Welcome to my analysis submission for the Sales Data Analyst role at Clipboard Health.

Below you will find the steps I have taken to come to the recommendations included in my presentation.

Import necessary packages for analysis

```
!pip install statsmodels
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
```

```
Requirement already satisfied: statsmodels in c:\users\cssca\
anaconda3\envs\testenv\lib\site-packages (0.14.1)
Requirement already satisfied: numpy<2,>=1.18 in c:\users\cssca\
anaconda3\envs\testenv\lib\site-packages (from statsmodels) (1.24.3)
Requirement already satisfied: scipy!=1.9.2,>=1.4 in c:\users\cssca\
anaconda3\envs\testenv\lib\site-packages (from statsmodels) (1.10.1)
Requirement already satisfied: pandas!=2.1.0,>=1.0 in c:\users\cssca\
anaconda3\envs\testenv\lib\site-packages (from statsmodels) (2.0.3)
Requirement already satisfied: patsy>=0.5.4 in c:\users\cssca\
anaconda3\envs\testenv\lib\site-packages (from statsmodels) (0.5.6)
Requirement already satisfied: packaging>=21.3 in c:\users\cssca\
anaconda3\envs\testenv\lib\site-packages (from statsmodels) (24.1)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\users\
cssca\anaconda3\envs\testenv\lib\site-packages (from pandas!
=2.1.0,>=1.0->statsmodels) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in c:\users\cssca\
anaconda3\envs\testenv\lib\site-packages (from pandas!=2.1.0,>=1.0-
>statsmodels) (2024.1)
Requirement already satisfied: tzdata>=2022.1 in c:\users\cssca\
anaconda3\envs\testenv\lib\site-packages (from pandas!=2.1.0,>=1.0-
>statsmodels) (2023.3)
Requirement already satisfied: six in c:\users\cssca\anaconda3\envs\
testenv\lib\site-packages (from patsy>=0.5.4->statsmodels) (1.16.0)
```

Read in data for analysis and specify the PROVNUM column as the string data type as some entries contain at least one letter and to keep the leading zero on others

```
df = pd.read_csv(r"C:\Users\cssca\ClipboardHealth\
PBJ_Daily_Nurse_Staffing_Q1_2024.csv", encoding='cp1252',
dtype={'PROVNUM':str})
```

```
df.head()
```

```
  PROVNUM                  PROVNAME          CITY STATE COUNTY_NAME  \
0  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin
1  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin
2  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin
3  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin
4  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin

   COUNTY_FIPS  CY_Qtr  WorkDate  MDScensus  Hrs_RNDON  ...
Hrs_LPN_ctr  \
0           59  2024Q1  20240101         50        8.0  ...
0.0
1           59  2024Q1  20240102         49        8.0  ...
0.0
2           59  2024Q1  20240103         49        8.0  ...
0.0
3           59  2024Q1  20240104         50        8.0  ...
0.0
4           59  2024Q1  20240105         51        8.0  ...
0.0

   Hrs_CNA  Hrs_CNA_emp  Hrs_CNA_ctr  Hrs_NAtrn  Hrs_NAtrn_emp
Hrs_NAtrn_ctr  \
0   156.34       156.34          0.0        0.0            0.0
0.0
1   149.40       149.40          0.0        0.0            0.0
0.0
2   147.15       147.15          0.0        0.0            0.0
0.0
3   142.21       142.21          0.0        0.0            0.0
0.0
4   149.40       149.40          0.0        0.0            0.0
0.0

   Hrs_MedAide  Hrs_MedAide_emp  Hrs_MedAide_ctr
0          0.0              0.0              0.0
1          0.0              0.0              0.0
2          0.0              0.0              0.0
3          0.0              0.0              0.0
4          0.0              0.0              0.0

[5 rows x 33 columns]
```

Convert the WorkDate column to a datetime data format to make it easier to work with

```
df['WorkDate'] = pd.to_datetime(df['WorkDate'], format='%Y%m%d')
df.head()
```

```
  PROVNUM                  PROVNAME          CITY STATE COUNTY_NAME  \
0  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin
1  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin
2  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin
3  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin
4  015009  BURNS NURSING HOME, INC.  RUSSELLVILLE    AL    Franklin

   COUNTY_FIPS  CY_Qtr   WorkDate  MDScensus  Hrs_RNDON  ...
Hrs_LPN_ctr  \
0           59  2024Q1 2024-01-01         50        8.0  ...
0.0
1           59  2024Q1 2024-01-02         49        8.0  ...
0.0
2           59  2024Q1 2024-01-03         49        8.0  ...
0.0
3           59  2024Q1 2024-01-04         50        8.0  ...
0.0
4           59  2024Q1 2024-01-05         51        8.0  ...
0.0

   Hrs_CNA  Hrs_CNA_emp  Hrs_CNA_ctr  Hrs_NAtrn  Hrs_NAtrn_emp
Hrs_NAtrn_ctr  \
0   156.34       156.34          0.0        0.0            0.0
0.0
1   149.40       149.40          0.0        0.0            0.0
0.0
2   147.15       147.15          0.0        0.0            0.0
0.0
3   142.21       142.21          0.0        0.0            0.0
0.0
4   149.40       149.40          0.0        0.0            0.0
0.0

   Hrs_MedAide  Hrs_MedAide_emp  Hrs_MedAide_ctr
0          0.0              0.0              0.0
1          0.0              0.0              0.0
2          0.0              0.0              0.0
3          0.0              0.0              0.0
4          0.0              0.0              0.0

[5 rows x 33 columns]
```

Sum the hours worked by employees and contractors in each row and add that information as a new column for ease of analysis later

```
emp_set = {'Hrs_RNDON_emp', 'Hrs_RNadmin_emp', 'Hrs_RN_emp',
'Hrs_LPNadmin_emp', 'Hrs_LPN_emp', 'Hrs_CNA_emp', 'Hrs_NAtrn_emp',
'Hrs_MedAide_emp'}
ctr_set = {'Hrs_RNDON_ctr', 'Hrs_RNadmin_ctr', 'Hrs_RN_ctr',
```

```
'Hrs_LPNadmin_ctr', 'Hrs_LPN_ctr', 'Hrs_CNA_ctr', 'Hrs_NAtrn_ctr',
'Hrs_MedAide_ctr'}

df['ctr_hours'] = df.filter(ctr_set).sum(axis=1)
df['emp_hours'] = df.filter(emp_set).sum(axis=1)
```

Inspect the size of the data set and see there are 1,330,966 entries and 35 columns

```
df.shape
```

```
(1330966, 35)
```

Inspect the data types present

```
df.dtypes
```

```
PROVNUM                        object
PROVNAME                       object
CITY                           object
STATE                          object
COUNTY_NAME                    object
COUNTY_FIPS                     int64
CY_Qtr                         object
WorkDate                datetime64[ns]
MDScensus                       int64
Hrs_RNDON                     float64
Hrs_RNDON_emp                 float64
Hrs_RNDON_ctr                 float64
Hrs_RNadmin                   float64
Hrs_RNadmin_emp               float64
Hrs_RNadmin_ctr               float64
Hrs_RN                        float64
Hrs_RN_emp                    float64
Hrs_RN_ctr                    float64
Hrs_LPNadmin                  float64
Hrs_LPNadmin_emp              float64
Hrs_LPNadmin_ctr              float64
Hrs_LPN                       float64
Hrs_LPN_emp                   float64
Hrs_LPN_ctr                   float64
Hrs_CNA                       float64
Hrs_CNA_emp                   float64
Hrs_CNA_ctr                   float64
Hrs_NAtrn                     float64
Hrs_NAtrn_emp                 float64
Hrs_NAtrn_ctr                 float64
Hrs_MedAide                   float64
Hrs_MedAide_emp               float64
Hrs_MedAide_ctr               float64
```

```
ctr_hours                  float64
emp_hours                  float64
dtype: object
```

Inspect to see if there are any null values present in the data and see that none exist

```
df.isnull().sum()
```

```
PROVNUM              0
PROVNAME             0
CITY                 0
STATE                0
COUNTY_NAME          0
COUNTY_FIPS          0
CY_Qtr               0
WorkDate             0
MDScensus            0
Hrs_RNDON            0
Hrs_RNDON_emp        0
Hrs_RNDON_ctr        0
Hrs_RNadmin          0
Hrs_RNadmin_emp      0
Hrs_RNadmin_ctr      0
Hrs_RN               0
Hrs_RN_emp           0
Hrs_RN_ctr           0
Hrs_LPNadmin         0
Hrs_LPNadmin_emp     0
Hrs_LPNadmin_ctr     0
Hrs_LPN              0
Hrs_LPN_emp          0
Hrs_LPN_ctr          0
Hrs_CNA              0
Hrs_CNA_emp          0
Hrs_CNA_ctr          0
Hrs_NAtrn            0
Hrs_NAtrn_emp        0
Hrs_NAtrn_ctr        0
Hrs_MedAide          0
Hrs_MedAide_emp      0
Hrs_MedAide_ctr      0
ctr_hours            0
emp_hours            0
dtype: int64
```

Calculate what percentage of reported work hours is performed by employees vs contractors

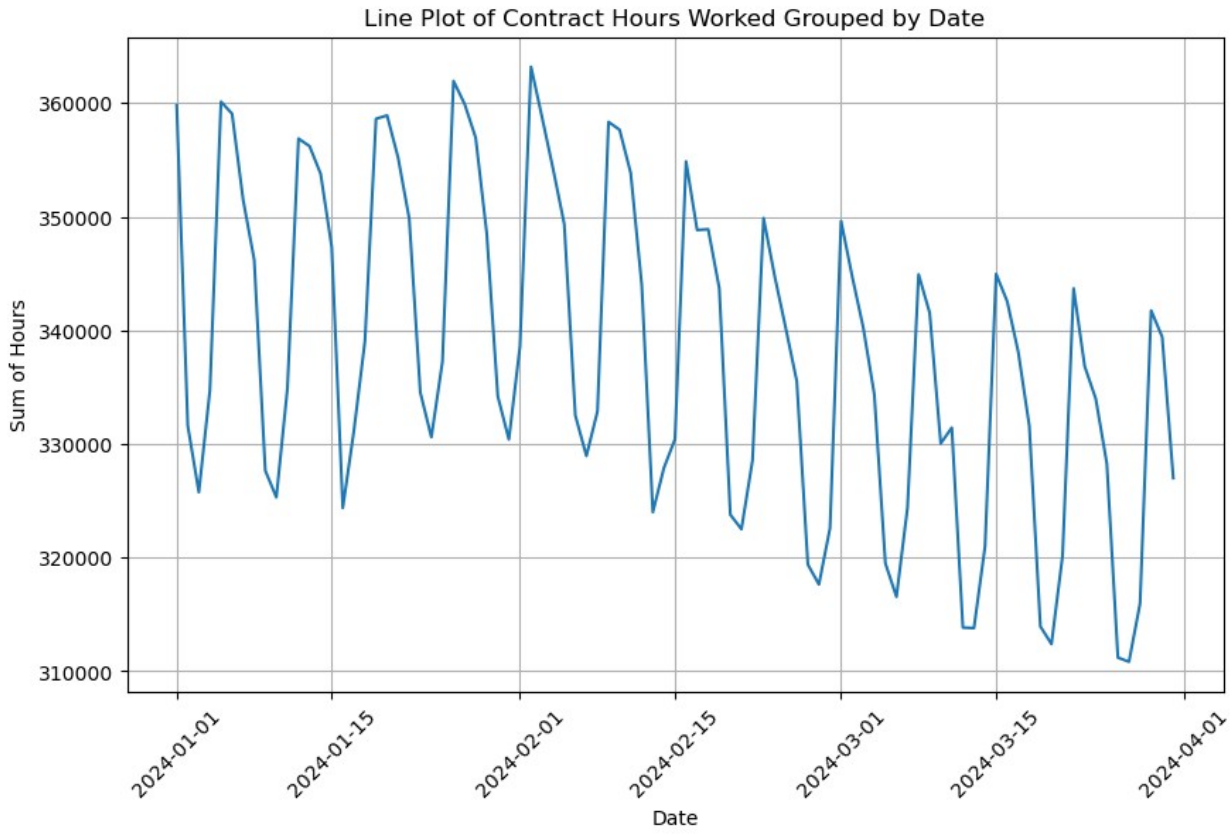
```
emp_hour_count = df.filter(emp_set).sum().sum()
ctr_hour_count = df.filter(ctr_set).sum().sum()
total_hours = emp_hour_count + ctr_hour_count

emp_ratio = ((emp_hour_count / total_hours) * 100)
ctr_ratio = ((ctr_hour_count / total_hours) * 100)

print('The percentage of hours worked by employees is: ' +
str(emp_ratio.round(2)) + '%')
print('The percentage of hours worked by contractors is: ' +
str(ctr_ratio.round(2)) + '%')
```

```
The percentage of hours worked by employees is: 92.47%
The percentage of hours worked by contractors is: 7.53%
```

We can see here that most of the hours reported are done by those employed by the care facilities.

Examine how the contractor hours are distributed across the quarter to see if there are any patterns

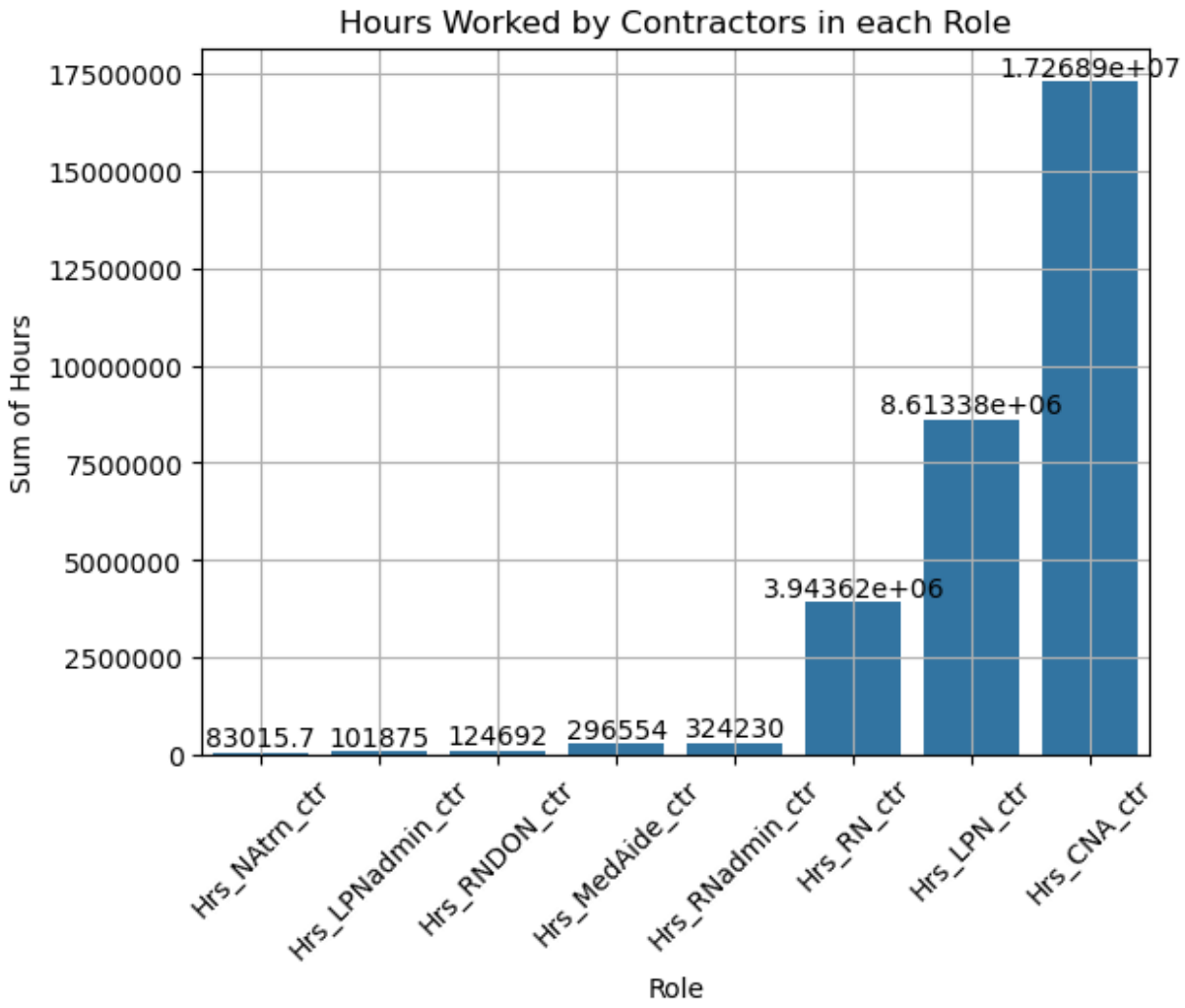
```
plot_data = df.groupby('WorkDate')['ctr_hours'].sum().reset_index()
plt.figure(figsize=(10, 6))
sns.lineplot(data=plot_data, x='WorkDate', y='ctr_hours')
plt.title('Line Plot of Contract Hours Worked Grouped by Date')
plt.xlabel('Date')
plt.ylabel('Sum of Hours')
plt.xticks(rotation=45)
plt.grid()
plt.show()
```



We can see here that the hours worked by contractors goes up and down throughout each month in the quarter and tends to overall trend downwards. Despite this, the hours are still high, never dipping below 310,000 hours total worked. It could be worth investigating what causes the spikes in hours worked in each month so we can plan accordingly for those spikes in the need for contractors.

Examine how the contractor hours are distributed across the different roles

```
plot_data = df[['Hrs_RNDON_ctr', 'Hrs_RNadmin_ctr', 'Hrs_RN_ctr',
'Hrs_LPNadmin_ctr', 'Hrs_LPN_ctr', 'Hrs_CNA_ctr', 'Hrs_NAtrn_ctr',
'Hrs_MedAide_ctr']].sum(axis=0)
ax = sns.barplot(plot_data.sort_values())
ax.bar_label(ax.containers[0])
plt.title('Hours Worked by Contractors in each Role')
plt.xlabel('Role')
plt.ylabel('Sum of Hours')
plt.ticklabel_format(style='plain', axis='y')
plt.xticks(rotation=45)
plt.grid()
plt.show()
```



We can see from this chart that the most in-demand roles that care facilities need contractors for are for registers nurses (RN), licensed practical nurses (LPN), and certified nursing asssistants (CNA). Notably, the CNA role is in a much higher demand than the other roles, being at approximately double the hours of the next highest role. I would recommend focusing on hiring and staffing for these roles in particulr since they seem to be so in demand.

Let's explore what there may be to find relating to the MDScensus data.

Checking some basic summary statistics of the MDScensus data to get an idea of its scale

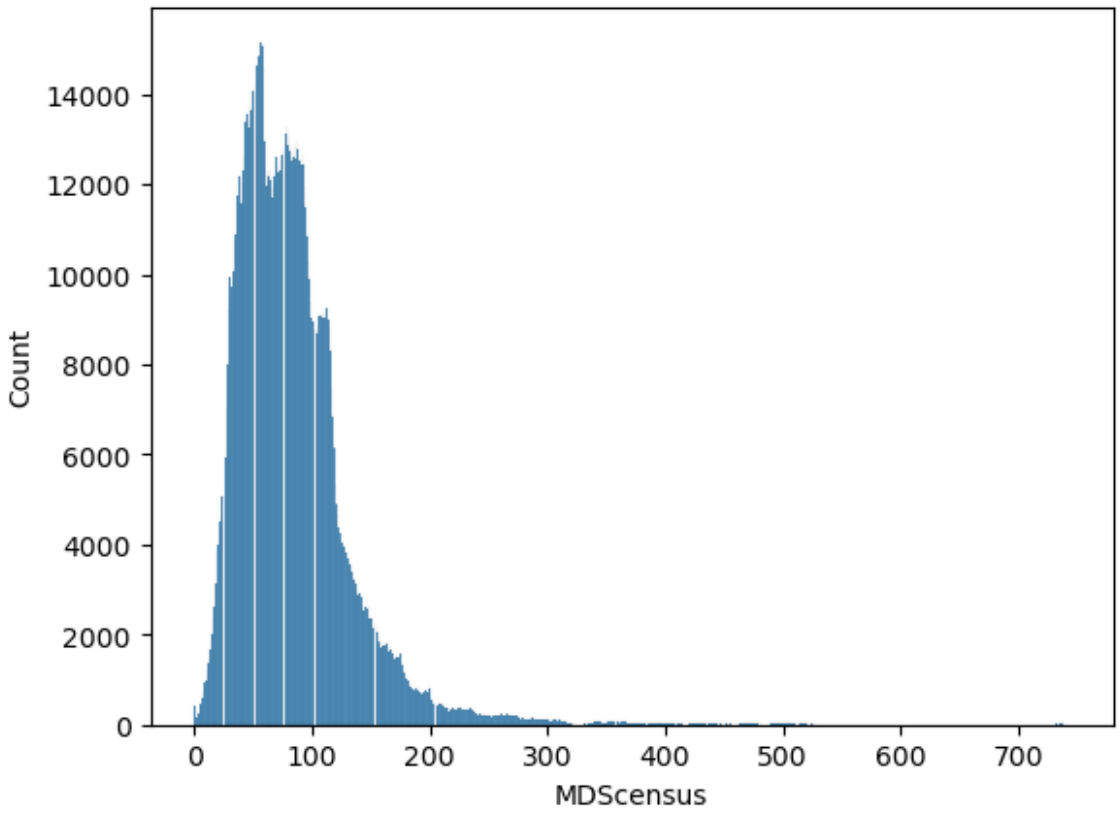
```
df[['MDScensus']].describe()
```

```
          MDScensus
count  1.330966e+06
mean   8.342205e+01
std    4.913768e+01
min    0.000000e+00
25%    5.100000e+01
50%    7.600000e+01
```

```
75%    1.040000e+02
max    7.430000e+02
```

Checking the distribution of the MDScensus data and we find it appears approximately normally distributed with a slight right skew.

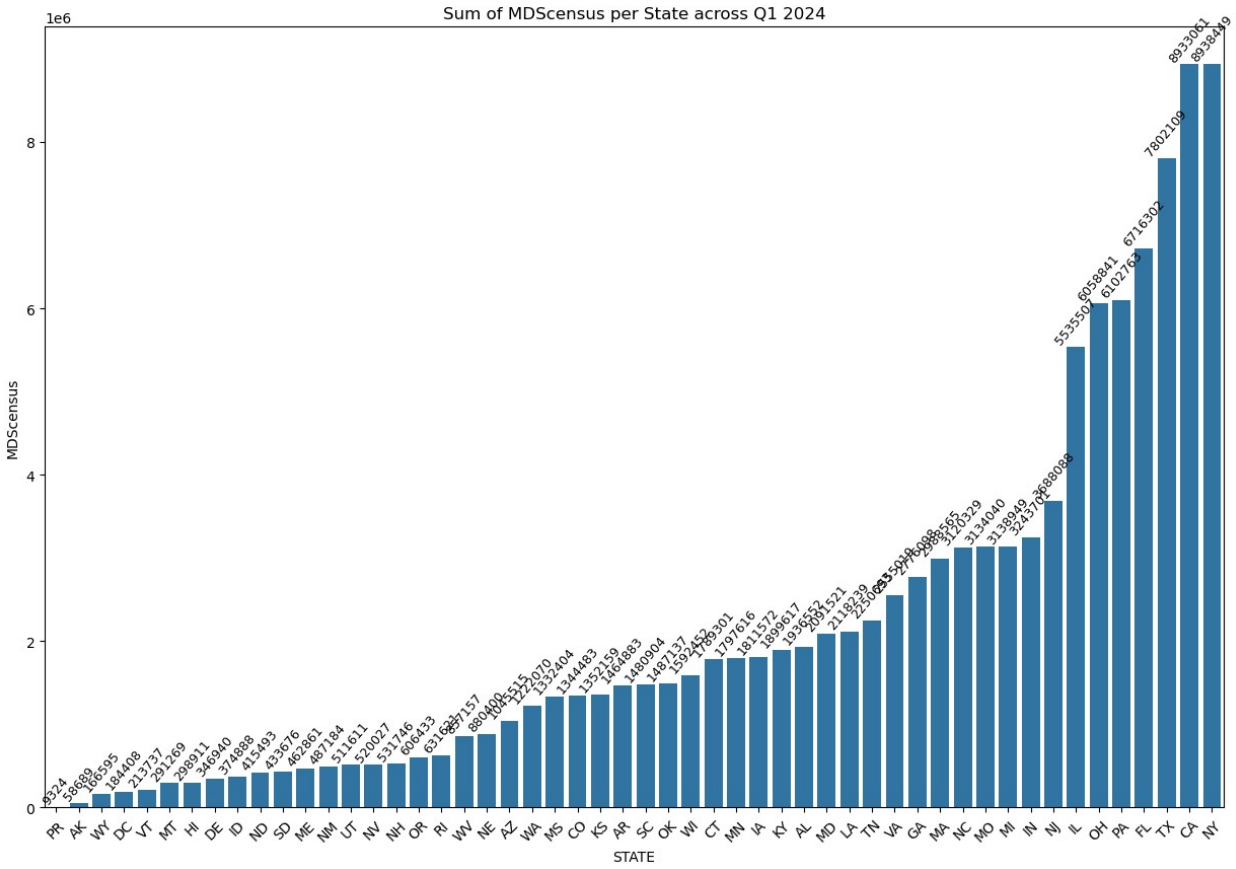
```
fig = sns.histplot(df['MDScensus'])
plt.show()
```



Let's look at the breakdown of which states have the highest combined MDScensus within Q12024.

```
plot_data = df.groupby('STATE')['MDScensus'].sum().sort_values()
plt.figure(figsize=(15, 10))
ax = sns.barplot(plot_data)

# Add value labels on each bar
for p in ax.patches:
    ax.text(p.get_x() + p.get_width() / 2,  # X position of the label
(center of the bar)
            p.get_height(),  # Y position (height of the bar)
            f'{p.get_height():.0f}',  # Label text (formatted to 0
decimal places)
```

```
            ha='center',  # Horizontal alignment
            va='bottom', # Vertical alignment
            rotation=50, #Rotate label
            fontsize=9) #Label font size

plt.xticks(rotation=45)
plt.title('Sum of MDScensus per state across Q1 2024')
plt.show()
```

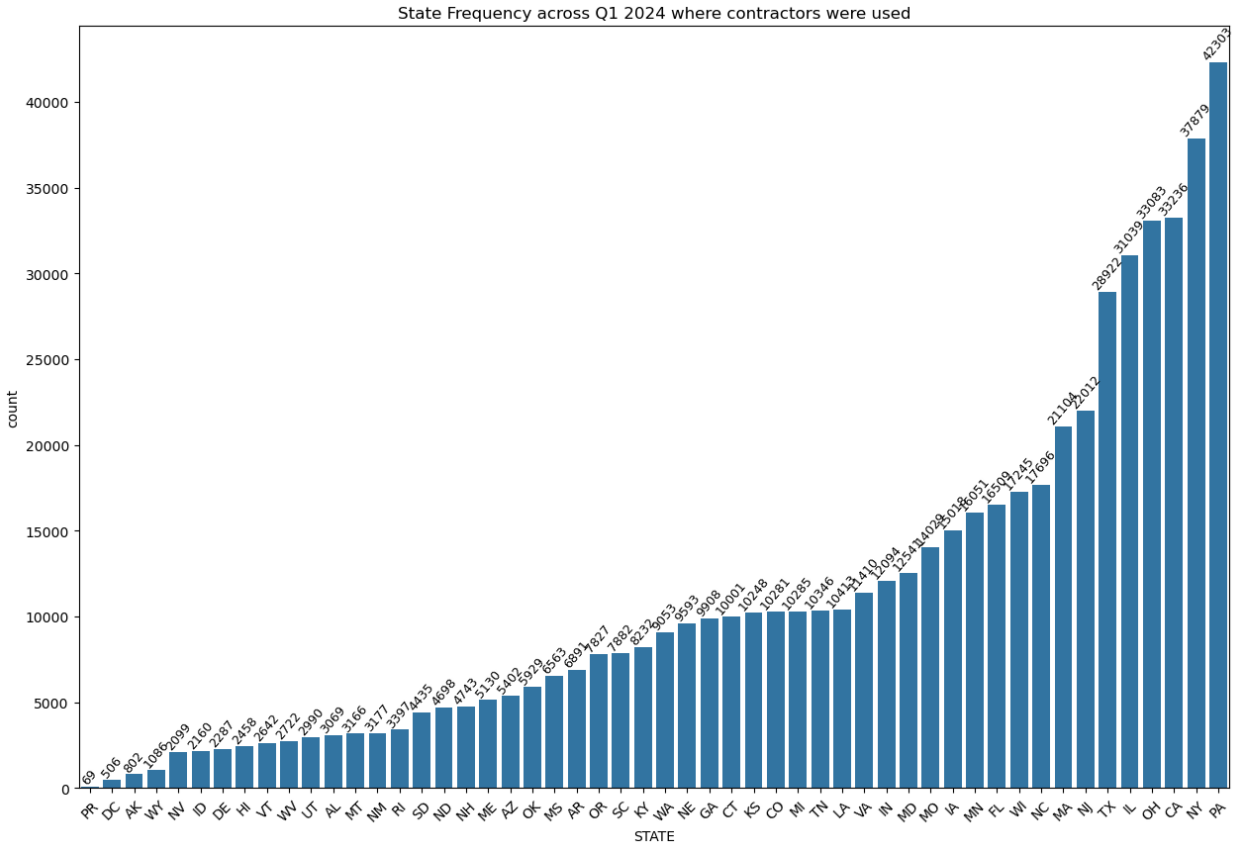


We find that there are 7 states with a notably higher MDScensus sum, indicating they tend to have more patients at their facilities that they are taking care of. This may be a good indicator that there will be a higher need for contract workers at the care facilities in these states. These 7 states are (in descending order) New York, California, Texas, Florida, Pennsylvania, Ohio, and Illinois.

Let's compare this data to the frequency that each state appears in the data when there are contractor hours.

```
plt.figure(figsize=(15, 10))
filtered_df = df[df['ctr_hours'] > 0]
sorted_counts = filtered_df['STATE'].value_counts().sort_values()
ax = sns.countplot(x='STATE', data=filtered_df,
order=sorted_counts.index)
```

```
# Add value labels on each bar
for p in ax.patches:
    ax.text(p.get_x() + p.get_width() / 2,  # X position of the label
(center of the bar)
            p.get_height(),  # Y position (height of the bar)
            f'{p.get_height():.0f}',  # Label text (formatted to 0
decimal places)
            ha='center',  # Horizontal alignment
            va='bottom', # Vertical alignment
            rotation=50, #Rotate label
            fontsize=9) #Label font size

plt.xticks(rotation=45)
plt.title('State Frequency across Q1 2024 where contractors were
used')
plt.show()
```



There are 6 standout states here which are (in descending order) Pennsylvania, New York, California, Ohio, Illinois, and Texas. The only state from the previous graph not in this list is Florida, indicating they have a good amount of employee hours compared to contractor hours.

I would recommend potentially focusing on finding need for contractors in the 6 states Pennsylvania, New York, California, Ohio, Illinois, and Texas. based on these findings.