Healthcare Accessibility in Nairobi

April 12, 2024

[1247]:
```
#importing data
import pandas as pd
import numpy as np
data=pd.read_excel('Health data.xls')
data2=pd.read_csv('Population1.csv')
data3=pd.read_csv('Population.csv')
data4=data3[382:].head(11)
#Health care facility information within Nairobi
HF_Nairobi=data[data['County']=='Nairobi']
HF_Nairobi=HF_Nairobi.replace(np.nan,'N',regex = True)
```

```
WARNING *** OLE2 inconsistency: SSCS size is 0 but SSAT size is non-zero
```

[1248]:
```
HF_Nairobi.head()
```

[1248]:

	Facility Code	Facility Name	Province	County	District	Division	Type	Owner	Location	Sub Location	…	IPD	OPD	OUTREACH	PMTCT	RAD/XRAY	RHTC/RHDC	TB DIAG
1	19310	St Jude's Huruma Community Health Services	Nairobi	Nairobi	Mathare	Huruma	Medical Clinic	Private Practice - Unspecified	Huruma	Huruma	…	N	N	N	N	N	N	N
7	13043	7Kr Mrs Health Centre	Nairobi	Nairobi	Langata	Lang'ata	Health Centre	Armed Forces	Mugumoini									
10	20346	AAR Adams Health Centre	Nairobi	Nairobi	Kibra	Woodly	Medical Clinic	Private Practice - General Practitioner	Woodly									
11	12861	AAR City Centre Clinic	Nairobi	Nairobi	Starehe	Starehe	Medical Clinic	Private Enterprise (Institution)	Central Business District									
12	16796	AAR Clinic Sarit Centre (Westlands)	Nairobi	Nairobi	Westlands	Parklands	Medical Clinic	Private Enterprise (Institution)	Parklands									

```
7          Mugumoini  …   Y   N        N      N         N         N       N
10            Woodly  …   N   N        N      N         N         N       N
11                 N  …   Y   N        N      N         N         N       N
12  Upper Parklands  …   N   N        N      N         N         N       N

   TB LABS TB TREAT YOUTH
1         N         N     N
7         N         N     N
10        N         N     N
11        N         N     N
12        N         N     N

[5 rows x 50 columns]
```

[ ]:

[1249]:
```
#population information per sub county within Nairobi based on 2019 census.
#columns=['name', 'Male', 'Female', 'Intersex', 'Total']
#data2=data2[columns]
Population_Nairobi=data2[31604:33080]
Population_Nairobi.tail(5)
```

[1249]:

	county	sub-county	Age	Male	Female	Total
33075	NAIROBI	WESTLANDS	98	3	8	11
33076	NAIROBI	WESTLANDS	99	9	14	23
33077	NAIROBI	WESTLANDS	95-99	29	63	92
33078	NAIROBI	WESTLANDS	100+	7	16	23
33079	NAIROBI	WESTLANDS	Not Stated	3	7	10

[1250]:
```
Grouped.get_group('WESTLANDS').tail(5)
```

[1250]:

	county	sub-county	Age	Male	Female	Total
33075	NAIROBI	WESTLANDS	98	3	8	11
33076	NAIROBI	WESTLANDS	99	9	14	23
33077	NAIROBI	WESTLANDS	95-99	29	63	92
33078	NAIROBI	WESTLANDS	100+	7	16	23
33079	NAIROBI	WESTLANDS	Not Stated	3	7	10

[1251]:
```
Age_0_4=[]
Age_5_19=[]
Age_20_34=[]
Age_35_54=[]
Age_55_74=[]
Age_75_plus=[]

sub_county=Population_Nairobi['sub-county'].unique()[1:]
for i in sub_county:
```

```
    Grouped=Population_Nairobi.groupby('sub-county')
    ar1=int(Grouped.get_group(i)['Total'][6:7].values[0])
    ar2=(int(Grouped.get_group(i)['Total'][12:13].values[0])+int(Grouped.
 ↪get_group(i)['Total'][18:19].values[0])+
         int(Grouped.get_group(i)['Total'][24:25].values[0]))
    ar3=(int(Grouped.get_group(i)['Total'][30:31].values[0])+int(Grouped.
 ↪get_group(i)['Total'][36:37].values[0])+
         int(Grouped.get_group(i)['Total'][42:43].values[0]))
    ar4=(int(Grouped.get_group(i)['Total'][48:49].values[0])+int(Grouped.
 ↪get_group(i)['Total'][54:55].values[0])+
         int(Grouped.get_group(i)['Total'][60:61].values[0])+int(Grouped.
 ↪get_group(i)['Total'][66:67].values[0]))
    ar5=(int(Grouped.get_group(i)['Total'][72:73].values[0])+int(Grouped.
 ↪get_group(i)['Total'][78:79].values[0])+
         int(Grouped.get_group(i)['Total'][84:85].values[0])+int(Grouped.
 ↪get_group(i)['Total'][90:91].values[0]))
    ar6=(int(Grouped.get_group(i)['Total'][96:97].values[0])+int(Grouped.
 ↪get_group(i)['Total'][102:103].values[0])+
         int(Grouped.get_group(i)['Total'][108:109].values[0])+int(Grouped.
 ↪get_group(i)['Total'][114:115].values[0])+
         int(Grouped.get_group(i)['Total'][120:121].values[0])+int(Grouped.
 ↪get_group(i)['Total'][121:122].values[0])+
         +int(Grouped.get_group(i)['Total'][122:123].values[0]))
    Age_0_4.append(ar1)
    Age_5_19.append(ar2)
    Age_20_34.append(ar3)
    Age_35_54.append(ar4)
    Age_55_74.append(ar5)
    Age_75_plus.append(ar6)

Data=[[sub_county[i],Age_0_4[i],Age_5_19[i],Age_20_34[i],Age_35_54[i],Age_55_74[i],Age_75_plus
 ↪for i in range(11)]
Population_data=pd.DataFrame(data=Data,
                             columns=['sub_county','Age_0_4','Age_5_19',
                                      ␣
 ↪'Age_20_34','Age_35_54','Age_55_74','Age_75_plus'])
Total=[]
for i in range(len(Data)):
    Total.append(sum(Data[i][1:]))
Population_data['Male']=data4['Male'].to_list()
Population_data['Female']=data4['Female'].to_list()
Population_data['Total Population']=Total
Population_data
```

[1251]:

	sub_county	Age_0_4	Age_5_19	Age_20_34	Age_35_54	Age_55_74	\
0	DAGORETTI	53989	115916	161203	86932	14560	

```
1     EMBAKASI   125958    251097     401101     187714      21566
2    KAMUKUNJI    33987     76754      98825      47857       9941
3     KASARANI    97672    206097     303948     147444      23682
4        KIBRA    20151     54638      61568      39945       8902
5     LANG'ATA    17915     50065      66678      47475      13745
6     MAKADARA    20248     47041      70537      42235       8714
7      MATHARE    25357     56581      77443      40130       6662
8        NJIRU    80678    182005     215467     126018      20687
9      STAREHE    20302     51300      84102      43809       9954
10   WESTLANDS    28730     71621     101165      78280      24909

    Age_75_plus    Male  Female  Total Population
0          1577  217651  216526            434177
1          1310  492476  496270            988746
2           905  136670  131599            268269
3          1776  381234  399385            780619
4           564   94199   91569            185768
5          1594   96698  100774            197472
6           751   96369   93157            189526
7           377  106522  100028            206550
8          1596  307642  318809            626451
9           944  109173  101238            210411
10         4134  153818  155021            308839
```

