Covid-19 Vaccination Campaign in Germany

The data used here were provided by Robert Koch Institute and the German federal ministry of Health.

These institutions publish the datasets and some analysis on the page impfdashboard.de.

Setup

Imports

In [1]:
```
# standard library
import datetime
import math
```

In [2]:
```
# third party
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import requests
import seaborn
```

Date this Notebook was run

In [3]:
```
today = datetime.datetime.today().strftime('%Y-%m-%d')
today
```

Out[3]:
```
'2021-10-03'
```

Set Defaults

In [4]:
```
# style like ggplot in R
plt.style.use('ggplot')
```

In [5]:
```
# Avoid cutting off part of the axis labels, see:
# https://stackoverflow.com/questions/6774086/why-is-my-xlabel-cut-off-in-my-matplotlib-plot
plt.rcParams.update({'figure.autolayout': True})
```

```
In [6]: population_germany = 83_200_000
```

Get and Transform Data

```
In [7]: vaccination_data_permalink = 'https://impfdashboard.de/static/data/germany_vaccinations_timeseries_v2.tsv'
        vaccinations = pd.read_csv(
            vaccination_data_permalink,
            sep="\t")
```

Drop unnecessary / misleading columns

List all columns:

```
In [8]: vaccinations.columns
```

```
Out[8]: Index(['date', 'dosen_kumulativ', 'dosen_biontech_kumulativ',
               'dosen_biontech_erst_kumulativ', 'dosen_biontech_zweit_kumulativ',
               'dosen_biontech_dritt_kumulativ', 'dosen_moderna_kumulativ',
               'dosen_moderna_erst_kumulativ', 'dosen_moderna_zweit_kumulativ',
               'dosen_moderna_dritt_kumulativ', 'dosen_astra_kumulativ',
               'dosen_astra_erst_kumulativ', 'dosen_astra_zweit_kumulativ',
               'dosen_astra_dritt_kumulativ', 'dosen_johnson_kumulativ',
               'dosen_erst_kumulativ', 'dosen_zweit_kumulativ',
               'dosen_dritt_kumulativ', 'dosen_differenz_zum_vortag',
               'dosen_erst_differenz_zum_vortag', 'dosen_zweit_differenz_zum_vortag',
               'dosen_dritt_differenz_zum_vortag', 'personen_erst_kumulativ',
               'personen_voll_kumulativ', 'personen_auffrisch_kumulativ',
               'impf_quote_erst', 'impf_quote_voll', 'dosen_dim_kumulativ',
               'dosen_kbv_kumulativ', 'indikation_alter_dosen',
               'indikation_beruf_dosen', 'indikation_medizinisch_dosen',
               'indikation_pflegeheim_dosen', 'indikation_alter_erst',
               'indikation_beruf_erst', 'indikation_medizinisch_erst',
               'indikation_pflegeheim_erst', 'indikation_alter_voll',
               'indikation_beruf_voll', 'indikation_medizinisch_voll',
               'indikation_pflegeheim_voll'],
              dtype='object')
```

Columns with names starting with 'indikation_' will not be analyzed as the data providers stopped updating them.

```
In [9]: cols_to_drop = vaccinations.columns[vaccinations.columns.str.contains('indikation_')]
        vaccinations.drop(columns=cols_to_drop, inplace=True)
```

Some more columns can be dropped, as there is no interest in analyzing differences on a vaccine level - especially since in some cases vaccines were mixed.

In [10]:
```
more_cols_to_drop = ['dosen_biontech_erst_kumulativ', 'dosen_biontech_zweit_kumulativ',
                     'dosen_moderna_erst_kumulativ', 'dosen_moderna_zweit_kumulativ',
                     'dosen_astra_erst_kumulativ', 'dosen_astra_zweit_kumulativ']
vaccinations.drop(columns=more_cols_to_drop, inplace=True)
```

Some columns are labeled misleadingly. As stated by the data provider the columns `personen_erst_kumulativ` and `impf_quote_erst` contain people vaccinated with the Johnson & Johnson vaccine. As this requires only one shot. the same persons are included in `personen_voll_kumulativ` . Therefore more columns are dropped and recalculated later.

In [11]:
```
vaccinations.drop(columns=['impf_quote_erst', 'impf_quote_voll'], inplace=True)
```

Convert datatype of date column

In [12]:
```
vaccinations.iloc[ : , [0]] = vaccinations.iloc[ : , [0]].apply(pd.to_datetime)
```

Show Data

In [13]:
```
vaccinations.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 279 entries, 0 to 278
Data columns (total 21 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   date                            279 non-null    datetime64[ns]
 1   dosen_kumulativ                 279 non-null    int64
 2   dosen_biontech_kumulativ        279 non-null    int64
 3   dosen_biontech_dritt_kumulativ  279 non-null    int64
 4   dosen_moderna_kumulativ         279 non-null    int64
 5   dosen_moderna_dritt_kumulativ   279 non-null    int64
 6   dosen_astra_kumulativ           279 non-null    int64
 7   dosen_astra_dritt_kumulativ     279 non-null    int64
 8   dosen_johnson_kumulativ         279 non-null    int64
 9   dosen_erst_kumulativ            279 non-null    int64
 10  dosen_zweit_kumulativ           279 non-null    int64
 11  dosen_dritt_kumulativ           279 non-null    int64
 12  dosen_differenz_zum_vortag      279 non-null    int64
 13  dosen_erst_differenz_zum_vortag 279 non-null    int64
 14  dosen_zweit_differenz_zum_vortag 279 non-null    int64
 15  dosen_dritt_differenz_zum_vortag 279 non-null    int64
 16  personen_erst_kumulativ         279 non-null    int64
 17  personen_voll_kumulativ          279 non-null    int64
 18  personen_auffrisch_kumulativ     279 non-null    int64
 19  dosen_dim_kumulativ              279 non-null    int64
 20  dosen_kbv_kumulativ              279 non-null    int64
dtypes: datetime64[ns](1), int64(20)
memory usage: 45.9 KB
```

In [14]:
```
vaccinations.tail(3)
```

Out[14]:

	date	dosen_kumulativ	dosen_biontech_kumulativ	dosen_biontech_dritt_kumulativ	dosen_moderna_kumulativ	dosen_moderna_dritt_kumulativ	do
276	2021-09-29	107679536	82144963	694793	9664125	29616	
277	2021-09-30	107893056	82345510	738708	9668318	30427	
278	2021-10-01	108011215	82456329	760297	9670126	30692	

3 rows × 21 columns

Check Validity

In [15]:
```
# get the last row / the newest available data
last_row = vaccinations.tail(1)
```

In [16]:
```
doses_used = last_row['dosen_kumulativ']
doses_used
```

Out[16]:
```
278    108011215
Name: dosen_kumulativ, dtype: int64
```

In [17]:
```
# The number of person having been vaccinated at least once, includes those fully vaccinated
at_least_once = last_row['personen_erst_kumulativ']
fully_vaccinated_people = last_row['personen_voll_kumulativ']
partially_vaccinated_people = at_least_once - fully_vaccinated_people
# The johnson & Johnson vaccine is the only one used in Germany that only needs a single shot:
johnson_doses = last_row['dosen_johnson_kumulativ']
```

In [18]:
```
# Must be exactly 0
result_substraction = doses_used - partially_vaccinated_people - (fully_vaccinated_people - johnson_doses) * 2 - johnso
```

```
result_substraction
```

Out[18]:
```
278    791781
dtype: int64
```

In [19]:
```
result_substraction ==  0
```

Out[19]:
```
278    False
dtype: bool
```

Calculate columns

In [20]:
```
vaccinations['partly vaccinated'] = round(
    (vaccinations['personen_erst_kumulativ'] - vaccinations['personen_voll_kumulativ']) * 100 / population_germany,
    2)
```

In [21]:
```
vaccinations['fully vaccinated'] = round(
    vaccinations['personen_voll_kumulativ'] * 100 / population_germany,
    2)
```

In [22]:
```
vaccinations.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 279 entries, 0 to 278
Data columns (total 23 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   date                            279 non-null    datetime64[ns]
 1   dosen_kumulativ                 279 non-null    int64
 2   dosen_biontech_kumulativ        279 non-null    int64
 3   dosen_biontech_dritt_kumulativ  279 non-null    int64
 4   dosen_moderna_kumulativ         279 non-null    int64
 5   dosen_moderna_dritt_kumulativ   279 non-null    int64
 6   dosen_astra_kumulativ           279 non-null    int64
 7   dosen_astra_dritt_kumulativ     279 non-null    int64
 8   dosen_johnson_kumulativ         279 non-null    int64
 9   dosen_erst_kumulativ            279 non-null    int64
 10  dosen_zweit_kumulativ           279 non-null    int64
 11  dosen_dritt_kumulativ           279 non-null    int64
 12  dosen_differenz_zum_vortag      279 non-null    int64
 13  dosen_erst_differenz_zum_vortag 279 non-null    int64
 14  dosen_zweit_differenz_zum_vortag 279 non-null    int64
 15  dosen_dritt_differenz_zum_vortag 279 non-null    int64
 16  personen_erst_kumulativ         279 non-null    int64
 17  personen_voll_kumulativ          279 non-null    int64
 18  personen_auffrisch_kumulativ     279 non-null    int64
 19  dosen_dim_kumulativ              279 non-null    int64
 20  dosen_kbv_kumulativ              279 non-null    int64
 21  partly vaccinated                279 non-null    float64
 22  fully vaccinated                 279 non-null    float64
dtypes: datetime64[ns](1), float64(2), int64(20)
memory usage: 50.3 KB
```

In [23]:
```
vaccinations.tail(3)
```

Out[23]:

	date	dosen_kumulativ	dosen_biontech_kumulativ	dosen_biontech_dritt_kumulativ	dosen_moderna_kumulativ	dosen_moderna_dritt_kumulativ	do
276	2021-09-29	107679536	82144963	694793	9664125	29616	
277	2021-09-30	107893056	82345510	738708	9668318	30427	
278	2021-10-01	108011215	82456329	760297	9670126	30692	

3 rows × 23 columns

Last Update

Often the data is not updated on weekends, so get the highest date in the dataset.

In [24]:
```
last_update = vaccinations.loc[vaccinations.index[-1], "date"].strftime('%Y-%m-%d')
last_update
```

Out[24]:
```
'2021-10-01'
```

Doses Used

In [25]:
```
doses = vaccinations.loc[ : , ['date', 'dosen_differenz_zum_vortag']]
# Rename columns
doses.columns = ['date', 'doses used']
```

In [26]:
```
# Scale number of doses as millions
```

```
doses['doses used'] = doses['doses used'] / 1_000_000
```

Doses Daily

In [27]:
```
doses_daily = doses.set_index('date', inplace=False)
doses_daily.tail(1)
```

Out[27]:

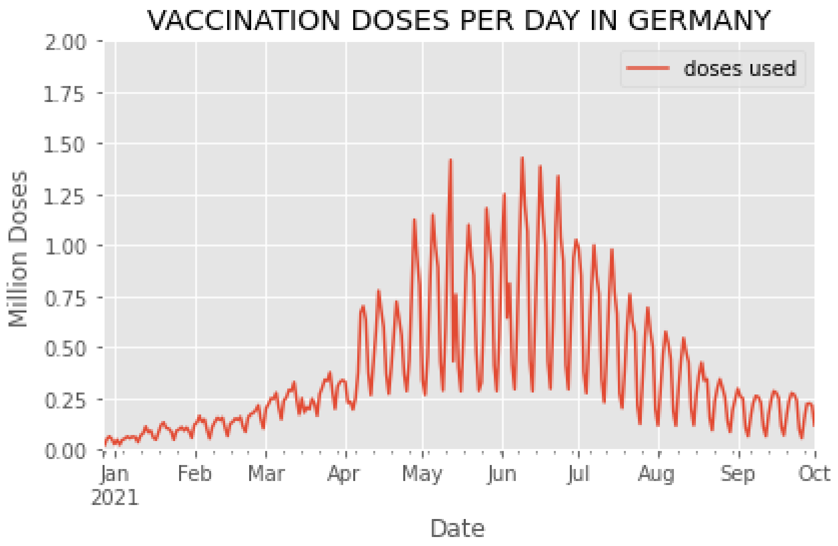
	doses used
date	
2021-10-01	0.118159

In [28]:
```
# What is the highest number of doses used in a day?
max_doses_daily = max(doses_daily['doses used'])
max_doses_daily
```

Out[28]:
```
1.427952
```

In [29]:
```
doses_daily.plot(
    ylim=(0,math.ceil(max_doses_daily)),
    xlabel='Date',
    ylabel='Million Doses',
    title='VACCINATION DOSES PER DAY IN GERMANY')
```

Out[29]:
```
<AxesSubplot:title={'center':'VACCINATION DOSES PER DAY IN GERMANY'}, xlabel='Date', ylabel='Million Doses'>
```



Doses per Weekday (in the last 6 weeks)

In [30]:
```
last_6_weeks = doses.tail(42)
```

In [31]:
```
# Yields a warning, but exactly like the docs prescribe and it works
# https://pandas.pydata.org/docs/getting_started/intro_tutorials/05_add_columns.html
last_6_weeks['weekday'] = last_6_weeks['date'].dt.day_name()
```

```
<ipython-input-31-45013977109e>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a
-view-versus-a-copy
  last_6_weeks['weekday'] = last_6_weeks['date'].dt.day_name()
```

In [32]:
```
# check:
last_6_weeks.tail(3)
```

Out[32]:

	date	doses used	weekday
276	2021-09-29	0.223539	Wednesday
277	2021-09-30	0.213520	Thursday
278	2021-10-01	0.118159	Friday

In [33]:
```
# drop the date column
last_6_weeks = last_6_weeks.drop(labels=['date'], axis=1)
```

In [34]:
```
#last_6_weeks.set_index('weekday', inplace=True)
last_6_weeks.tail(3)
```

Out[34]:

	doses used	weekday
276	0.223539	Wednesday
277	0.213520	Thursday
278	0.118159	Friday

In [35]:
```
pivot_table =last_6_weeks.pivot(columns='weekday', values='doses used')
pivot_table.tail()
```

Out[35]:

weekday	Friday	Monday	Saturday	Sunday	Thursday	Tuesday	Wednesday
274	NaN	0.149894	NaN	NaN	NaN	NaN	NaN
275	NaN	NaN	NaN	NaN	NaN	0.220281	NaN
276	NaN	NaN	NaN	NaN	NaN	NaN	0.223539
277	NaN	NaN	NaN	NaN	0.21352	NaN	NaN
278	0.118159	NaN	NaN	NaN	NaN	NaN	NaN

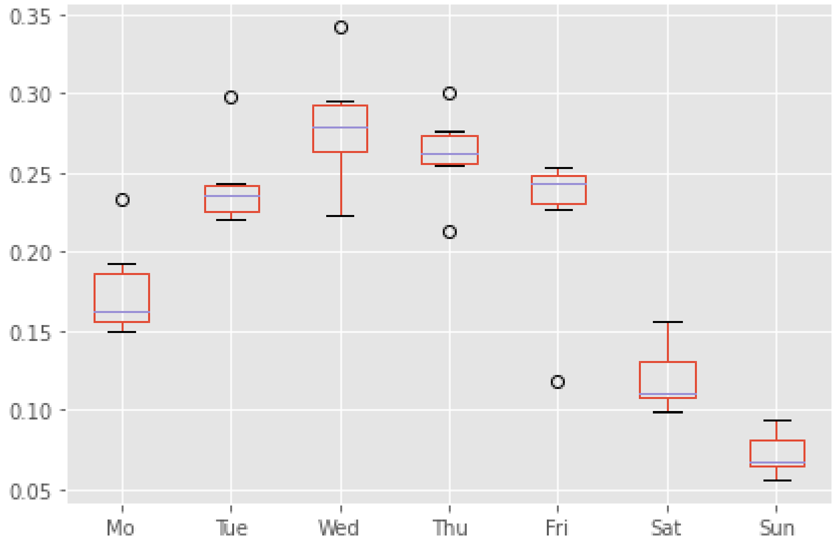
In [36]:
```
# Reorder the columns
pivot_table = pivot_table[['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday']]
# Rename the columns
pivot_table.columns=['Mo', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat', 'Sun']
pivot_table.tail()
```

Out[36]:

	Mo	Tue	Wed	Thu	Fri	Sat	Sun
274	0.149894	NaN	NaN	NaN	NaN	NaN	NaN
275	NaN	0.220281	NaN	NaN	NaN	NaN	NaN
276	NaN	NaN	0.223539	NaN	NaN	NaN	NaN
277	NaN	NaN	NaN	0.21352	NaN	NaN	NaN

	Mo	Tue	Wed	Thu	Fri	Sat	Sun
278	NaN	NaN	NaN	NaN	0.118159	NaN	NaN

In [37]:
```
weekday_boxplot = pivot_table.boxplot()
```



In [38]:
```
fig = weekday_boxplot.get_figure()
fig.savefig('img/weekday_boxplot.png')
```

Doses per Week

In [39]:
```
# W-Mon in order to start the week on a Monday, see:
# https://pandas.pydata.org/pandas-docs/stable/user_guide/timeseries.html#anchored-offsets
doses_weekly = doses.groupby(pd.Grouper(key='date',freq='W-Mon')).sum()
doses_weekly.columns = ['million doses used']
doses_weekly.tail()
```

Out[39]:

	million doses used
date	
2021-09-06	1.370367
2021-09-13	1.306847

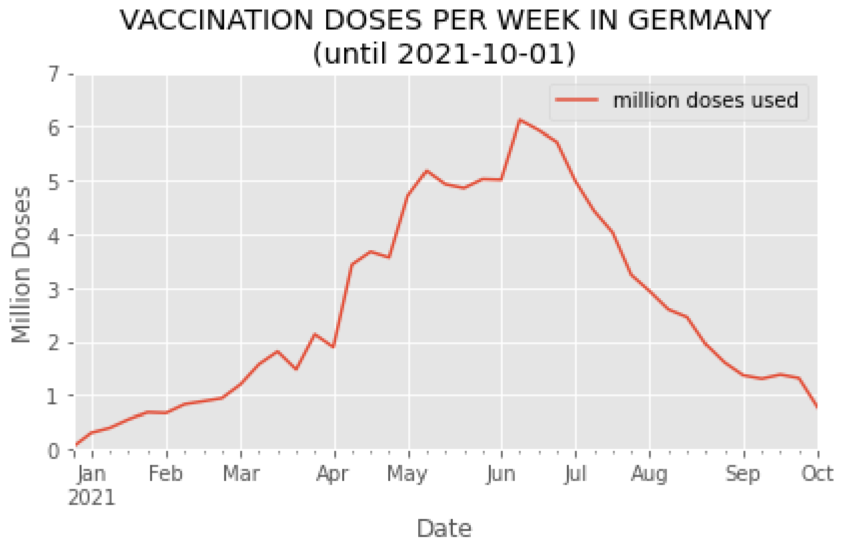
	million doses used
date	
2021-09-20	1.383952
2021-09-27	1.318021
2021-10-04	0.775499

In [40]:
```
# What is the highest number of doses used in a week?
max_million_doses_weekly = max(doses_weekly['million doses used'])
max_million_doses_weekly
```

Out[40]:
```
6.123856
```

In [41]:
```
doses_weekly.plot(
    ylim=(0, math.ceil(max_million_doses_weekly)),
    xlabel='Date',
    ylabel='Million Doses',
    title=f"VACCINATION DOSES PER WEEK IN GERMANY\n(until {last_update})")
```

Out[41]:
```
<AxesSubplot:title={'center':'VACCINATION DOSES PER WEEK IN GERMANY\n(until 2021-10-01)'}, xlabel='Date', ylabel='Milli
on Doses'>
```



Doses per Month

In [42]:
```
# M = month end frequency
doses_monthly = doses.groupby(pd.Grouper(key='date',freq='M')).sum()
doses_monthly.tail()
```

Out[42]:

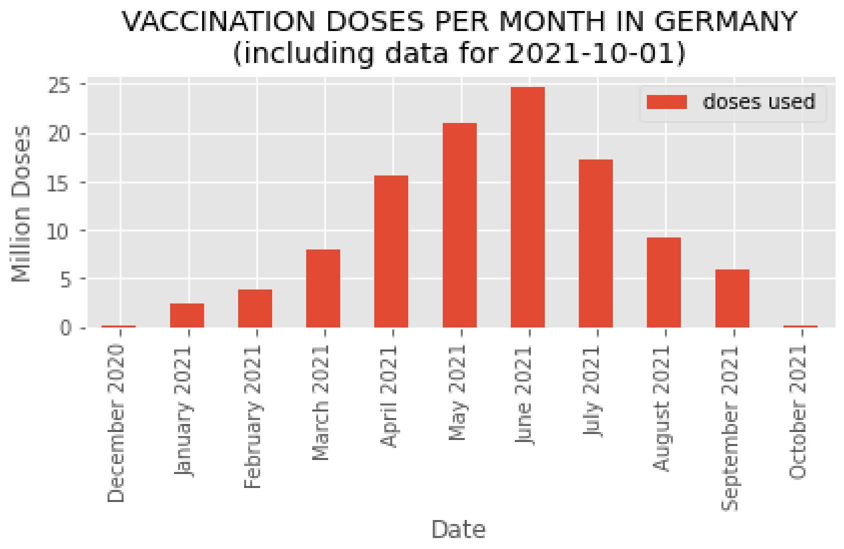
date	doses used
2021-06-30	24.753819
2021-07-31	17.259313
2021-08-31	9.265896
2021-09-30	5.793155
2021-10-31	0.118159

In [43]:
```
max_doses_monthly = max(doses_monthly['doses used'])
max_doses_monthly
doses_monthly['month'] = doses_monthly.index.strftime('%B')
doses_monthly['year'] =  doses_monthly.index.strftime('%Y')
doses_monthly['label'] = doses_monthly['month'] + ' ' + doses_monthly['year']
doses_monthly.drop(columns=['month', 'year'], inplace=True)
doses_monthly.set_index('label', inplace=True)
doses_monthly.tail(6)
```

Out[43]:

label	doses used
May 2021	21.056333
June 2021	24.753819
July 2021	17.259313
August 2021	9.265896
September 2021	5.793155
October 2021	0.118159

In [44]:
```
monthly_plot = doses_monthly.plot.bar(
    ylim=(0,math.ceil(max_doses_monthly) + 1),
    xlabel='Date',
    ylabel='Million Doses',
    title=f"VACCINATION DOSES PER MONTH IN GERMANY\n(including data for {last_update})")
```



In [45]:
```
fig = monthly_plot.get_figure()
fig.savefig('img/monthly_doses_germany.png')
```

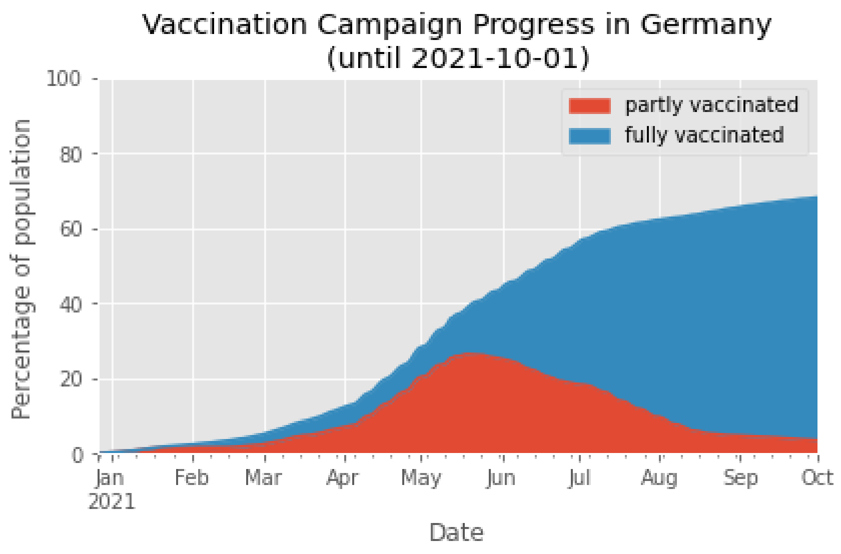
Vaccination Campaign Progress

In [46]:
```
doses_cumulative = vaccinations.loc[ : , ['date', 'partly vaccinated', 'fully vaccinated']]
doses_cumulative.set_index('date', inplace=True)
doses_cumulative.tail(3)
```

Out[46]:

	partly vaccinated	fully vaccinated
date		
2021-09-29	3.58	64.40
2021-09-30	3.53	64.53
2021-10-01	3.51	64.60

In [47]:
```
doses_area_plot = doses_cumulative.plot.area(
    ylim=(0,100),
    xlabel='Date',
    ylabel='Percentage of population',
    title=f"Vaccination Campaign Progress in Germany\n(until {last_update})")
```



In [48]:

```
fig = doses_area_plot.get_figure()
fig.savefig('img/vaccinations_germany_area_plot.png')
```

As of Today

In [49]:

```
# get the last line of the data
current_state = doses_cumulative.iloc[-1]
current_state
```

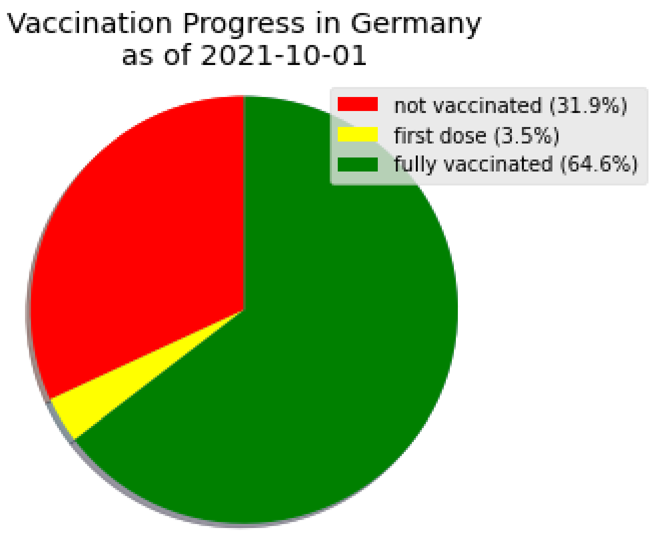
Out[49]:

```
partly vaccinated     3.51
fully vaccinated     64.60
Name: 2021-10-01 00:00:00, dtype: float64
```

In [50]:

```
percentage_not_vacc = 100 - current_state['partly vaccinated'] - current_state['fully vaccinated']
labels = [f"not vaccinated ({round(percentage_not_vacc, 1)}%)",
          f"first dose ({round(current_state['partly vaccinated'], 1)}%)",
          f"fully vaccinated ({round(current_state['fully vaccinated'], 1)}%)"]
colors = ['red', 'yellow', 'green']
sizes = [percentage_not_vacc,
         current_state['partly vaccinated'],
         current_state['fully vaccinated']]
fig1, ax1 = plt.subplots()
```

```
ax1.pie(sizes, shadow=True, startangle=90)
ax1.axis('equal')  # Equal aspect ratio ensures that pie is drawn as a circle.
patches, texts = plt.pie(sizes, colors=colors, startangle=90)
plt.legend(patches, labels, loc="best")
plt.title(f"Vaccination Progress in Germany\nas of {last_update}")
# plt.savefig must be before show()
# BEWARE plt.savefig must be in the same Jupyter code cell that creates the graph!
# See comment by ijoseph here:
# https://stackoverflow.com/questions/9012487/matplotlib-pyplot-savefig-outputs-blank-image
plt.savefig('img/vaccination_in_germany_pie.png', bbox_inches='tight')
plt.show()
```



Vaccines in Use

In [51]:

```
vaccinations.columns
```

Out[51]:

```
Index(['date', 'dosen_kumulativ', 'dosen_biontech_kumulativ',
       'dosen_biontech_dritt_kumulativ', 'dosen_moderna_kumulativ',
       'dosen_moderna_dritt_kumulativ', 'dosen_astra_kumulativ',
       'dosen_astra_dritt_kumulativ', 'dosen_johnson_kumulativ',
       'dosen_erst_kumulativ', 'dosen_zweit_kumulativ',
       'dosen_dritt_kumulativ', 'dosen_differenz_zum_vortag',
       'dosen_erst_differenz_zum_vortag', 'dosen_zweit_differenz_zum_vortag',
       'dosen_dritt_differenz_zum_vortag', 'personen_erst_kumulativ',
       'personen_voll_kumulativ', 'personen_auffrisch_kumulativ',
       'dosen_dim_kumulativ', 'dosen_kbv_kumulativ', 'partly vaccinated',
       'fully vaccinated'],
      dtype='object')
```

In [52]:

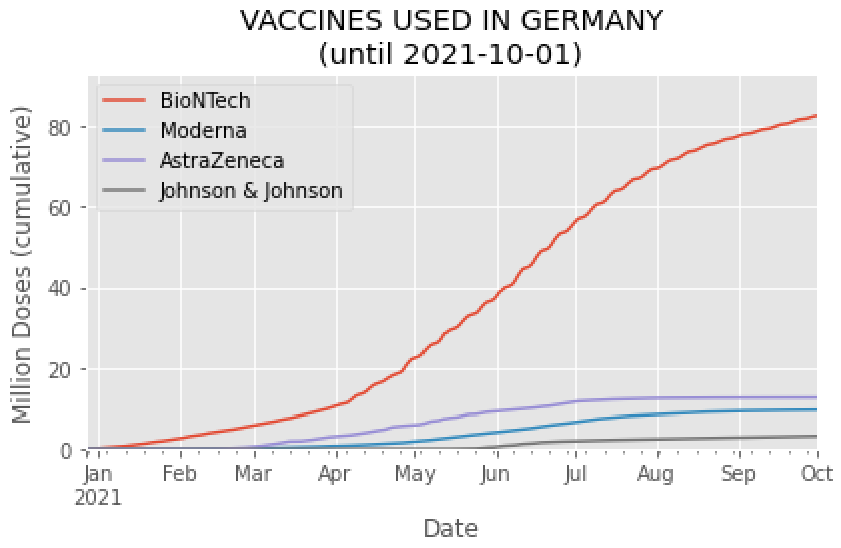
```
vaccine_use = vaccinations.loc[ : , ['date', 'dosen_biontech_kumulativ',
                                     'dosen_moderna_kumulativ',
                                     'dosen_astra_kumulativ',
                                     'dosen_johnson_kumulativ']]
# Rename columns
vaccine_use.columns = ['date', 'BioNTech', 'Moderna', 'AstraZeneca', 'Johnson & Johnson']
# make 'date' an index
vaccine_use.set_index('date', inplace=True)
# divide columns by 1 million
vaccine_use["BioNTech"] = vaccine_use["BioNTech"] / 1_000_000
vaccine_use["Moderna"] = vaccine_use["Moderna"] / 1_000_000
vaccine_use["AstraZeneca"] = vaccine_use["AstraZeneca"] / 1_000_000
vaccine_use["Johnson & Johnson"] = vaccine_use["Johnson & Johnson"] / 1_000_000
vaccine_use.tail(3)
```

Out[52]:

	BioNTech	Moderna	AstraZeneca	Johnson & Johnson
date				
2021-09-29	82.144963	9.664125	12.691576	3.178872
2021-09-30	82.345510	9.668318	12.692823	3.186405
2021-10-01	82.456329	9.670126	12.693057	3.191703

In [53]:

```
vaccines_used = vaccine_use.plot(
    # as it is cumulative, the last row must contain the single highest number
    ylim=(0,math.ceil(max(vaccine_use.iloc[-1]))+10),
    xlabel='Date',
    ylabel='Million Doses (cumulative)',
    title=f"VACCINES USED IN GERMANY\n(until {last_update})")
```



In [54]:
```
fig = vaccines_used.get_figure()
fig.savefig('img/vaccines_used_in_germany.png')
```

Vaccination Centers versus Doctor's Practices

In [55]:
```
vaccinations.tail()
```

Out[55]:

	date	dosen_kumulativ	dosen_biontech_kumulativ	dosen_biontech_dritt_kumulativ	dosen_moderna_kumulativ	dosen_moderna_dritt_kumulativ	do
274	2021-09-27	107235716	81729705	602789	9654504	27600	
275	2021-09-28	107455997	81934453	646903	9660010	28995	
276	2021-09-29	107679536	82144963	694793	9664125	29616	
277	2021-09-30	107893056	82345510	738708	9668318	30427	
278	2021-10-01	108011215	82456329	760297	9670126	30692	

5 rows × 23 columns

In [56]:
```
by_place = vaccinations.loc[ : , ['date', 'dosen_dim_kumulativ', 'dosen_kbv_kumulativ']]
by_place.columns = ['date', 'vaccination centers', 'practices']
```

In [57]:
```
by_place['vaccination centers daily'] = by_place['vaccination centers'].diff()
by_place['practices daily'] = by_place['practices'].diff()
```

In [58]:
```
by_place['percentage practices'] =  round(
    by_place['practices daily'] * 100 /
    (by_place['vaccination centers daily'] + by_place['practices daily']), 2)

by_place['percentage centers'] = 100 - by_place['percentage practices']
```

In [59]:
```
# make 'date' an index
by_place.set_index('date', inplace=True)
```

In [60]:
```
by_place
```

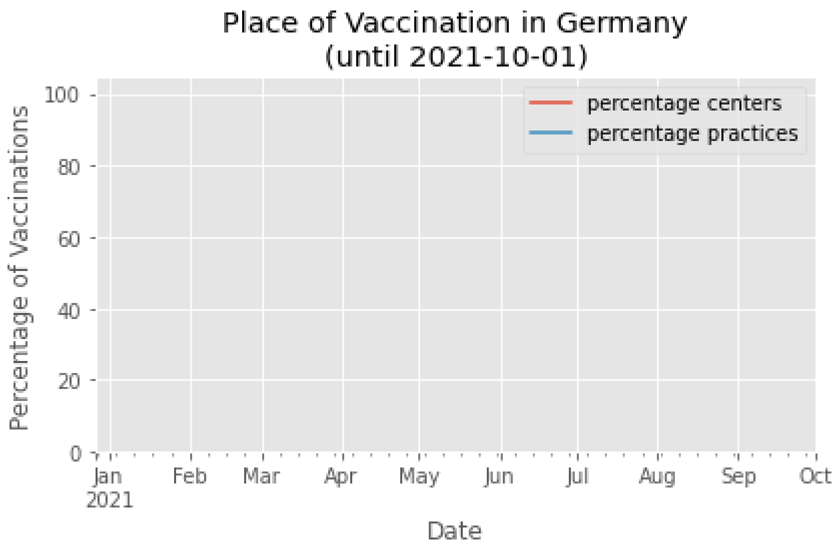
Out[60]:

	vaccination centers	practices	vaccination centers daily	practices daily	percentage practices	percentage centers
date						
2020-12-27	0	0	NaN	NaN	NaN	NaN
2020-12-28	0	0	0.0	0.0	NaN	NaN
2020-12-29	0	0	0.0	0.0	NaN	NaN
2020-12-30	0	0	0.0	0.0	NaN	NaN
2020-12-31	0	0	0.0	0.0	NaN	NaN
...	...	...	...	...	...	...
2021-09-27	0	0	0.0	0.0	NaN	NaN
2021-09-28	0	0	0.0	0.0	NaN	NaN
2021-09-29	0	0	0.0	0.0	NaN	NaN
2021-09-30	0	0	0.0	0.0	NaN	NaN
2021-10-01	0	0	0.0	0.0	NaN	NaN

279 rows × 6 columns

```
In [61]: share = by_place.loc[ : , ['percentage centers', 'percentage practices']]
```

```
In [62]: vacc_shares = share.plot(
             # as it is cumulative, the last row must contain the single highest number
             ylim=(0, 105),  # above 100 to see the line
             xlabel='Date',
             ylabel='Percentage of Vaccinations',
             title=f"Place of Vaccination in Germany\n(until {last_update})")
```



```
In [63]: fig = vacc_shares.get_figure()
         fig.savefig('img/vaccinations_germany_by_place.png')
```

Other units of Time

```
In [64]: by_place_daily = by_place.loc[ : , ['vaccination centers daily', 'practices daily']]
         by_place_daily.columns = ['vaccination centers', 'practices']
         by_place_daily.reset_index(inplace=True)
```

Monthly

```
In [65]: by_place_monthly = by_place_daily.groupby(pd.Grouper(key='date',freq='M')).sum()
```

```
by_place_monthly.tail()
```

Out[65]:

	vaccination centers	practices
date		
2021-06-30	0.0	0.0
2021-07-31	0.0	0.0
2021-08-31	0.0	0.0
2021-09-30	0.0	0.0
2021-10-31	0.0	0.0

Scale:

In [66]:
```
by_place_monthly['vaccination centers'] = by_place_monthly['vaccination centers'] / 1_000_000
by_place_monthly['practices'] = by_place_monthly['practices'] / 1_000_000
```

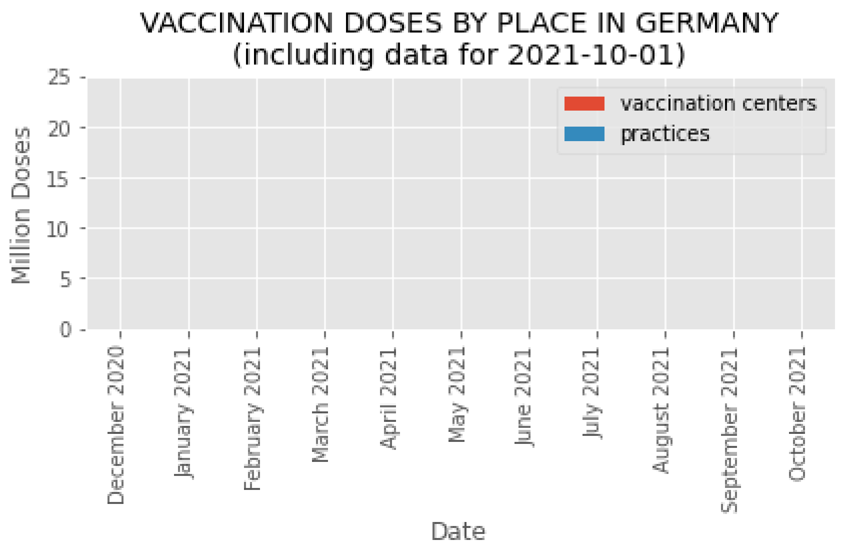
Rename the columns

In [67]:
```
by_place_monthly['month'] = by_place_monthly.index.strftime('%B')
by_place_monthly['year'] =  by_place_monthly.index.strftime('%Y')
by_place_monthly['label'] = by_place_monthly['month'] + ' ' + by_place_monthly['year']
by_place_monthly.drop(columns=['month', 'year'], inplace=True)
by_place_monthly.set_index('label', inplace=True)
by_place_monthly.tail(6)
```

Out[67]:

	vaccination centers	practices
label		
May 2021	0.0	0.0
June 2021	0.0	0.0
July 2021	0.0	0.0
August 2021	0.0	0.0
September 2021	0.0	0.0
October 2021	0.0	0.0

In [68]:
```
monthly_plot = by_place_monthly.plot.bar(
    stacked=True,
    ylim=(0, 25),
    xlabel='Date',
    ylabel='Million Doses',
    title=f"VACCINATION DOSES BY PLACE IN GERMANY\n(including data for {last_update})")
```



In [69]:
```
fig = monthly_plot.get_figure()
fig.savefig('img/monthly_doses_by_place_germany.png')
```