Visualization_Project_#1

May 9, 2021

1 Redesigning Nightingale's Rose Diagram

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[1]:
```
# Import the necessary libraries
# You will likely need to install a number of these modules/libraries
# (e.g. pip install plotly or conda install plotly)
import pandas as pd
import numpy as np
import plotly.graph_objects as go
from plotly.subplots import make_subplots
from plotly.subplots import _set_trace_grid_reference
import plotly.express as px
# import plotly
```

[2]:
```
# Use pandas to read in the dataset
# Data comes from the R HistData package: https://rdrr.io/cran/HistData/man/
 ↪HistData-package.html
# Thank Michael Friendly (who we read in Week 1) for providing it
df = pd.read_csv("nightingale.csv")
```

[3]:
```
# Take a quick look at the data
df.head()
```

[3]:

	Unnamed: 0	Date	Month	Year	Army	Disease	Wounds	Other	Disease.rate	Wounds.rate	Other.rate
0	1	1854-04-01	Apr	1854	8571	1	0	5	1.4	0.0	7.0
1	2	1854-05-01	May	1854	23333	12	0	9	6.2	0.0	4.6
2	3	1854-06-01	Jun	1854	28333	11	0	6	4.7	0.0	2.5
3	4	1854-07-01	Jul	1854	28722	359	0	23	150.0	0.0	9.6
4	5	1854-08-01	Aug	1854	30246	828	1	30	328.5	0.4	11.9

[4]:
```
# Concactening the month and year
df["Period"] = df["Month"] + "-" + df["Year"].astype(str)
# Sort according to Date (just to be on the safe side)
df.sort_values(by=['Date'],inplace=True)
```

2 Introduction

For this redesign of Nightingale's rose diagrams, we decided to make a self-contained and interactive Jupyter notebook to give our audience the freedom to interact with visualizations from their own angle of view and be able to derive their own additional insights. We lso tried to use colorblind friendly palette while employing generally nice colors for aesthetics reasons. Additionally, both Python and Jupyter notebook are free and widely used.

Dubbed as the the mother of modern nursing, Florence Nightingale used a the Crimean war casualties data as an argument for the need to improve sanitation in both the army and among civilians. She advocated for hygiene and care for wounded soldiers as a solution to scale down preventable illnesses and deaths. Nightingale was definitely a pioneer in the field of visualization. Indeed, to drive her message home, she made use of graphical representaions rather than statistics because the latter could not have been expected to be understood by non-experts. Her rose diagrams of the "*Cause of Mortality in the Army in the East*" intends to visually prove that the mortality rate from diseases was lower after improvements in sanitation in camps and hospitals were made midway through the war. Indeed, by displaying the monthly mortality rate in the army in two juxtaposed coxcombs, one for the first year of the war (April 1854 - March 1855) and another for the second year (April 1855 - March 1856), Nightingale allowed for direct visual comparaison between the causes of death and the before/after sanitation inprovement mark, April 1855 (Nigthingale and her fellow nurses were allowed entry to the wards in March 1855, which also marks the one year mark of the war).

During war, it is fair to assume that most casualties in an army would be due to wounds, not disease. By including the deaths caused by wounds and other in her diagram, Nightingale wanted to prove that soldiers were dying unnecessarily at a rate that was unacceptable compared to the expected deaths (*wounds and other*). Assuming that deaths caused by wounds and other causes were unavoidable and deaths caused by diseases were preventable, we will redesign Nightingale's rose diagrams pitting the preventable deaths against the unavoidable ones to see if they are better modern methods to visually illustrate Nightingale's two main points: soldiers were dying unnecessarily due to preventable disease at a rate that was unacceptable compared to the expected deaths (*wounds and other*), and sanitation improvements in the army's camps and hospitals following Nightingale and her fellow nurses's arrival helped decrease deaths from preventable diseases.

First, we will try to recreate Nightingale rose's diagrams the way they initially were, then with axis labels, combine the two diagrams into one, and finally explore different redesign ideas pitting the preventable deaths against the unavoidable ones.

