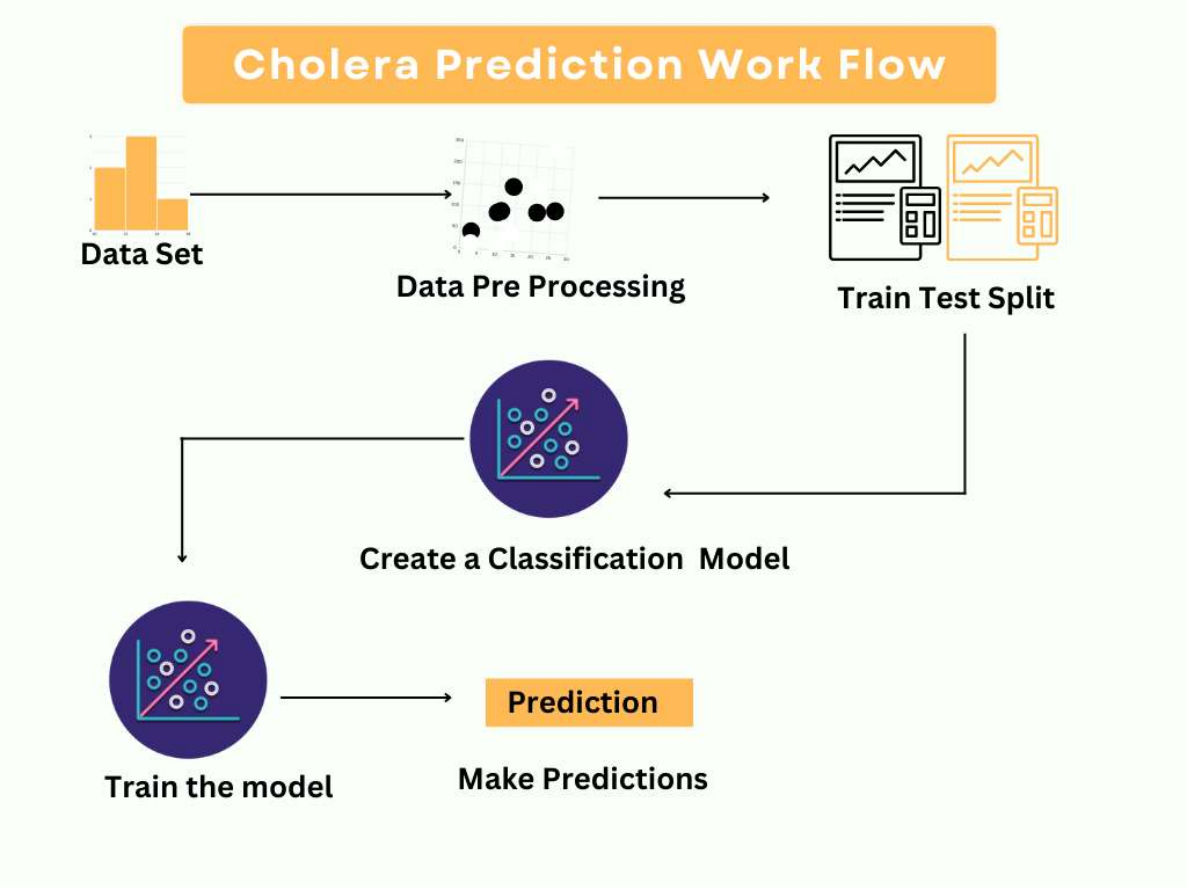
In [105]:
```
from IPython.display import Image

# Provide the file path to your image
Image(filename="C:/Users/Yusuf Nasir/OneDrive/Desktop/Zakiya/Cholera Predi
```

Out[105]:



Importing Dependencies

In [1]:
```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) wil

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))
```

```
1
```

Reading the cholera Dataset as input

In [5]:
```
file = pd.read_csv(r'C:\Users\Yusuf Nasir\OneDrive\Desktop\Zakiya\data.csv
file.head()
```

Out[5]:

	Country	Year	Number of reported cases of cholera	Number of reported deaths from cholera	Cholera case fatality rate	WHO Region
0	Afghanistan	2016	677	5	0.7	Eastern Mediterranean
1	Afghanistan	2015	58064	8	0.01	Eastern Mediterranean
2	Afghanistan	2014	45481	4	0	Eastern Mediterranean
3	Afghanistan	2013	3957	14	0.35	Eastern Mediterranean
4	Afghanistan	2012	12	0	0.1	Eastern Mediterranean

IDENTIFYING THE DATA TYPE

In [6]:
```
file.dtypes
```

Out[6]:
```
Country                                 object
Year                                     int64
Number of reported cases of cholera     object
Number of reported deaths from cholera  object
Cholera case fatality rate              object
WHO Region                              object
dtype: object
```

IDENTIFYING DATA GAPS

In [7]:
```
file.isnull().sum()
```

Out[7]:
```
Country                                   0
Year                                      0
Number of reported cases of cholera      22
Number of reported deaths from cholera  117
Cholera case fatality rate              127
WHO Region                                0
dtype: int64
```

DATA CLEANING

In [8]:
```
file.replace(np.nan,0,regex=True,inplace=True)
```

DATA CLEAN CHECK

In [9]:
```
1 file.isnull().sum()
```

Out[9]:
```
Country                                 0
Year                                    0
Number of reported cases of cholera     0
Number of reported deaths from cholera  0
Cholera case fatality rate              0
WHO Region                              0
dtype: int64
```

CHECKING IF UNKNOWN VALUES EXISTS

In [10]:
```
1 file[(file['Number of reported deaths from cholera']=='Unknown') | (file[
```

Out[10]:

	Country	Year	Number of reported cases of cholera	Number of reported deaths from cholera	Cholera case fatality rate	WHO Region
761	Germany	2016	1	Unknown	Unknown	Europe

CORRECTING THE UNKNOWN VALUES

In [11]:
```
1 file.replace('Unknown',0,regex=True,inplace=True)
```

IDENTIFYING THE TOTAL NUMBER OF COUNTRIES IN THE DATA SET

In [12]:
```
1 country_list=file.Country.unique()
2 len(file.Country.unique())
```

Out[12]:
```
162
```

Upon checking the data, I observed an issue with this particular entry

In [13]:
```
1 file[file['Number of reported cases of cholera']=="3 5"]
```

Out[13]:

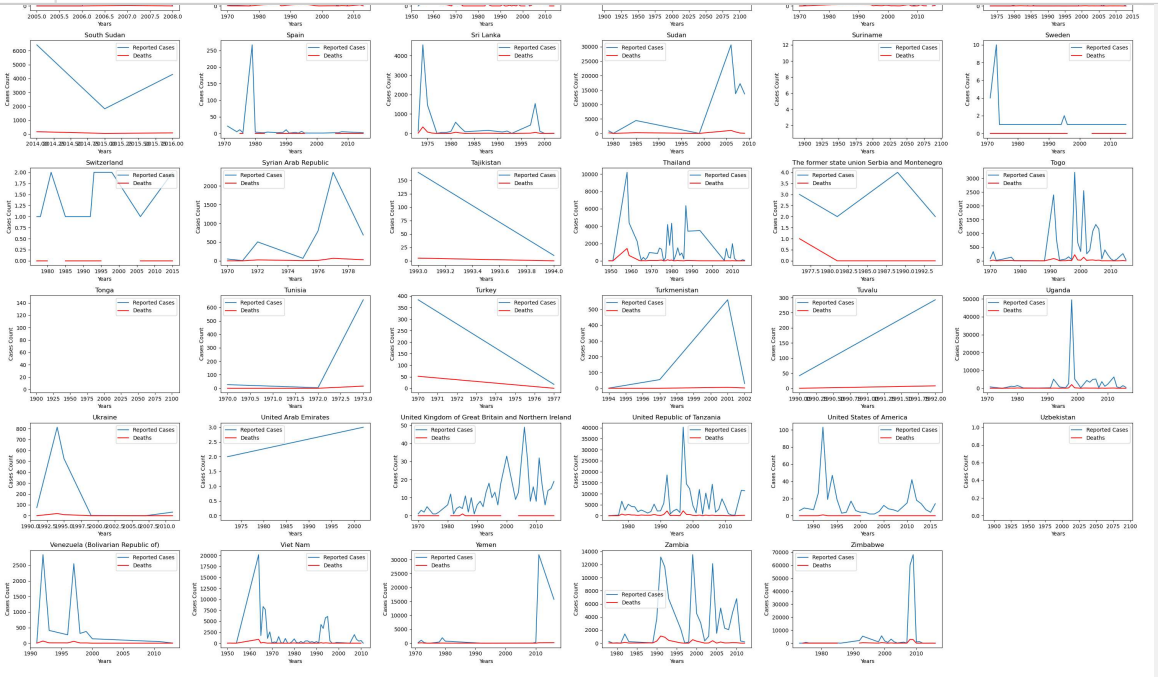
	Country	Year	Number of reported cases of cholera	Number of reported deaths from cholera	Cholera case fatality rate	WHO Region
1059	Iraq	2016	3 5	0 0	0.0 0.0	Eastern Mediterranean

This entry needs to be cleaned. Since the fatality rate is given as 0.0 and 0.0, we assume, that all the entries here to be 0 and assign the variables accordingly.

In [14]:
```
file['Number of reported cases of cholera'] = file['Number of reported cas
file['Number of reported deaths from cholera'] = file['Number of reported
file['Cholera case fatality rate'] = file['Cholera case fatality rate'].st
```

Country wise visualization of Total Number of Reported Cases and Total Number of Deaths over the Years

In [15]:
```
import seaborn as sns
import matplotlib.pyplot as plt
fig = plt.figure(figsize=(30,90))
for c,num in zip(file.Country.unique(), np.arange(1,len(file.Country.uniqu
    file_req=file[file['Country']==c]
    ax = fig.add_subplot(27,6,num)
    x=file_req['Year']
    y1=pd.to_numeric(file_req['Number of reported cases of cholera'])
    ax.plot(x,y1)
    y2=pd.to_numeric(file_req['Number of reported deaths from cholera'])
    ax.plot(x,y2,color='r')
    ax.legend(['Reported Cases','Deaths'])
    ax.set_title(c)
    ax.set_xlabel('Years')
    ax.set_ylabel('Cases Count')

plt.tight_layout()
plt.show()
```



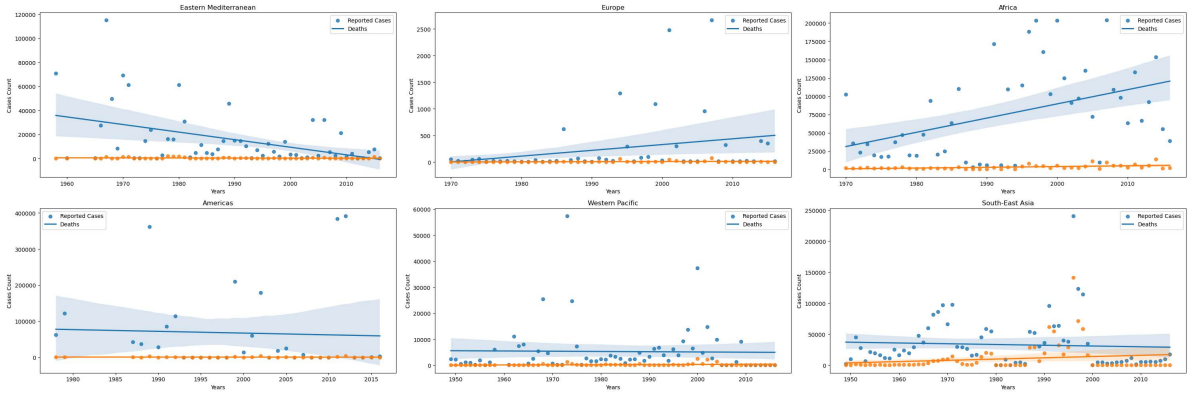
In [ ]:
```
1
```

In [55]:
```
import warnings
warnings.filterwarnings('ignore', category=DeprecationWarning)

# Your existing code follows
y11 = file_req.groupby('Year').apply(lambda x: np.sum(pd.to_numeric(x['Nur
y21 = file_req.groupby('Year').apply(lambda x: np.sum(pd.to_numeric(x['Nur

```

WHO Region wise visualization of Total Number of Reported Cases and Total Number of Deaths

over the Years

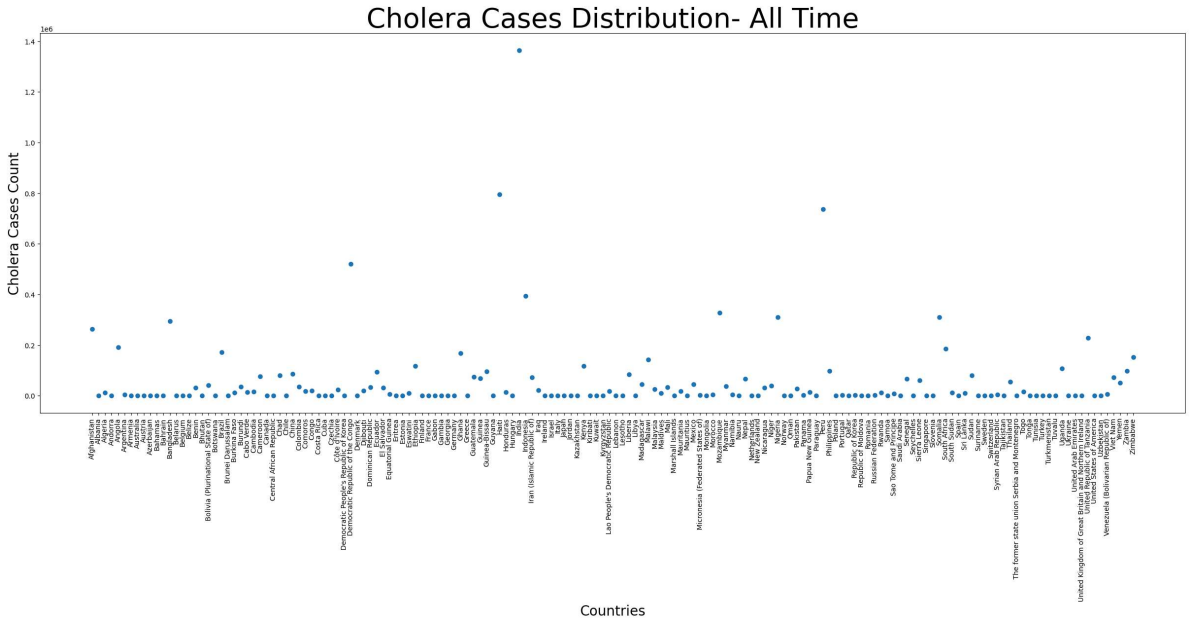
In [56]:
```
fig = plt.figure(figsize=(30,10))
for c, num in zip(file['WHO Region'].unique(), np.arange(1, 1 + len(file[
    file_req = file[file['WHO Region'] == c]
    ax = fig.add_subplot(2, 3, num)
    x = file_req['Year'].unique()

    # Summing reported cases and plotting
    y11 = file_req.groupby('Year').apply(lambda x: np.sum(pd.to_numeric(x
    y1 = y11['Counts']
    sns.regplot(x=x, y=y1)  # Fixed here

    # Summing reported deaths and plotting
    y21 = file_req.groupby('Year').apply(lambda x: np.sum(pd.to_numeric(x
    y2 = y21['Counts']
    sns.regplot(x=x, y=y2)  # Fixed here

    ax.legend(['Reported Cases', 'Deaths'])
    ax.set_title(c)
    ax.set_xlabel('Years')
    ax.set_ylabel('Cases Count')

plt.tight_layout()
plt.show()

```



To identify the number of Cases Registered in the World (All time data)

In [57]:
```
file_ctry=file.groupby(['Country']).apply(lambda x:np.sum(pd.to_numeric(x
print('The Number of Cholera Cases for the counties:\n',file_ctry)
plt.figure(figsize=(30,10))
plt.scatter(file_ctry['Country'],file_ctry['Count of Cholera Cases'])
plt.xlabel('Countries',size=20)
plt.ylabel('Cholera Cases Count',size=20)
plt.title('Cholera Cases Distribution- All Time',size=40)
plt.xticks(rotation=90)
plt.show()
```

```
The Number of Cholera Cases for the counties:
                                  Country  Count of Cholera Cases
0                             Afghanistan                263843.0
1                                 Albania                   626.0
2                                 Algeria                 12729.0
3                                 Andorra                     0.0
4                                  Angola                191036.0
..                                    ...                     ...
157  Venezuela (Bolivarian Republic of)                  6969.0
158                            Viet Nam                 73128.0
159                               Yemen                 52462.0
160                              Zambia                 97606.0
161                            Zimbabwe                153428.0

[162 rows x 2 columns]
```



Importing a shape file, that will be required for the plotting of the Global Heatmap

In [33]:
```
import geopandas as gpd

# Correct file path (using raw string literal)
fp = r"C:\Users\Yusuf Nasir\OneDrive\Desktop\Zakiya\TM_WORLD_BORDERS-0.3.s

# Read the shapefile
map_df = gpd.read_file(fp)

# Display the GeoDataFrame
print(map_df.head())

```

```
  FIPS ISO2 ISO3  UN                 NAME    AREA   POP2005  REGION  \
0   AC   AG  ATG  28  Antigua and Barbuda      44     83039      19
1   AG   DZ  DZA  12              Algeria  238174  32854159       2
2   AJ   AZ  AZE  31           Azerbaijan    8260   8352021     142
3   AL   AL  ALB   8              Albania    2740   3153731     150
4   AM   AM  ARM  51              Armenia    2820   3017661     142

   SUBREGION     LON     LAT  \
0         29 -61.783  17.078
1         15   2.632  28.163
2        145  47.395  40.430
3         39  20.068  41.143
4        145  44.563  40.534

                                            geometry
0  MULTIPOLYGON (((-61.68667 17.02444, -61.73806 ...
1  POLYGON ((2.96361 36.80222, 2.98139 36.80694, ...
2  MULTIPOLYGON (((45.08332 39.76804, 45.26639 39...
3  POLYGON ((19.43621 41.02106, 19.45055 41.06, 1...
4  MULTIPOLYGON (((45.57305 40.63249, 45.52888 40...
```

The Countries in the .shp file needs to be the same as the Country name in the data file. Identifying those countries and replacing their names.

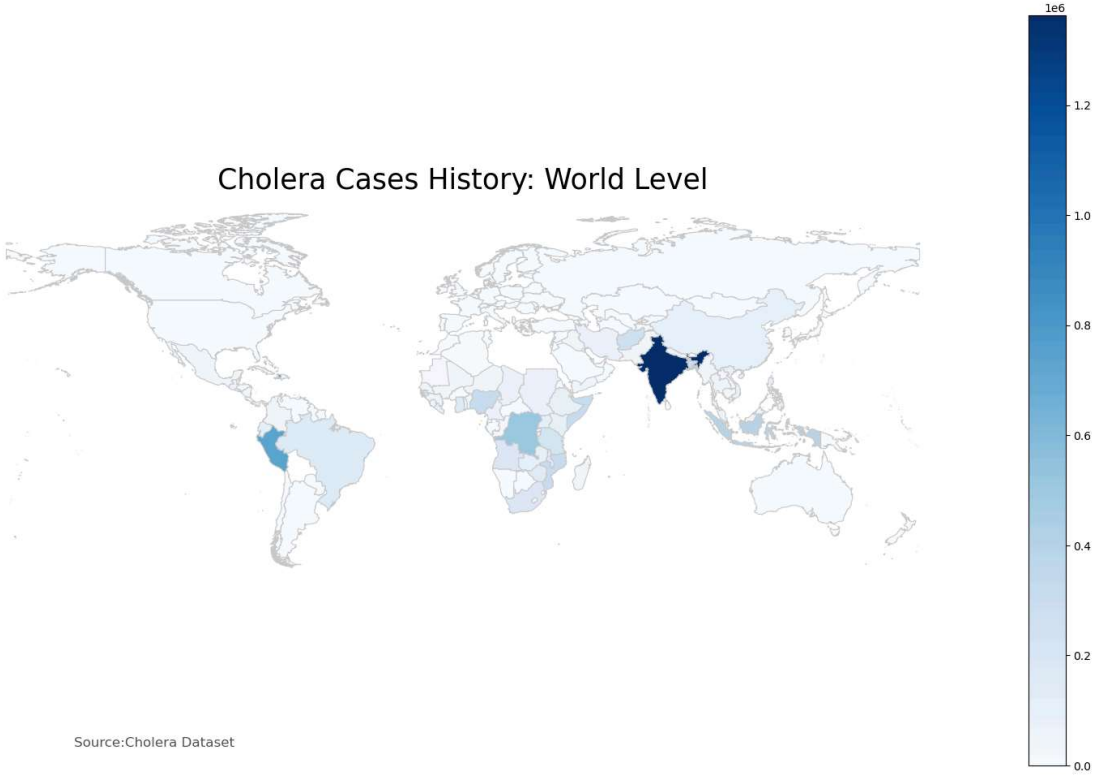
In [35]:
```
print(map_df.columns)

```

```
Index(['FIPS', 'ISO2', 'ISO3', 'UN', 'NAME', 'AREA', 'POP2005', 'REGION',
       'SUBREGION', 'LON', 'LAT', 'geometry'],
      dtype='object')
```

In [36]:
```
map_df.NAME.replace({'Burma':'Myanmar'},regex=True,inplace=True)
map_df.NAME.replace({'Korea, Republic of':'Republic of Korea'},regex=True,
map_df.NAME.replace({'Russia':'Russian Federation'},regex=True,inplace=Tru
map_df.NAME.replace({'United Kingdom':'United Kingdom of Great Britain and
map_df.NAME.replace({'United States':'United States of America'},regex=Tru
map_df.NAME.replace({ 'Venezuela': 'Venezuela (Bolivarian Republic of)'},
```

Creating a World Heat Map to display the total number of cases

In [58]:
```
merged = map_df.set_index('NAME').join(file_ctry.set_index('Country'))
variable = 'Count of Cholera Cases'
vmin, vmax = np.min(merged['Count of Cholera Cases']), np.max(merged['Cou

fig, ax = plt.subplots(1, figsize=(20, 12))
merged.plot(column=variable, cmap='Blues', linewidth=0.8, ax=ax, edgecolo
ax.axis('off')
ax.set_title('Cholera Cases History: World Level', fontdict={'fontsize':
ax.annotate('Source:Cholera Dataset', xy=(0.1, .08), xycoords='figure fra
sm = plt.cm.ScalarMappable(cmap='Blues', norm=plt.Normalize(vmin=vmin, vma
sm._A = []
cbar = fig.colorbar(sm)
```



To identify the span of last 10 years from the dataset

In [39]:
```
file_yrs=file.Year.unique()
file_yrs.sort()
final_10_yrs=file_yrs[-10:]
final_10_yrs
```

Out[39]:
```
array([2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016],
      dtype=int64)
```

Countries with the Least number of Cases in the past 10 years

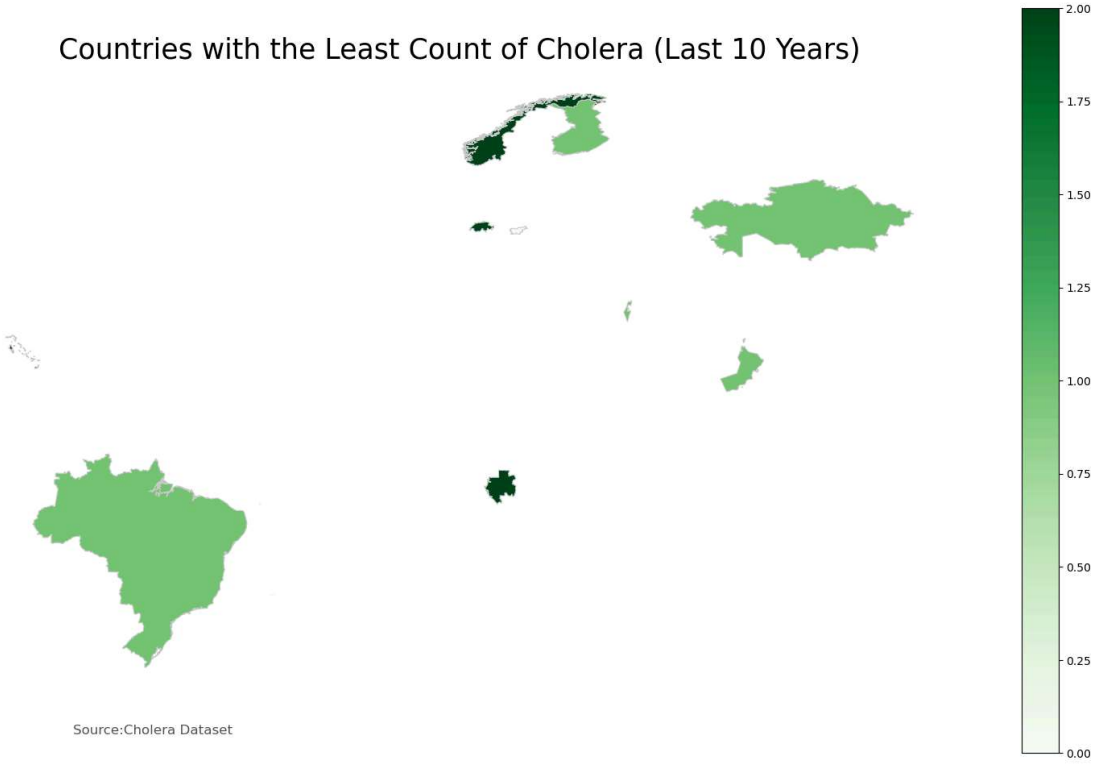
In [59]:
```
ten_yr_case=file[file['Year'].isin(final_10_yrs)]
file_yr_ctry=ten_yr_case.groupby(['Country']).apply(lambda x:np.sum(pd.to_
best_cases_country=file_yr_ctry.sort_values(by='Count of Cholera Cases',as
print('Countries having the least number of Cholera Cases in the last 10 y
```

```
Countries having the least number of Cholera Cases in the last 10 years:
         Country  Count of Cholera Cases
76     Slovenia                     0.0
45   Kazakhstan                     1.0
42       Israel                     1.0
7        Brazil                     1.0
63         Oman                     1.0
29      Finland                     1.0
31        Gabon                     2.0
3       Bahamas                     2.0
62       Norway                     2.0
83  Switzerland                     2.0
```

Plotting the Countries with the Least Number of Cases in the Last 10 Years

In [60]:

```
merged = map_df.set_index('NAME').join(best_cases_country.set_index('Coun
variable = 'Count of Cholera Cases'
vmin, vmax = np.min(merged['Count of Cholera Cases']), np.max(merged['Cou

fig, ax = plt.subplots(1, figsize=(20, 12))
merged.plot(column=variable, cmap='Greens', linewidth=0.8, ax=ax, edgecol
ax.axis('off')
ax.set_title('Countries with the Least Count of Cholera (Last 10 Years)',
ax.annotate('Source:Cholera Dataset', xy=(0.1, .08), xycoords='figure fra

sm = plt.cm.ScalarMappable(cmap='Greens', norm=plt.Normalize(vmin=vmin, v
sm._A = []
cbar = fig.colorbar(sm)

```



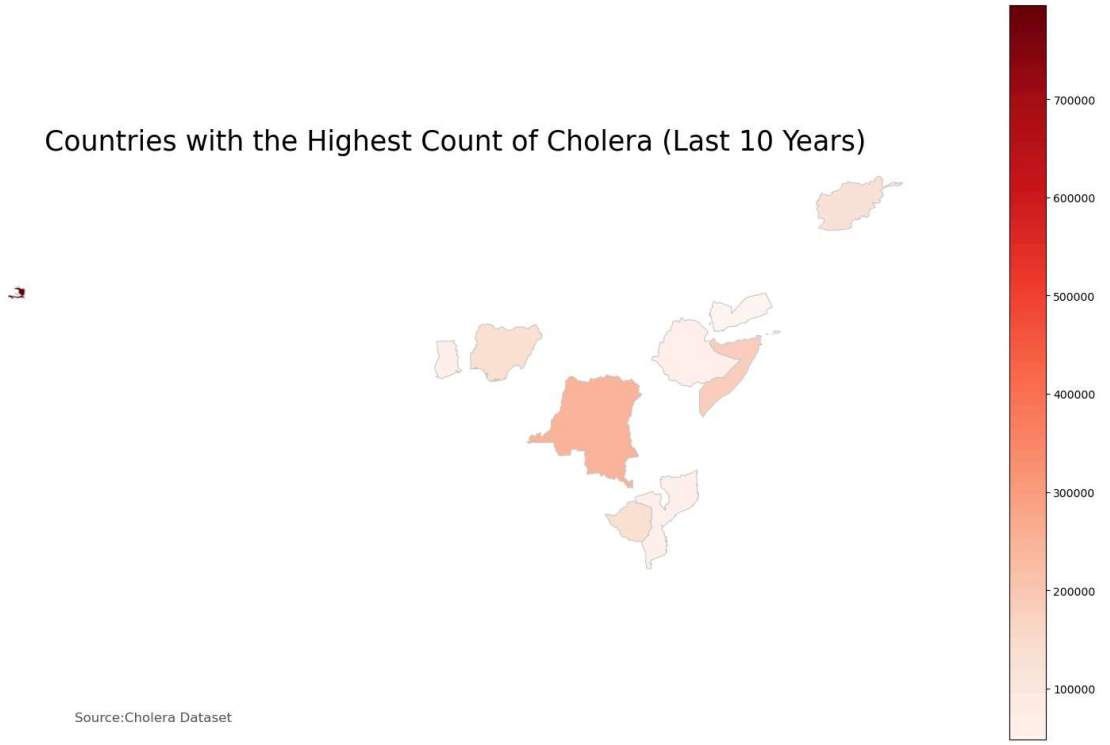
List of Countries with the Maximum number of cases in the past 10 Years

In [42]:
```
worst_cases_country=file_yr_ctry.sort_values(by='Count of Cholera Cases',a
print('Countries having the most number of Cholera Cases in the last 10 ye
```

```
Countries having the most number of Cholera Cases in the last 10 years:
                            Country  Count of Cholera Cases
37                            Haiti                795794.0
22  Democratic Republic of the Congo                246985.0
77                          Somalia                179693.0
61                          Nigeria                137846.0
95                         Zimbabwe                130537.0
0                         Afghanistan               119339.0
28                          Ethiopia                 61174.0
34                             Ghana                 53171.0
55                        Mozambique                 52715.0
93                             Yemen                 47895.0
```

Plotting the Countries with the Maximum number of Cases in the last 10 Years

In [61]:
```
merged = map_df.set_index('NAME').join(worst_cases_country.set_index('Cou
variable = 'Count of Cholera Cases'
vmin, vmax = np.min(merged['Count of Cholera Cases']), np.max(merged['Cou

fig, ax = plt.subplots(1, figsize=(20, 12))
merged.plot(column=variable, cmap='Reds', linewidth=0.8, ax=ax, edgecolor
ax.axis('off')
ax.set_title('Countries with the Highest Count of Cholera (Last 10 Years)
ax.annotate('Source:Cholera Dataset', xy=(0.1, .08), xycoords='figure fra

sm = plt.cm.ScalarMappable(cmap='Reds', norm=plt.Normalize(vmin=vmin, vma
sm._A = []
cbar = fig.colorbar(sm)

```

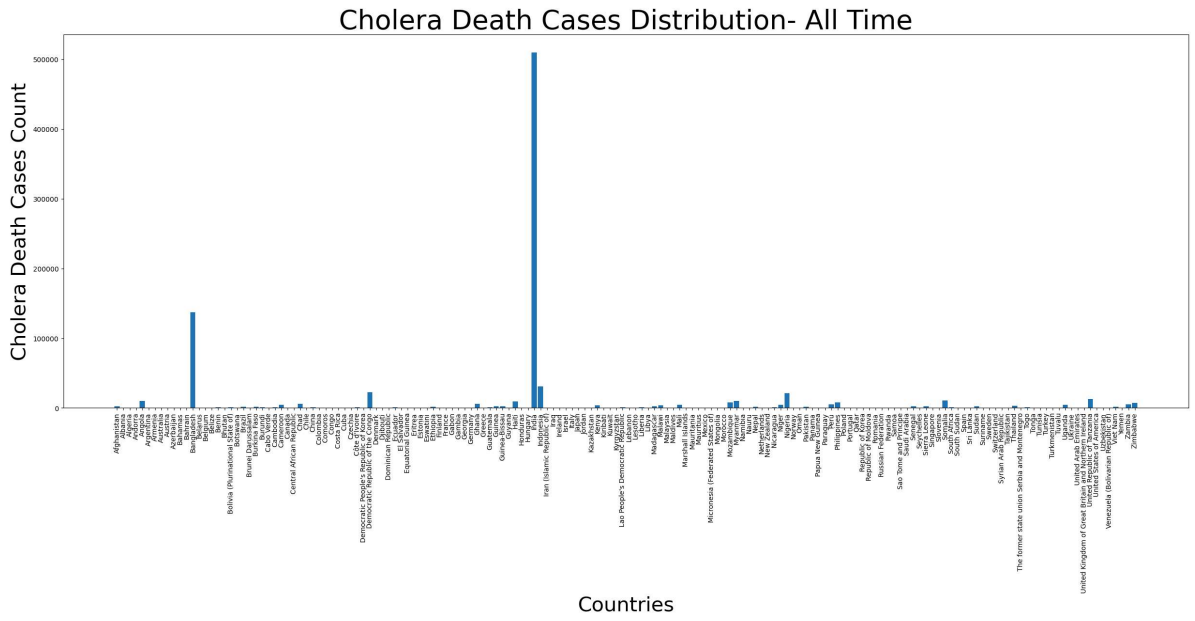


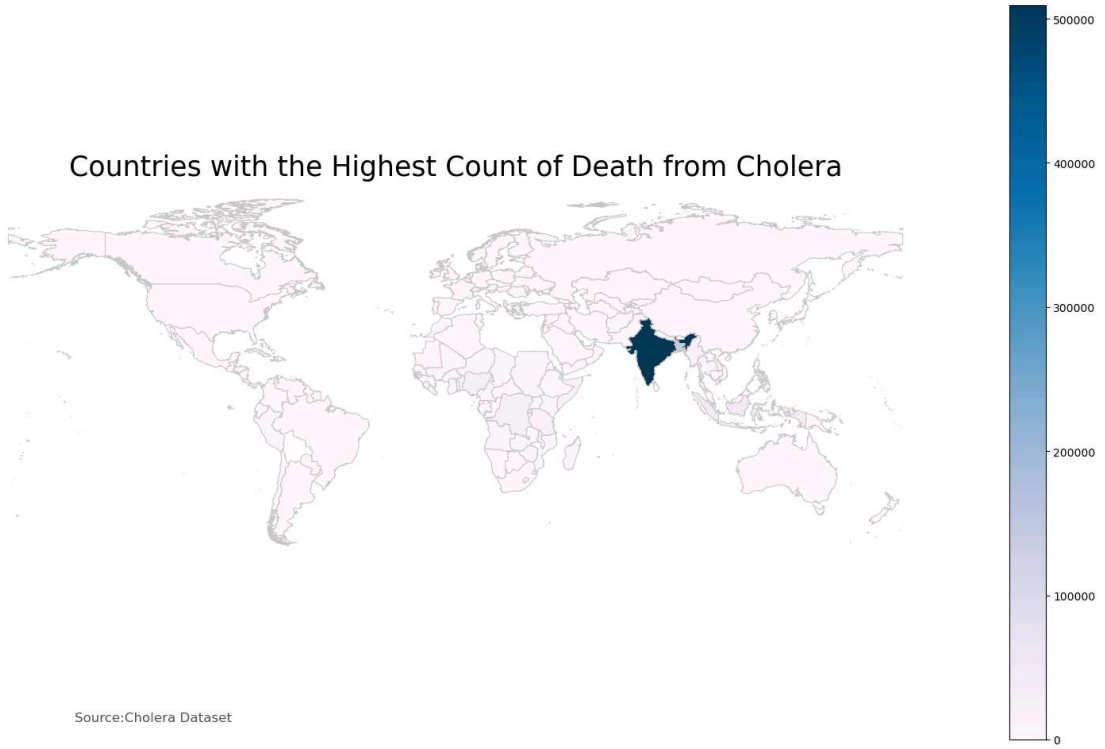
Countries Level Analysis- Deaths from Cholera (All Time)

In [62]:

```
file_ctry_deaths = file.groupby(['Country']).apply(lambda x: (pd.to_numer
print('The Number of Cholera Cases for the counties:\n', file_ctry_deaths

plt.figure(figsize=(30, 10))
plt.bar(file_ctry_deaths['Country'], file_ctry_deaths['Count of Deaths fr
plt.xlabel('Countries', size=30)
plt.ylabel('Cholera Death Cases Count', size=30)
plt.title('Cholera Death Cases Distribution- All Time', size=40)
plt.xticks(rotation=90)
plt.show()

merged = map_df.set_index('NAME').join(file_ctry_deaths.set_index('Country
variable = 'Count of Deaths from Cholera'
vmin, vmax = np.min(merged['Count of Deaths from Cholera']), np.max(merge

fig, ax = plt.subplots(1, figsize=(20, 12))
merged.plot(column=variable, cmap='PuBu', linewidth=0.8, ax=ax, edgecolor
ax.axis('off')
ax.set_title('Countries with the Highest Count of Death from Cholera', fo
ax.annotate('Source:Cholera Dataset', xy=(0.1, .08), xycoords='figure fra

sm = plt.cm.ScalarMappable(cmap='PuBu', norm=plt.Normalize(vmin=vmin, vma
sm._A = []
cbar = fig.colorbar(sm)

```

```
The Number of Cholera Cases for the counties:
                                Country  Count of Deaths from Cholera
0                           Afghanistan                        2641.0
1                               Albania                          25.0
2                               Algeria                         650.0
3                               Andorra                           0.0
4                                Angola                        9920.0
..                                  ...                           ...
157  Venezuela (Bolivarian Republic of)                         163.0
158                            Viet Nam                        1592.0
159                               Yemen                         572.0
160                              Zambia                        4877.0
161                            Zimbabwe                        7137.0

[162 rows x 2 columns]
```

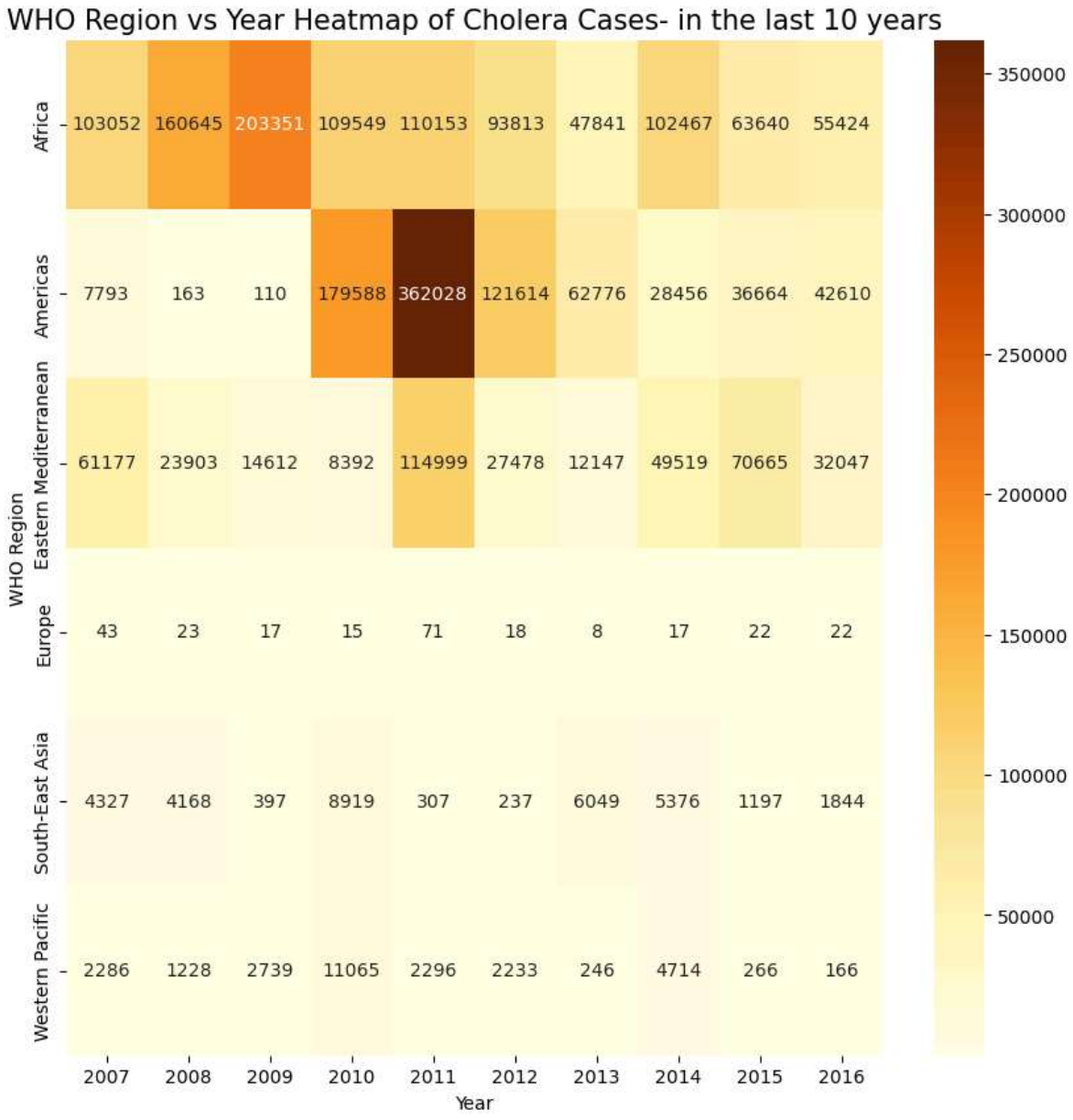




Creating a "WHO Region vs Year Heatmap" for the Total Counts of Cases- Analysis of the Last 10 years

In [63]:
```
file_yr_region=ten_yr_case.groupby(['WHO Region','Year']).apply(lambda x:
heatmap1_data = pd.pivot_table(file_yr_region, values='Count of Cholera Ca
                    index=['WHO Region'],columns='Year')
plt.figure(figsize=(10,10))
sns.heatmap(heatmap1_data,annot=True,fmt='.0f', cmap='YlOrBr').set_title(
```

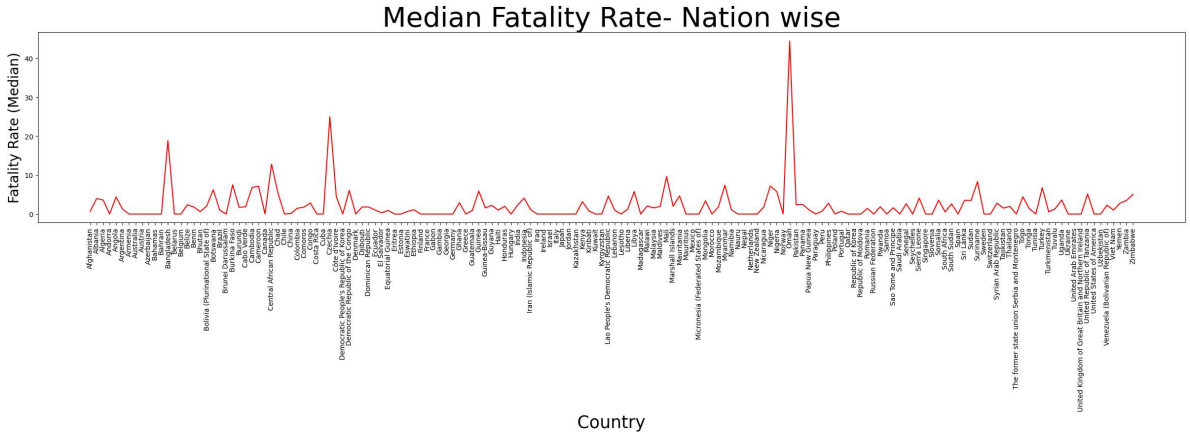
Out[63]: Text(0.5, 1.0, 'WHO Region vs Year Heatmap of Cholera Cases- in the last 10 years')

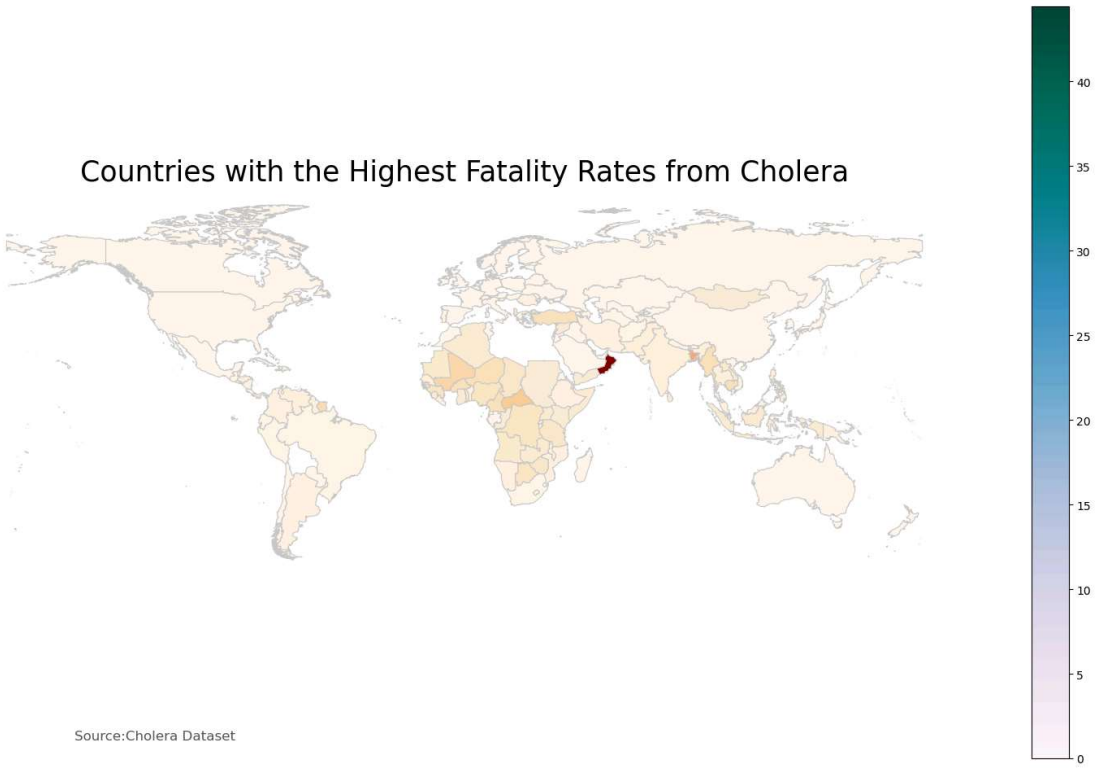


Plotting the average fatality rate in the Nations over the years

In [64]:

```
fat_ctry = file.groupby('Country').apply(lambda x: pd.to_numeric(x['Cholera
fat_ctry.replace(np.NaN, 0, inplace=True)

plt.figure(figsize=(30, 5))
plt.plot(fat_ctry['Country'], fat_ctry['Median Fatality'], color='r')
plt.xlabel('Country', size=25)
plt.ylabel('Fatality Rate (Median)', size=20)
plt.title('Median Fatality Rate- Nation wise', size=40)
plt.xticks(rotation=90)

merged = map_df.set_index('NAME').join(fat_ctry.set_index('Country'))
variable = 'Median Fatality'
vmin, vmax = np.min(merged['Median Fatality']), np.max(merged['Median Fata

fig, ax = plt.subplots(1, figsize=(20, 12))
merged.plot(column=variable, cmap='OrRd', linewidth=0.8, ax=ax, edgecolor=
ax.axis('off')
ax.set_title('Countries with the Highest Fatality Rates from Cholera', for
ax.annotate('Source:Cholera Dataset', xy=(0.1, .08), xycoords='figure frac

sm = plt.cm.ScalarMappable(cmap='PuBuGn', norm=plt.Normalize(vmin=vmin, vm
sm._A = []
cbar = fig.colorbar(sm)

```





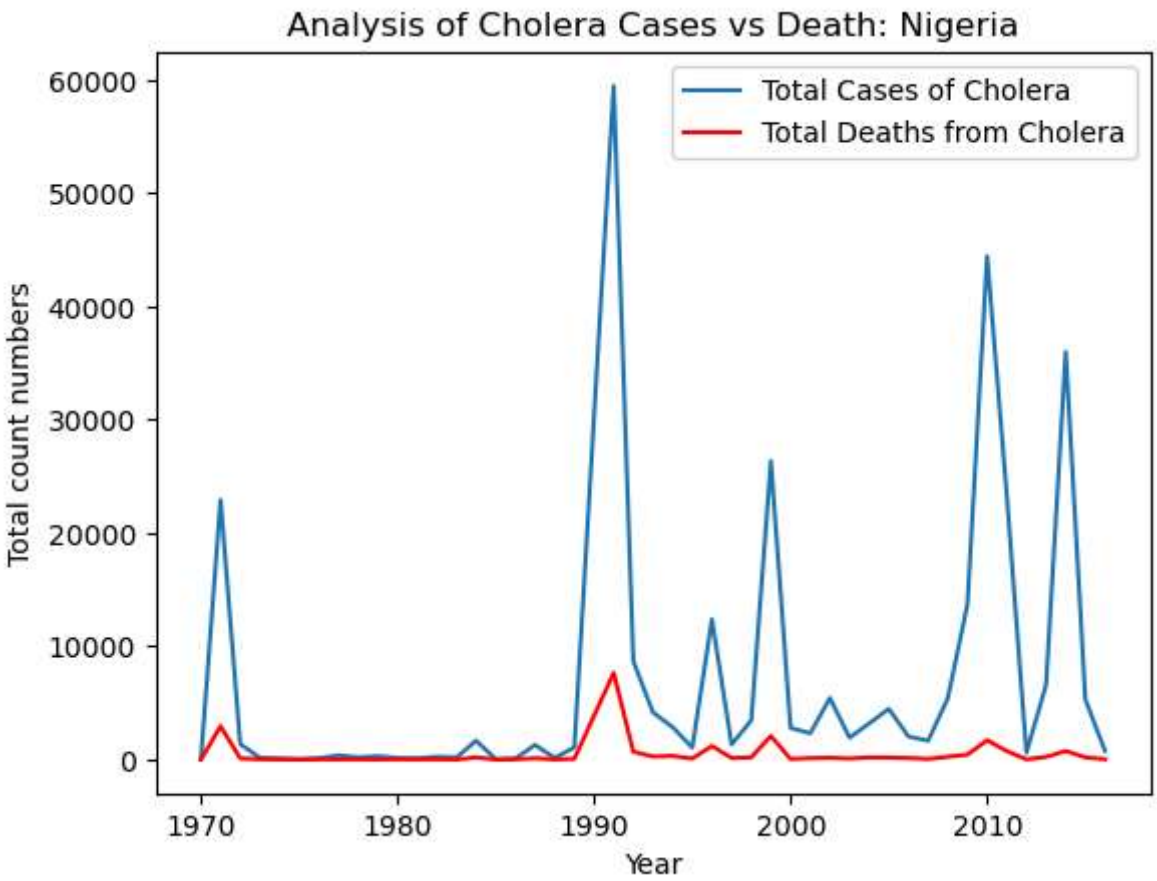
We will now be summarizing the overall data for 2 nations- One which has the highest counts in all time data, and the other having the highest counts in the past 10 years

We are defining a function from where we shall be recieving the Counts Analysis for the particular country

In [69]:
```
def country_summary(country):
    country_file = file[file['Country'] == country]
    country_case_counts = country_file.groupby('Year').apply(lambda x: pd
    country_death_counts = country_file.groupby('Year').apply(lambda x: pd

    plt.plot(country_case_counts['Year'], country_case_counts['Total Cases
    plt.plot(country_death_counts['Year'], country_death_counts['Total Dea
    plt.xlabel('Year')
    plt.ylabel('Total count numbers')
    plt.title('Analysis of Cholera Cases vs Death: {}'.format(country))
    plt.legend(['Total Cases of Cholera', 'Total Deaths from Cholera'])

    print('The Year {:.0f} has seen the maximum number of Cholera Cases: {
        country_case_counts.loc[np.max(country_case_counts['Total Cases of
        np.max(country_case_counts['Total Cases of Cholera'])))

    print('The Year {:.0f} has seen the maximum number of deaths due to Ch
        round(country_death_counts.loc[np.max(country_death_counts['Total
        round(np.max(country_death_counts['Total Deaths from Cholera'])))


```

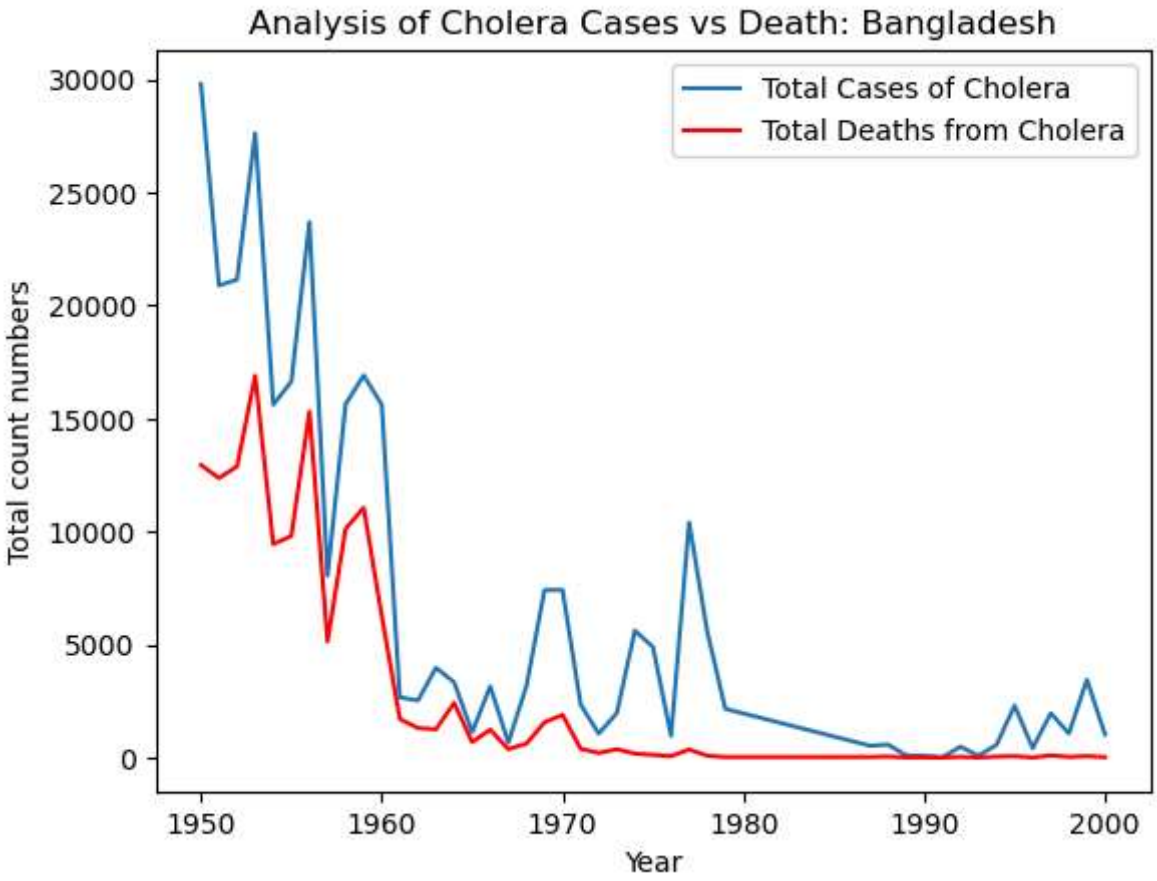
In [70]:
```
Nigerian_Data=country_summary('Nigeria')
```

```
The Year 1991 has seen the maximum number of Cholera Cases: 59478
The Year 1991 has seen the maximum number of deaths due to Cholera: 7654
```



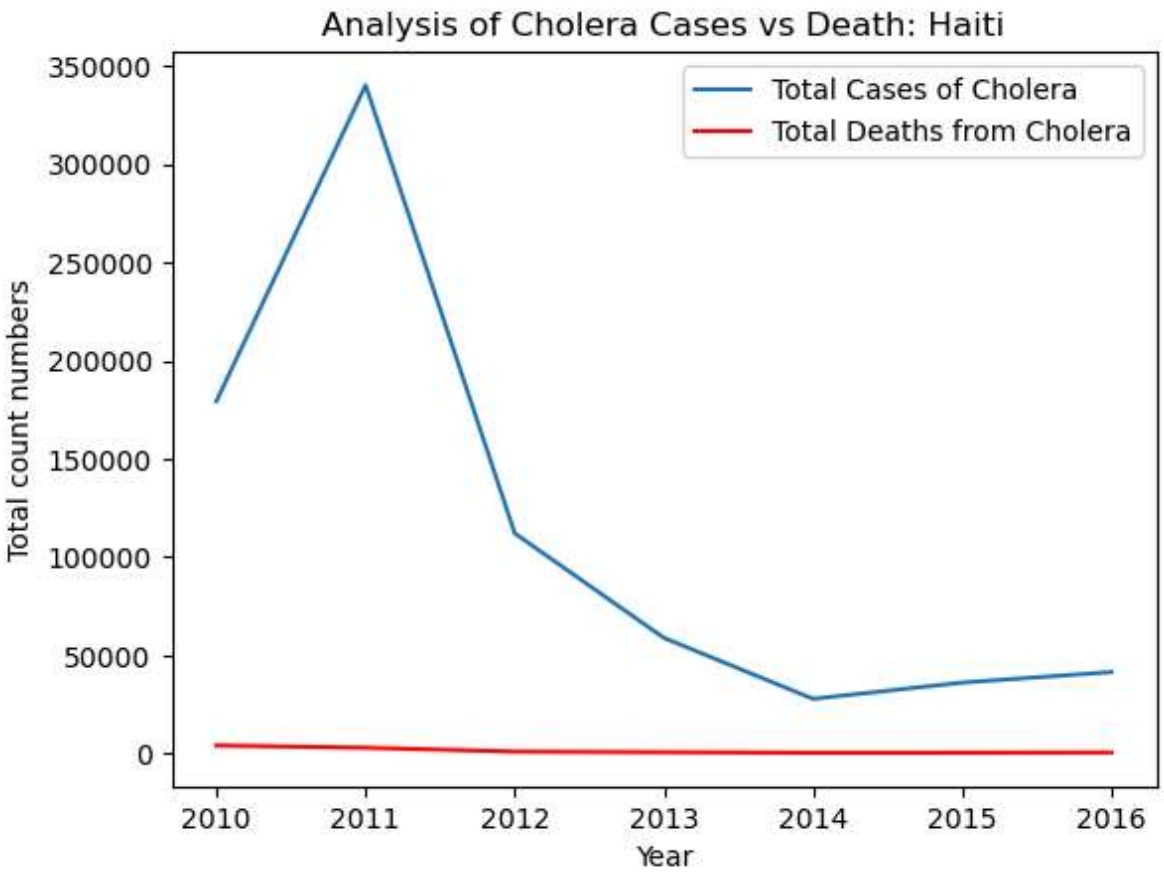
In [71]:
```
1 Bangladesh_Data=country_summary('Bangladesh')
```

```
The Year 1950 has seen the maximum number of Cholera Cases: 29809
The Year 1953 has seen the maximum number of deaths due to Cholera: 16904
```



In [72]:
```
1 Haiti_Data=country_summary('Haiti')
```

```
The Year 2011 has seen the maximum number of Cholera Cases: 340311
The Year 2010 has seen the maximum number of deaths due to Cholera: 3990
```



Machine Leanrning Model

In [106]:
```
1 from sklearn.model_selection import train_test_split
2 from sklearn.ensemble import RandomForestClassifier
3 from sklearn.metrics import classification_report, accuracy_score
4 from sklearn.preprocessing import LabelEncoder
5 from sklearn.model_selection import cross_val_score
```

In [74]:
```
1 # Loading dataset
2 file = pd.read_csv(r'C:\Users\Yusuf Nasir\OneDrive\Desktop\Zakiya\data.csv
```

In [75]:
```
# Data Preprocessing
# Replace 'Unknown' values with 0
file.replace('Unknown', 0, regex=True, inplace=True)

# Clean specific columns (example for "Reported Cases" and "Reported Death
file['Number of reported cases of cholera'] = pd.to_numeric(file['Number
file['Number of reported deaths from cholera'] = pd.to_numeric(file['Numb
file['Cholera case fatality rate'] = pd.to_numeric(file['Cholera case fat
```

```
```

In [114]:
```
# Encode categorical data like 'Country' and 'WHO Region' using LabelEncod
le_country = LabelEncoder()
file['Country_encoded'] = le_country.fit_transform(file['Country'])

le_region = LabelEncoder()
file['Region_encoded'] = le_region.fit_transform(file['WHO Region'])

# Feature Engineering: Create some new features based on the existing data
file['Year'] = pd.to_datetime(file['Year'], format='%Y')
file['Month'] = file['Year'].dt.month
file['Case Fatality Rate'] = file['Number of reported deaths from cholera
```

Create a binary target variable (1 = Potential outbreak, 0 = No outbreak)

In [77]:
```

file['Potential_Outbreak'] = (file['Number of reported cases of cholera']

# Select Features and Target
features = ['Year', 'Month', 'Country_encoded', 'Region_encoded', 'Case Fa
target = 'Potential_Outbreak'
```

In [112]:
```
import pandas as pd
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import LabelEncoder

```

Extract useful date-related features from 'Month'

In [109]:
```
file['Month'] = pd.to_datetime(file['Month'], errors='coerce')
file['Year'] = file['Month'].dt.year
file['Month'] = file['Month'].dt.month

```

Encode categorical variables

In [ ]:
```

label_encoder = LabelEncoder()
file['Country_encoded'] = label_encoder.fit_transform(file['Country'])
file['Region_encoded'] = label_encoder.fit_transform(file['WHO Region'])

```

Select features (X) and target (y)

In [ ]:
```
X = file[['Year', 'Country_encoded', 'Region_encoded', 'Month', 'Case Fata
y = file['Potential_Outbreak']  # Assuming this is the target variable

```

Train-Test Split

In [ ]:
```

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, r

```

Initialize and train the Random Forest model

In [111]:
```
rf_model = RandomForestClassifier(n_estimators=100, random_state=42)
rf_model.fit(X_train, y_train)
y_pred = rf_model.predict(X_test)

```

Model Accuracy

In [113]:
```
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy}')
```

```
Accuracy: 0.7975951903807615
```

In [108]:
```
rf_model.fit(X_train, y_train)
```

Out[108]:
```
RandomForestClassifier
RandomForestClassifier(random_state=42)
```

In [ ]:
```
```

In [91]:
```
predictions = rf_model.predict(X_test)
scores = accuracy_score(y_test, predictions)
scores
```

Out[91]:
```
0.7975951903807615
```

In [92]:
```
predictions
```

Out[92]:
```
array([1, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1,
       0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0,
       1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0,
       0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0,
       1, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0,
       1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0,
       0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1,
       0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0,
       0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0,
       0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 0, 1,
       1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 1,
       1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0,
       0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0,
       0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1,
       0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 1,
       0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0])
```

In [ ]:
```
```