In [54]:
```
import pandas as pd
import numpy as np

import geopandas as gpd
import json

import statsmodels

import plotly
import plotly.express as px
import plotly.io as pio

# pio.renderers.default='jupyter'
pio.renderers.default='jupyterlab'

# allow full interactivity offlice
plotly.offline.init_notebook_mode()
```

Load Data

Giffords Gun Law Scorecard

Load the Giffords Gun Law Scorecard for each state. Giffords gun law score have the following scale, from strongest gun laws to weakest: [A+, A, A-, B+, B, B-, C+, C, C-, D+, D, D-, F].

Note, original Giffords scores have been coerced into a 5-point Likert scale and a numeric grade was assigned to each letter grade: [A: 4, B: 3, C: 2, D: 1, F: 0].

In [55]:
```
scorecard_df = pd.read_csv('giffords_gun_law_scorecard.csv')
scorecard_df.head(n=10)
```

Out[55]:

	state_abbrev	giffords_grade	grade
0	NY	A	4.0
1	NJ	A	4.0
2	MD	A	4.0
3	MA	A	4.0
4	IL	A	4.0
5	HI	A	4.0
6	CT	A	4.0
7	CA	A	4.0
8	WA	B	3.0
9	VA	B	3.0

Firearm Related Deaths

Load the firearm related mortality data for each state from the CDC. Data was acquired using the Socrata Open Data API and wrangled for this presentation. See DataWrangling.ipynb for details.

In [56]:
```
firearm_related_deaths_df = pd.read_csv('tidy-489q-934x-firearm-related-injury.csv')
firearm_related_deaths_df.tail(n=10)
```

Out[56]:

	year_and_quarter	state	state_abbrev	mortality_per_100k
540	2022 Q3	South Dakota	SD	16.7
541	2022 Q3	Tennessee	TN	21.6
542	2022 Q3	Texas	TX	16.1
543	2022 Q3	Utah	UT	12.4
544	2022 Q3	Vermont	VT	13.4
545	2022 Q3	Virginia	VA	15.3
546	2022 Q3	Washington	WA	13.0
547	2022 Q3	West Virginia	WV	17.9
548	2022 Q3	Wisconsin	WI	14.5
549	2022 Q3	Wyoming	WY	23.6

Retain only the latest data for firearm related deaths.

In [57]:
```
deaths_q3_2022 = firearm_related_deaths_df[firearm_related_deaths_df['year_and_quarter'] == '2022 Q3']
deaths_q3_2022.head()
```

Out[57]:

	year_and_quarter	state	state_abbrev	mortality_per_100k
500	2022 Q3	Alabama	AL	25.6
501	2022 Q3	Alaska	AK	23.3
502	2022 Q3	Arizona	AZ	20.9
503	2022 Q3	Arkansas	AR	22.4
504	2022 Q3	California	CA	9.1

Merge firearm related deaths and Giffords scrore datasets.

In [58]:
```
df = deaths_q3_2022.merge(scorecard_df, on='state_abbrev')
df = df.sort_values(by=['giffords_grade'], ascending=True)
df = df.reset_index(drop=True)
df.head()
```

Out[58]:

	year_and_quarter	state	state_abbrev	mortality_per_100k	giffords_grade	grade
0	2022 Q3	Illinois	IL	14.7	A	4.0
1	2022 Q3	Maryland	MD	13.5	A	4.0
2	2022 Q3	New Jersey	NJ	5.3	A	4.0
3	2022 Q3	Hawaii	HI	4.3	A	4.0
4	2022 Q3	Massachusetts	MA	3.9	A	4.0

Choropleth map of Firearm Mortality

Load GeoJSON data that was previously downloaded from here.

In [59]:
```
us_states = json.load(open('states.geojson', 'r'))
```

Add a new property 'id' to features - 'id' is the default name of column that is used to map values from the dataset ('state') to the corresponding State in GerJSON data.

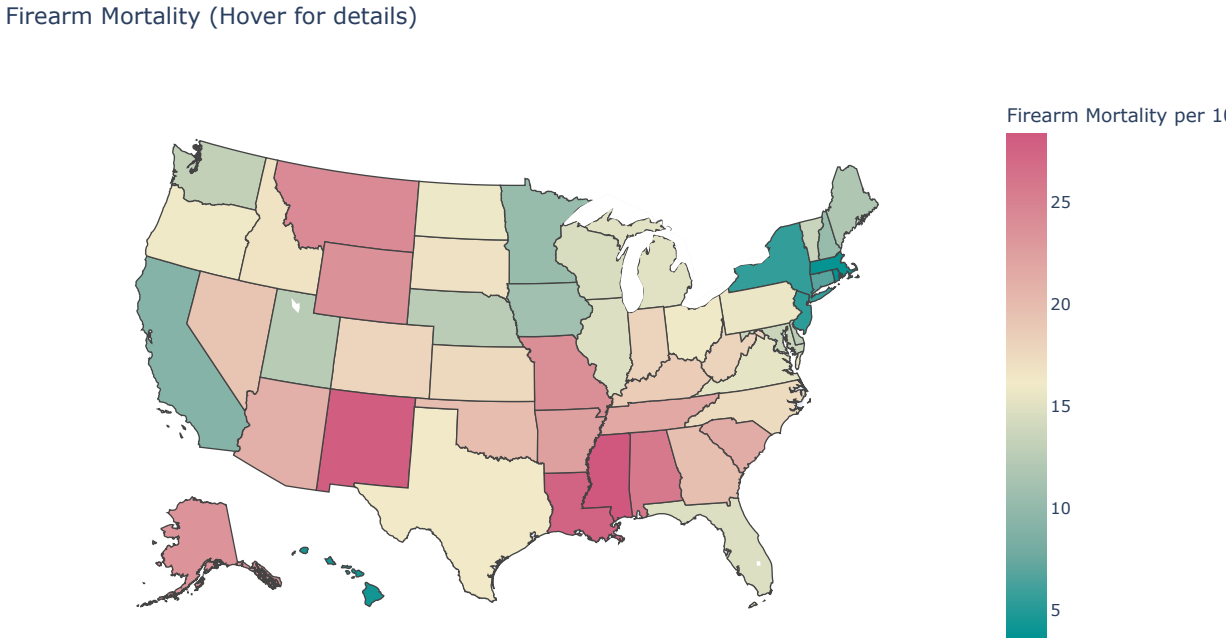
In [60]:
```
for feat in us_states['features']:
    feat['id'] = feat['properties']['NAME']
```

Display Firearm Mortality by State on map.

In [61]:
```
fig = px.choropleth(df, locations='state', scope='usa', geojson=us_states,
                    color='mortality_per_100k',
                    hover_name='state',
                    hover_data=['giffords_grade'],
                    color_continuous_scale='Tealrose',
                    color_continuous_midpoint=np.average(df['mortality_per_100k']),
                    labels={
                     "mortality_per_100k": "Firearm Mortality per 100,000 persons",
                     "giffords_grade" : "Giffords Gun Law Scorecard",
                     "state" : "State"
```

```
                    },
                    height=600,
                    width=1100,
                    title='Firearm Mortality (Hover for details)')


fig.show()
```

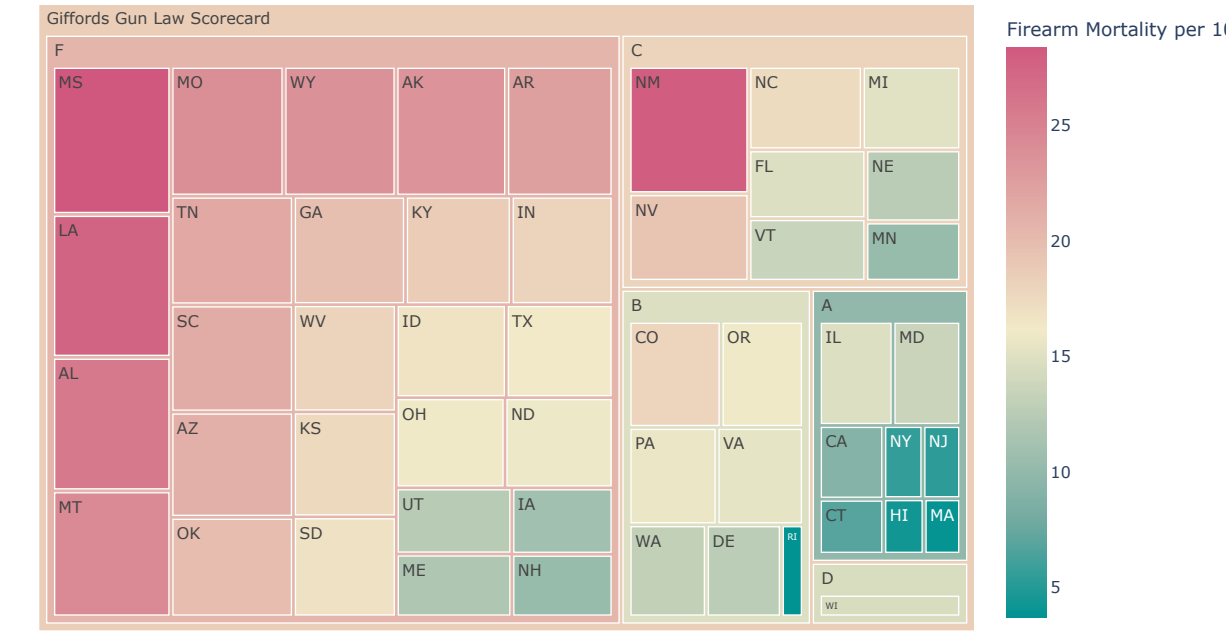


Heatmap of Firearm Mortality grouped by Giffords Gun Law Scorecard

The Heatmap shows the following trends:

- States with the strictest gun laws have the lowest firearm related mortality rates.
- There are some outliers: e.g. New Mexico, which has extremely high firearm related mortality despite an average gun law score. Utah, Maine, Iowa, and New Hampshire are other outliers. Explaining outliers is not in scope for this presentation.

In [62]:
```
import plotly.graph_objects as go
fig = px.treemap(df, path=[px.Constant('Giffords Gun Law Scorecard'), 'giffords_grade', 'state_abbrev'], values='mortality
                 color='mortality_per_100k',
                labels={"mortality_per_100k": "Firearm Mortality per 100,000 persons"},
                height=650,
                width=1100,
                title='Trend: States with <b>Higher</b> Gun Law Scores have <b>Lower</b> Firearm Mortality<br>(Hover for
                # hover_name='state',
                # hover_data=['mortality_per_100k'],
                color_continuous_scale='Tealrose',
                color_continuous_midpoint=np.average(df['mortality_per_100k'])
               )
fig.show()
```



Scatterplot with trend line using Ordinary Least Squares

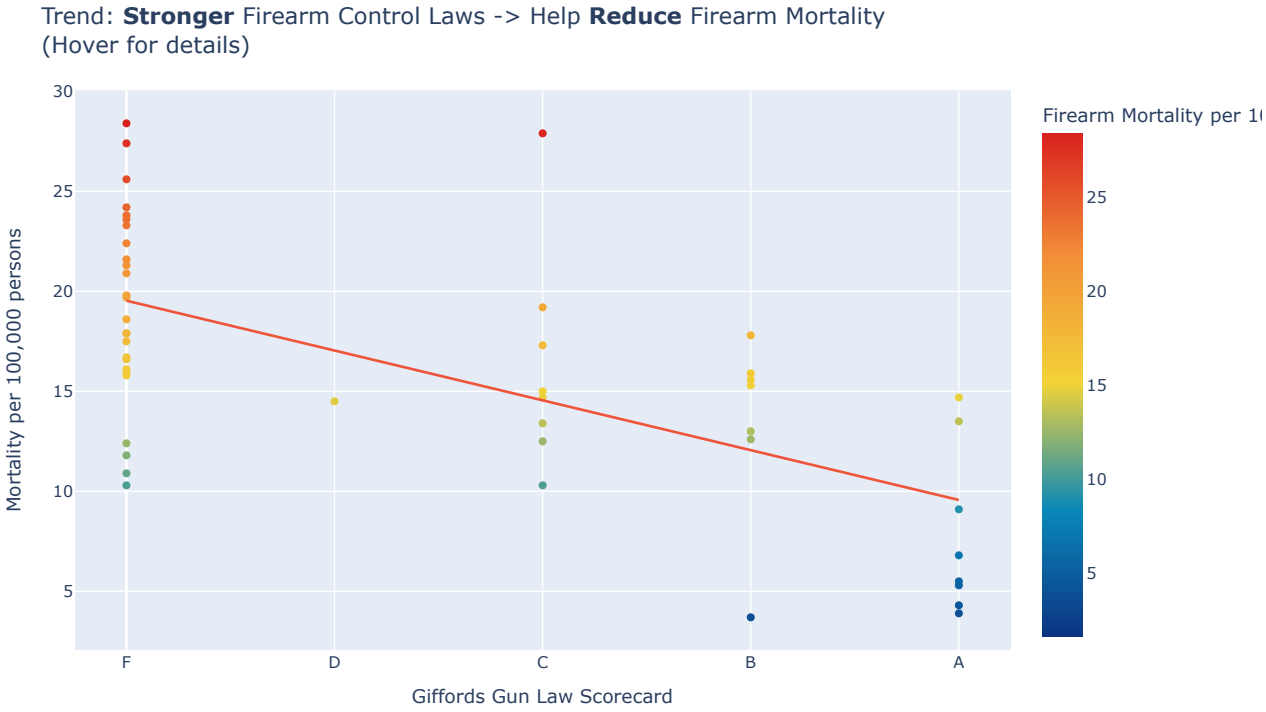
In [63]:

```
fig = px.scatter(df, x="grade", y="mortality_per_100k",
                 color="mortality_per_100k",
                 labels={
                     "mortality_per_100k": "Firearm Mortality per 100,000 persons",
                     "state" : "State",
                     "grade" : 'Giffords Gun Law Scorecard'
                 },
                 height=600,
                 width=1100,
                 hover_name='state',
                 hover_data=['giffords_grade', 'mortality_per_100k'],

                 color_continuous_scale=px.colors.diverging.Portland,
                 color_continuous_midpoint=15,

                 trendline='ols',
                 title='Trend: <b>Stronger</b> Firearm Control Laws -> Help <b>Reduce</b> Firearm Mortality<br>(Hover for
             )

fig.update_xaxes(tickmode='array', tickvals=df['grade'], ticktext=df['giffords_grade'])
fig.update_layout(
          xaxis_title='Giffords Gun Law Scorecard',
          yaxis_title="Mortality per 100,000 persons"
)
#fig.update_traces(visible=False, selector=dict(mode="markers"))
fig.show()
```


Trend: **Stronger** Firearm Control Laws -> Help **Reduce** Firearm Mortality
(Hover for details)
Mortality per 100,000 persons
30
25
20
15
10
5
F
D
C
B
A
Giffords Gun Law Scorecard
Firearm Mortality per 1
25
20
15
10
5