[5]:
```
# Select the particular date range we'll use
# Diagram 1 (on the right of Nightingale's original) displays data from April␣
 ↪1854 to March 1855
df_year1 = df[df['Date']<'1855-04-01']
# Diagram 2 (on the right of Nightingale's original) displays data from April␣
 ↪1855 to March 1856
df_year2 = df[df['Date']>='1855-04-01']
```

2.0.1 Recreacting Nightingale Rose's Diagrams

[6]:
```
# These are the parameters for the Plotly visualization

fig = []
fig = make_subplots(
     rows=1, cols=2, subplot_titles=('1st year (April 1854 - March 1855)', '2nd␣
 ↪year (April 1855 - March 1856)'), specs=[[{'type': 'polar'}]*2]*1)

# This "trace" will display the "other" data
fig.add_trace(go.Barpolar(
    r = list(df_year1['Other']),
    theta=list(df_year1['Month']),
    offset=12,
    name = 'Other',
    legendgroup="Other",
    marker_color='rgb(234,164,168)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)


# This "trace" will display the "wounds" data
fig.add_trace(go.Barpolar(
    r = list(df_year1['Wounds']),
    theta=list(df_year1['Month']),
    offset=12,
    name = 'Wounds',
    legendgroup="Wounds",
    marker_color='rgb(141,127,127)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)


# This "trace" will display the "disease" data
fig.add_trace(go.Barpolar(
    r = list(df_year1['Disease']),
    theta=list(df_year1['Month']),
    offset=12,
    name = 'Disease',
    legendgroup="Disease",
    marker_color='rgb(93,188,210)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)
```

```
# This "trace" will display the "other" data
fig.add_trace(go.Barpolar(
    r = list(df_year2['Other']),
    theta=list(df_year2['Month']),
    offset=12,
    name = 'Other',
    legendgroup="Other",
    showlegend=False,
    marker_color='rgb(234,164,168)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,2)


# This "trace" will display the "wounds" data
fig.add_trace(go.Barpolar(
    r = list(df_year2['Wounds']),
    theta=list(df_year2['Month']),
    offset=12,
    name = 'Wounds',
    legendgroup="Wounds",
    showlegend=False,
    marker_color='rgb(141,127,127)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,2)


# This "trace" will display the "disease" data
fig.add_trace(go.Barpolar(
    r = list(df_year2['Disease']),
    theta=list(df_year2['Month']),
    offset=12,
    name = 'Disease',
    legendgroup="Disease",
    showlegend=False,
    marker_color='rgb(93,188,210)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,2)
```

```
# This code is responsible for the layout of your figure
# (remember the Matplotlib "Anatomy of a Figure" at https://matplotlib.org/3.1.
 ↪1/gallery/showcase/anatomy.html)
# Plotly builds on it
fig.update_layout(
    title='Diagram of the Causes of Mortality in the Army in the East␣
 ↪(Recreation, Exact Count)',
    font_size=12,
    legend_font_size=10,
    polar_angularaxis_rotation=180,
    width=900,
    height=600,

    polar = dict(
        angularaxis =
                dict(
                    linewidth = 3,
                    showline=False,
                    linecolor='black'
                    ),
        radialaxis =
                dict(showline = False,
                    linewidth = 2,
                    gridcolor = "white",
                    gridwidth = 2
                    )
                ),
            )
fig.update_polars(radialaxis_showticklabels=False,
                  radialaxis_range=[0, max(df['Disease'])],
                  angularaxis_direction= "clockwise",
                 angularaxis_gridcolor="white",
                 bgcolor="rgb(240,240,240)")

#plotly.offline.plot(fig, filename='nightingale.html')
fig.show()
```

3 Redesign Iteration 1

We tried recreating Nightingale's rose diagrams of *the causes of mortality in the army in the East* scaling both years' diagrams the same radially for fair comparaison. Although it is apparent that the origanal diagram was a little bit off in terms of scaling, the recreated diagram supports Nightingale's key points. In the original diagrams, raw death numbers were used. For our first redesign

iteration, we will use the annual death rates instead of the raw numbers for scalibility and comparaison reasons, add radial axis sticks for readability purposes, change the color palette to accomodate for color blindness, and combine both diagrams into one for contuinity and comparison purposes.

[7]:
```
# These are the parameters for the Plotly visualization

fig = []
fig = make_subplots(
     rows=1, cols=2, subplot_titles=('1st year (April 1854 - March 1855)', '2nd␣
 ↪year (April 1855 - March 1856)'), specs=[[{'type': 'polar'}]*2]*1)


fig.add_trace(go.Barpolar(
    r = list(df_year1['Other.rate']),
    theta=list(df_year1['Month']),
    offset=12,
    name = 'Other',
    legendgroup="Other",
    marker_color='rgb(253,184,99)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)



fig.add_trace(go.Barpolar(
    r = list(df_year1['Wounds.rate']),
    theta=list(df_year1['Month']),
    offset=12,
    name = 'Wounds',
    legendgroup="Wounds",
    marker_color='rgb(230,97,1)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)



fig.add_trace(go.Barpolar(
    r = list(df_year1['Disease.rate']),
    theta=list(df_year1['Month']),
    offset=12,
    name = 'Disease',
    legendgroup="Disease",
    marker_color='rgb(178,171,210)',
    marker_line_color="black",
    hoverinfo = ['all'],
```

```
    opacity=0.7),1,1)



fig.add_trace(go.Barpolar(
    r = list(df_year2['Other.rate']),
    theta=list(df_year2['Month']),
    offset=12,
    name = 'Other',
    legendgroup="Other",
    showlegend=False,
    marker_color='rgb(253,184,99)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,2)


fig.add_trace(go.Barpolar(
    r = list(df_year2['Wounds.rate']),
    theta=list(df_year2['Month']),
    offset=12,
    name = 'Wounds',
    legendgroup="Wounds",
    showlegend=False,
    marker_color='rgb(230,97,1)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,2)


fig.add_trace(go.Barpolar(
    r = list(df_year2['Disease.rate']),
    theta=list(df_year2['Month']),
    offset=12,
    name = 'Disease',
    legendgroup="Disease",
    showlegend=False,
    marker_color='rgb(178,171,210)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,2)



fig.update_layout(
```

```
    title='Redesign #1: Diagram of the Causes of Mortality in the Army in the␣
↪East (Annual Death Rates)',
    font_size=12,
    legend_font_size=10,
    polar_angularaxis_rotation=180,
    width=900,
    height=600,

    polar = dict(
        angularaxis =
                dict(
                    linewidth = 3,
                    showline=False,
                    linecolor='black'
                    ),
        radialaxis =
                dict(
                    showline = False,
                    linewidth = 2,
                    gridcolor = "white",
                    gridwidth = 2
                    )
                ),
            )
fig.update_polars(radialaxis_range=[0, max(df['Disease.rate'])],
                  angularaxis_direction= "clockwise",
                  angularaxis_gridcolor="white",
                  bgcolor="rgb(240,240,240)")

#plotly.offline.plot(fig, filename='nightingale.html')
fig.show()
```

[8]:
```
# These are the parameters for the Plotly visualization

fig = go.Figure()


fig.add_trace(go.Barpolar(
    r = list(df['Other.rate']),
    theta=list(df['Period']),
    offset=24,
    name = 'Other',
    legendgroup="Other",
    marker_color='rgb(253,184,99)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7))
```

```
fig.add_trace(go.Barpolar(
    r = list(df['Wounds.rate']),
    theta=list(df['Period']),
    offset=24,
    name = 'Wounds',
    legendgroup="Wounds",
    marker_color='rgb(230,97,1)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7))



fig.add_trace(go.Barpolar(
    r = list(df['Disease.rate']),
    theta=list(df['Period']),
    offset=24,
    name = 'Disease',
    legendgroup="Disease",
    marker_color='rgb(178,171,210)',
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7))







fig.update_layout(
    title='Redesign #1b: Diagram of the Causes of Mortality in the Army in the␣
 ↪East (April 1854 - March 1856, Annual Death Rates)',
    font_size=10,
    legend_font_size=10,
    polar_angularaxis_rotation=180,
    width=900,
    height=500,

    polar = dict(
        angularaxis =
                dict(
                    linewidth = 3,
                    showline=False,
                    linecolor='black'
```

```
                    ),
        radialaxis =
                dict(
                    showline = False,
                    linewidth = 2,
                    gridcolor = "white",
                    gridwidth = 2
                    )
                ),
            )
fig.update_polars(angularaxis_direction= "clockwise",
                  angularaxis_gridcolor="white",
                  bgcolor="rgb(240,240,240)")

#plotly.offline.plot(fig, filename='nightingale.html')
fig.show()
```

4 Redesign Iteration 2

The first iteration of our redesign process was more for aesthetics purposes than finding new insights although the new combined continuous diagram (*Redesign #1b*) makes the noticeable drop in the disease mortality rate over the course of the second year of the war more obvious and renders comparaison between year one and year two of the war much easier. However, dwarfed by *disease*, *wounds* and *other* are barely visible, although this reinforces Nightingale's point about too many soldiers dying unnecessarily from preventable or mitagable zymotic diseases compared to the unavoidable typical causes (*wounds and other*). Hence, we will push the comparaison further by grouping the *wounds* and *other* into one category: *typical* in the second iteration of our redesign process.

[9]:
```
# Adding the wounds mortality rate and others rate together. the math is sound!
df["Typical.rate"] = df["Wounds.rate"] + df["Other.rate"]
```

4.0.1 Grouped Bars

[10]:
```
# These are the parameters for the Plotly visualization

fig = []
fig = make_subplots(
     rows=1, cols=2,
    specs=[[{'type': 'polar'}, {"type": "bar"}]])


colors1 = ['rgb(243,184,99)',] * 24
colors1[12] = 'rgb(242, 96, 1)'
```

```
colors2 = ['rgb(178,171,210)',] * 24
colors2[12] = 'rgb(136,86,167)'



fig.add_trace(go.Barpolar(
    r = list(df['Typical.rate']),
    theta=list(df['Period']),
    offset=24,
    name = 'Typical',
    legendgroup="Typical",
    marker_color=colors1,
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)



fig.add_trace(go.Barpolar(
    r = list(df['Disease.rate']),
    theta=list(df['Period']),
    offset=24,
    name = 'Disease',
    legendgroup="Disease",
    marker_color=colors2,
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)


fig.add_trace(go.Bar(
    x=list(df['Period']),
    y=list(df['Typical.rate']),
    name = 'Typical',
    legendgroup="Typical",
    showlegend=False,
    marker_color=colors1),1,2)



fig.add_trace(go.Bar(
    x=list(df['Period']),
    y=list(df['Disease.rate']),
    name = 'Disease',
    legendgroup="Disease",
    showlegend=False,
    marker_color=colors2),1,2)
```

```
fig.add_annotation(
        x=11.8,
        y=150,
        xref="x",
        yref="y",
        text="sanitation improvement mark",
        showarrow=True,
        font=dict(
            family="Courier New, monospace",
            size=12,
            color="#fffeff"
            ),
        align="center",
        arrowhead=2,
        arrowsize=1,
        arrowwidth=2,
        arrowcolor="#636363",
        ax=-50,
        ay=-40,
        bordercolor="#c7c7c7",
        borderwidth=2,
        borderpad=4,
    bgcolor="#034d00",
        opacity=0.8
        )



fig.add_annotation(
        x=24,
        y=1000,
        xref="x",
        yref="y",
        text="Sanitation Improvement Mark: April 1855. <br> We arbitraryly␣
 ↪chose April 1855 as <br> the sanitation impovement mark because <br> it␣
 ↪marks the beginning of the second year <br> of the war. Additionally,␣
 ↪Nigthingale and her <br> fellow nurses were allowed entry to the wards <br>␣
 ↪in March 1855 and began improving <br>  the camps' sanitation soon␣
 ↪afterwards. <br> Darker color hues are used to <br> highlight this mark." ,
       xanchor='right',
    yanchor='auto',
    xshift=0,
    yshift=0,
    align='left',
    showarrow=False,
```

```
      font=dict(size=8, color='black'),
bordercolor="#c7c7c7",
        borderwidth=2,
        borderpad=4,
        opacity=0.8)




fig.update_layout(
    title='Redesign #2: Diagram of the Causes of Mortality in the Army in the␣
 ↪East (April 1854 - March 1856, Annual Death Rates)',
    font_size=10,
    legend_font_size=10,
    polar_angularaxis_rotation=180,
    width=1000,
    height=600
                )

fig.update_polars(angularaxis_direction= "clockwise",
                  angularaxis_gridcolor="white",
                  bgcolor="rgb(240,240,240)")

fig.update_layout(barmode='group', xaxis_tickangle=-45,␣
 ↪paper_bgcolor='rgb(240,240,240)', plot_bgcolor='rgb(240,240,240)')

#plotly.offline.plot(fig, filename='nightingale.html')
fig.show()
```

4.0.2 Stacked Bars

[11]:
```
# These are the parameters for the Plotly visualization

fig = []
fig = make_subplots(
     rows=1, cols=2,
    specs=[[{'type': 'polar'}, {"type": "bar"}]])


colors1 = ['rgb(243,184,99)',] * 24
colors1[12] = 'rgb(242, 96, 1)'


colors2 = ['rgb(178,171,210)',] * 24
colors2[12] = 'rgb(136,86,167)'
```

```
fig.add_trace(go.Barpolar(
    r = list(df['Typical.rate']),
    theta=list(df['Period']),
    offset=24,
    name = 'Typical',
    legendgroup="Typical",
    marker_color=colors1,
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)



fig.add_trace(go.Barpolar(
    r = list(df['Disease.rate']),
    theta=list(df['Period']),
    offset=24,
    name = 'Disease',
    legendgroup="Disease",
    marker_color=colors2,
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)


fig.add_trace(go.Bar(
    x=list(df['Period']),
    y=list(df['Typical.rate']),
    name = 'Typical',
    legendgroup="Typical",
    showlegend=False,
    marker_color=colors1),1,2)



fig.add_trace(go.Bar(
    x=list(df['Period']),
    y=list(df['Disease.rate']),
    name = 'Disease',
    legendgroup="Disease",
    showlegend=False,
    marker_color=colors2),1,2)
```

```
fig.add_annotation(
        x=11.8,
        y=150,
        xref="x",
        yref="y",
        text="sanitation improvement mark",
        showarrow=True,
        font=dict(
            family="Courier New, monospace",
            size=12,
            color="#fffeff"
            ),
        align="center",
        arrowhead=2,
        arrowsize=1,
        arrowwidth=2,
        arrowcolor="#636363",
        ax=-50,
        ay=-40,
        bordercolor="#c7c7c7",
        borderwidth=2,
        borderpad=4,
    bgcolor="#034d00",
        opacity=0.8
        )



fig.add_annotation(
        x=25,
        y=1050,
        xref="x",
        yref="y",
        text="Sanitation Improvement Mark: April 1855. <br> We arbitraryly␣
 ↪chose April 1855 as <br> the sanitation impovement mark because <br> it␣
 ↪marks the beginning of the second year <br> of the war. Additionally,␣
 ↪Nigthingale and her <br> fellow nurses were allowed entry to the wards <br>␣
 ↪in March 1855 and began improving <br>  the camps' sanitation soon␣
 ↪afterwards. <br> Darker color hues are used to <br> highlight this mark." ,
       xanchor='right',
    yanchor='auto',
    xshift=0,
    yshift=0,
    align='left',
    showarrow=False,
      font=dict(size=8, color='black'),
bordercolor="#c7c7c7",
```

```
        borderwidth=2,
        borderpad=4,
        opacity=0.8)




fig.update_layout(
    title='Redesign #2: Diagram of the Causes of Mortality in the Army in the␣
 ↪East (April 1854 - March 1856, Annual Death Rates)',
    font_size=10,
    legend_font_size=10,
    polar_angularaxis_rotation=180,
    width=1000,
    height=600
                )

fig.update_polars(angularaxis_direction= "clockwise",
                  angularaxis_gridcolor="white",
                  bgcolor="rgb(240,240,240)")

fig.update_layout(barmode='stack', xaxis_tickangle=-45,␣
 ↪paper_bgcolor='rgb(240,240,240)', plot_bgcolor='rgb(240,240,240)')

#plotly.offline.plot(fig, filename='nightingale.html')
fig.show()
```