[1252]:
```
#Health care facility information within Nairobi
HF_Nairobi=data[data['County']=='Nairobi']
HF_Nairobi=HF_Nairobi.replace(np.nan,'N',regex = True)
Dist=[]
District=list(HF_Nairobi['District'].values)
for i in range(len(District)):
    if (District[i]=='Embakasi East'or District[i]=='Embakasi West'
        or  District[i]=='Embakasi Central' or  District[i]=='Embakasi South'
        or District[i]=='Embakasi North'):
        Dist.append('Embakasi')
    elif District[i]=='Dagoretti North' or District[i]=='Dagoretti South':
        Dist.append('Dagoretti')
    elif District[i]=='Ruaraka' or District[i]=='Roysambu':
         Dist.append('Njiru')
    else:
        Dist.append(District[i])
#Classifying different facilities
dict={'Private Practice - Unspecified':'Private', 'Armed Forces':'Public',
       'Private Practice - General Practitioner':'Private',
       'Private Enterprise (Institution)':'Private',
       'Private Practice - Medical Specialist':'Private',
       'Private Practice - Nurse / Midwife':'Private',
```

```
      'Non-Governmental Organizations':'NGO', 'Academic (if registered)':
↪'Public',
      'Local Authority':'Public', 'Ministry of Health':'Public', 'Parastatal':
↪'Public',
      'Kenya Episcopal Conference-Catholic Secretariat':'Faith based',
      'Other Faith Based':'Faith based', 'Private Practice - Clinical Officer':
↪'Private',
      'Community':'Community', 'Other Public Institution':'Public', 'Company␣
↪Medical Service':'Private',
      'Humanitarian Agencies':'NGO', 'Christian Health Association of Kenya':
↪'Faith based',
      'State Coorporation':'Public', 'Supreme Council for Kenya Muslims':
↪'Faith based'}
HF_Nairobi= HF_Nairobi.replace({"Owner": dict})
HF_Nairobi['District']=Dist
```

[1253]:
```
HF_Nairobi.head()
```

[1253]:

	Facility Code	Facility Name	Province	County	District	Division	Type	Owner	Location	Sub Location	…	IPD	OPD	OUTREACH	PMTCT	RAD/XRAY	RHTC/RHDC	TB DIAG	TB LABS	TB TREAT	YOUTH
1	19310	St Jude's Huruma Community Health Services	Nairobi	Nairobi	Mathare	Huruma	Medical Clinic	Private	Huruma	Huruma	…	N	N	N	N	N	N	N	N	N	N
7	13043	7Kr Mrs Health Centre	Nairobi	Nairobi	Langata	Lang'ata	Health Centre	Public	Mugumoini	Mugumoini	…	Y	N	N	N	N	N	N	N	N	N
10	20346	AAR Adams Health Centre	Nairobi	Nairobi	Kibra	Woodly	Medical Clinic	Private	Woodly	Woodly	…	N	N	N	N	N	N	N	N	N	N
11	12861	AAR City Centre Clinic	Nairobi	Nairobi	Starehe	Starehe	Medical Clinic	Private	Central Business District	N	…	Y	N	N	N	N	N	N	N	N	N
12	16796	AAR Clinic Sarit Centre (Westlands)	Nairobi	Nairobi	Westlands	Parklands	Medical Clinic	Private	Parklands	Upper Parklands	…	N	N	N	N	N	N	N	N	N	N

[5 rows x 50 columns]

[1254]:
```
HF_Nairobi.columns
```

[1254]:
```
Index(['Facility Code', 'Facility Name', 'Province', 'County', 'District',
       'Division', 'Type', 'Owner', 'Location', 'Sub Location',
       'Description of Location', 'Constituency', 'Nearest Town', 'Beds',
       'Cots', 'Official Landline', 'Official Fax', 'Official Mobile',
       'Official Email', 'Official Address', 'Official Alternate No', 'Town',
       'Post Code', 'In Charge', 'Job Title of in Charge', 'Open 24 Hours',
       'Open Weekends', 'Operational Status', 'ANC', 'ART', 'BEOC', 'BLOOD',
       'CAES SEC', 'CEOC', 'C-IMCI', 'EPI', 'FP', 'GROWM', 'HBC', 'HCT', 'IPD',
       'OPD', 'OUTREACH', 'PMTCT', 'RAD/XRAY', 'RHTC/RHDC', 'TB DIAG',
       'TB LABS', 'TB TREAT', 'YOUTH'],
      dtype='object')
```

[1255]:
```
Columns=[ 'Open 24 Hours',
       'Open Weekends','ANC', 'ART', 'BEOC', 'BLOOD',
       'CAES SEC', 'CEOC', 'C-IMCI', 'EPI', 'FP', 'GROWM', 'HBC', 'HCT', 'IPD',
       'OPD', 'OUTREACH', 'PMTCT', 'RAD/XRAY', 'RHTC/RHDC', 'TB DIAG',
       'TB LABS', 'TB TREAT']
for col in Columns:
    HF_Nairobi[col] .replace({'Y': 1, 'N': 0}, inplace=True)
    #HF_Nairobi[col] = HF_Nairobi[col].str.replace('Y', 'y')
```

[1256]:
```
HF_Nairobi=HF_Nairobi[HF_Nairobi['Operational Status']=='Operational']
HF_Nairobi['District'] = HF_Nairobi['District'].str.upper()
```

[1257]:
```
HF_Nairobi['Open 24 Hours'].head()
```

[1257]:
```
1     0
7     1
10    0
11    0
12    0
Name: Open 24 Hours, dtype: int64
```

[1258]:
```
#HF_Nairobi=HF_Nairobi[HF_Nairobi['Owner']=='Ministry of Health']
#HF_Nairobi.head(50)
```

[ ]:
```

```

[1259]:
```
import numpy as np
#Number of health facilities per sub county and pecentage opening through out␣
 ↪the day and on weekends
HF_Nairobi_Count=pd.DataFrame(HF_Nairobi['District'].value_counts())
HF_Nairobi_Count.columns=['Number of health facilities']
HF_Nairobi_Count=HF_Nairobi_Count.sort_index()
```

```
HF_Nairobi_Count2=HF_Nairobi.groupby('District')[['Open 24 Hours', 'Open␣
 ↪Weekends']]. sum()
HF_Nairobi_Count2['Open 24 Hours']=np.round((HF_Nairobi_Count2['Open 24 Hours'].
 ↪values
                                    /HF_Nairobi_Count['Number of health␣
 ↪facilities'].values)*100)
HF_Nairobi_Count2['Open Weekends']=np.round((HF_Nairobi_Count2['Open Weekends'].
 ↪values
                                    /HF_Nairobi_Count['Number of health␣
 ↪facilities'].values)*100)
HF_Nairobi_Count2=HF_Nairobi_Count2.sort_index()
HF_Nairobi_Count2.columns=['% open 24 Hours','% open Weekends']
HF_Nairobi_Count2.insert(0, 'Number of facilities', HF_Nairobi_Count['Number of␣
 ↪health facilities'].to_list())
HF_Nairobi_Count=HF_Nairobi_Count2
HF_Nairobi_Count
```

[1259]:

District	Number of facilities	% open 24 Hours	% open Weekends
DAGORETTI	105	19.0	48.0
EMBAKASI	157	36.0	66.0
KAMUKUNJI	59	31.0	58.0
KASARANI	57	12.0	51.0
KIBRA	89	17.0	55.0
LANGATA	60	20.0	55.0
MAKADARA	51	27.0	59.0
MATHARE	16	19.0	50.0
NJIRU	116	13.0	59.0
STAREHE	136	7.0	44.0
WESTLANDS	71	38.0	63.0

[1260]:
```
Columns=[ 'ANC', 'ART', 'BEOC', 'BLOOD',
       'CAES SEC', 'CEOC', 'C-IMCI', 'EPI', 'FP', 'GROWM', 'HBC', 'HCT', 'IPD',
       'OPD', 'OUTREACH', 'PMTCT', 'RAD/XRAY', 'RHTC/RHDC', 'TB DIAG',
       'TB LABS', 'TB TREAT']
```

[1261]:
```
#Health services offered in each sub county
Grouped_HF=HF_Nairobi.groupby(["District"])[Columns].sum()
Grouped_HF['C-IMCI']=(Grouped_HF['C-IMCI'].values+1)
Grouped_HF
```

[1261]:

District	ANC	ART	BEOC	BLOOD	CAES SEC	CEOC	C-IMCI	EPI	FP	GROWM	…	\
DAGORETTI	0	10	0	0	0	0	16	0	36	0	…	
EMBAKASI	0	13	0	0	0	0	10	0	60	0	…	
KAMUKUNJI	0	10	0	0	0	0	10	0	21	0	…	
KASARANI	0	6	0	0	0	0	3	0	16	0	…	

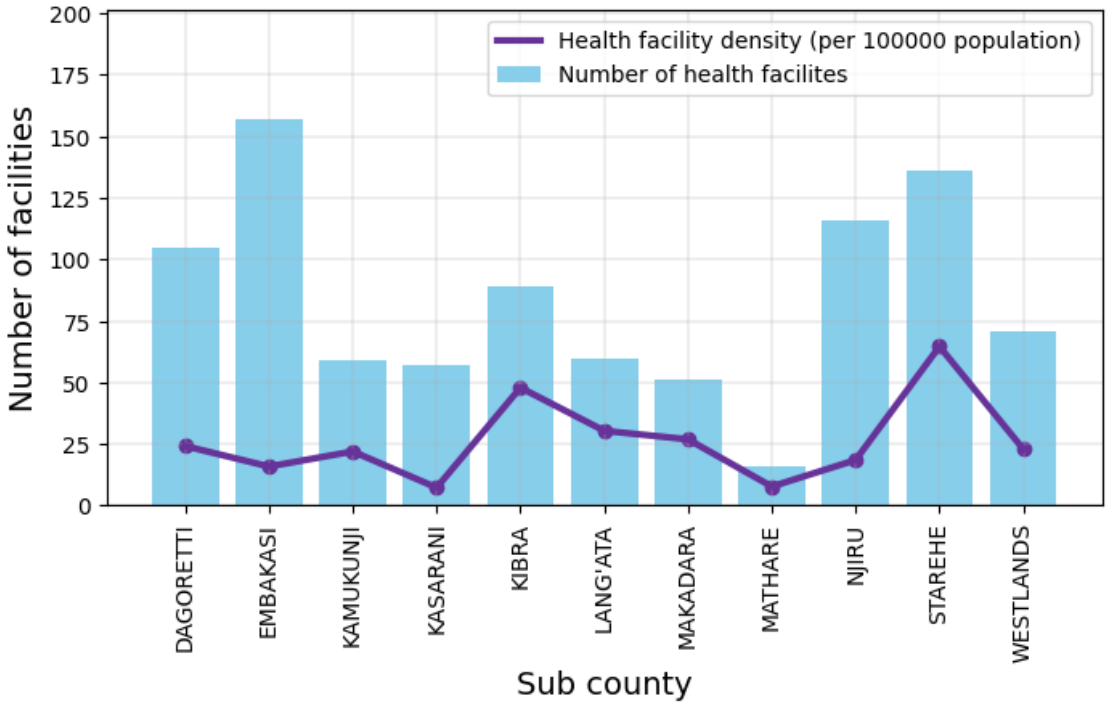
```
KIBRA        0    9     0      0         0     0       5    0  24       0  …
LANGATA      0    8     0      0         0     0      12    0  20       0  …
MAKADARA     0    9     0      0         0     0       4    0  22       0  …
MATHARE      0    5     0      0         0     0       1    0   6       0  …
NJIRU        0   14     0      0         0     0       6    0  29       0  …
STAREHE      0   18     0      0         0     0       8    0  23       0  …
WESTLANDS    0    7     0      0         0     0       8    0  15       0  …

             HCT  IPD  OPD  OUTREACH  PMTCT  RAD/XRAY  RHTC/RHDC  TB DIAG  \
District
DAGORETTI    0   38    0         0      0         0          0        0
EMBAKASI     0   61    0         0      0         0          0        0
KAMUKUNJI    0   22    0         0      0         0          0        0
KASARANI     0   15    0         0      0         0          0        0
KIBRA        0   21    0         0      0         0          0        0
LANGATA      0   23    0         0      0         0          0        0
MAKADARA     0   25    0         0      0         0          0        0
MATHARE      0    6    0         0      0         0          0        0
NJIRU        0   31    0         0      0         0          0        0
STAREHE      0   29    0         0      0         0          0        0
WESTLANDS    0   17    0         0      0         0          0        0

             TB LABS  TB TREAT
District
DAGORETTI          0         0
EMBAKASI           0         0
KAMUKUNJI          0         0
KASARANI           0         0
KIBRA              0         0
LANGATA            0         0
MAKADARA           0         0
MATHARE            0         0
NJIRU              0         0
STAREHE            0         0
WESTLANDS          0         0

[11 rows x 21 columns]
```

1 Data Analysis

2 (a) Number of health facilities vs population density

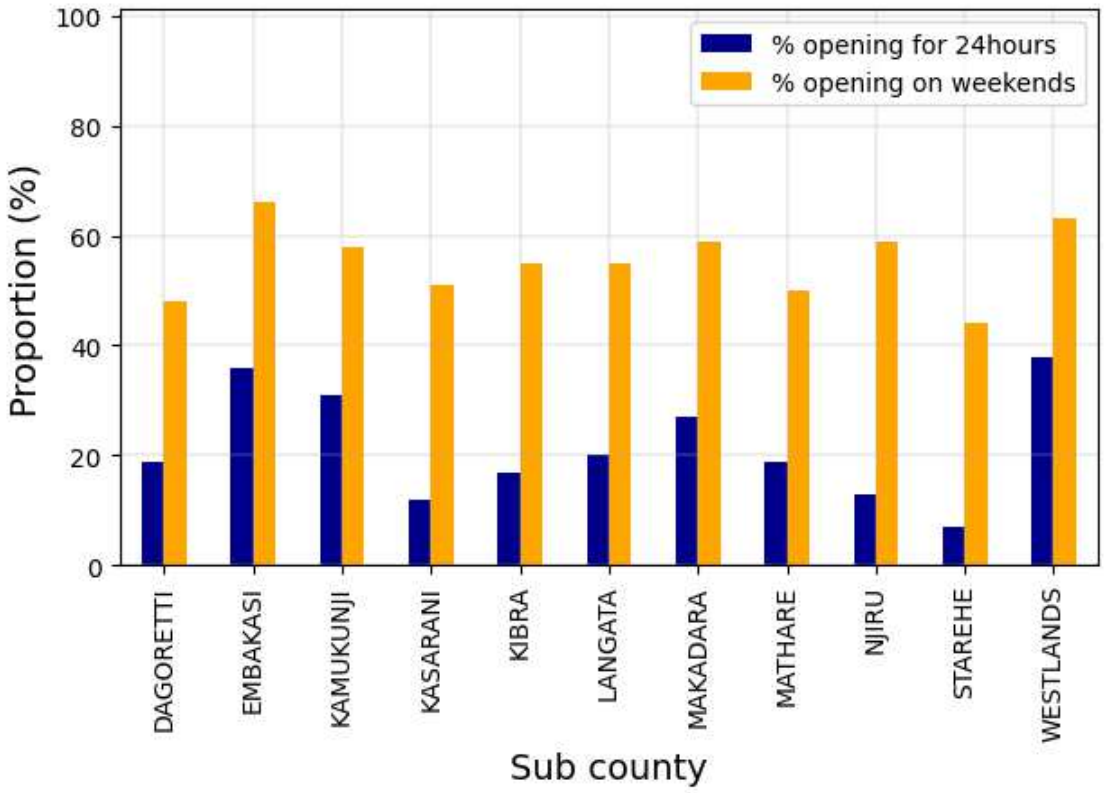
[1262]:
```
import seaborn as sns
import matplotlib.pyplot as plt
fig, ax = plt.subplots(figsize = ( 8 , 4 ))
No_Facilities=HF_Nairobi_Count['Number of facilities'].to_list()
```

```
Tot_pop=Population_data['Total Population'].to_list()
plt.grid(linewidth=0.3)
plt.bar(sub_county,No_Facilities, color='skyblue')
#plt.plot(sub_county,np.array(Tot_pop)/10000, color='orange', linewidth=3)
plt.plot(sub_county,np.array(No_Facilities)/(np.array(Tot_pop)/100000),␣
 ↪color='rebeccapurple', linewidth=3)
plt.legend(['Health facility density (per 100000 population)',
            'Number of health facilites'],fontsize=10)
#plt.scatter(sub_county,np.array(Tot_pop)/10000, color='orange')
plt.scatter(sub_county,np.array(No_Facilities)/(np.array(Tot_pop)/100000),␣
 ↪color='rebeccapurple')
plt.xlabel('Sub county', fontsize=14)
plt.ylabel('Number of facilities', fontsize=14)
plt.xticks(rotation=90)

plt.ylim(0, 201)
plt.savefig("No. FF.pdf", format="pdf", bbox_inches="tight")
plt.show()
```



3 (b) Accessibility of health services daily and on weekends

[1263]:
```
HF_Nairobi_Count['dist']=list(HF_Nairobi_Count. index)
HF_Nairobi_Count.plot(x="dist", y=['% open 24 Hours','% open␣
 ↪Weekends'],kind="bar", figsize=(7, 4),
                       color=['darkblue','orange'])
plt.legend(['% opening for 24hours','% opening on weekends'])
plt.grid(linewidth=0.3)
plt.ylim(0, 101)
plt.xlabel('')
plt.xlabel('Sub county', fontsize=14)
plt.ylabel('Proportion (%)', fontsize=14)
plt.savefig("Proportion_HF.pdf", format="pdf", bbox_inches="tight")
plt.show()
```



[1264]:
```
HF_Nairobi_Count2['dist']
```

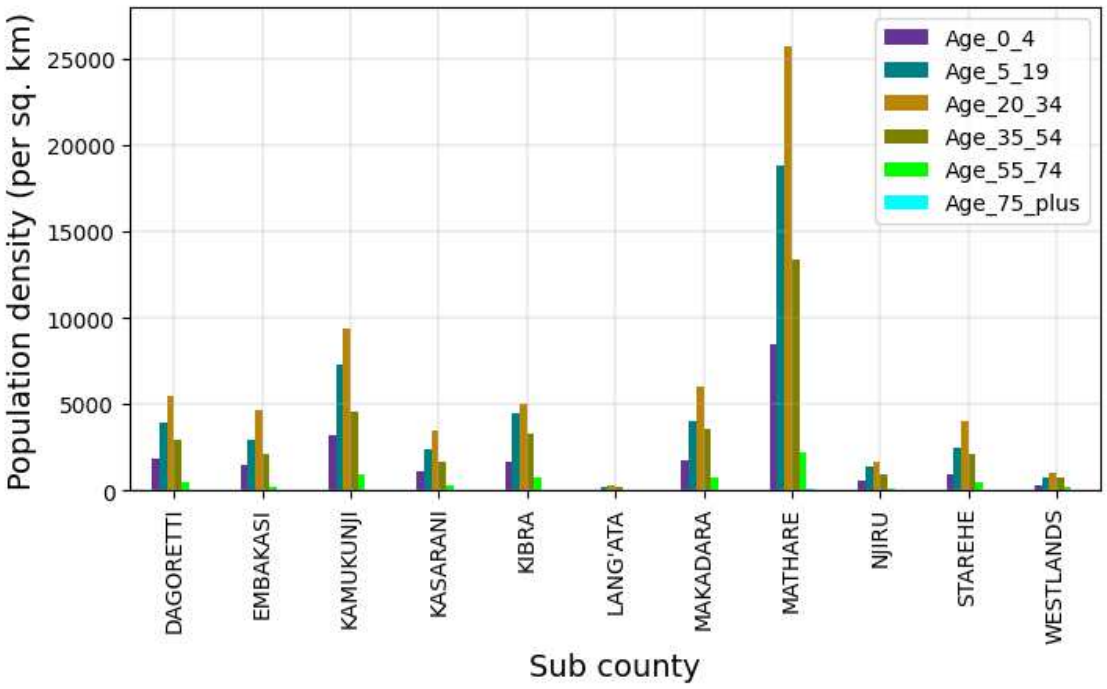
[1264]:
```
District
DAGORETTI     DAGORETTI
EMBAKASI       EMBAKASI
KAMUKUNJI     KAMUKUNJI
```

```
KASARANI      KASARANI
KIBRA            KIBRA
LANGATA        LANGATA
MAKADARA      MAKADARA
MATHARE        MATHARE
NJIRU            NJIRU
STAREHE        STAREHE
WESTLANDS    WESTLANDS
Name: dist, dtype: object
```

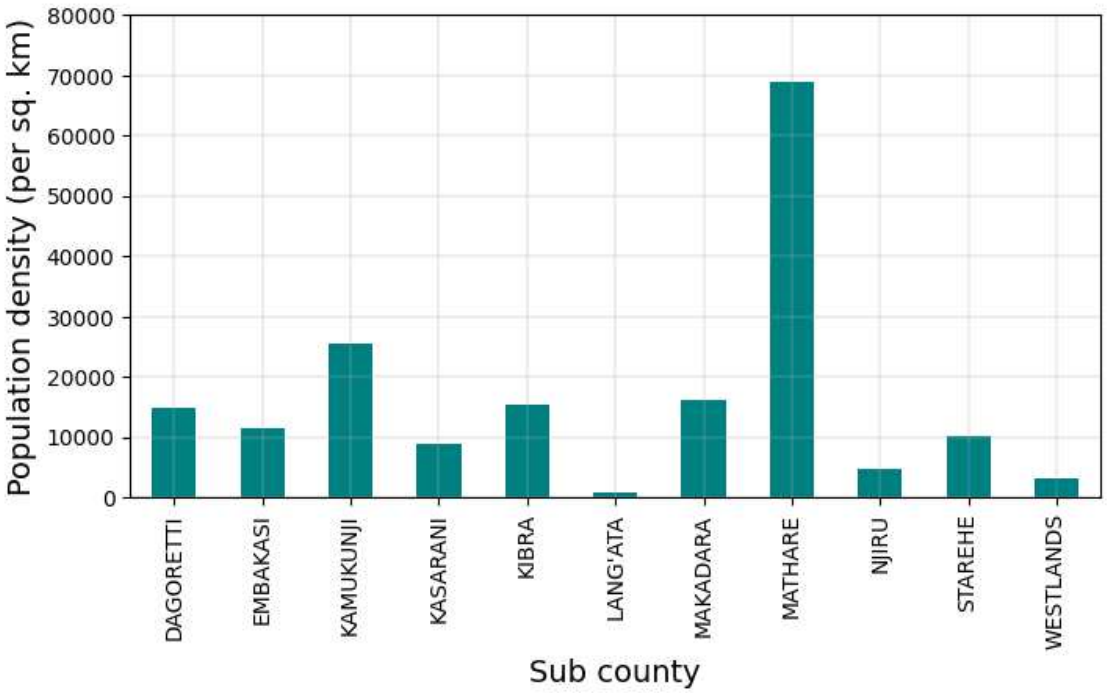
4 (c) Population density per age per sub county

[ ]:
```
Land_Area=np.array([29.1,86.3,10.5,86.2,12.1,216.8,11.7,3,129.9,20.6,97.5])
Population_data3=Population_data
Population_data3['Land_Area']=Land_Area
Population_data3[[ 'Age_0_4', 'Age_5_19', 'Age_20_34', 'Age_35_54','Age_55_74',␣
↪'Age_75_plus', 'Male', 'Female',
                  'Total Population']]=Population_data3[[ 'Age_0_4', 'Age_5_19',␣
↪'Age_20_34', 'Age_35_54','Age_55_74',
                                                        'Age_75_plus', 'Male',␣
↪'Female',
                                                        'Total Population']].
↪div(Population_data3['Land_Area'], axis=0)
```

[1272]:
```
Population_data3.plot(x="sub_county",␣
↪y=['Age_0_4','Age_5_19','Age_20_34','Age_35_54','Age_55_74','Age_75_plus'],
       kind="bar", figsize=(8,␣
↪4),color=['rebeccapurple','teal','darkgoldenrod','olive','lime','cyan'])
plt.grid(linewidth=0.3)
plt.xlabel('Sub county', fontsize=14)
plt.ylabel('Population density (per sq. km)', fontsize=14)
plt.ylim(0, 28000)
plt.savefig("population_dist_Age.pdf", format="pdf", bbox_inches="tight")
plt.show()
```

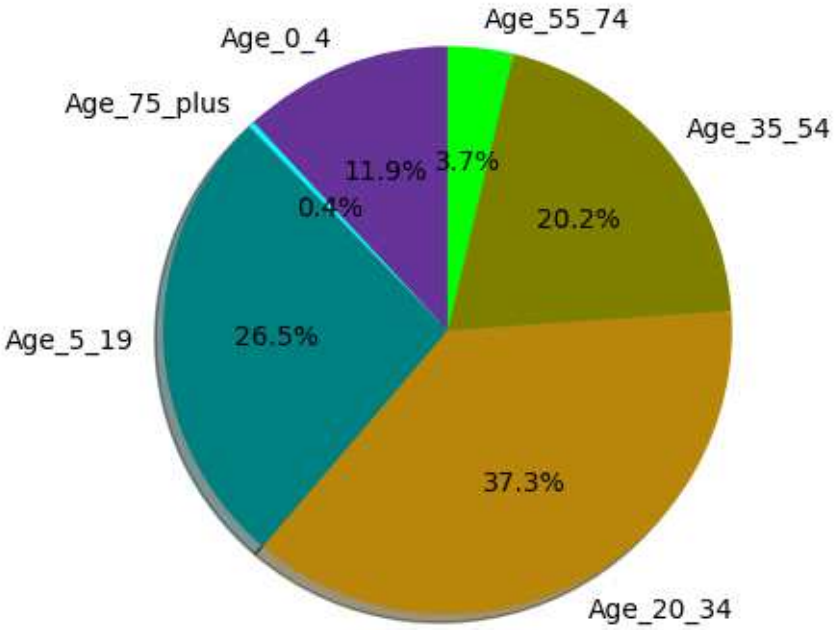


[1295]:
```
Population_data3.plot(x="sub_county", y=['Total Population'],
        kind="bar", figsize=(8, 4),color=['teal'],legend=False)
plt.grid(linewidth=0.3)
#plt.set_facecolor('olive')
plt.xlabel('Sub county', fontsize=14)
plt.ylabel('Population density (per sq. km)', fontsize=14)
plt.ylim(0, 80000)
plt.savefig("population_dist_ov.pdf", format="pdf", bbox_inches="tight")
plt.show()
```



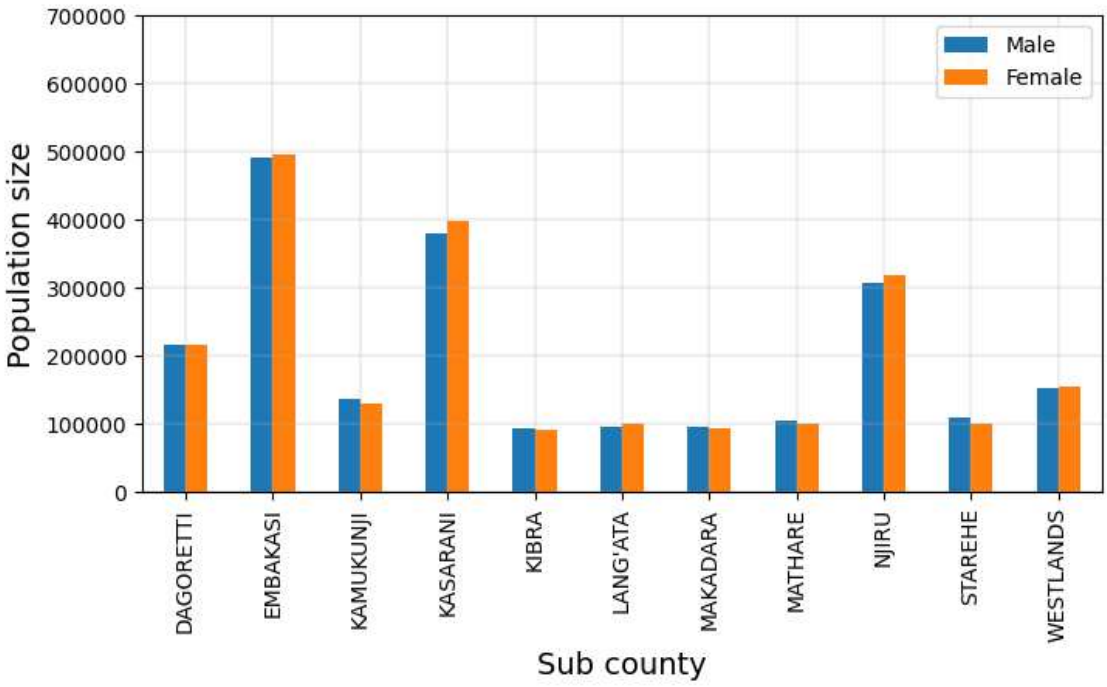
[1150]:
```
L_total=[Population_data['Age_0_4'].sum(),Population_data['Age_75_plus'].
  ↪sum(),Population_data['Age_5_19'].sum(),Population_data['Age_20_34'].sum(),
         Population_data['Age_35_54'].sum(),Population_data['Age_55_74'].sum()]
print(sum(L_total))
import matplotlib.pyplot as plt

slices =L_total
Age= ['Age_0_4','Age_75_plus','Age_5_19','Age_20_34','Age_35_54','Age_55_74']
cols = ['rebeccapurple','cyan','teal','darkgoldenrod','olive','lime',]

plt.pie(slices,
        labels=Age,
        colors=cols,
        startangle=90,
        shadow= True,
        explode=(0,0,0,0,0,0),
        autopct='%1.1f%%')

#plt.title('Interesting Graph\nCheck it out')
plt.savefig("population_dist_Age_pie.pdf", format="pdf", bbox_inches="tight")
plt.show()
```

4396828



5 (d) Population distribution per gender per sub county

[1131]:
```
Population_data.plot(x="sub_county", y=['Male','Female'],
        kind="bar", figsize=(8, 4))
plt.grid(linewidth=0.3)
plt.xlabel('Sub county', fontsize=14)
plt.ylabel('Population size', fontsize=14)
plt.ylim(0, 700001)
plt.savefig("Papulation_dist_gender.pdf", format="pdf", bbox_inches="tight")
plt.show()
```

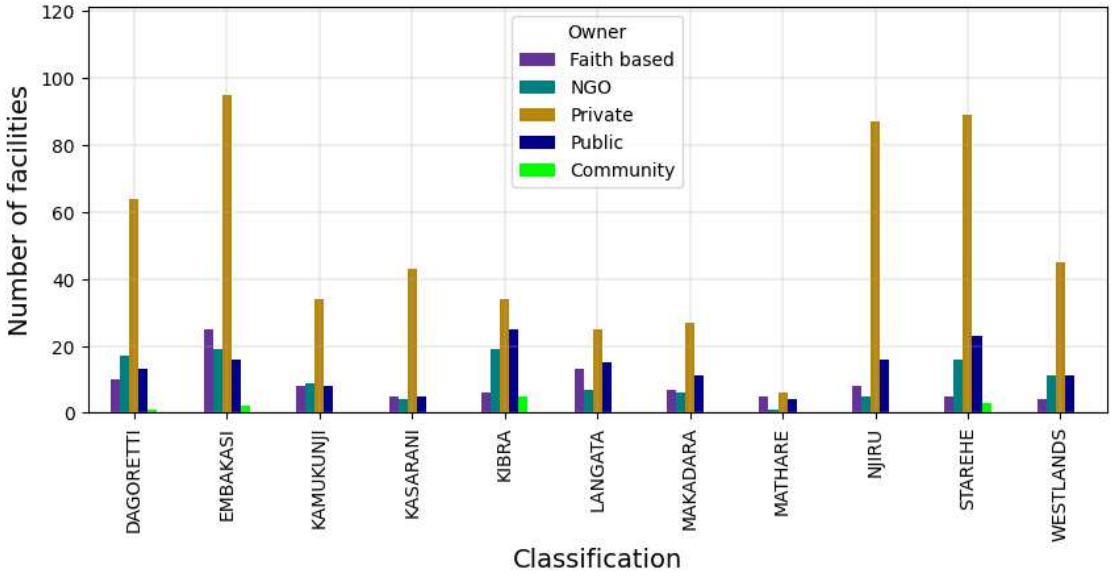


import seaborn as sns import matplotlib.pyplot as plt fig, ax = plt.subplots(figsize = (5 , 4)) HF_Nairobi_Count=HF_Nairobi['District'].value_counts() sns.countplot(HF_Nairobi, y="District", color='teal') ax.set_xlabel("Number of facilities" , size = 12) # Set label for y-axis ax.set_ylabel("Sub County" , size = 12)

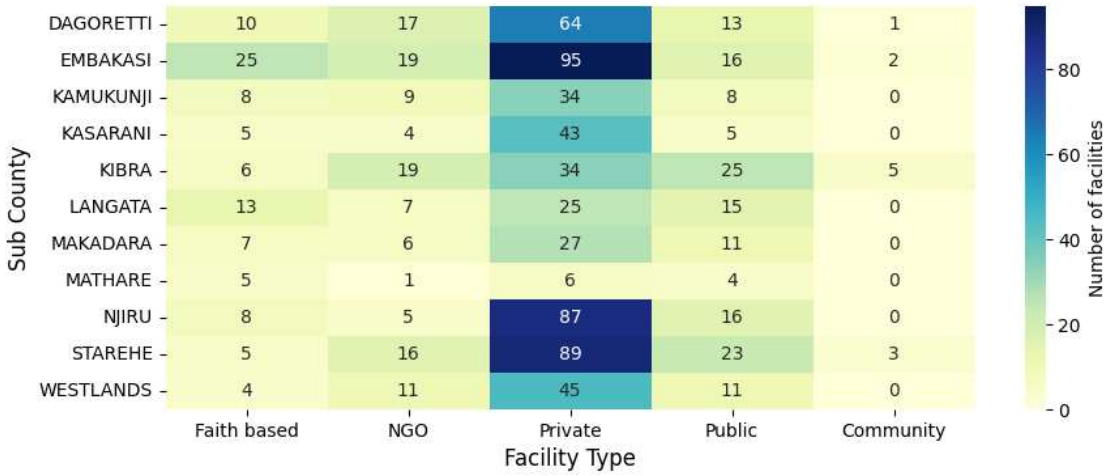
6 (e) Classification of health facility per sub county

[1132]:
```
s_c=list(HF_Nairobi['District'].unique())
FC=[]
Facility_Class= HF_Nairobi.groupby(['District','Owner']).size()
for i in s_c:
    FC.append(pd.DataFrame(Facility_Class[i],columns=[i]))
Facility_class_data=pd.concat(FC, axis=1)
Facility_class_data=Facility_class_data.fillna(0)
Facility_class_data=Facility_class_data.T
Facility_class_data['Owner']=list(Facility_class_data.index)
Facility_class_data=Facility_class_data.sort_index()
Facility_class_data['Owner'] = Facility_class_data['Owner'].str.upper()
Facility_class_data.plot(x='Owner', y=['Faith␣
 ↪based','NGO','Private','Public','Community'],
       kind="bar",␣
 ↪color=['rebeccapurple','teal','darkgoldenrod','darkblue','lime'],␣
 ↪figsize=(10, 4))
plt.grid(linewidth=0.3)
```

```
plt.ylim(0, 121)
plt.xlabel('Classification', fontsize=14)
plt.ylabel('Number of facilities', fontsize=14)
plt.savefig("HF_classification.pdf", format="pdf", bbox_inches="tight")
plt.show()
```

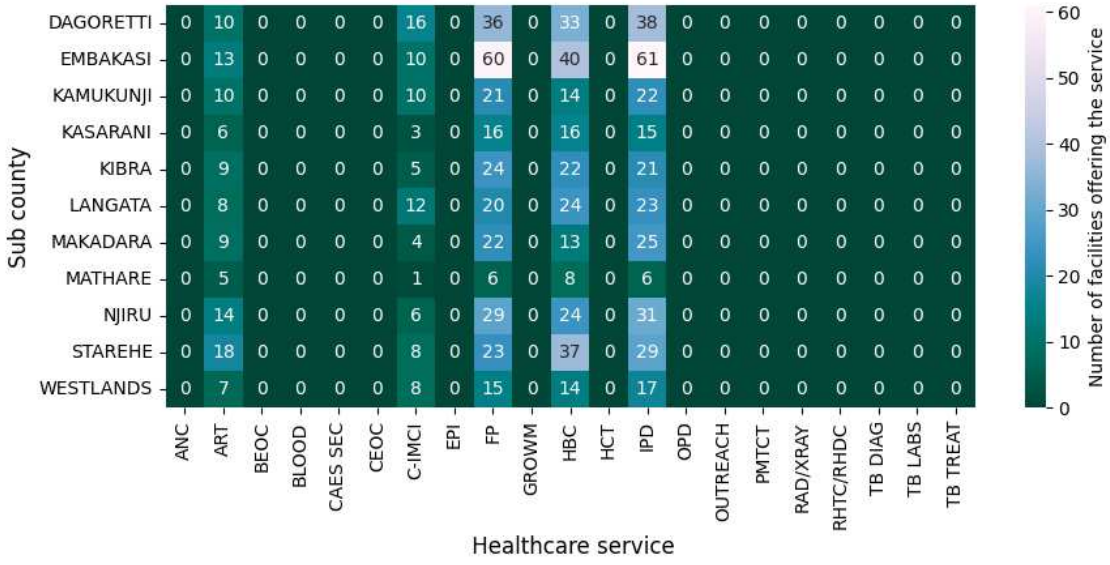


[1133]:
```
fig, ax = plt.subplots(figsize = ( 10, 4 ))
Facility_class_data2= Facility_class_data.drop('Owner', axis=1)

sns.heatmap(Facility_class_data2, annot=True,cmap="YlGnBu",cbar_kws={'label':␣
↪'Number of facilities'})
ax.set_ylabel( "Sub County" , size = 12 )
ax.set_xlabel( "Facility Type" , size = 12 )
plt.savefig("Hf_classification2.pdf", format="pdf", bbox_inches="tight")
```



7 (f) Accessibility of a given health service per sub county

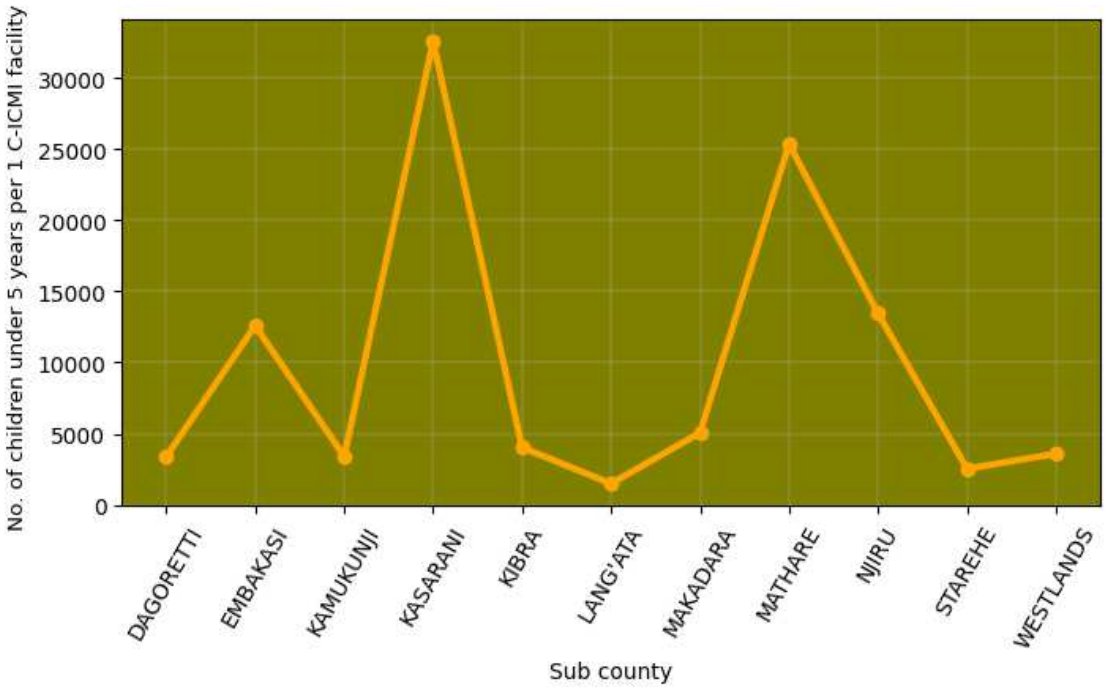
[1134]:
```
fig, ax = plt.subplots(figsize = ( 10, 4 ))
Grouped_HF=HF_Nairobi.groupby(["District"])[Columns].sum()
Grouped_HF['C-IMCI']=(Grouped_HF['C-IMCI'].values+1)
res=sns.heatmap(Grouped_HF, annot=True,cmap="PuBuGn_r",cbar_kws={'label':␣
↪'Number of facilities offering the service'})
ax.set_ylabel( "Sub county" , size = 12 )
ax.set_xlabel( " Healthcare service" , size = 12)
plt.savefig("HS_Accessibility.pdf", format="pdf", bbox_inches="tight")
```



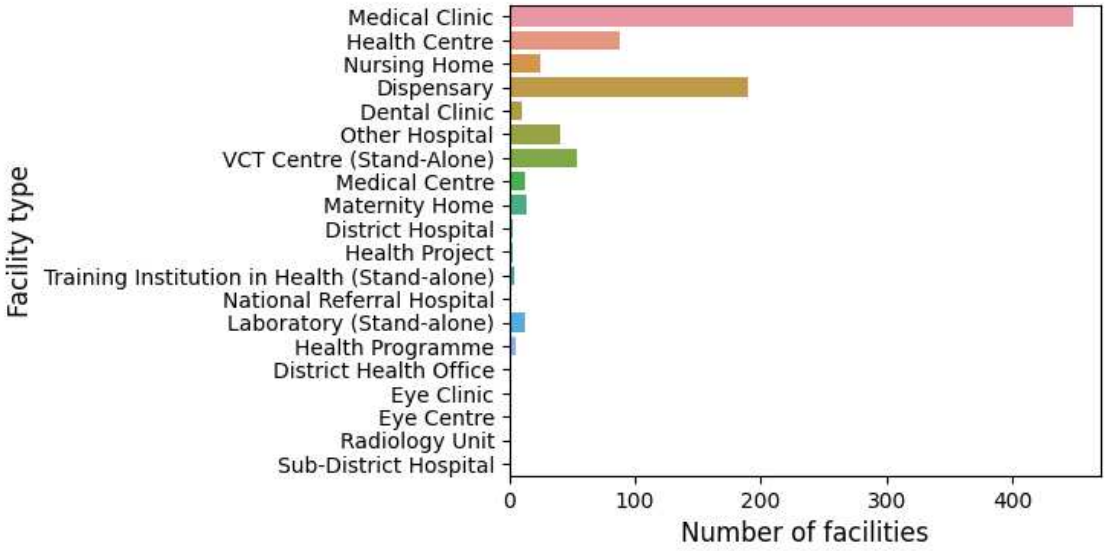
8 (g) Accessibility of C-IMCI by children under 5 years per sub county

[1135]:
```
import numpy as np
import matplotlib.pyplot as plt
fig, ax1 = plt.subplots(figsize = ( 8, 4 ))
#ax2 = ax1.twinx()
No_Facilities=Grouped_HF['C-IMCI'].to_list()
Tot_pop=Population_data['Age_0_4'].to_list()
#ax1.bar(sub_county,No_Facilities, color='teal')
ax1.plot(sub_county,(np.array(Tot_pop))/(np.array(No_Facilities)),␣
 ↪color='orange',linewidth=3)
ax1.scatter(sub_county,(np.array(Tot_pop))/(np.array(No_Facilities)),␣
 ↪color='orange')
#ax2.plot(sub_county,np.array(Tot_pop), color='orange', linewidth=3)

ax1.set_xlabel('Sub county')
ax1.set_ylabel('No. of children under 5 years per 1 C-ICMI facility␣
 ↪',fontsize=9.7)
#ax1.set_title('Number of children under 5 years served by 1 C-IMCI facility')
#ax2.set_ylabel('No. of children below 5 years',color='orange', fontsize=14)
ax1.set_xticklabels(sub_county, rotation=60)
plt.grid(linewidth=0.3)
ax1.set_facecolor('olive')
plt.savefig("CIMCI_Accessibility.pdf", format="pdf", bbox_inches="tight")
plt.show()
```

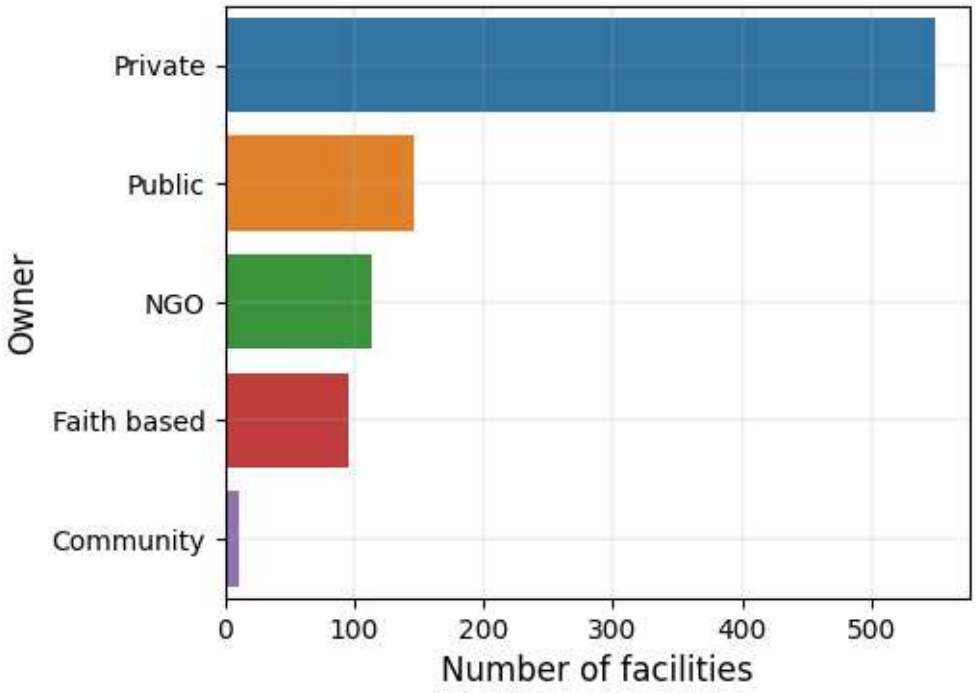
```
/var/folders/5z/n41n443j3qzcct4lc48rplhw0000gn/T/ipykernel_27832/4172923281.py:1
6: UserWarning: FixedFormatter should only be used together with FixedLocator
  ax1.set_xticklabels(sub_county, rotation=60)
```



[1136]:
```
fig, ax = plt.subplots(figsize = ( 5 , 4 ))
HF_Nairobi_Count=HF_Nairobi['District'].value_counts()
sns.countplot(HF_Nairobi, y="Type" )
ax.set_xlabel( "Number of facilities" , size = 12 )
# Set label for y-axis
ax.set_ylabel( "Facility type" , size = 12 )
plt.savefig("HF_Type.pdf", format="pdf", bbox_inches="tight")
```



[1137]:
```
fig, ax = plt.subplots(figsize = ( 5 , 4 ))

sns.countplot(HF_Nairobi, y="Owner" )
ax.set_xlabel( "Number of facilities" , size = 12 )
# Set label for y-axis
ax.set_ylabel( "Owner" , size = 12 )
plt.grid(linewidth=0.2)
```



[ ]: