe
pd.set_option('display.max_rows', None)
pd.set_option('display.max_columns', None)
pd.set_option('display.width', None)
pd.set_option('display.max_colwidth', -1)
```

In [23]:

```
datewise_china['Mortality'] = (datewise_china['Deaths']/datewise_china['Confirmed'])*100
datewise_Italy['Mortality'] = (datewise_Italy['Deaths']/datewise_Italy['Confirmed'])*100
datewise_US['Mortality'] = (datewise_US['Deaths']/datewise_US['Confirmed'])*100
datewise_spain['Mortality'] = (datewise_spain['Deaths']/datewise_spain['Confirmed'])*100
datewise_brazil['Mortality'] = (datewise_brazil['Deaths']/datewise_brazil['Confirmed'])*100
datewise_rest['Mortality'] = (datewise_rest['Deaths']/datewise_rest['Confirmed'])*100

datewise_china['Recovery'] = (datewise_china['Recovered']/datewise_china['Confirmed'])*100
datewise_Italy['Recovery'] = (datewise_Italy['Recovered']/datewise_Italy['Confirmed'])*100
datewise_US['Recovery'] = (datewise_US['Recovered']/datewise_US['Confirmed'])*100
datewise_spain['Recovery'] = (datewise_spain['Recovered']/datewise_spain['Confirmed'])*100
datewise_brazil['Recovery'] = (datewise_brazil['Recovered']/datewise_brazil['Confirmed'])*100
datewise_rest['Recovery'] = (datewise_rest['Recovered']/datewise_rest['Confirmed'])*100
```

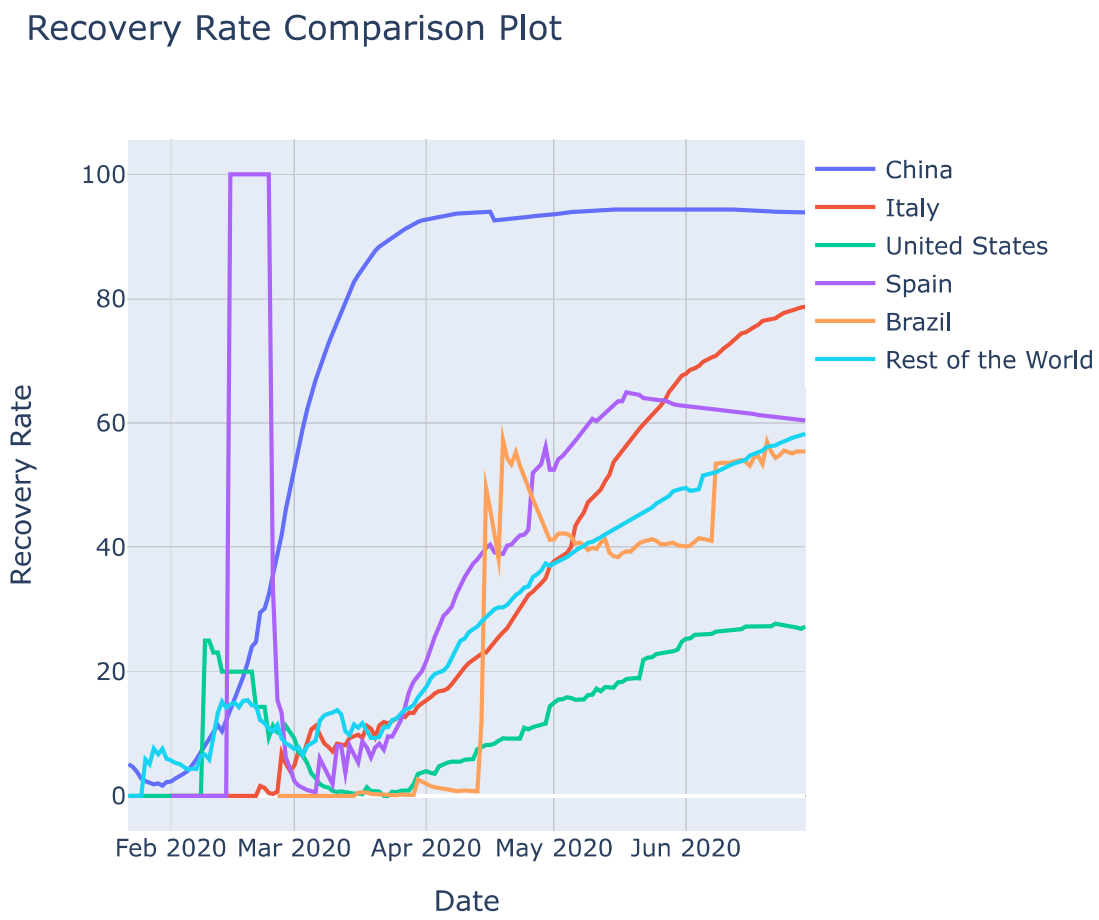
In [24]:

```
fig = go.Figure()

fig.add_trace(go.Scatter(x=datewise_china.index, y=datewise_china['Mortality'],
                         mode='lines', name='China'))
fig.add_trace(go.Scatter(x=datewise_Italy.index, y=datewise_Italy['Mortality'],
                         mode='lines', name='Italy'))
fig.add_trace(go.Scatter(x=datewise_US.index, y=datewise_US['Mortality'],
                         mode='lines', name='United States'))
fig.add_trace(go.Scatter(x=datewise_spain.index, y=datewise_spain['Mortality'],
                         mode='lines', name='Spain'))
fig.add_trace(go.Scatter(x=datewise_brazil.index, y=datewise_brazil['Mortality'],
                         mode='lines', name='Brazil'))
fig.add_trace(go.Scatter(x=datewise_rest.index, y=datewise_rest['Mortality'],
                         mode='lines', name='Rest of the World'))

fig.update_layout(title='Mortality Rate comparison plot',
                  xaxis_title='Date', yaxis_title='Mortality Rate',
                  legend = dict(x=0, y=1, traceorder='normal'))
fig.show()
```



In [25]:

```
fig = go.Figure()

fig.add_trace(go.Scatter(x=datewise_china.index, y=datewise_china['Recovery'],
                         mode='lines', name='China'))
fig.add_trace(go.Scatter(x=datewise_Italy.index, y=datewise_Italy['Recovery'],
                         mode='lines', name='Italy'))
fig.add_trace(go.Scatter(x=datewise_US.index, y=datewise_US['Recovery'],
                         mode='lines', name='United States'))
fig.add_trace(go.Scatter(x=datewise_spain.index, y=datewise_spain['Recovery'],
                         mode='lines', name='Spain'))
fig.add_trace(go.Scatter(x=datewise_brazil.index, y=datewise_brazil['Recovery'],
                         mode='lines', name='Brazil'))
fig.add_trace(go.Scatter(x=datewise_rest.index, y=datewise_rest['Recovery'],
                         mode='lines', name='Rest of the World'))

fig.update_layout(title='Recovery Rate Comparison Plot',
                  xaxis_title = 'Date', yaxis_title='Recovery Rate',
                  legend=dict(x=1, y=1, traceorder='normal'))

fig.show()
```

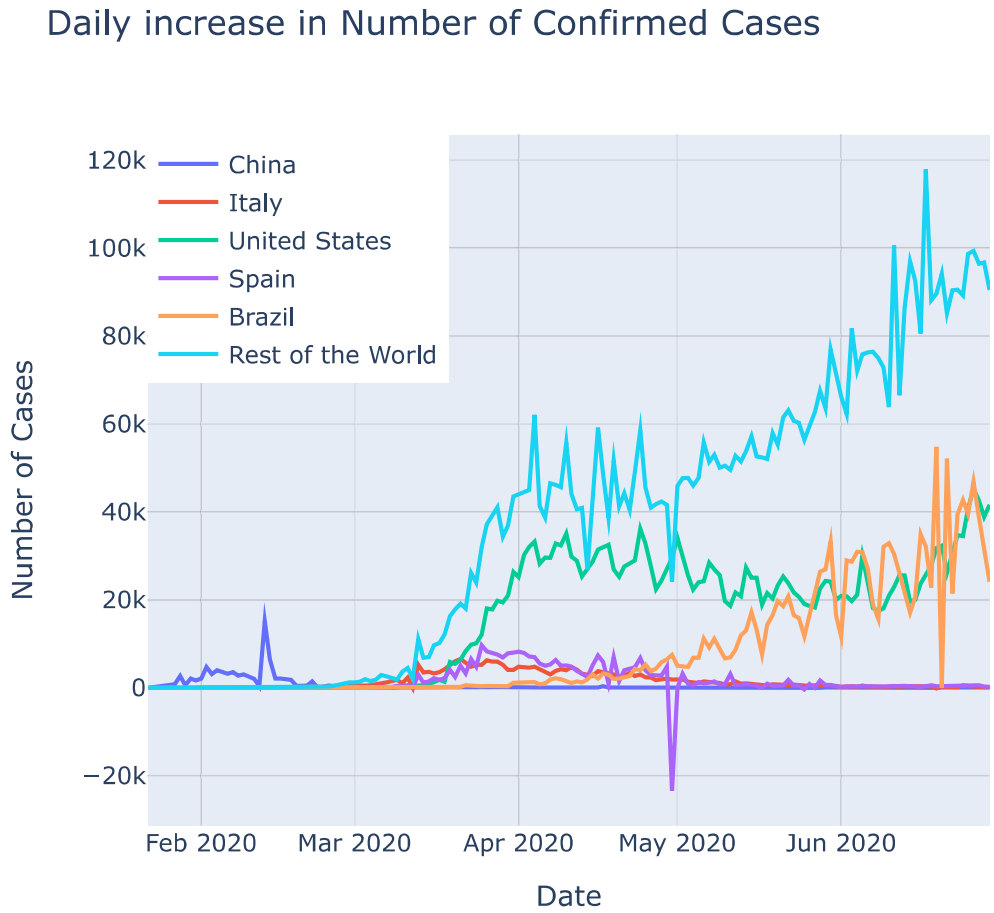


Taking off Recovery Rate of Spain is a good sifn but it's nowhere in comparison to the Mortality Rate.

Its alarming sign for USA and Brazil as their Recovery Rate is improving considerably as compared to other severly affected countries.

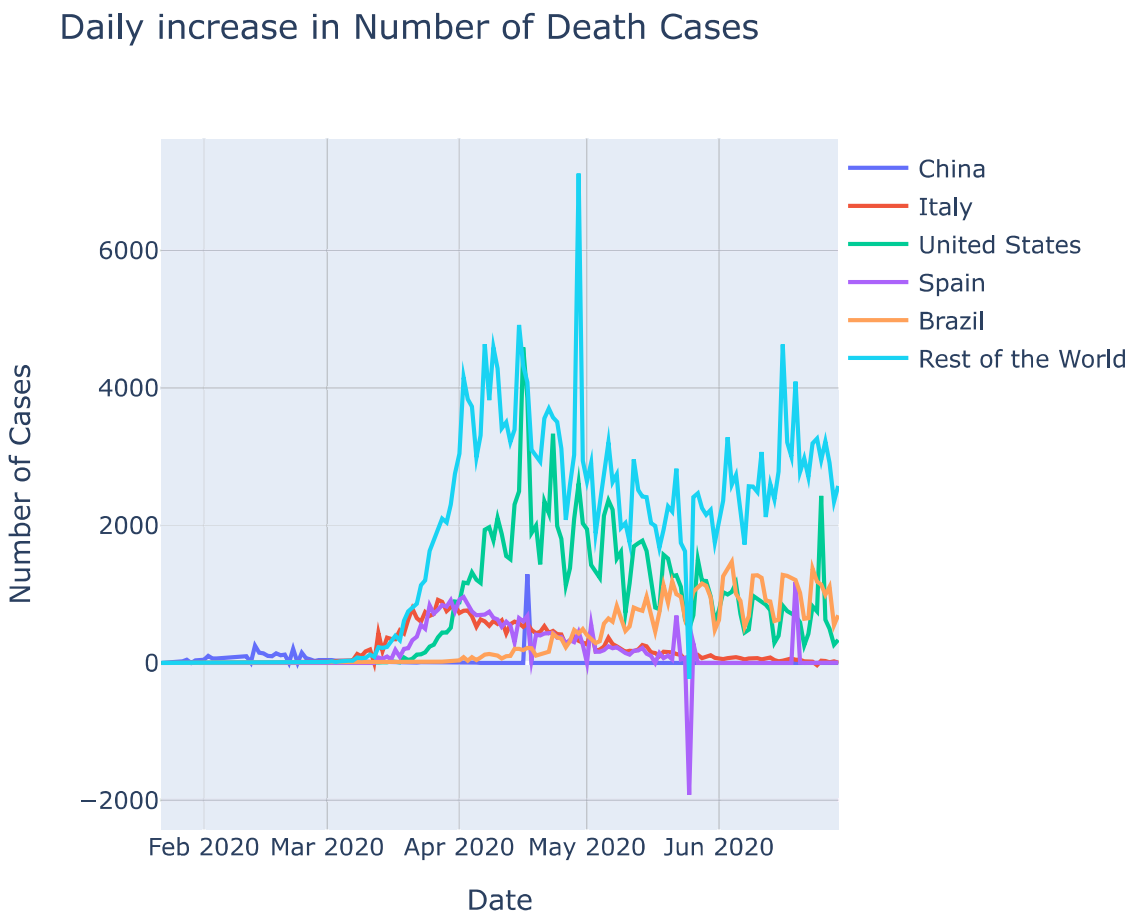
In [26]:

```
fig = go.Figure()

fig.add_trace(go.Scatter(x=datewise_china.index, y=datewise_china['Confirmed'].diff().fillna(0),
                         mode='lines', name='China'))
fig.add_trace(go.Scatter(x=datewise_Italy.index, y=datewise_Italy['Confirmed'].diff().fillna(0),
                         mode='lines', name='Italy'))
fig.add_trace(go.Scatter(x=datewise_US.index, y=datewise_US['Confirmed'].diff().fillna(0),
                         mode='lines', name='United States'))
fig.add_trace(go.Scatter(x=datewise_spain.index, y=datewise_spain['Confirmed'].diff().fillna(0),
                         mode='lines', name='Spain'))
fig.add_trace(go.Scatter(x=datewise_brazil.index, y=datewise_brazil['Confirmed'].diff().fillna(0
),
                         mode='lines', name='Brazil'))
fig.add_trace(go.Scatter(x=datewise_rest.index, y=datewise_rest['Confirmed'].diff().fillna(0),
                         mode='lines', name='Rest of the World'))

fig.update_layout(title='Daily increase in Number of Confirmed Cases',
                  xaxis_title='Date', yaxis_title='Number of Cases',
                  legend=dict(x=0, y=1, traceorder='normal'))

fig.show()
```



In [27]:

```
fig = go.Figure()

fig.add_trace(go.Scatter(x=datewise_china.index, y=datewise_china['Deaths'].diff().fillna(0),
                         mode='lines', name='China'))
fig.add_trace(go.Scatter(x=datewise_Italy.index, y=datewise_Italy['Deaths'].diff().fillna(0),
                         mode='lines', name='Italy'))
fig.add_trace(go.Scatter(x=datewise_US.index, y=datewise_US['Deaths'].diff().fillna(0),
                         mode='lines', name='United States'))
fig.add_trace(go.Scatter(x=datewise_spain.index, y=datewise_spain['Deaths'].diff().fillna(0),
                         mode='lines', name='Spain'))
fig.add_trace(go.Scatter(x=datewise_brazil.index, y=datewise_brazil['Deaths'].diff().fillna(0),
                         mode='lines', name='Brazil'))
fig.add_trace(go.Scatter(x=datewise_rest.index, y=datewise_rest['Deaths'].diff().fillna(0),
                         mode='lines', name='Rest of the World'))

fig.update_layout(title='Daily increase in Number of Death Cases',
                  xaxis_title='Date', yaxis_title='Number of Cases',
                  legend=dict(x=1, y=1, traceorder='normal'))

fig.show()
```



We can clearly notice the decreasing trend in the number of Daily Confirmed and Death Cases of Spain and Italy. That's really positive sign for both the countries.

In [ ]:

```
```

Export files

In [28]:

```
datewise_china.head()
```

Out[28]:

ObservationDate	Confirmed	Recovered	Deaths	Mortality	Recovery
2020-01-22	547.0	28.0	17.0	3.107861	5.118830
2020-01-23	639.0	30.0	18.0	2.816901	4.694836
2020-01-24	916.0	36.0	26.0	2.838428	3.930131
2020-01-25	1399.0	39.0	42.0	3.002144	2.787706
2020-01-26	2062.0	49.0	56.0	2.715810	2.376334

In [29]:

```
datewise_china.to_csv('./datewise_china.csv', sep=',', na_rep='NaN')
```

In [30]:

```
datewise_Italy.head()
```

Out[30]:

ObservationDate	Confirmed	Recovered	Deaths	Mortality	Recovery
2020-01-31	2.0	0.0	0.0	0.0	0.0
2020-02-01	2.0	0.0	0.0	0.0	0.0
2020-02-02	2.0	0.0	0.0	0.0	0.0
2020-02-03	2.0	0.0	0.0	0.0	0.0
2020-02-04	2.0	0.0	0.0	0.0	0.0

In [31]:

```
datewise_Italy.to_csv('./datewise_Italy.csv', sep=',', na_rep='NaN')
```

In [32]:

```
datewise_spain.head()
```

Out[32]:

ObservationDate	Confirmed	Recovered	Deaths	Mortality	Recovery
2020-02-01	1.0	0.0	0.0	0.0	0.0
2020-02-02	1.0	0.0	0.0	0.0	0.0
2020-02-03	1.0	0.0	0.0	0.0	0.0
2020-02-04	1.0	0.0	0.0	0.0	0.0
2020-02-05	1.0	0.0	0.0	0.0	0.0

In [33]:

```
datewise_spain.to_csv('./datewise_spain.csv', sep=',', na_rep='NaN')
```

In [34]:

```
datewise_brazil.head()
```

Out[34]:

ObservationDate	Confirmed	Recovered	Deaths	Mortality	Recovery
2020-01-23	0.0	0.0	0.0	NaN	NaN
2020-02-26	1.0	0.0	0.0	0.0	0.0
2020-02-27	1.0	0.0	0.0	0.0	0.0
2020-02-28	1.0	0.0	0.0	0.0	0.0
2020-02-29	2.0	0.0	0.0	0.0	0.0

In [35]:

```
datewise_brazil.to_csv('./datewise_brazil.csv', sep=',', na_rep='NaN')
```

In [36]:

```
datewise_US.head()
```

Out[36]:

ObservationDate	Confirmed	Recovered	Deaths	Mortality	Recovery
2020-01-22	1.0	0.0	0.0	0.0	0.0
2020-01-23	1.0	0.0	0.0	0.0	0.0
2020-01-24	2.0	0.0	0.0	0.0	0.0
2020-01-25	2.0	0.0	0.0	0.0	0.0
2020-01-26	5.0	0.0	0.0	0.0	0.0

In [37]:

```
datewise_US.to_csv('./datewise_US.csv', sep=',', na_rep='NaN')
```

In [38]:

```
datewise_rest.head()
```

Out[38]:

ObservationDate	Confirmed	Recovered	Deaths	Mortality	Recovery
2020-01-22	7.0	0.0	0.0	0.0	0.000000
2020-01-23	13.0	0.0	0.0	0.0	0.000000
2020-01-24	23.0	0.0	0.0	0.0	0.000000
2020-01-25	37.0	0.0	0.0	0.0	0.000000
2020-01-26	51.0	3.0	0.0	0.0	5.882353

In [39]:

```
datewise_rest.to_csv('./datewise_rest.csv', sep=',', na_rep='NaN')
```

In [40]:

```
countrywise
```

Out[40]:

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
US	2590651.0	705203.0	126140.0	4.869046	27.221073	1759308.0	831343.0
Brazil	1368195.0	757811.0	58314.0	4.262112	55.387646	552070.0	816125.0
Russia	640246.0	402778.0	9152.0	1.429451	62.909882	228316.0	411930.0
India	566840.0	334822.0	16893.0	2.980206	59.068167	215125.0	351715.0
United Kingdom	313470.0	1368.0	43659.0	13.927649	0.436405	268443.0	45027.0
Peru	282365.0	171159.0	9504.0	3.365856	60.616224	101702.0	180663.0
Chile	275999.0	236154.0	5575.0	2.019935	85.563353	34270.0	241729.0
Spain	248970.0	150376.0	28346.0	11.385307	60.399245	70248.0	178722.0
Italy	240436.0	189196.0	34744.0	14.450415	78.688716	16496.0	223940.0
Iran	225205.0	186180.0	10670.0	4.737905	82.671344	28355.0	196850.0
Mexico	220657.0	170147.0	27121.0	12.291022	77.109269	23389.0	197268.0
Pakistan	209337.0	98503.0	4304.0	2.056015	47.054749	106530.0	102807.0
France	201522.0	76124.0	29816.0	14.795407	37.774536	95582.0	105940.0
Turkey	198613.0	171809.0	5115.0	2.575360	86.504408	21689.0	176924.0
Germany	195042.0	177770.0	8976.0	4.602086	91.144471	8296.0	186746.0
Saudi Arabia	186436.0	127118.0	1599.0	0.857667	68.183184	57719.0	128717.0
South Africa	144264.0	70614.0	2529.0	1.753036	48.947762	71121.0	73143.0
Bangladesh	141801.0	57780.0	1783.0	1.257396	40.747244	82238.0	59563.0
Canada	105830.0	68698.0	8628.0	8.152698	64.913541	28504.0	77326.0
Qatar	95106.0	80170.0	113.0	0.118815	84.295418	14823.0	80283.0
Colombia	91995.0	38345.0	3256.0	3.539323	41.681613	50394.0	41601.0
Mainland China	84780.0	79619.0	4641.0	5.474168	93.912479	520.0	84260.0
Sweden	67667.0	0.0	5310.0	7.847252	0.000000	62357.0	5310.0
Egypt	66754.0	17951.0	2872.0	4.302364	26.891272	45931.0	20823.0
Argentina	62268.0	21138.0	1280.0	2.055631	33.946811	39850.0	22418.0
Belarus	61790.0	45213.0	387.0	0.626315	73.172034	16190.0	45600.0
Belgium	61361.0	16941.0	9732.0	15.860237	27.608742	34688.0	26673.0
Ecuador	55665.0	27430.0	4502.0	8.087667	49.276924	23733.0	31932.0
Indonesia	55092.0	23800.0	2805.0	5.091483	43.200465	28487.0	26605.0
Netherlands	50433.0	186.0	6126.0	12.146809	0.368806	44121.0	6312.0
United Arab Emirates	48246.0	37076.0	314.0	0.650831	76.847822	10856.0	37390.0
Iraq	47151.0	22974.0	1839.0	3.900235	48.724311	22338.0	24813.0
Kuwait	45524.0	36313.0	350.0	0.768825	79.766716	8861.0	36663.0
Ukraine	44538.0	19679.0	1161.0	2.606763	44.184741	23698.0	20840.0
Singapore	43661.0	37985.0	26.0	0.059550	86.999840	5650.0	38011.0

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
Portugal	41912.0	27205.0	1568.0	3.741172	64.909811	13139.0	28773.0
Oman	39060.0	22422.0	169.0	0.432668	57.403994	16469.0	22591.0
Philippines	36438.0	9956.0	1255.0	3.444207	27.323124	25227.0	11211.0
Poland	34154.0	20897.0	1444.0	4.227909	61.184634	11813.0	22341.0
Panama	32785.0	15595.0	620.0	1.891109	47.567485	16570.0	16215.0
Bolivia	32125.0	8928.0	1071.0	3.333852	27.791440	22126.0	9999.0
Dominican Republic	31816.0	17280.0	733.0	2.303872	54.312296	13803.0	18013.0
Switzerland	31652.0	29100.0	1962.0	6.198660	91.937318	590.0	31062.0
Afghanistan	31238.0	13934.0	733.0	2.346501	44.605929	16571.0	14667.0
Romania	26582.0	18912.0	1634.0	6.147017	71.145888	6036.0	20546.0
Bahrain	26239.0	20928.0	84.0	0.320134	79.759137	5227.0	21012.0
Ireland	25462.0	23364.0	1735.0	6.814076	91.760270	363.0	25099.0
Nigeria	25133.0	9402.0	573.0	2.279871	37.408984	15158.0	9975.0
Armenia	25127.0	13297.0	433.0	1.723246	52.919171	11397.0	13730.0
Israel	24441.0	17218.0	319.0	1.305184	70.447199	6904.0	17537.0
Kazakhstan	21819.0	13008.0	188.0	0.861634	59.617764	8623.0	13196.0
Honduras	18818.0	1961.0	485.0	2.577320	10.420874	16372.0	2446.0
Japan	18476.0	16388.0	972.0	5.260879	88.698853	1116.0	17360.0
Austria	17723.0	16420.0	703.0	3.966597	92.647972	600.0	17123.0
Guatemala	17409.0	3170.0	746.0	4.285140	18.208972	13493.0	3916.0
Ghana	17351.0	12994.0	112.0	0.645496	74.889055	4245.0	13106.0
Azerbaijan	16968.0	9369.0	206.0	1.214050	55.215700	7393.0	9575.0
Moldova	16357.0	9229.0	536.0	3.276885	56.422327	6592.0	9765.0
Serbia	14288.0	12581.0	274.0	1.917693	88.052912	1433.0	12855.0
Algeria	13571.0	9674.0	905.0	6.668632	71.284356	2992.0	10579.0
Nepal	13248.0	3134.0	29.0	0.218901	23.656401	10085.0	3163.0
Denmark	12951.0	11812.0	605.0	4.671454	91.205312	534.0	12417.0
Korea, South	12800.0	11537.0	282.0	2.203125	90.132812	981.0	11819.0
Cameroon	12592.0	10100.0	313.0	2.485705	80.209657	2179.0	10413.0
Morocco	12290.0	8833.0	225.0	1.830757	71.871440	3232.0	9058.0
Czechia	11805.0	7746.0	348.0	2.947903	65.616264	3711.0	8094.0
Sudan	9257.0	4014.0	572.0	6.179108	43.361780	4671.0	4586.0
Cote d'Ivoire	9214.0	3996.0	66.0	0.716301	43.368787	5152.0	4062.0
Norway	8862.0	8138.0	249.0	2.809749	91.830287	475.0	8387.0
Malaysia	8637.0	8334.0	121.0	1.400949	96.491837	182.0	8455.0
Uzbekistan	8222.0	5496.0	23.0	0.279737	66.845050	2703.0	5519.0
Australia	7834.0	7037.0	104.0	1.327547	89.826398	693.0	7141.0

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
Finland	7209.0	6600.0	328.0	4.549868	91.552226	281.0	6928.0
Congo (Kinshasa)	6939.0	1050.0	167.0	2.406687	15.131863	5722.0	1217.0
Senegal	6698.0	4341.0	108.0	1.612422	64.810391	2249.0	4449.0
North Macedonia	6209.0	2427.0	298.0	4.799485	39.088420	3484.0	2725.0
Kenya	6190.0	2013.0	144.0	2.326333	32.520194	4033.0	2157.0
El Salvador	6173.0	3648.0	164.0	2.656731	59.096064	2361.0	3812.0
Haiti	5933.0	839.0	105.0	1.769762	14.141244	4989.0	944.0
Tajikistan	5900.0	4506.0	52.0	0.881356	76.372881	1342.0	4558.0
Ethiopia	5846.0	2430.0	103.0	1.761888	41.566883	3313.0	2533.0
Venezuela	5530.0	1649.0	48.0	0.867993	29.819168	3833.0	1697.0
Gabon	5394.0	2420.0	42.0	0.778643	44.864664	2932.0	2462.0
Guinea	5351.0	4296.0	31.0	0.579331	80.284059	1024.0	4327.0
Kyrgyzstan	5296.0	2370.0	57.0	1.076284	44.750755	2869.0	2427.0
Bulgaria	4831.0	2582.0	223.0	4.616022	53.446491	2026.0	2805.0
Djibouti	4656.0	4433.0	53.0	1.138316	95.210481	170.0	4486.0
Bosnia and Herzegovina	4325.0	2366.0	184.0	4.254335	54.705202	1775.0	2550.0
Luxembourg	4256.0	3997.0	110.0	2.584586	93.914474	149.0	4107.0
Mauritania	4237.0	1497.0	128.0	3.021005	35.331603	2612.0	1625.0
Hungary	4145.0	2685.0	585.0	14.113390	64.776840	875.0	3270.0
Central African Republic	3613.0	773.0	47.0	1.300858	21.394963	2793.0	820.0
Greece	3390.0	1374.0	191.0	5.634218	40.530973	1825.0	1565.0
Costa Rica	3269.0	1394.0	15.0	0.458856	42.643010	1860.0	1409.0
Thailand	3169.0	3053.0	58.0	1.830230	96.339539	58.0	3111.0
Somalia	2904.0	910.0	90.0	3.099174	31.336088	1904.0	1000.0
Croatia	2725.0	2155.0	107.0	3.926606	79.082569	463.0	2262.0
Kosovo	2677.0	1425.0	49.0	1.830407	53.231229	1203.0	1474.0
Albania	2466.0	1438.0	58.0	2.351987	58.313058	970.0	1496.0
Cuba	2340.0	2211.0	86.0	3.675214	94.487179	43.0	2297.0
Maldives	2337.0	1927.0	8.0	0.342319	82.456140	402.0	1935.0
Paraguay	2191.0	1080.0	16.0	0.730260	49.292560	1095.0	1096.0
West Bank and Gaza	2185.0	447.0	5.0	0.228833	20.457666	1733.0	452.0
Mali	2173.0	1447.0	115.0	5.292223	66.589968	611.0	1562.0
Nicaragua	2170.0	1238.0	74.0	3.410138	57.050691	858.0	1312.0
Madagascar	2138.0	966.0	20.0	0.935454	45.182413	1152.0	986.0

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
Sri Lanka	2039.0	1678.0	11.0	0.539480	82.295243	350.0	1689.0
Equatorial Guinea	2001.0	515.0	32.0	1.599200	25.737131	1454.0	547.0
South Sudan	1989.0	246.0	36.0	1.809955	12.368024	1707.0	282.0
Estonia	1987.0	1818.0	69.0	3.472572	91.494716	100.0	1887.0
Iceland	1840.0	1818.0	10.0	0.543478	98.804348	12.0	1828.0
Lithuania	1816.0	1512.0	78.0	4.295154	83.259912	226.0	1590.0
Lebanon	1745.0	1170.0	34.0	1.948424	67.048711	541.0	1204.0
Slovakia	1665.0	1464.0	28.0	1.681682	87.927928	173.0	1492.0
Guinea-Bissau	1654.0	317.0	24.0	1.451028	19.165659	1313.0	341.0
Slovenia	1585.0	1384.0	111.0	7.003155	87.318612	90.0	1495.0
Zambia	1568.0	1311.0	22.0	1.403061	83.609694	235.0	1333.0
New Zealand	1528.0	1484.0	22.0	1.439791	97.120419	22.0	1506.0
Sierra Leone	1450.0	961.0	60.0	4.137931	66.275862	429.0	1021.0
Benin	1187.0	323.0	19.0	1.600674	27.211457	845.0	342.0
Tunisia	1172.0	1029.0	50.0	4.266212	87.798635	93.0	1079.0
Cabo Verde	1165.0	608.0	12.0	1.030043	52.188841	545.0	620.0
Malawi	1152.0	260.0	13.0	1.128472	22.569444	879.0	273.0
Jordan	1128.0	867.0	9.0	0.797872	76.861702	252.0	876.0
Yemen	1128.0	432.0	304.0	26.950355	38.297872	392.0	736.0
Latvia	1117.0	932.0	30.0	2.685765	83.437780	155.0	962.0
Congo (Brazzaville)	1087.0	456.0	37.0	3.403864	41.950322	594.0	493.0
Niger	1075.0	939.0	67.0	6.232558	87.348837	69.0	1006.0
Rwanda	1001.0	443.0	2.0	0.199800	44.255744	556.0	445.0
Cyprus	996.0	833.0	19.0	1.907631	83.634538	144.0	852.0
Burkina Faso	959.0	830.0	53.0	5.526590	86.548488	76.0	883.0
Uruguay	932.0	822.0	27.0	2.896996	88.197425	83.0	849.0
Georgia	926.0	791.0	15.0	1.619870	85.421166	120.0	806.0
Mozambique	883.0	229.0	6.0	0.679502	25.934315	648.0	235.0
Uganda	870.0	808.0	0.0	0.000000	92.873563	62.0	808.0
Chad	866.0	781.0	74.0	8.545035	90.184758	11.0	855.0
Andorra	855.0	799.0	52.0	6.081871	93.450292	4.0	851.0
Libya	802.0	206.0	23.0	2.867830	25.685786	573.0	229.0
Eswatini	795.0	380.0	11.0	1.383648	47.798742	404.0	391.0
Liberia	770.0	312.0	36.0	4.675325	40.519481	422.0	348.0
Sao Tome and Principe	713.0	235.0	13.0	1.823282	32.959327	465.0	248.0

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
Diamond Princess	712.0	651.0	13.0	1.825843	91.432584	48.0	664.0
San Marino	698.0	656.0	42.0	6.017192	93.982808	0.0	698.0
Jamaica	698.0	553.0	10.0	1.432665	79.226361	135.0	563.0
Malta	670.0	639.0	9.0	1.343284	95.373134	22.0	648.0
Togo	643.0	401.0	14.0	2.177294	62.363919	228.0	415.0
Zimbabwe	574.0	152.0	7.0	1.219512	26.480836	415.0	159.0
Tanzania	509.0	183.0	21.0	4.125737	35.952849	305.0	204.0
Suriname	501.0	217.0	13.0	2.594810	43.313373	271.0	230.0
Montenegro	501.0	315.0	11.0	2.195609	62.874251	175.0	326.0
Taiwan*	447.0	435.0	7.0	1.565996	97.315436	5.0	442.0
Vietnam	355.0	335.0	0.0	0.000000	94.366197	20.0	335.0
Mauritius	341.0	326.0	10.0	2.932551	95.601173	5.0	336.0
Burma	299.0	221.0	6.0	2.006689	73.913043	72.0	227.0
Angola	276.0	93.0	11.0	3.985507	33.695652	172.0	104.0
Comoros	272.0	161.0	7.0	2.573529	59.191176	104.0	168.0
Syria	269.0	102.0	9.0	3.345725	37.918216	158.0	111.0
Guyana	235.0	114.0	12.0	5.106383	48.510638	109.0	126.0
Mongolia	220.0	175.0	0.0	0.000000	79.545455	45.0	175.0
Namibia	196.0	24.0	0.0	0.000000	12.244898	172.0	24.0
Eritrea	191.0	53.0	0.0	0.000000	27.748691	138.0	53.0
Botswana	175.0	25.0	1.0	0.571429	14.285714	149.0	26.0
Burundi	170.0	115.0	1.0	0.588235	67.647059	54.0	116.0
Brunei	141.0	138.0	3.0	2.127660	97.872340	0.0	141.0
Cambodia	141.0	130.0	0.0	0.000000	92.198582	11.0	130.0
Trinidad and Tobago	126.0	109.0	8.0	6.349206	86.507937	9.0	117.0
Bahamas	104.0	87.0	11.0	10.576923	83.653846	6.0	98.0
Monaco	103.0	95.0	4.0	3.883495	92.233010	4.0	99.0
Barbados	97.0	90.0	7.0	7.216495	92.783505	0.0	97.0
Liechtenstein	82.0	81.0	1.0	1.219512	98.780488	0.0	82.0
Seychelles	77.0	11.0	0.0	0.000000	14.285714	66.0	11.0
Bhutan	77.0	44.0	0.0	0.000000	57.142857	33.0	44.0
Antigua and Barbuda	69.0	22.0	3.0	4.347826	31.884058	44.0	25.0
Gambia	47.0	26.0	2.0	4.255319	55.319149	19.0	28.0
Saint Vincent and the Grenadines	29.0	29.0	0.0	0.000000	100.000000	0.0	29.0

Country/Region	Confirmed	Recovered	Deaths	Mortality	Recovery	Active Cases	Closed Cases
Lesotho	27.0	4.0	0.0	0.000000	14.814815	23.0	4.0
Timor-Leste	24.0	24.0	0.0	0.000000	100.000000	0.0	24.0
Belize	24.0	18.0	2.0	8.333333	75.000000	4.0	20.0
Grenada	23.0	23.0	0.0	0.000000	100.000000	0.0	23.0
Saint Lucia	19.0	19.0	0.0	0.000000	100.000000	0.0	19.0
Laos	19.0	19.0	0.0	0.000000	100.000000	0.0	19.0
Dominica	18.0	18.0	0.0	0.000000	100.000000	0.0	18.0
Fiji	18.0	18.0	0.0	0.000000	100.000000	0.0	18.0
Saint Kitts and Nevis	15.0	15.0	0.0	0.000000	100.000000	0.0	15.0
Holy See	12.0	12.0	0.0	0.000000	100.000000	0.0	12.0
Papua New Guinea	11.0	8.0	0.0	0.000000	72.727273	3.0	8.0
Western Sahara	10.0	8.0	1.0	10.000000	80.000000	1.0	9.0
MS Zaandam	9.0	0.0	2.0	22.222222	0.000000	7.0	2.0

In [41]:

```
countrywise.to_csv('./countrywise.csv', sep=',', na_rep='NaN')
```

In [ ]:

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In [ ]:

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In [ ]:

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