Adding the sanitation improvement mark makes the noticeable drop in the disease mortality rate from the sanitation improvement mark (April 1855) and onwards much more striking, especially compared to the three to four months right before. Both the typical mortality rate and the disease mortality rate also seem to generally follow the same trend with both typee of death reaching peak level between November 1854 and March 1855. The sharp increase and then decrease of the disease mortality rate in the same time period becomes even more obvious in the barplot. One might wonder what caused these drastic changes (maybe the three significant battles in september and october 1854?) before Nightingale and her fellow nurses even got the chance to enter the camps and implement any sanitation changes. The barplot also reveals that the disease mortality rate was already on the downward trend before the sanitation improvement mark and then stalled and even went up in the two months folloing the sanitations improvement mark. This weakens Nightingale's main argument about sanitation in the camps. One might also wonders why the typical and disease mortality rate generally follow the same trend. Does this have anything to do with sanitation? low moral? poor health among soldiers?

To better understand the dynamics between the mortality rate of preventable or mitagable zymotic diseases and of unavoidable typical causes (*wounds and other*), we will push the comparaison further by dividing the disease mortality rate by the typical mortality rate. This will tell us how many soldiers died from a preventable disease for every soldier death that was unavoidable (*typical: wounds and other*). Were soldiers really dying unncessarily because of preventable disease at an unacceptable rate compared to fatal casualties that are unavoidable in a time of war (*wounds and other*) on the montly basis? And if so, did sanitation improvements help as Nightingale claimed

and tried to prove? This will be our third and final redesign.

5 Redesign Iteration 3

[12]:
```
# Computing the perventable per unvavoidable deaths
df["PreventablePerUnavoidable"] = df["Disease.rate"]  / df["Typical.rate"]
```

[13]:
```
# These are the parameters for the Plotly visualization

fig = []
fig = make_subplots(
     rows=1, cols=2,
    specs=[[{'type': 'polar'}, {"type": "bar"}]])


colors1 = ['rgb(158,188,218)',] * 24
colors1[12] = 'rgb(136,86,167)'


# This "trace" will display the "other" data
fig.add_trace(go.Barpolar(
    r = list(df['PreventablePerUnavoidable']),
    theta=list(df['Period']),
    offset=24,
    name = 'PreventRate',
    showlegend=False,
    marker_color=colors1,
    marker_line_color="black",
    hoverinfo = ['all'],
    opacity=0.7),1,1)



fig.add_trace(go.Bar(
    x=list(df['Period']),
    y=list(df['PreventablePerUnavoidable']),
     name = 'PreventRate',
    showlegend=False,
    marker_color=colors1),1,2)

import itertools
fig.add_trace(go.Scatter(x=list(df['Period']), y=list(itertools.repeat(1, 24)),␣
 ↪showlegend=False, hoverinfo='skip',
                          line = dict(color='firebrick', width=4, dash='dot')))

fig.add_annotation(
        x=12,
```

```
        y=5,
        xref="x",
        yref="y",
        text="sanitation improvement mark",
        showarrow=True,
        font=dict(
            family="Courier New, monospace",
            size=12,
            color="#fffeff"
            ),
        align="center",
        arrowhead=2,
        arrowsize=1,
        arrowwidth=2,
        arrowcolor="#636363",
        ax=0,
        ay=-50,
        bordercolor="#c7c7c7",
        borderwidth=2,
        borderpad=4,
    bgcolor="#034d00",
        opacity=0.8
        )

fig.add_annotation(
        x=23,
        y=23,
        xref="x",
        yref="y",
        text="Sanitation Improvement Mark: April 1855. <br> We arbitraryly␣
 ↪chose April 1855 as <br> the sanitation impovement mark because <br> it␣
 ↪marks the beginning of the second year <br> of the war. Additionally,␣
 ↪Nigthingale and her <br> fellow nurses were allowed entry to the wards <br>␣
 ↪in March 1855 and began improving <br>  the camps' sanitation soon␣
 ↪afterwards. <br> Darker color hues are used to <br> highlight this mark." ,
      xanchor='right',
    yanchor='auto',
    xshift=0,
    yshift=0,
    align='left',
    showarrow=False,
      font=dict(size=9, color='black'),
bordercolor="#c7c7c7",
        borderwidth=2,
        borderpad=4,
        opacity=0.8)
```

```
fig.update_layout(
    title='Redesign #3: A Look at Unavoidable/Typical Deaths versus Preventable␣
 ↪Deaths (April 1854 - March 1856). <br> For every soldier dead due to␣
 ↪unavoidable circumstances (wounds/other), this is how many of their␣
 ↪counterparts died from a <br> preventable or mitagable zymotic disease over␣
 ↪the course of the war. The red dotted line indicates the 1-to-1 ratio or␣
 ↪when as <br> many soldiers dies under unavoidable/war-typical circumstances␣
 ↪than from preventable diseases.',
    font_size=10,
    legend_font_size=10,
    polar_angularaxis_rotation=180,
    width=1000,
    height=600
                )

fig.update_polars(angularaxis_direction= "clockwise",
                  angularaxis_gridcolor="white",
                  bgcolor="rgb(240,240,240)")

fig.update_layout(barmode='group', xaxis_tickangle=-45,␣
 ↪paper_bgcolor='rgb(240,240,240)', plot_bgcolor='rgb(240,240,240)')

#plotly.offline.plot(fig, filename='nightingale.html')
fig.show()
```

Nightingale was right! Thoughout most of the Crimean war, especially during the first year of the war, preventable or mitagable zymotic diseases were by far more of a fatal foo than wounds and other causes of death and improved sanitation measures did help down the line even though the estimated average monthly strength of the British army kept increasing. Indeed. by the end of the war, preventable diseases were no longer killing soldiers at a higher rate than wounds and other causes combined as seen in the bar barplot of *Redesign #3*.

6 Conclusion

Although Nightingale proved her main points with her rose's diagrams or coxcombs, in both redesign iteraion #2 and #3, using a simple barplot proved to be more useful at proving her key points. Although coxcombs allow for more interaction and look from diffrent angles, it is not the most suitable mean to make fair comparaison. Indeed, for both redesign iteration #2 and #3, although the same insights can be derived from either the coxcombs or barplot, it is much easier the spot the trends, similarities and differences in the barplot. Additionally, using a reference point (the sanitation improvement mark here) proved to be vital to estimating the impact of a new measure/variable since we always know where to start looking. The reference point also made it easier to go forward and backwards in time like Drucker argued. Finally, depending on how we

interpret and what we intend to make use of our data, different conclusions can be drawn. Indeed, in redesign #2 for instance, focussing only on death by disease, the most dangerous period was December 1854 - March 1855. However in Redesign #3, the dangerous period shifts back to July 1854 - August 1854. This again calls back context and meaning of data like Drucker argued.

[ ]: