# Coronavirus Disease: COVID-19 Dashboard

COVID-19's effect on the entire world is apparent as we are struggling to fight this deadly virus. The first COVID-19 case was reported on December 31, 2019 in Wuhan, China. On January 21, 2020, the CDC (Center for Disease Control) confirmed the first COVID-19 case in the U.S. ("A Timeline of Covid-19 Developments in 2020").

Since then, cases have risen exponentially and numerous precautionary measures have been taken to prevent the spread of the virus. By May 26, 2021, there were 168 million cases around the world with 3.49 million deaths. AI, machine learning, and data science allows us to analyze the spread of COVID-19 to better understand the virus. It also allows us to help inform the world of new discoveries around COVID-19.

Predictions for confirmed cases, recovered, deaths, and were made based on the dataset. To make these predictions, I used Prophet. Prophet is a forecasting tool from Facebook that uses data to predict future behavoir. Prophet gives a future trend to the data instead of just predictions. It makes forecasts based on irregular holidays and year, weekly, and daily seasonality.

A novel strain of coronavirus — SARS-CoV-2 — was first detected in December 2019 in Wuhan, a city in China’s Hubei province with a population of 11 million, after an outbreak of pneumonia without an obvious cause. The virus has now spread to over 200 countries and territories across the globe, and was characterised as a pandemic by the World Health Organization (WHO).

**Dataset:** Data is from scrapped from JHU github repository. Any variation in the data there will also reflect in this notebook|

**Importing required Libraries:**

In [1]:
```
# to load json files
import json
# datetime oprations
from datetime import timedelta
# to get web contents
from urllib.request import urlopen

# for numerical analyiss
import numpy as np
# to store and process data in dataframe
import pandas as pd

# basic visualization package
import matplotlib.pyplot as plt
# advanced ploting
import seaborn as sns
#color patch
import matplotlib.patches as mpatches

# hide warnings
import warnings
warnings.filterwarnings('ignore')

plt.style.use('seaborn')
```

**Importing and Reading Datasets:**

In [2]:
```
full_table = pd.read_csv('covid_19_clean_complete.csv')
full_table.head()
```

Out[2]:

| | Province/State | Country/Region | Lat | Long | Date | Confirmed | Deaths | Recovered | Active | WHO Region |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | NaN | Afghanistan | 33.93911 | 67.709953 | 2020-01-22 | 0 | 0 | 0 | 0 | Eastern Mediterranean |
| **1** | NaN | Albania | 41.15330 | 20.168300 | 2020-01-22 | 0 | 0 | 0 | 0 | Europe |
| **2** | NaN | Algeria | 28.03390 | 1.659600 | 2020-01-22 | 0 | 0 | 0 | 0 | Africa |
| **3** | NaN | Andorra | 42.50630 | 1.521800 | 2020-01-22 | 0 | 0 | 0 | 0 | Europe |
| **4** | NaN | Angola | -11.20270 | 17.873900 | 2020-01-22 | 0 | 0 | 0 | 0 | Africa |

In [3]:
```
# Grouped by day, country
# ======================
full_grouped = pd.read_csv('full_grouped.csv')
full_grouped['Date'] = pd.to_datetime(full_grouped['Date'])
full_grouped.head()
```

Out[3]:

| | Date | Country/Region | Confirmed | Deaths | Recovered | Active | New cases | New deaths | New recovered | WHO Region |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 2020-01-22 | Afghanistan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Eastern Mediterranean |
| **1** | 2020-01-22 | Albania | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Europe |
| **2** | 2020-01-22 | Algeria | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Africa |
| **3** | 2020-01-22 | Andorra | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Europe |
| **4** | 2020-01-22 | Angola | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Africa |

In [4]:
```
# Day wise
# ========
day_wise = pd.read_csv('day_wise.csv')
day_wise['Date'] = pd.to_datetime(day_wise['Date'])
day_wise.head()
```

Out[4]:

| | Date | Confirmed | Deaths | Recovered | Active | New cases | New deaths | New recovered | Deaths / 100 Cases | Recovered / 100 Cases | Deaths / 100 Recovered | No. of countries |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 2020-01-22 | 555 | 17 | 28 | 510 | 0 | 0 | 0 | 3.06 | 5.05 | 60.71 | 6 |
| **1** | 2020-01-23 | 654 | 18 | 30 | 606 | 99 | 1 | 2 | 2.75 | 4.59 | 60.00 | 8 |
| **2** | 2020-01-24 | 941 | 26 | 36 | 879 | 287 | 8 | 6 | 2.76 | 3.83 | 72.22 | 9 |
| **3** | 2020-01-25 | 1434 | 42 | 39 | 1353 | 493 | 16 | 3 | 2.93 | 2.72 | 107.69 | 11 |
| **4** | 2020-01-26 | 2118 | 56 | 52 | 2010 | 684 | 14 | 13 | 2.64 | 2.46 | 107.69 | 13 |

In [5]:
```
# Country wise
# ============
country_wise = pd.read_csv('country_wise_latest.csv')
country_wise = country_wise.replace('', np.nan).fillna(0)
country_wise.head()
```

Out[5]:

| | Country/Region | Confirmed | Deaths | Recovered | Active | New cases | New deaths | New recovered | Deaths / 100 Cases | Recovered / 100 Cases | Deaths / 100 Recovered | Confirmed last week | 1 wee chang |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | Afghanistan | 36263 | 1269 | 25198 | 9796 | 106 | 10 | 18 | 3.50 | 69.49 | 5.04 | 35526 | 73 |
| **1** | Albania | 4880 | 144 | 2745 | 1991 | 117 | 6 | 63 | 2.95 | 56.25 | 5.25 | 4171 | 70 |
| **2** | Algeria | 27973 | 1163 | 18837 | 7973 | 616 | 8 | 749 | 4.16 | 67.34 | 6.17 | 23691 | 428 |
| **3** | Andorra | 907 | 52 | 803 | 52 | 10 | 0 | 0 | 5.73 | 88.53 | 6.48 | 884 | 2 |
| **4** | Angola | 950 | 41 | 242 | 667 | 18 | 1 | 0 | 4.32 | 25.47 | 16.94 | 749 | 20 |

In [6]:
```
# Worldometer data
# ================
worldometer_data = pd.read_csv('worldometer_data.csv')
worldometer_data = worldometer_data.replace('', np.nan).fillna(0)
worldometer_data.head()
```

Out[6]:

| | Country/Region | Continent | Population | TotalCases | NewCases | TotalDeaths | NewDeaths | TotalRecovered | NewRecovered | ActiveCas |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | USA | North America | 3.311981e+08 | 5032179 | 0.0 | 162804.0 | 0.0 | 2576668.0 | 0.0 | 229270 |
| **1** | Brazil | South America | 2.127107e+08 | 2917562 | 0.0 | 98644.0 | 0.0 | 2047660.0 | 0.0 | 77125 |
| **2** | India | Asia | 1.381345e+09 | 2025409 | 0.0 | 41638.0 | 0.0 | 1377384.0 | 0.0 | 60638 |
| **3** | Russia | Europe | 1.459409e+08 | 871894 | 0.0 | 14606.0 | 0.0 | 676357.0 | 0.0 | 18093 |
| **4** | South Africa | Africa | 5.938157e+07 | 538184 | 0.0 | 9604.0 | 0.0 | 387316.0 | 0.0 | 14126 |

### Data Cleaning and Checking Null Values

In [7]:
```
country_wise.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 187 entries, 0 to 186
Data columns (total 15 columns):
 #   Column                 Non-Null Count  Dtype  
---  ------                 --------------  -----  
 0   Country/Region         187 non-null    object 
 1   Confirmed              187 non-null    int64  
 2   Deaths                 187 non-null    int64  
 3   Recovered              187 non-null    int64  
 4   Active                 187 non-null    int64  
 5   New cases              187 non-null    int64  
 6   New deaths             187 non-null    int64  
 7   New recovered          187 non-null    int64  
 8   Deaths / 100 Cases     187 non-null    float64
 9   Recovered / 100 Cases  187 non-null    float64
 10  Deaths / 100 Recovered  187 non-null    float64
 11  Confirmed last week    187 non-null    int64  
 12  1 week change          187 non-null    int64  
 13  1 week % increase      187 non-null    float64
 14  WHO Region             187 non-null    object 
dtypes: float64(4), int64(9), object(2)
memory usage: 22.0+ KB
```

In [8]:
```
worldometer_data.isnull().sum()
```

Out[8]:
```
Country/Region      0
Continent           0
Population          0
TotalCases          0
NewCases            0
TotalDeaths         0
NewDeaths           0
TotalRecovered      0
NewRecovered        0
ActiveCases         0
Serious,Critical    0
Tot Cases/1M pop    0
Deaths/1M pop       0
TotalTests          0
Tests/1M pop        0
WHO Region          0
dtype: int64
```

In [9]:
```
full_grouped.isnull().sum()
```

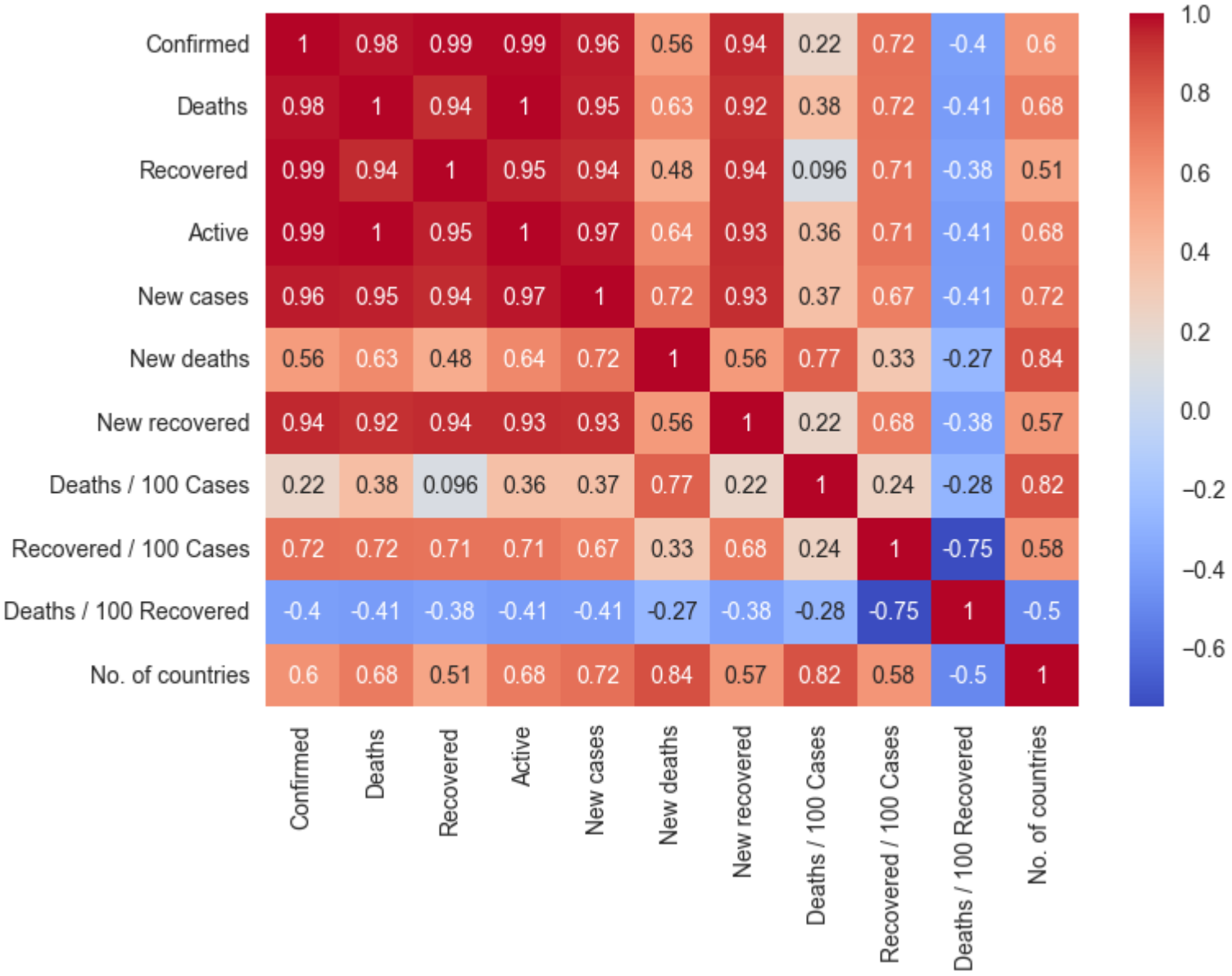
Out[9]:
```
Date              0
Country/Region    0
Confirmed         0
Deaths            0
Recovered         0
Active            0
New cases         0
New deaths        0
New recovered     0
WHO Region        0
dtype: int64
```

In [10]:
```
day_wise.isnull().sum()
```

Out[10]:
```
Date                      0
Confirmed                 0
Deaths                    0
Recovered                 0
Active                    0
New cases                 0
New deaths                0
New recovered             0
Deaths / 100 Cases        0
Recovered / 100 Cases     0
Deaths / 100 Recovered    0
No. of countries          0
dtype: int64
```

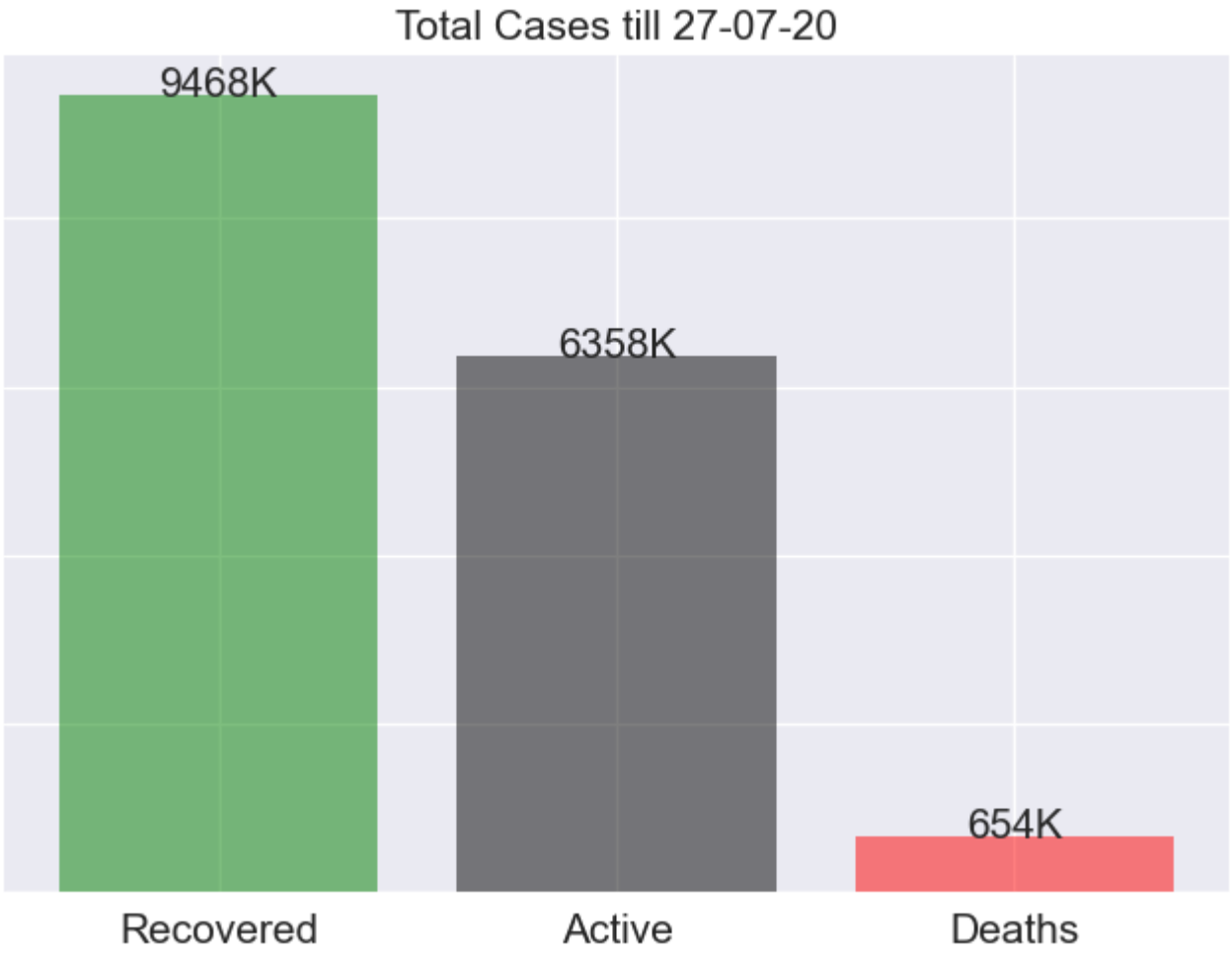
**Heat Map for day wise Dataset**

In [11]:
```
# create the heatmap
sns.heatmap(day_wise.corr(), annot=True, cmap="coolwarm")

# display the heatmap
plt.show()
```



## COVID-19 Status

In [12]:
```
#get values from dataframe
temp = day_wise[['Date','Deaths', 'Recovered', 'Active']].tail(1)
dt = temp.Date.dt.strftime("%d-%m-%y").values
temp = temp.melt(id_vars="Date", value_vars=['Active', 'Deaths', 'Recovered'])
temp.sort_values(by='value', inplace=True, ascending=False)

#fig = plt.treemap(temp, path=["variable"], values="value", height=225)
#fig.data[0].textinfo = 'label+text+value'
#fig.show()
bars = plt.bar(temp.variable, temp.value, color=['green', 'black', 'red'], alpha=0.5)

#remove ytick labels
plt.tick_params(top=False, bottom=False, left=False, right=False, labelleft=False, labelbottom=True)

# remove the frame of the chart
for spine in plt.gca().spines.values():
    spine.set_visible(False)

# direct label each bar with Y axis values
for bar in bars:
    plt.gca().text(bar.get_x() + bar.get_width()/2, bar.get_height()-5, str(int(bar.get_height()/1000)) + 'K',
                ha='center', fontsize=15)

plt.xticks(temp.variable.values,fontsize=15)
plt.title('Total Cases till {}'.format(dt[0]), fontsize=15);
```

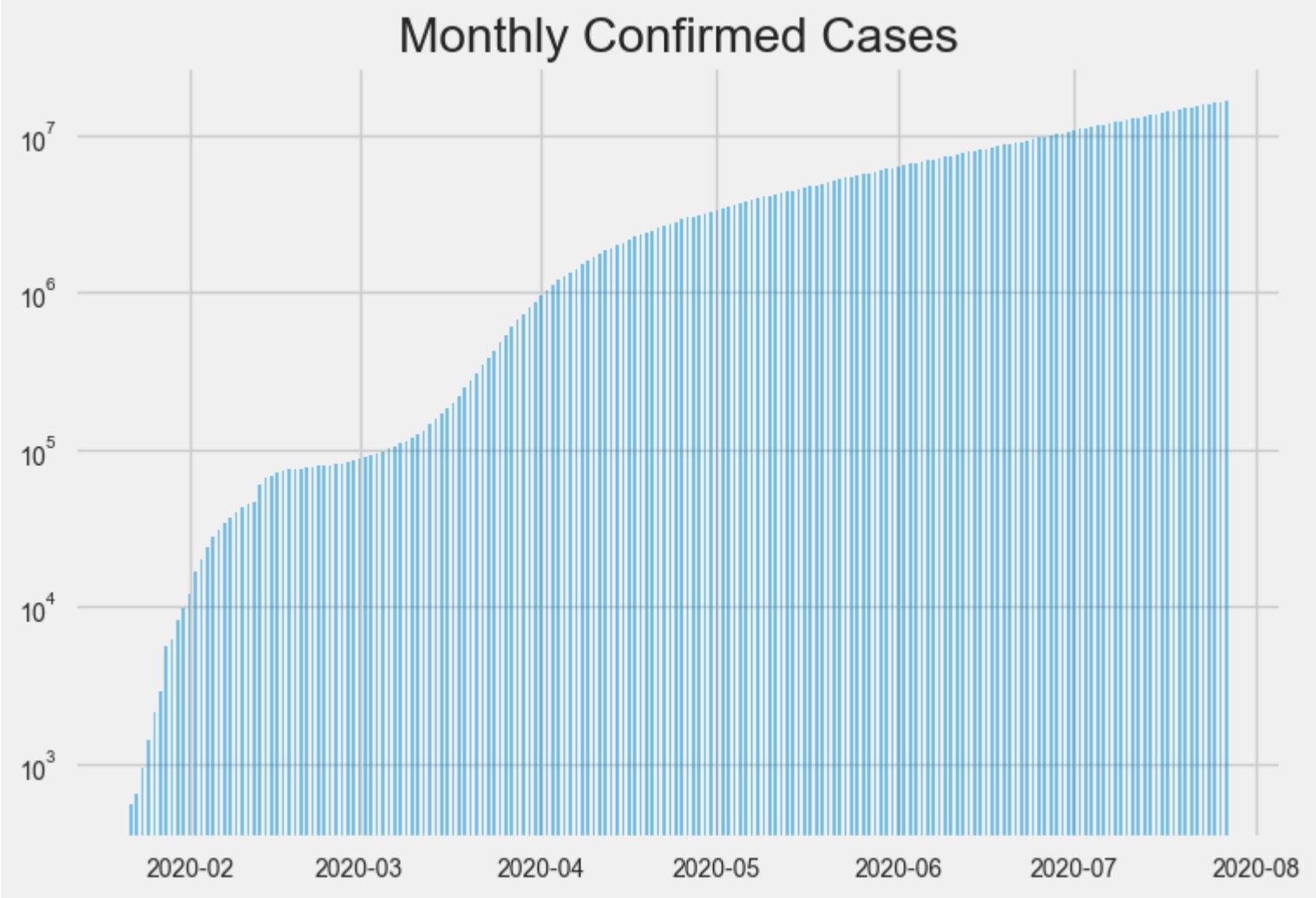


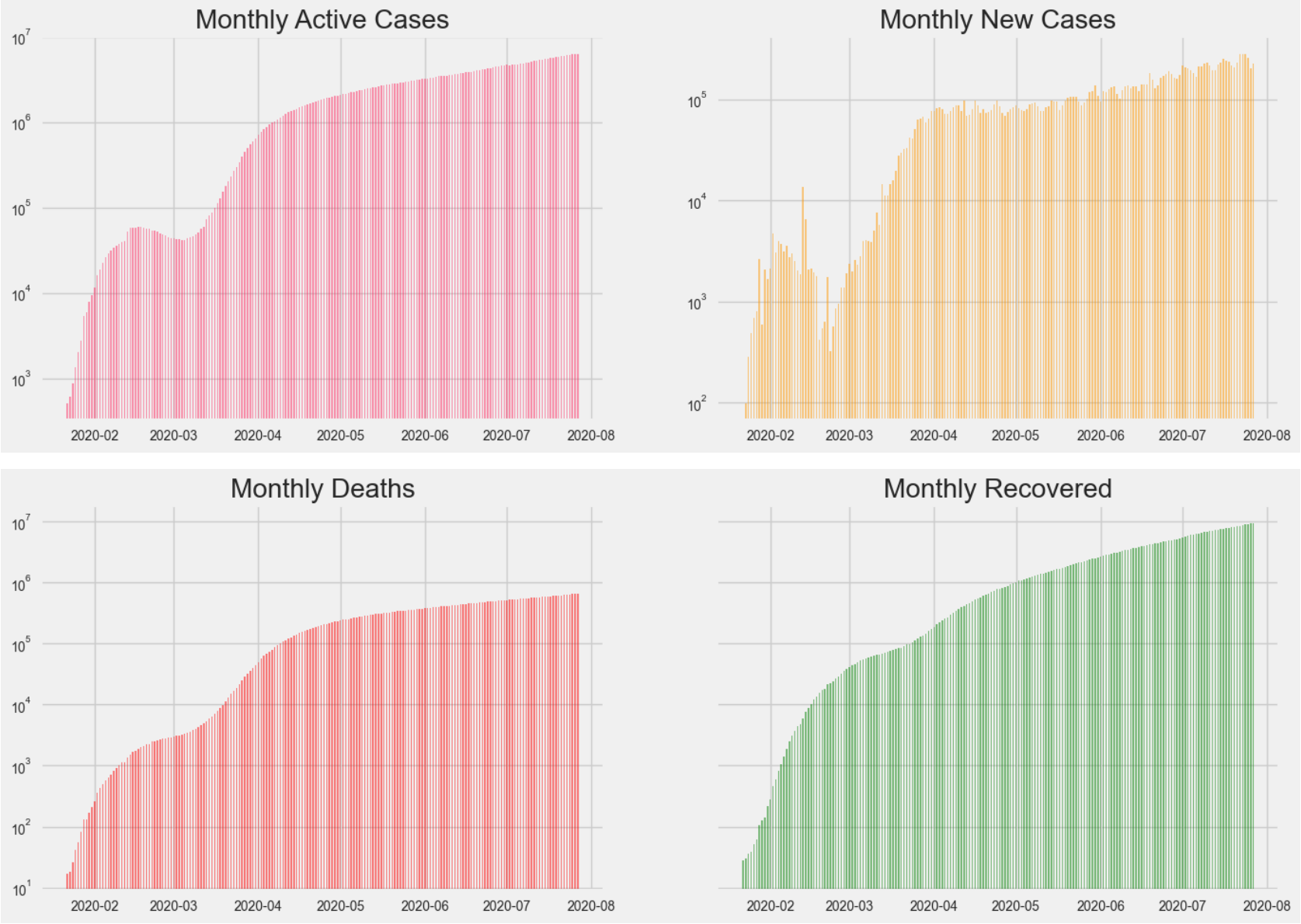

## HYPOTHESIS - 1

**A month-by-month breakdown of the number of covid-19 conforming cases, active cases, new cases, deaths, and recovered cases.**

The graph below depicts the number of confirmed cases, active cases, new cases, and recovered cases per month.

In [13]:
```
plt.style.use('fivethirtyeight')
fig, ax = plt.subplots()
plt.bar(day_wise.Date,day_wise.Confirmed,width=0.5,alpha=0.5)

ax.set_yscale("log")
plt.title('Monthly Confirmed Cases');

fig, (ax1,ax2) = plt.subplots(1,2,figsize=(15,5))

ax1.bar(day_wise.Date,day_wise.Active,color='#ff2e63', width=0.5,alpha=0.5)
ax1.set_yscale("log")
ax1.set_title('Monthly Active Cases');

ax2.bar(day_wise.Date,day_wise['New cases'],color='#fe9801', width=0.5,alpha=0.5)
ax2.set_yscale("log")
ax2.set_title('Monthly New Cases');

fig, (ax1,ax2) = plt.subplots(1,2,figsize=(15,5),sharey=True)

ax1.bar(day_wise.Date,day_wise.Deaths,color='red', width=0.5,alpha=0.5)
ax1.set_yscale("log")
ax1.set_title('Monthly Deaths');

ax2.bar(day_wise.Date,day_wise.Recovered,color='green', width=0.5,alpha=0.5)
ax2.set_yscale("log")
ax2.set_title('Monthly Recovered');
```

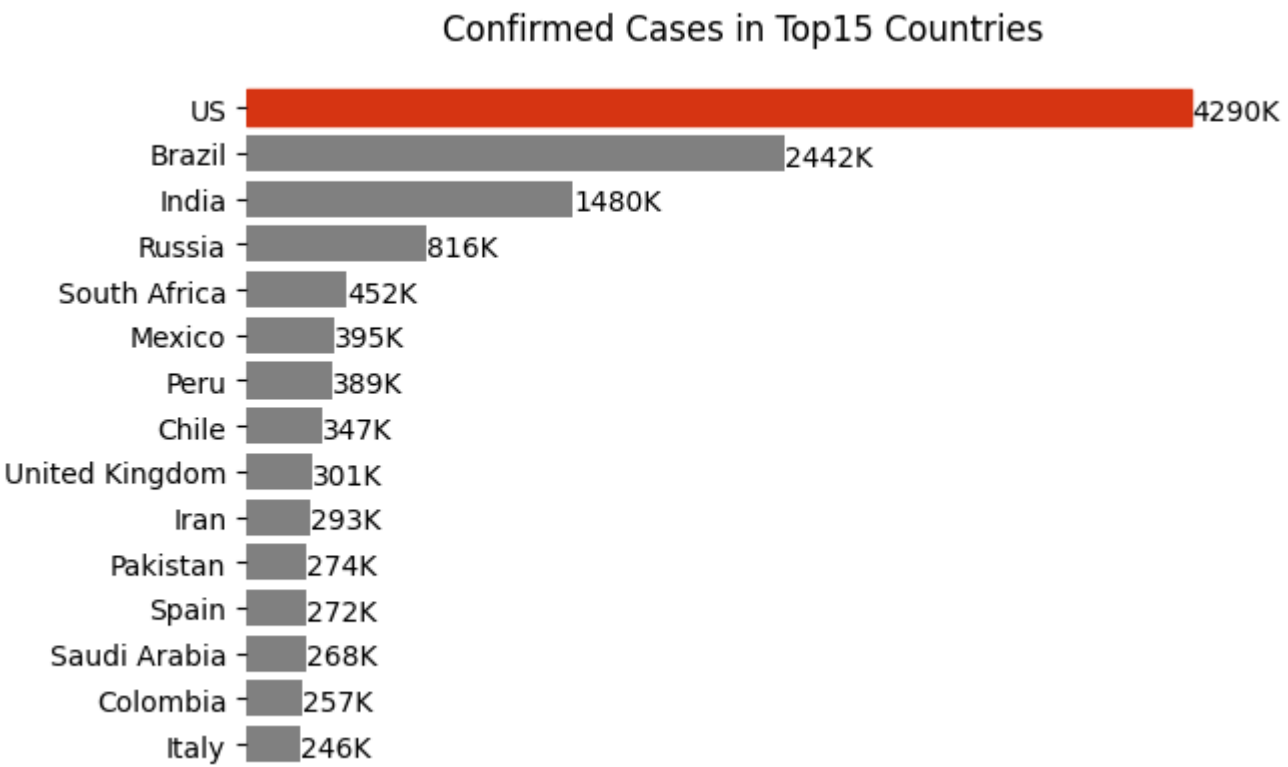

Monthly Confirmed Cases
$10^7$
$10^6$
$10^5$
$10^4$
$10^3$
2020-02
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08



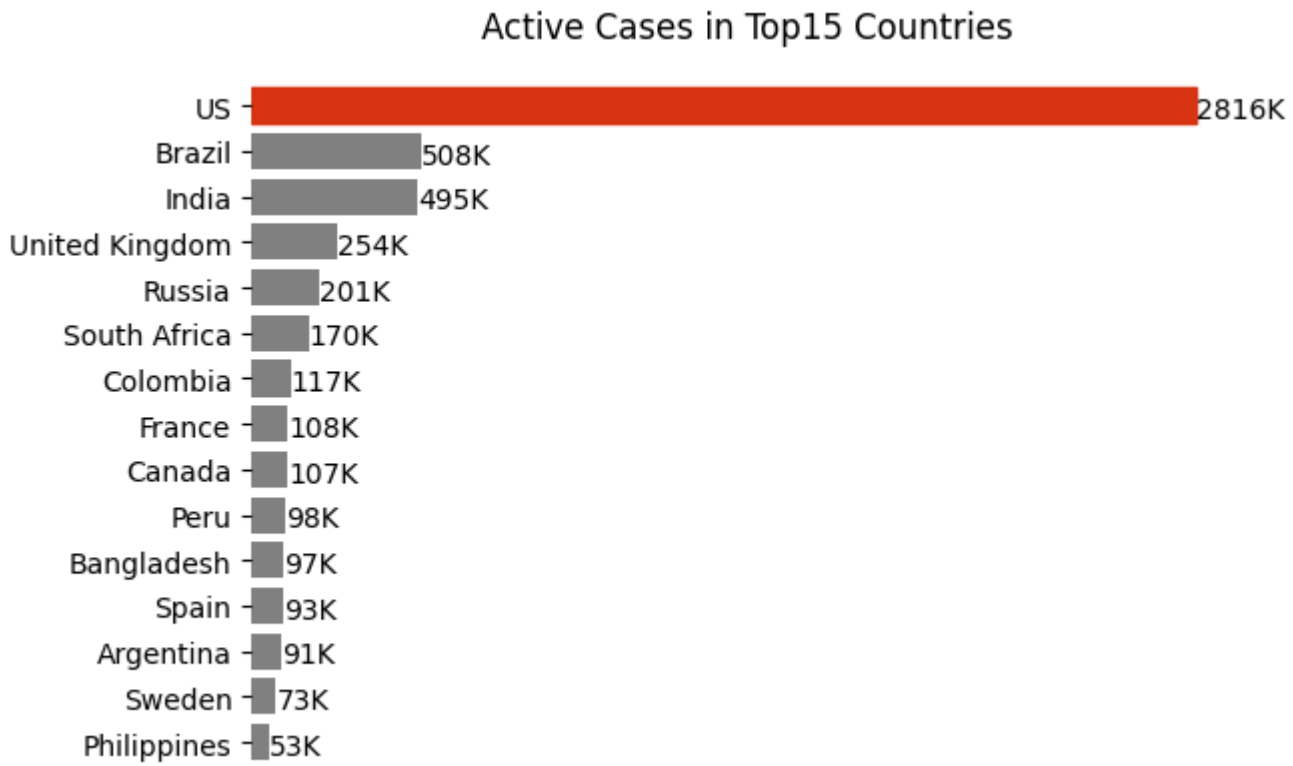

## HYPOTHESIS - 2

**The Top 15 countries for all confirmed cases, active cases, deaths, recovered cases, new cases of covid, and new recovered cases of covid were determined using a horizontal bar graph.**

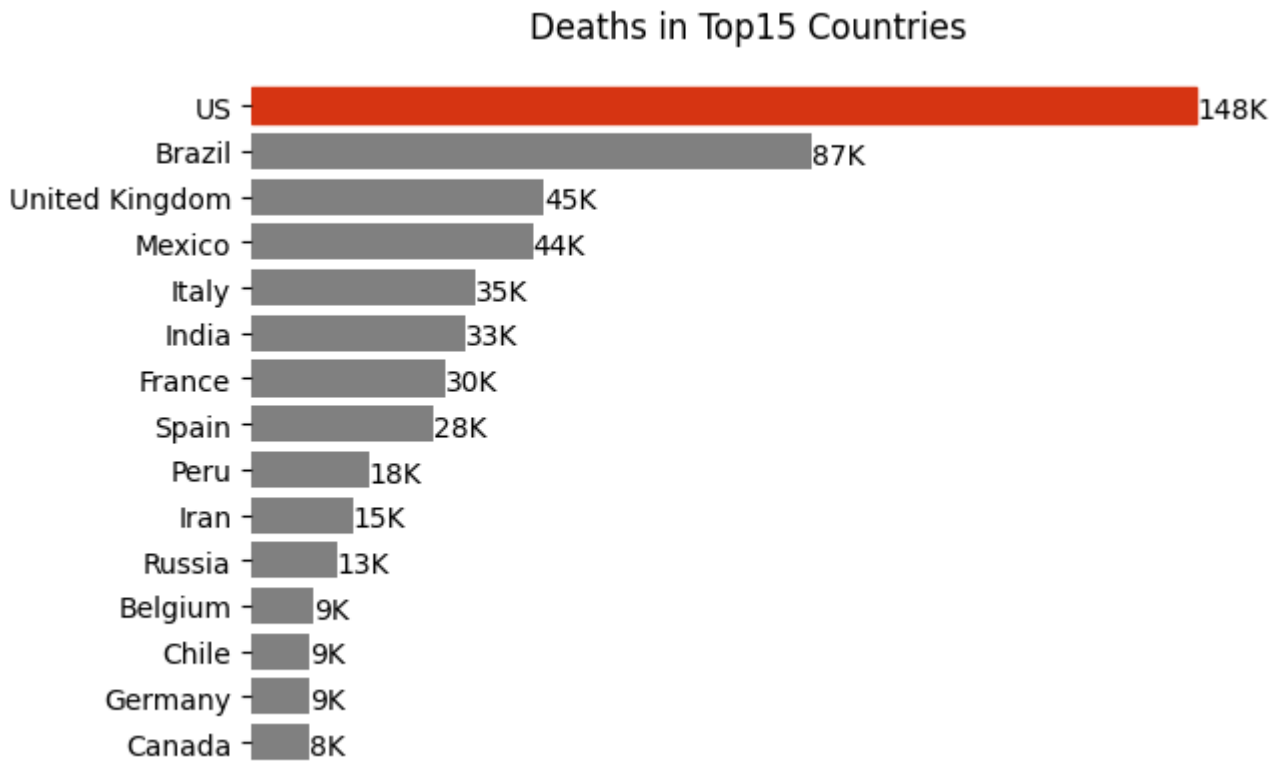
In [14]:
```
plt.style.use('default')

temp = country_wise[['Country/Region', 'Confirmed']].sort_values(by='Confirmed', ascending=False)[0:15]
temp.sort_values(by='Confirmed', inplace=True)

bars = plt.barh(temp['Country/Region'], temp['Confirmed'],color=['gray'])
bars[-1].set_color('#D63412')
plt.tick_params(labelbottom=False, bottom=False, top=False)
plt.title('Confirmed Cases in Top15 Countries')
plt.gca().ticklabel_format(useOffset=False, style='plain', axis='x')

# remove the frame of the chart
for spine in plt.gca().spines.values():
    spine.set_visible(False)

# direct label each bar with Y axis values
for i, v in enumerate(temp['Confirmed']):
    plt.gca().text(v + 3, i - .25, str(int(v/1000))+'K', color='black', fontsize=10)
```


Confirmed Cases in Top15 Countries
US
Brazil
India
Russia
South Africa
Mexico
Peru
Chile
United Kingdom
Iran
Pakistan
Spain
Saudi Arabia
Colombia
Italy
4290K
2442K
1480K
816K
452K
395K
389K
347K
301K
293K
274K
272K
268K
257K
246K

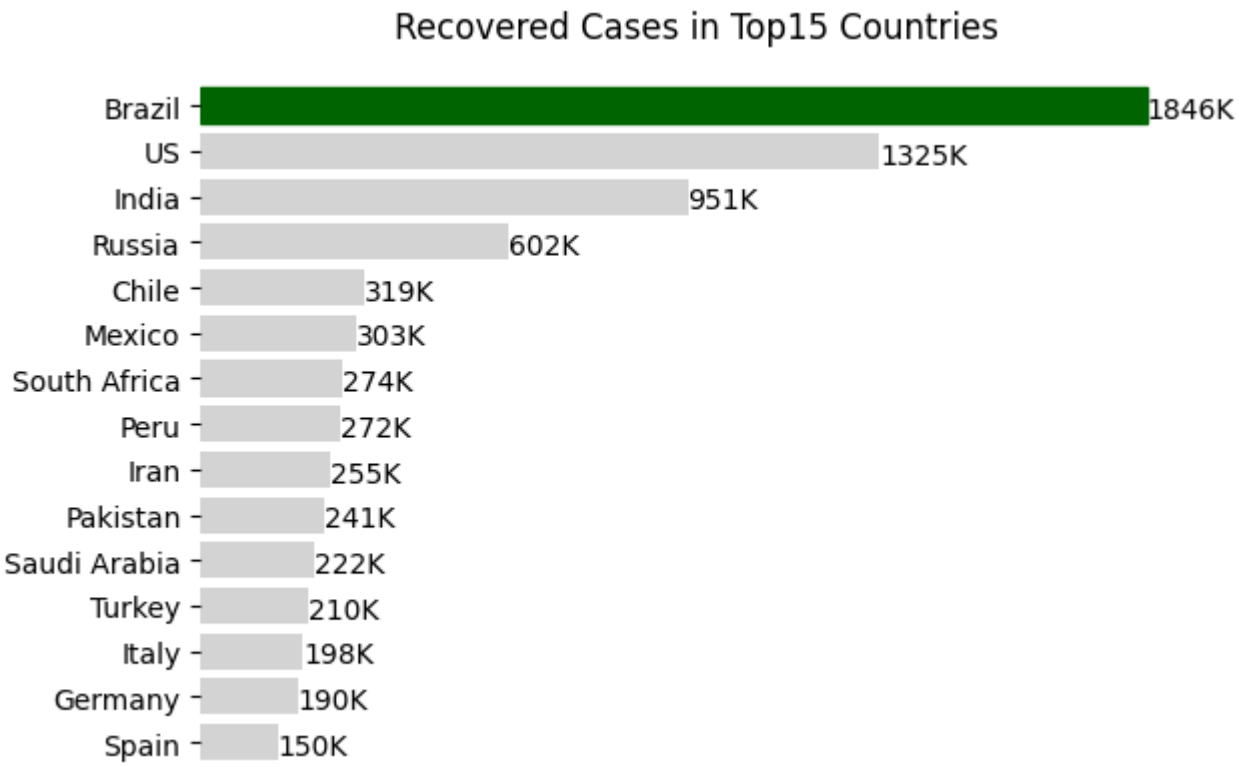
In [15]:
```
temp = country_wise[['Country/Region', 'Active']].sort_values(by='Active', ascending=False)[0:15]
temp.sort_values(by='Active', inplace=True)

bars = plt.barh(temp['Country/Region'], temp['Active'],color=['gray'])
bars[-1].set_color('#D63412')
plt.tick_params(labelbottom=False, bottom=False, top=False)
plt.title('Active Cases in Top15 Countries')
plt.gca().ticklabel_format(useOffset=False, style='plain', axis='x')

# remove the frame of the chart
for spine in plt.gca().spines.values():
    spine.set_visible(False)

# direct label each bar with Y axis values
for i, v in enumerate(temp['Active']):
    plt.gca().text(v + 3, i - .25, str(int(v/1000))+'K', color='black', fontsize=10)
```



In [16]:
```
temp = country_wise[['Country/Region', 'Deaths']].sort_values(by='Deaths', ascending=False)[0:15]
temp.sort_values(by='Deaths', inplace=True)

bars = plt.barh(temp['Country/Region'], temp['Deaths'],color=['gray'])
bars[-1].set_color('#D63412')
plt.tick_params(labelbottom=False, bottom=False, top=False)
plt.title('Deaths in Top15 Countries')
plt.gca().ticklabel_format(useOffset=False, style='plain', axis='x')

# remove the frame of the chart
for spine in plt.gca().spines.values():
    spine.set_visible(False)

# direct label each bar with Y axis values
for i, v in enumerate(temp['Deaths']):
    plt.gca().text(v + 3, i - .25, str(int(v/1000))+'K', color='black', fontsize=10)
```

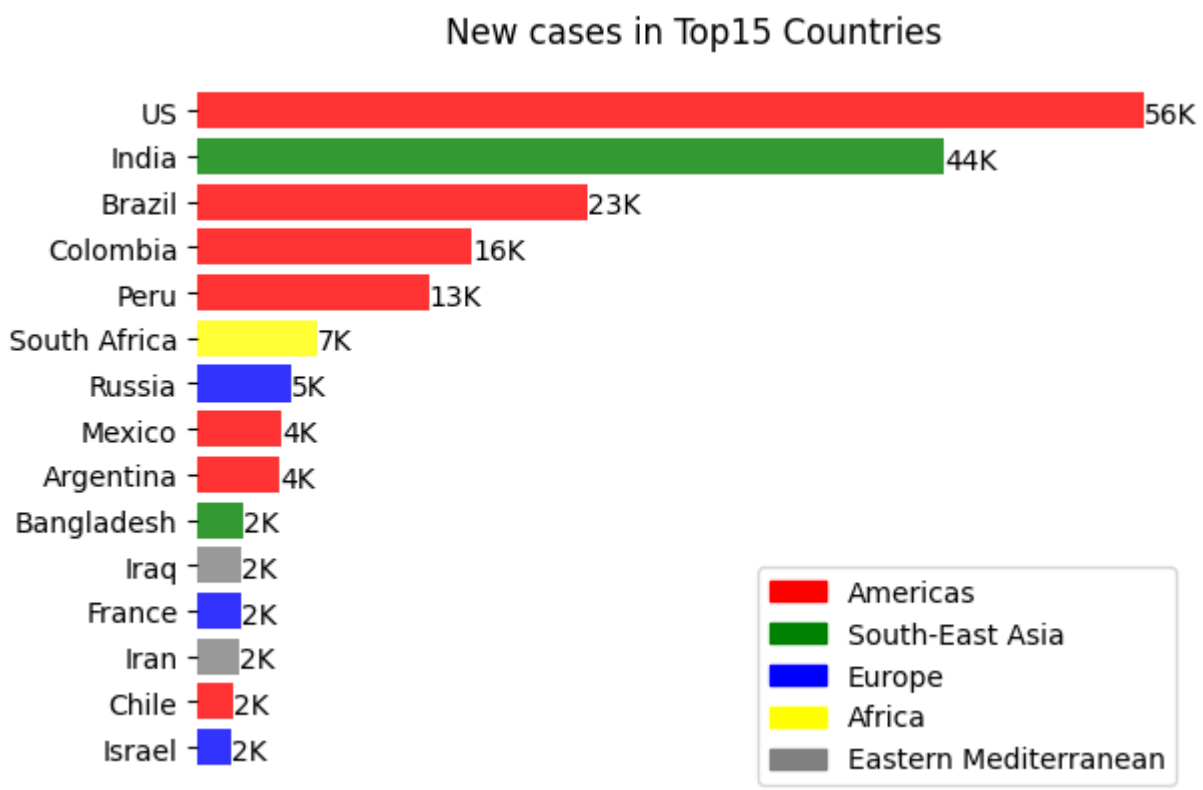


In [17]:
```
temp = country_wise[['Country/Region', 'Recovered']].sort_values(by='Recovered', ascending=False)[0:15]
temp.sort_values(by='Recovered', inplace=True)

bars = plt.barh(temp['Country/Region'], temp['Recovered'],color=['lightgray'])
bars[-1].set_color('darkgreen')
plt.tick_params(labelbottom=False, bottom=False, top=False)
plt.title('Recovered Cases in Top15 Countries')
plt.gca().ticklabel_format(useOffset=False, style='plain', axis='x')

# remove the frame of the chart
for spine in plt.gca().spines.values():
    spine.set_visible(False)

# direct label each bar with Y axis values
for i, v in enumerate(temp['Recovered']):
    plt.gca().text(v + 3, i - .25, str(int(v/1000))+'K', color='black', fontsize=10)
```



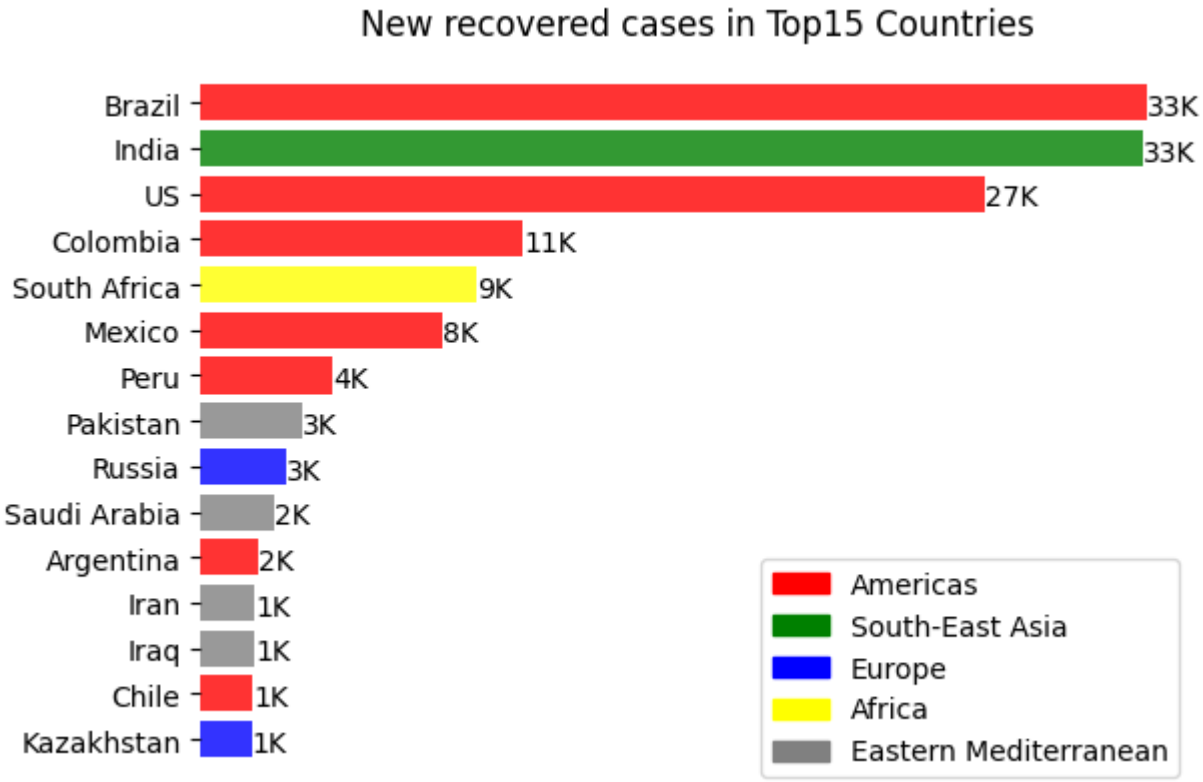
In [18]:
```
dic = {'Americas':'red','South-East Asia':'green','Europe':'blue','Africa':'yellow','Eastern Mediterranean':'g
temp = country_wise[['Country/Region', 'New cases', 'WHO Region']].sort_values(by='New cases', ascending=False
temp.sort_values(by='New cases', inplace=True)
temp['WHO Region']=temp['WHO Region'].map(dic)
temp['WHO Region'].dropna(inplace=True)


bars = plt.barh(temp['Country/Region'], temp['New cases'], color=temp['WHO Region'], alpha=0.8)
plt.tick_params(labelbottom=False, bottom=False, top=False)
plt.title('New cases in Top15 Countries')
plt.gca().ticklabel_format(useOffset=False, style='plain', axis='x')
plt.legend()

# remove the frame of the chart
for spine in plt.gca().spines.values():
    spine.set_visible(False)

# direct label each bar with Y axis values
for i, v in enumerate(temp['New cases']):
    plt.gca().text(v + 3, i - .25, str(int(v/1000))+'K', color='black', fontsize=10)

#Add Legend
patchList = []
for key in dic:
        data_key = mpatches.Patch(color=dic[key], label=key)
        patchList.append(data_key)
plt.legend(handles=patchList, loc='best');
```

```
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are i
gnored when legend() is called with no argument.
```


New cases in Top15 Countries
US
India
Brazil
Colombia
Peru
South Africa
Russia
Mexico
Argentina
Bangladesh
Iraq
France
Iran
Chile
Israel
56K
44K
23K
16K
13K
7K
5K
4K
4K
2K
2K
2K
2K
2K
2K
Americas
South-East Asia
Europe
Africa
Eastern Mediterranean

In [19]:
```
temp = country_wise[['Country/Region', 'New recovered', 'WHO Region']].sort_values(by='New recovered', ascendi
temp.sort_values(by='New recovered', inplace=True)
temp['WHO Region']=temp['WHO Region'].map(dic)
temp['WHO Region'].dropna(inplace=True)

bars = plt.barh(temp['Country/Region'], temp['New recovered'], color=temp['WHO Region'], alpha=0.8)
plt.tick_params(labelbottom=False, bottom=False, top=False)
plt.title('New recovered cases in Top15 Countries')
plt.gca().ticklabel_format(useOffset=False, style='plain', axis='x')
plt.legend()

# remove the frame of the chart
for spine in plt.gca().spines.values():
    spine.set_visible(False)

# direct label each bar with Y axis values
for i, v in enumerate(temp['New recovered']):
    plt.gca().text(v + 3, i - .25, str(int(v/1000))+'K', color='black', fontsize=10)

#Add Legend
patchList = []
for key in dic:
        data_key = mpatches.Patch(color=dic[key], label=key)
        patchList.append(data_key)
plt.legend(handles=patchList, loc='best');
```

```
No artists with labels found to put in legend.  Note that artists whose label start with an underscore are i
gnored when legend() is called with no argument.
```




## HYPOTHESIS - 3

**Let's start with Interactive Visualization with the help of plotly And lets see confirmed cases and death cases entrie world and also a world map displying cases over time through a scroll bar.**

World Wide spread using Dynamic Analysis.

We can use plotly visualisation tool for dynamic plotting.Python visualization tool that’s capable of handling geographical, scientific, statistical, and financial data. Plotly has several advantages over matplotlib. One of the main advantages is that only a few lines of codes are necessary to create aesthetically pleasing, interactive plots.

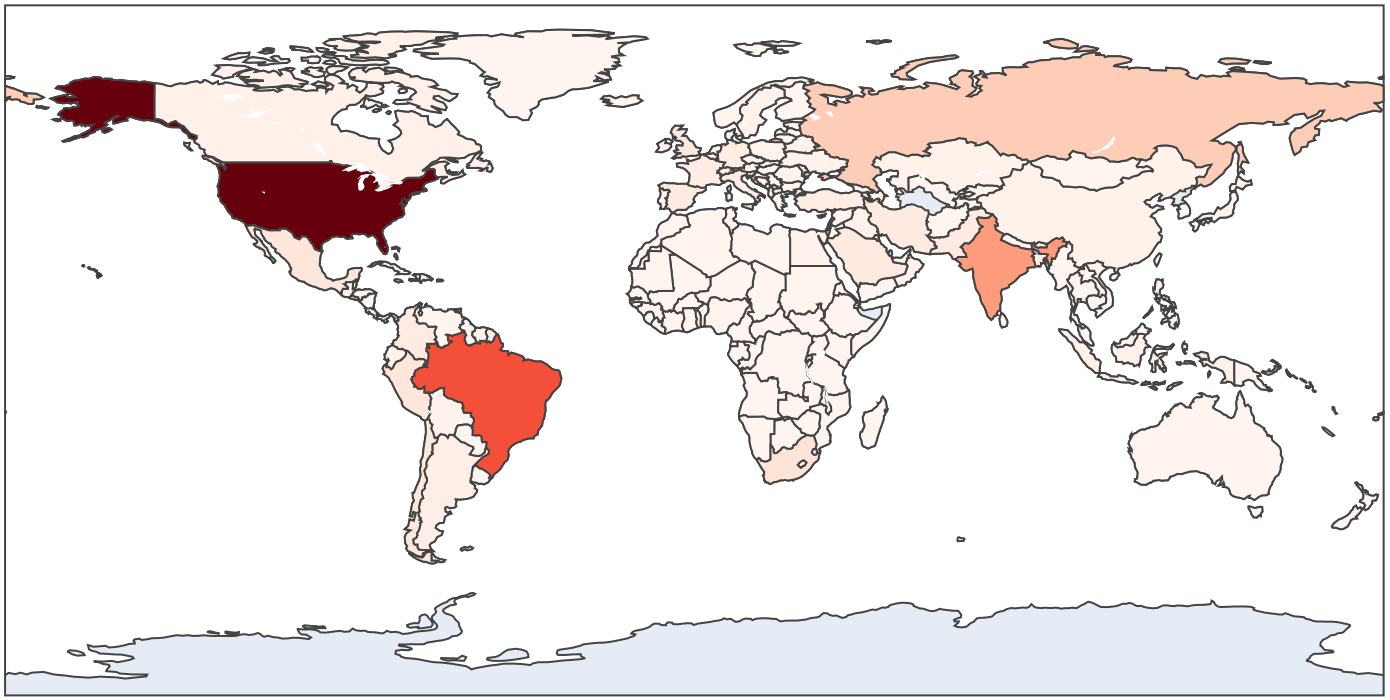
In [20]:
```
import plotly.express as px
```

**WORLD MAP**

In [21]:
```
def plot_map(df,col):
    df = df[df[col]>0]
    fig = px.choropleth(df, locations="Country/Region", locationmode='country names',
                        color=col, hover_name="Country/Region",
                        title=col, hover_data=[col], color_continuous_scale="Reds")
    fig.show()
```

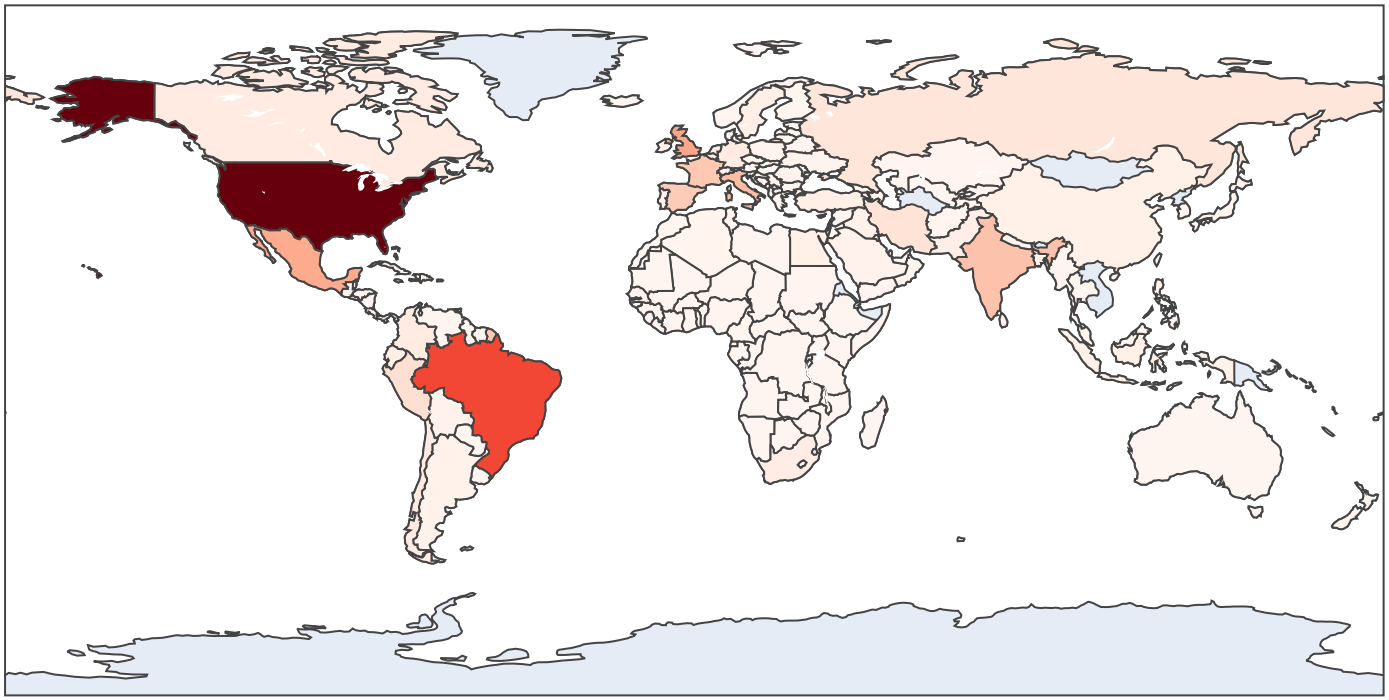
In [22]:
```
plot_map(country_wise, 'Confirmed')
```

## Confirmed



```
In [23]: plot_map(country_wise, 'Deaths')
```

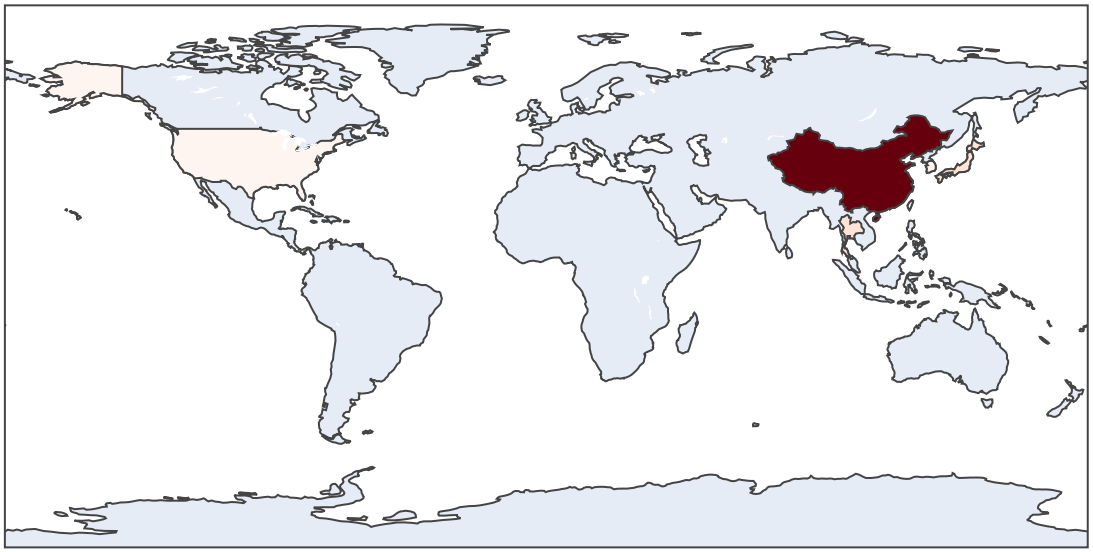
## Deaths



**Now below we can see cases increases over the time!**

In [24]:
```
#the plot i will be using is same choropleth plot as used in above plots the
#differnece is i will be updating the plot with colors according to the animation frame!

fig = px.choropleth(full_grouped, locations="Country/Region",
                    color=np.log(full_grouped["Confirmed"]),
                    locationmode='country names', hover_name="Country/Region",
                    animation_frame=full_grouped["Date"].dt.strftime('%Y-%m-%d'),
                    title='Cases over time', color_continuous_scale=px.colors.sequential.Reds)
fig.update(layout_coloraxis_showscale=False)
fig.show()
```

Cases over time

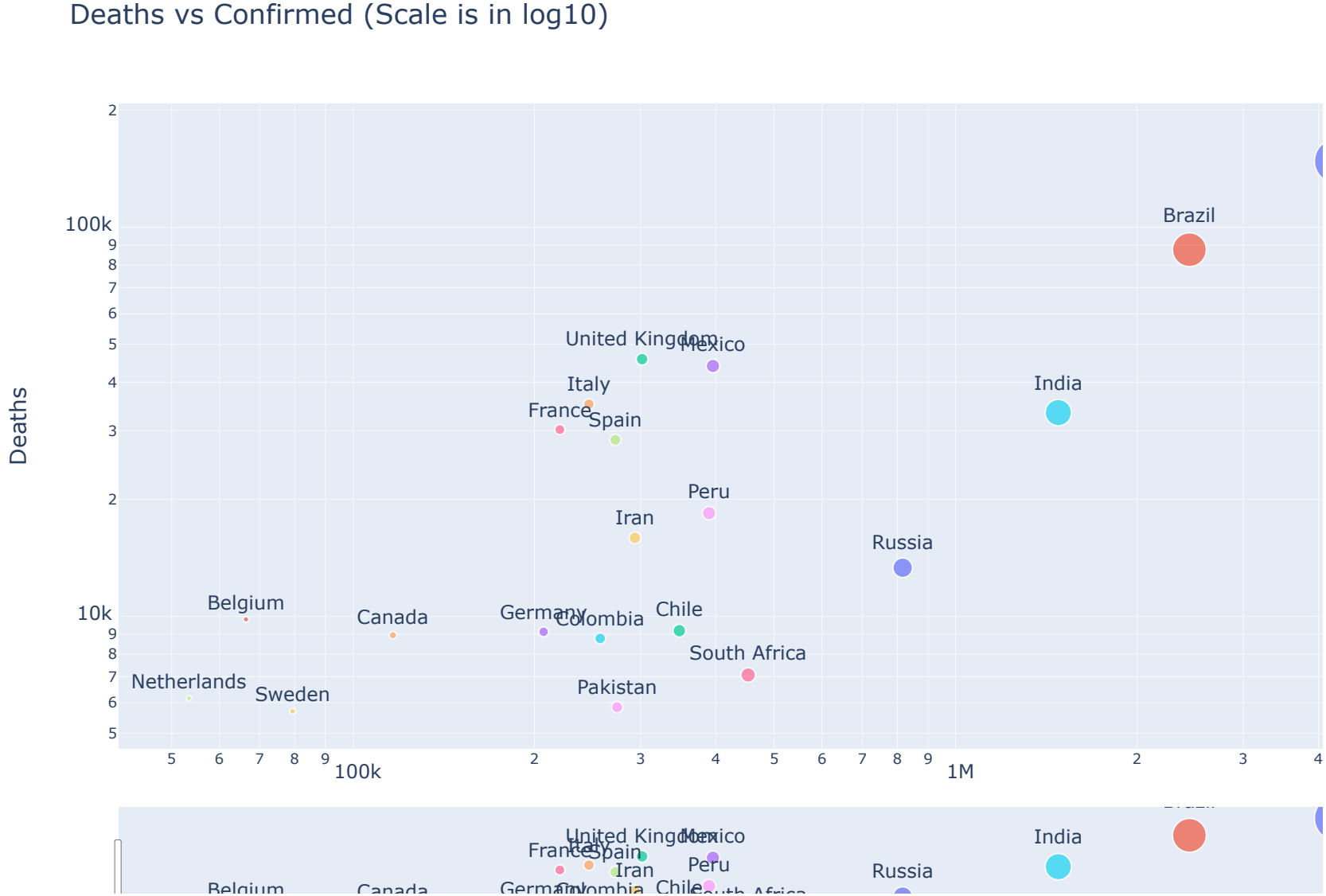


animation frame=2020-01-22

## HYPOTHESIS - 4

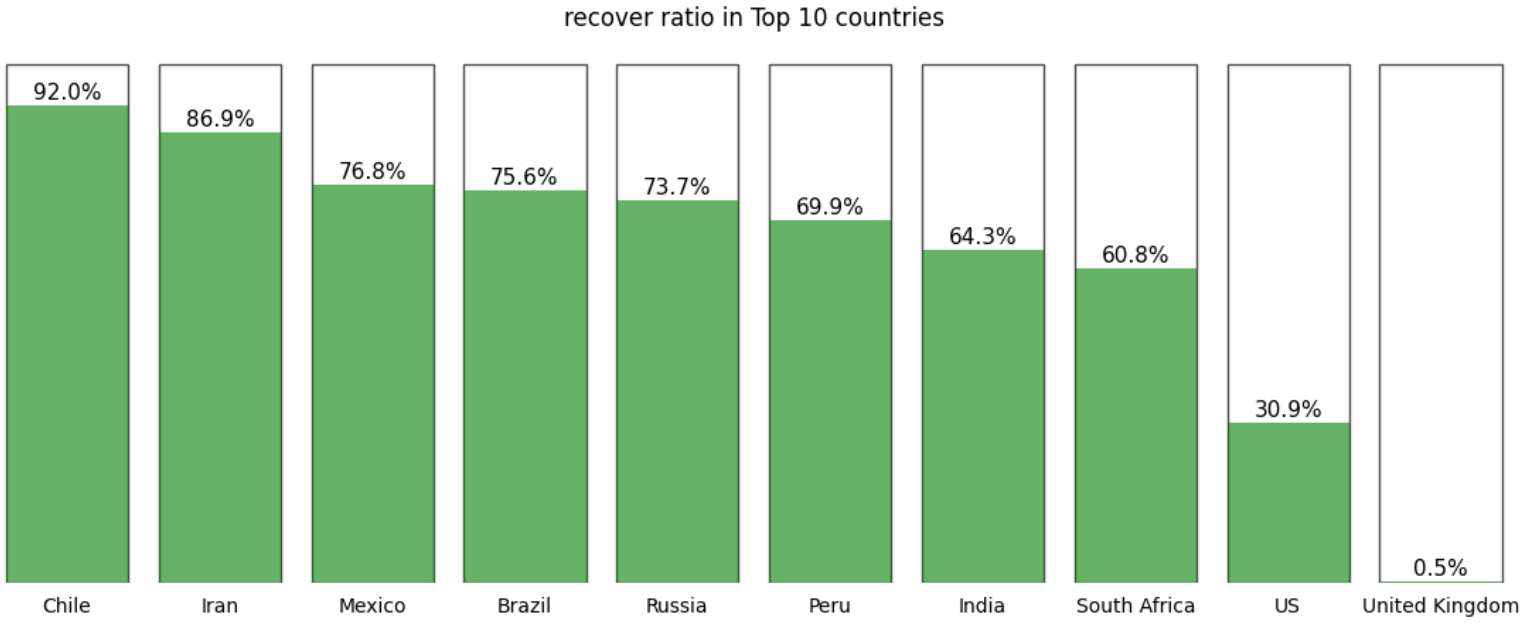
**Comparing number of deaths vs confimed cases using scatter plot in plotly Top 10 countries Recover ratio and Death ratios affected by the Corona virus**

In [25]:
```
fig = px.scatter(country_wise.sort_values('Deaths', ascending=False).iloc[:20, :],
                 x='Confirmed', y='Deaths', color='Country/Region', size='Confirmed',
                 height=700, text='Country/Region', log_x=True, log_y=True,
                 title='Deaths vs Confirmed (Scale is in log10)')
fig.update_traces(textposition='top center')
fig.update_layout(showlegend=False)
fig.update_layout(xaxis_rangeslider_visible=True)
fig.show()
```


Deaths vs Confirmed (Scale is in log10)
Deaths
100k
10k
Brazil
India
Russia
United Kingdom
Mexico
Italy
France
Spain
Peru
Iran
Belgium
Canada
Germany
Colombia
Chile
South Africa
Pakistan
Netherlands
Sweden
100k
1M

In [26]:
```
temp = country_wise.iloc[:,0:5].sort_values(ascending=False, by='Confirmed').set_index('Country/Region')[:10]
temp['Death ratio'] = temp.Deaths/temp.Confirmed
temp['recover ratio'] = temp.Recovered/temp.Confirmed
temp['var'] = 1
```

In [27]:
```
temp.sort_values(by='recover ratio',ascending=False,inplace=True)

plt.figure(figsize=(15,5))
plt.bar(temp.index,temp['var'],color='white',edgecolor='black',alpha=0.7)
bars = plt.bar(temp.index,temp['recover ratio'],color='green',alpha=0.6)
for spine in plt.gca().spines.values():
    spine.set_visible(False)
plt.tick_params(top=False, bottom=False, left=False, right=False, labelleft=False, labelbottom=True)
for bar in bars:
    plt.gca().text(bar.get_x() + bar.get_width()/2, bar.get_height()+0.01, str(round(bar.get_height()*100,1))
                ha='center', color='black', fontsize=11)
plt.title('recover ratio in Top 10 countries');
```



In [28]:
```
temp.sort_values(by='Death ratio',ascending=False,inplace=True)

plt.figure(figsize=(15,2.5))
plt.bar(temp.index,temp['var'],color='white',edgecolor='black',alpha=0.7)
bars = plt.bar(temp.index,temp['Death ratio'],color='red',alpha=0.6)
for spine in plt.gca().spines.values():
    spine.set_visible(False)
plt.tick_params(top=False, bottom=False, left=False, right=False, labelleft=False, labelbottom=True)
for bar in bars:
    plt.gca().text(bar.get_x() + bar.get_width()/2, bar.get_height()+0.02, str(round(bar.get_height()*100,2))
                ha='center', color='black', fontsize=11)
plt.title('Death ratio in Top 10 countries');
```