Project: Investigate a Dataset - [Medical Appointment No Shows]

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Introduction

Dataset Description

Dataset Variables

- **PatientId**: Identification of a patient
- **AppointmentID**: Identification of each appointment
- **Gender**: Male or Female . Female is the greater proportion, woman takes way more care of they health in comparison to man.
- **ScheduledDay**: The day of the actuall appointment, when they have to visit the doctor.
- **AppointmentDay**: The day someone called or registered the appointment, this is before appointment of course.
- **Age**: How old is the patient.
- **Neighbourhood**: Where the appointment takes place.
- **Scholarship**: True or False.
- **Hipertension**: True or False.
- **Diabetes**: True or False.
- **Alcoholism**: True or False.
- **Handcap**: True or False.
- **SMS_received**: True or False.
- **No-show**: True or False.

Question(s) for Analysis

- **What factors are important for us to know in order to predict if a patient will show up for their scheduled appointment?**

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

%matplotlib inline
```

Data Wrangling

Importing The Dateset

In [2]:
```
df = pd.read_csv('noshowappointments.csv')
df.head()
```

Out[2]:

	PatientId	AppointmentID	Gender	ScheduledDay	AppointmentDay	Age	Neighbourhood	Scholarship	H
0	2.987250e+13	5642903	F	2016-04-29T18:38:08Z	2016-04-29T00:00:00Z	62	JARDIM DA PENHA	0	
1	5.589978e+14	5642503	M	2016-04-29T16:08:27Z	2016-04-29T00:00:00Z	56	JARDIM DA PENHA	0	
2	4.262962e+12	5642549	F	2016-04-29T16:19:04Z	2016-04-29T00:00:00Z	62	MATA DA PRAIA	0	
3	8.679512e+11	5642828	F	2016-04-29T17:29:31Z	2016-04-29T00:00:00Z	8	PONTAL DE CAMBURI	0	
4	8.841186e+12	5642494	F	2016-04-29T16:07:23Z	2016-04-29T00:00:00Z	56	JARDIM DA PENHA	0	

Investigating the data

In [3]:
```
df.shape #checking number of rows and columns in the dataset
```

Out[3]:
```
(110527, 14)
```

The data has 110527 rows and 14 columns

In [4]:
```
df.info() #checking data types of the variables and if there is any missing values
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 110527 entries, 0 to 110526
Data columns (total 14 columns):
 #   Column          Non-Null Count   Dtype
---  ------          --------------   -----
 0   PatientId       110527 non-null  float64
 1   AppointmentID   110527 non-null  int64
 2   Gender          110527 non-null  object
 3   ScheduledDay    110527 non-null  object
 4   AppointmentDay  110527 non-null  object
 5   Age             110527 non-null  int64
 6   Neighbourhood   110527 non-null  object
 7   Scholarship     110527 non-null  int64
```

```
 8   Hipertension    110527 non-null  int64
 9   Diabetes        110527 non-null  int64
 10  Alcoholism      110527 non-null  int64
 11  Handcap         110527 non-null  int64
 12  SMS_received    110527 non-null  int64
 13  No-show         110527 non-null  object
dtypes: float64(1), int64(8), object(5)
memory usage: 11.8+ MB
```

In [5]:
```
df.describe() #seeing some statistical information about the dataset
```

Out[5]:

	PatientId	AppointmentID	Age	Scholarship	Hipertension	Diabetes	Alcoholism
count	1.105270e+05	1.105270e+05	110527.000000	110527.000000	110527.000000	110527.000000	110527.000000
mean	1.474963e+14	5.675305e+06	37.088874	0.098266	0.197246	0.071865	0.030400
std	2.560949e+14	7.129575e+04	23.110205	0.297675	0.397921	0.258265	0.171686
min	3.921784e+04	5.030230e+06	-1.000000	0.000000	0.000000	0.000000	0.000000
25%	4.172614e+12	5.640286e+06	18.000000	0.000000	0.000000	0.000000	0.000000
50%	3.173184e+13	5.680573e+06	37.000000	0.000000	0.000000	0.000000	0.000000
75%	9.439172e+13	5.725524e+06	55.000000	0.000000	0.000000	0.000000	0.000000
max	9.999816e+14	5.790484e+06	115.000000	1.000000	1.000000	1.000000	1.000000

In [6]:
```
df.nunique() #checking number of unique values for each variable
```

Out[6]:
```
PatientId          62299
AppointmentID     110527
Gender                 2
ScheduledDay      103549
AppointmentDay        27
Age                  104
Neighbourhood         81
Scholarship            2
Hipertension           2
Diabetes               2
Alcoholism             2
Handcap                5
SMS_received           2
No-show                2
dtype: int64
```

In [7]:
```
df.duplicated(['PatientId','No-show']).sum() #number of patients in the dataset that hav
#we will need to drop the duplicates in order to have more accurate results
```

Out[7]:
```
38710
```

In [8]:
```
df.duplicated().sum() #checking the number of duplicate rows in our dataset
```

Out[8]:
```
0
```

The data has no duplicate rows

In [9]:
```
df.isna().sum() #checking the number of NaN values in our dataset
```

Out[9]:
```
PatientId         0
AppointmentID     0
Gender            0
ScheduledDay      0
AppointmentDay    0
```

```
Age               0
Neighbourhood     0
Scholarship       0
Hipertension      0
Diabetes          0
Alcoholism        0
Handcap           0
SMS_received      0
No-show           0
dtype: int64
```

The data has no missing values

Checking unique values of columns

In [10]:
```
df['No-show'].unique()
```

Out[10]:
```
array(['No', 'Yes'], dtype=object)
```

In [11]:
```
df['Gender'].unique()
```

Out[11]:
```
array(['F', 'M'], dtype=object)
```

In [12]:
```
df['Age'].unique()
```

Out[12]:
```
array([ 62,  56,   8,  76,  23,  39,  21,  19,  30,  29,  22,  28,  54,
        15,  50,  40,  46,   4,  13,  65,  45,  51,  32,  12,  61,  38,
        79,  18,  63,  64,  85,  59,  55,  71,  49,  78,  31,  58,  27,
         6,   2,  11,   7,   0,   3,   1,  69,  68,  60,  67,  36,  10,
        35,  20,  26,  34,  33,  16,  42,   5,  47,  17,  41,  44,  37,
        24,  66,  77,  81,  70,  53,  75,  73,  52,  74,  43,  89,  57,
        14,   9,  48,  83,  72,  25,  80,  87,  88,  84,  82,  90,  94,
        86,  91,  98,  92,  96,  93,  95,  97, 102, 115, 100,  99,  -1],
      dtype=int64)
```

In [13]:
```
df.query('Age < 0') #removing invalid input of age
```

Out[13]:

	PatientId	AppointmentID	Gender	ScheduledDay	AppointmentDay	Age	Neighbourhood	Scholarshi
99832	4.659432e+14	5775010	F	2016-06-06T08:58:13Z	2016-06-06T00:00:00Z	-1	ROMÃO	

In [14]:
```
df['Handcap'].unique() # we need to convert all the values > than 1 to 1 because they me
```

Out[14]:
```
array([0, 1, 2, 3, 4], dtype=int64)
```

In [15]:
```
df['Alcoholism'].unique()
```

Out[15]:
```
array([0, 1], dtype=int64)
```

In [16]:
```
df['Diabetes'].unique()
```

Out[16]:
```
array([0, 1], dtype=int64)
```

In [17]:
```
df['Hipertension'].unique()
```

Out[17]:
```
array([1, 0], dtype=int64)
```

In [18]:
```
df['Scholarship'].unique()
```

Out[18]:
```
array([0, 1], dtype=int64)
```

In [19]:
```
df.Handcap.value_counts()
```

Out[19]:
```
0    108286
1      2042
2       183
3        13
4         3
Name: Handcap, dtype: int64
```

Data Cleaning

In [20]:
```
df.drop(index=99832, inplace=True)
```

In [21]:
```
df.rename(columns={'No-show':'no_show'}, inplace = True)#renaming columns for easier acc
df.rename(columns = lambda x: x.lower(), inplace=True)#convering column names to lower c
```

In [22]:
```
df.drop_duplicates(['patientid','no_show'], inplace=True)#dropping the number of patient
```

In [23]:
```
df.columns
df.drop(['patientid','appointmentid','scheduledday','appointmentday'], axis=1, inplace=T
```

In [24]:
```
df.columns #checking if the columns have been renamed
```

Out[24]:
```
Index(['gender', 'age', 'neighbourhood', 'scholarship', 'hipertension',
       'diabetes', 'alcoholism', 'handcap', 'sms_received', 'no_show'],
      dtype='object')
```

In [25]:
```
df['handcap'] = df['handcap'].apply(lambda x: True if (x >= 1) else False) #converting a
```

In [26]:
```
df['no_show'] = df['no_show'].apply(lambda x: True if (x == 'Yes') else False)#convertin
```

In [27]:
```
df['no_show'].unique() #checking if the values have been changed
```

Out[27]:
```
array([False,  True])
```

In [28]:
```
df['no_show'] = df['no_show'].astype(int) #converting all bool values to int True -> 1 ,
```

In [29]:
```
df['handcap'] = df['handcap'].astype(int) #converting all bool values to int True -> 1 ,
```

In [30]:
```
df.dtypes #checking variables data types after the change
```

Out[30]:
```
gender           object
age               int64
neighbourhood    object
scholarship       int64
hipertension      int64
diabetes          int64
alcoholism        int64
handcap           int32
sms_received      int64
no_show           int32
dtype: object
```

The no_show column and handcap column have been changed successfully

Exploratory Data Analysis

Research Question (What factors are important for us to know in order to predict if a patient will show up for their scheduled appointment?)

In [31]:
```
showed = df.no_show == 0 #getting the subset of data where the patient had showed
didnt_show = df.no_show == 1 #getting the subset of data where the patient didn't show
```

In [32]:
```
df.groupby(['no_show','gender']).mean() #Checking the mean of the variables grouped by t
```

Out[32]:

no_show	gender	age	scholarship	hipertension	diabetes	alcoholism	handcap	sms_received
0	F	39.130292	0.115160	0.219765	0.078518	0.013558	0.016276	0.307609
	M	33.766269	0.047934	0.172302	0.062575	0.041890	0.023863	0.278331
1	F	36.065010	0.137146	0.183817	0.069181	0.020337	0.013993	0.471059
	M	31.220400	0.054734	0.146825	0.057496	0.046451	0.019003	0.419522

In [33]:
```
df.groupby('sms_received').mean() #Checking the mean of the variables grouped by sms rec
```

Out[33]:

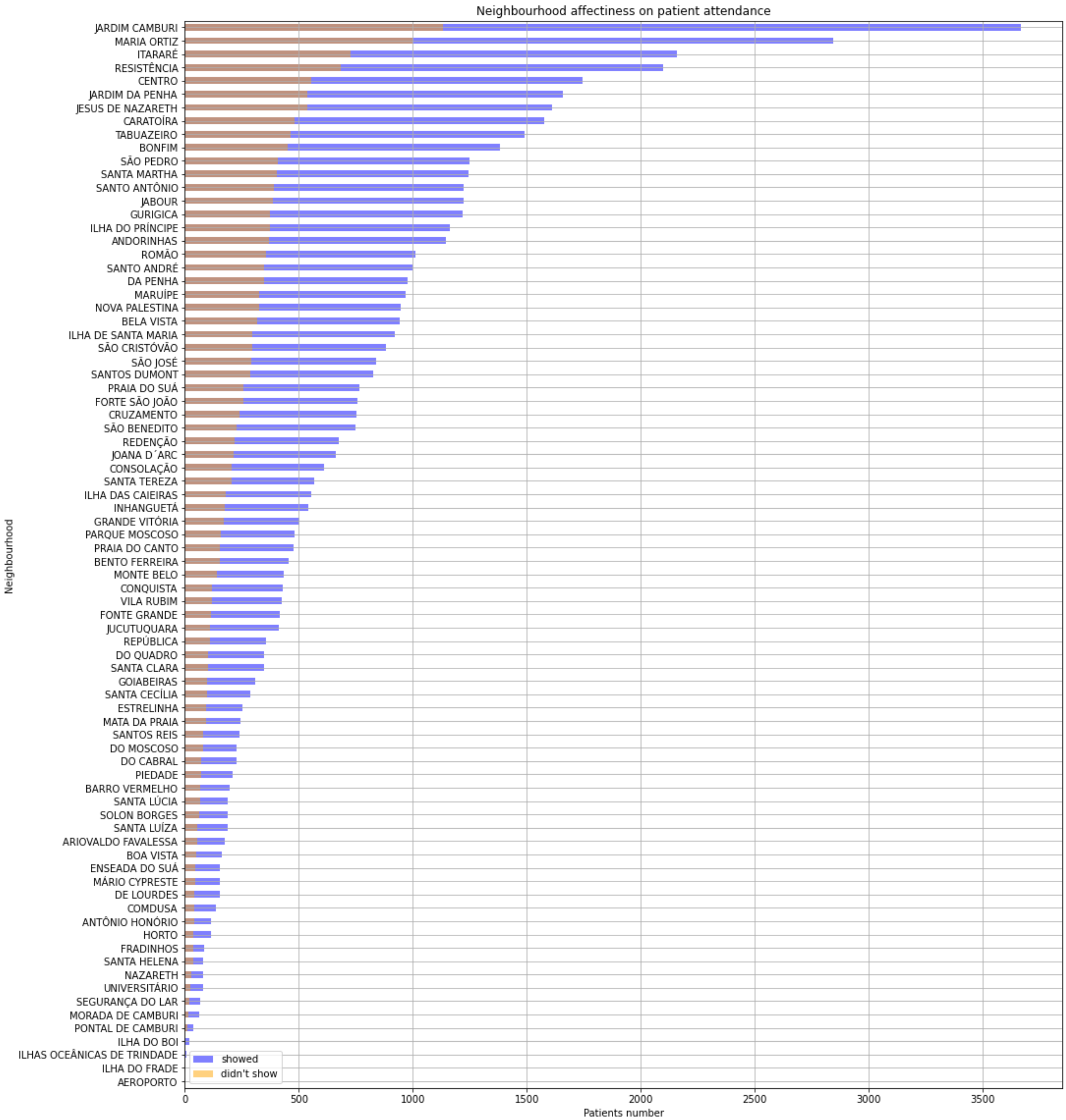
sms_received	age	scholarship	hipertension	diabetes	alcoholism	handcap	no_show
0	36.233711	0.095019	0.197330	0.074166	0.026217	0.020161	0.202444
1	37.109216	0.096560	0.190589	0.064608	0.022698	0.014233	0.332088

people who received an sms has a lower attendance rate than the one who didn't maybe there is a probelm in sms system

Making a function to make bar plots

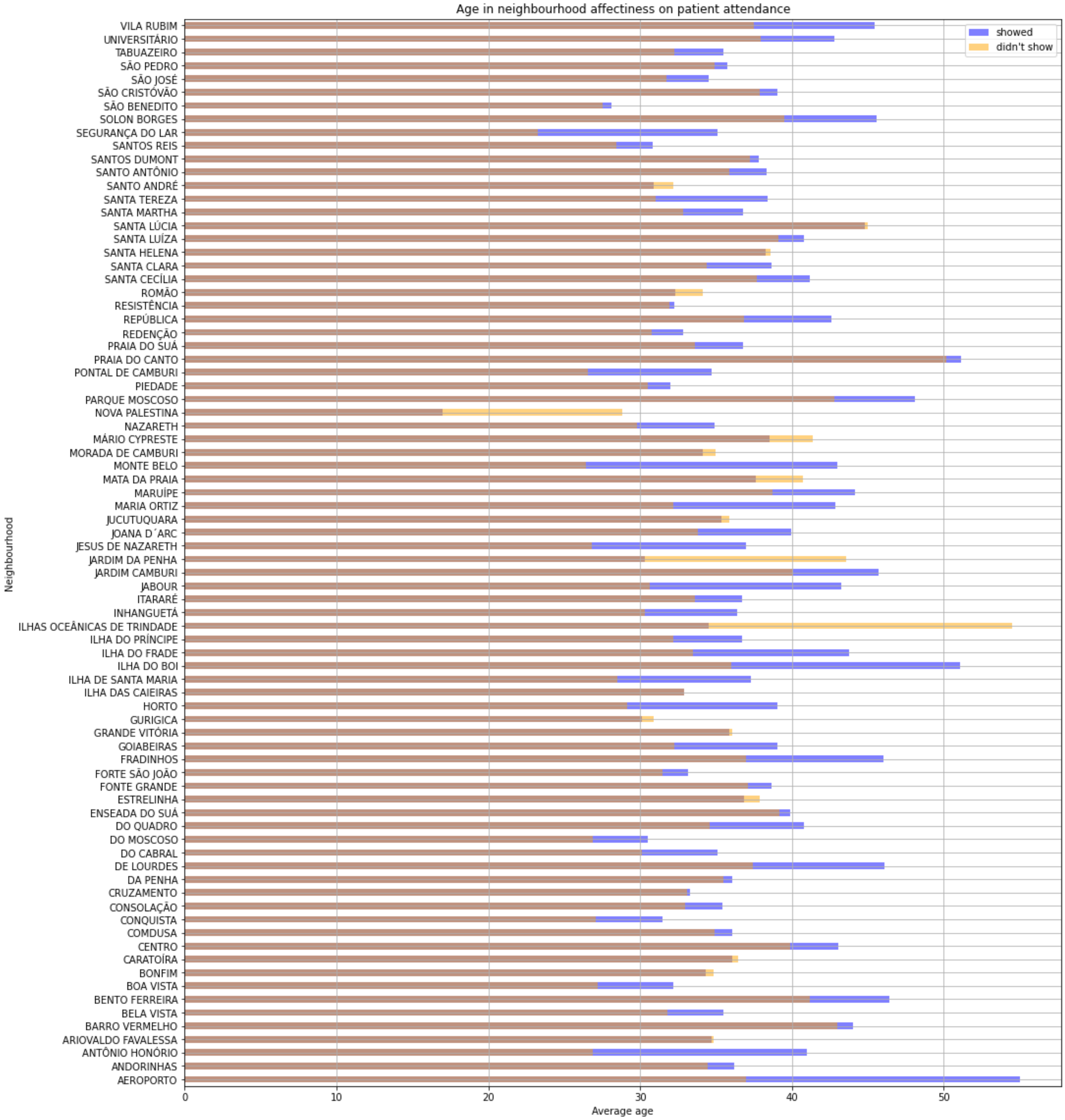
In [34]:
```
def plot_bar(data,col,showed,didnt_show,title,xlab,ylab):
    """
    plot a bar for a specific col in the dataset to compare people who showed vs. people

    parameters:

    data: the dataframe
    col: the specific column
    showed: the sample who showed
    didnt_show: the sample who didn't show
    title: the title you want to give to the plot
    xlab: the x-axis label you want to give to the plot
    ylab: the y-axis label you want to give to the plot

    """
    plt.figure(figsize=(16,20))
    data[col][showed].value_counts().sort_values(ascending=True).plot(kind='barh', alpha
    data[col][didnt_show].value_counts().sort_values(ascending=True).plot(kind='barh', a
    plt.title(title)
    plt.xlabel(xlab)
    plt.ylabel(ylab)
    plt.grid(True)
    plt.legend()
    plt.show();
```

In [35]:
```
plot_bar(df,'neighbourhood',showed,didnt_show,'Neighbourhood affectiness on patient atte
         'Patients number','Neighbourhood')
```



As we can see that the neighbourhood has correlation of attending or not

In [36]:
```
plt.figure(figsize=(16,20))
df[showed].groupby('neighbourhood').age.mean().plot(kind='barh', alpha=0.5, color='blue'
df[didnt_show].groupby('neighbourhood').age.mean().plot(kind='barh', alpha=0.5, color='o
plt.title('Age in neighbourhood affectiness on patient attendance')
plt.xlabel('Average age')
plt.ylabel('Neighbourhood')
plt.grid(True)
plt.legend()
plt.show();
```



Making a function to make histogram plots

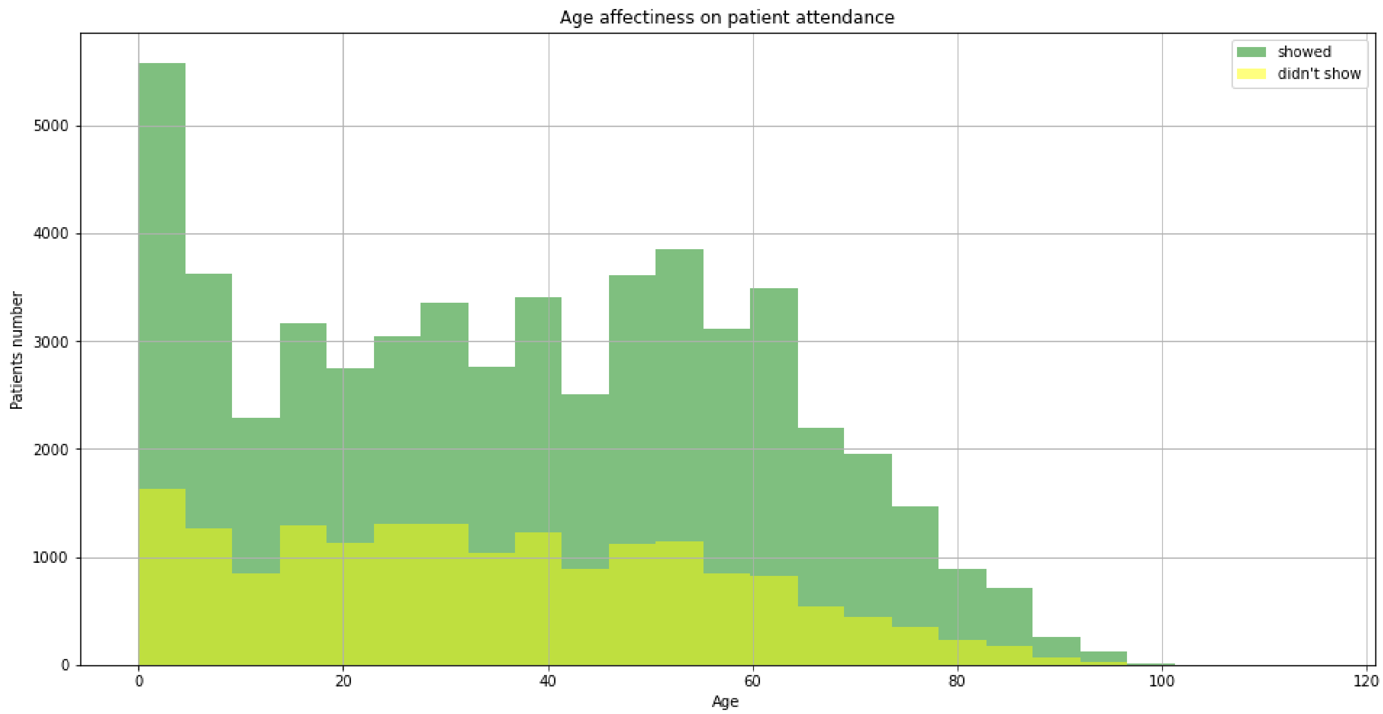
In [37]:

```
def plot_hist(data,col,showed,didnt_show,title,xlab,ylab):
    """
    plot a histogram for a specific col in the dataset to compare people who showed vs.

    parameters:

    data: the dataframe
    col: the specific column
    showed: the sample who showed
    didnt_show: the sample who didn't show
    title: the title you want to give to the plot
    xlab: the x-axis label you want to give to the plot
    ylab: the y-axis label you want to give to the plot

    """
```

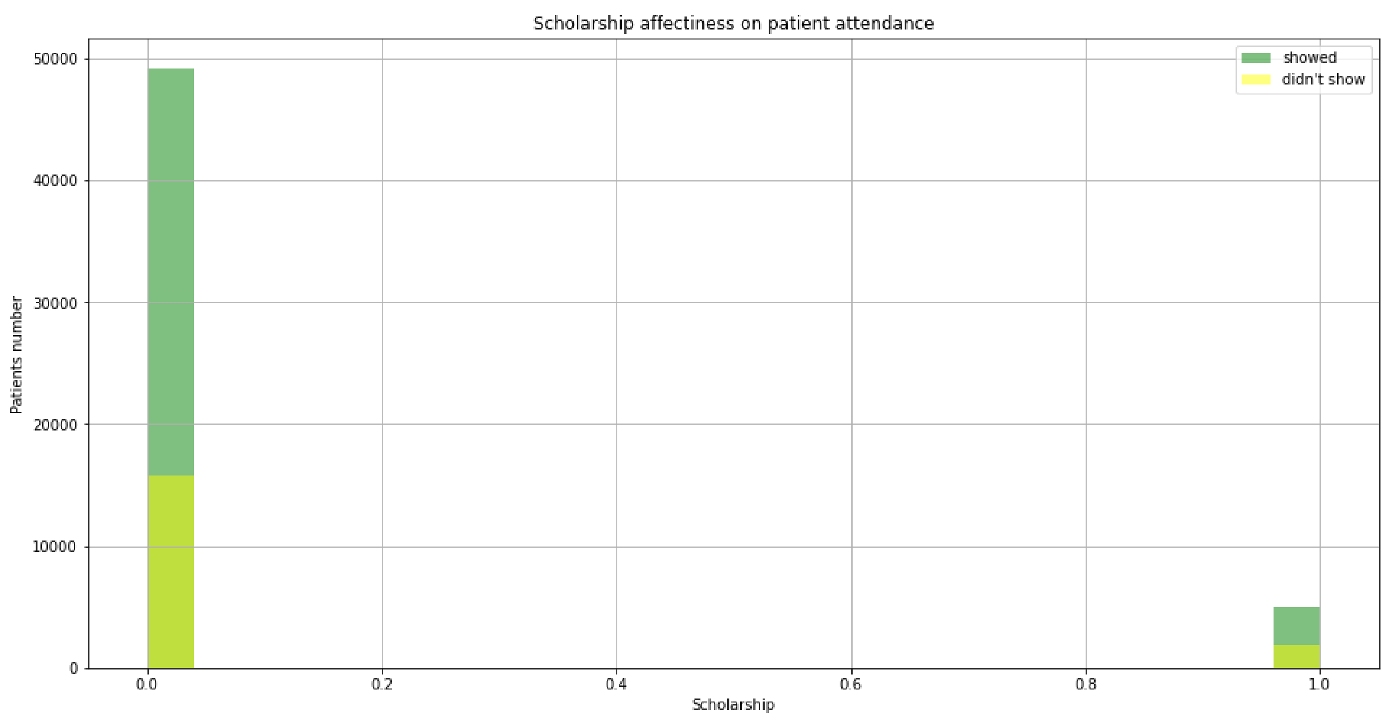
```
    plt.figure(figsize=(16,8))
    data[col][showed].hist(alpha=0.5, bins=25, label='showed', color='green');
    data[col][didnt_show].hist(alpha=0.5, bins=25, label='didn\'t show', color='yellow')
    plt.title(title)
    plt.xlabel(xlab)
    plt.ylabel(ylab)
    plt.grid(True)
    plt.legend()
    plt.show();
```

Making a histogram of the different variables in order to see relations

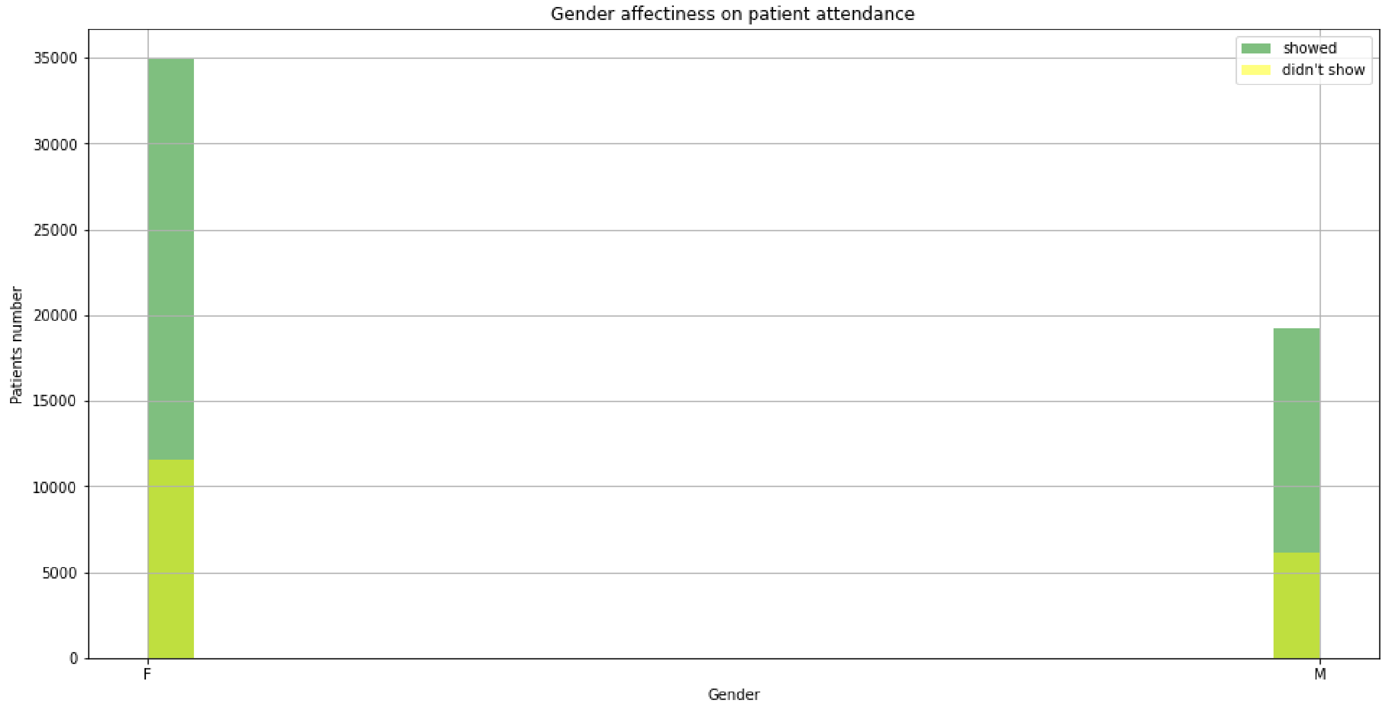
In [38]:
```
plot_hist(df,'age',showed,didnt_show,'Age affectiness on patient attendance','Age','Pati
```



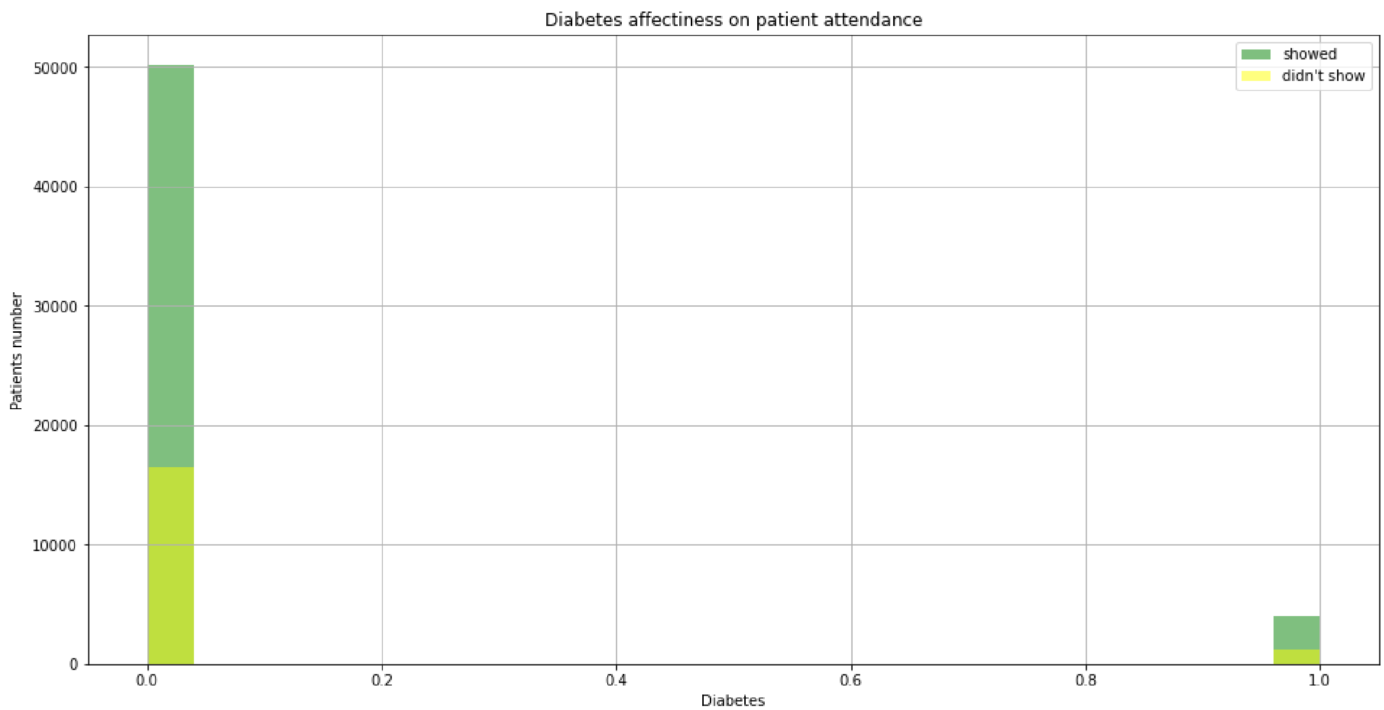
In [39]:
```
plot_hist(df,'scholarship',showed,didnt_show,'Scholarship affectiness on patient attenda
```



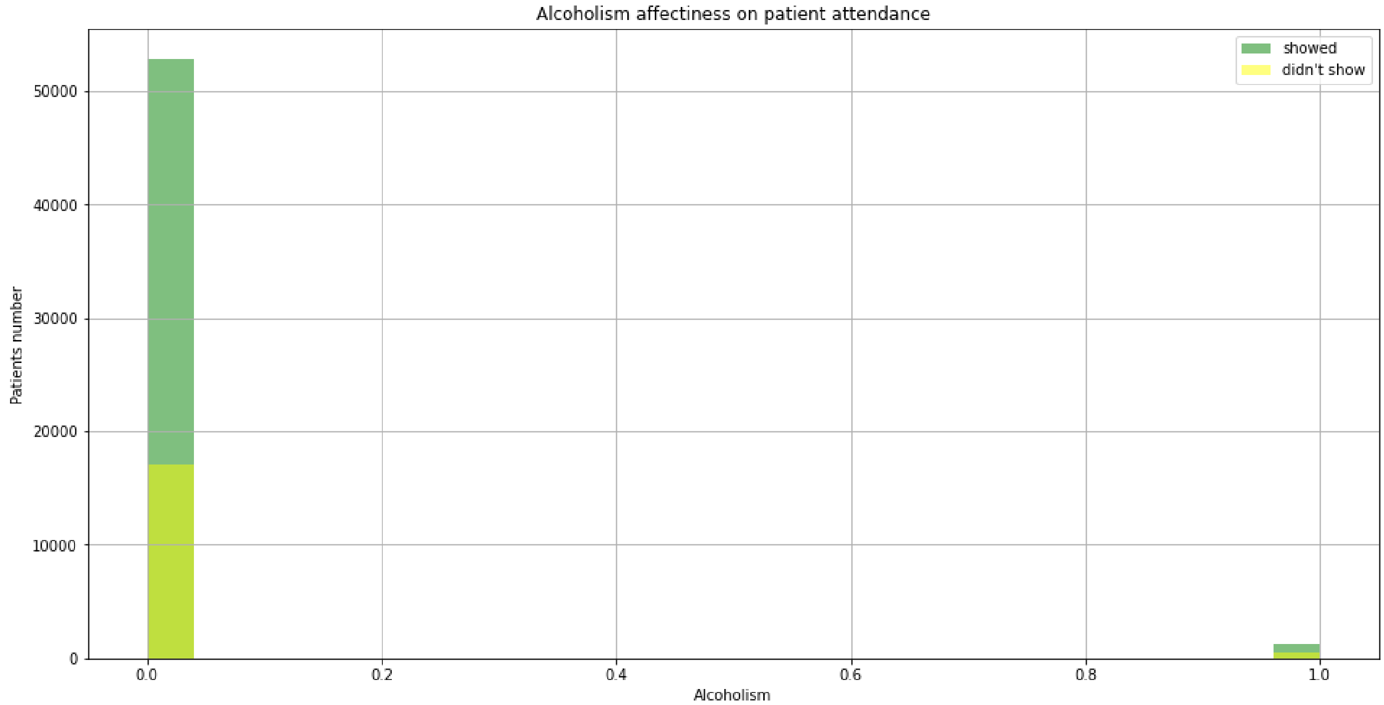
In [40]:
```
plot_hist(df,'gender',showed,didnt_show,'Gender affectiness on patient attendance','Gend
```



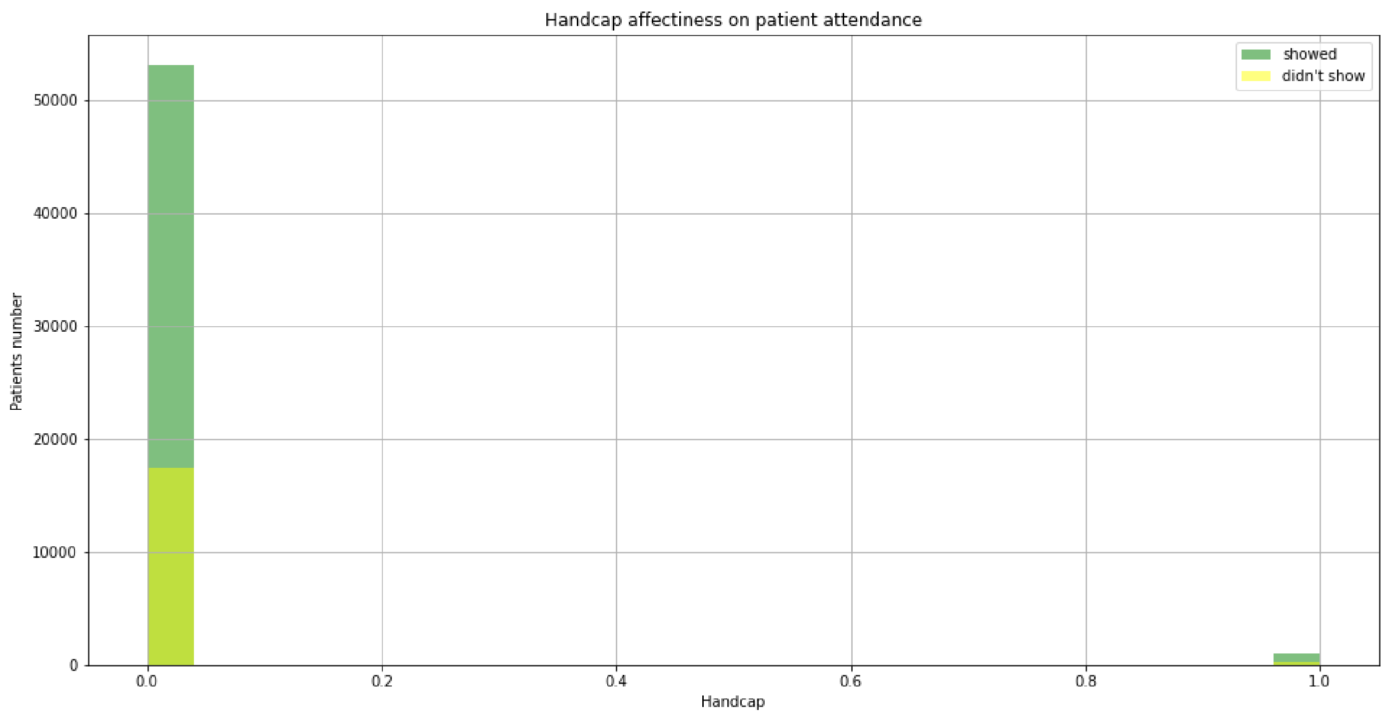
In [41]:
```
plot_hist(df,'diabetes',showed,didnt_show,'Diabetes affectiness on patient attendance','
```



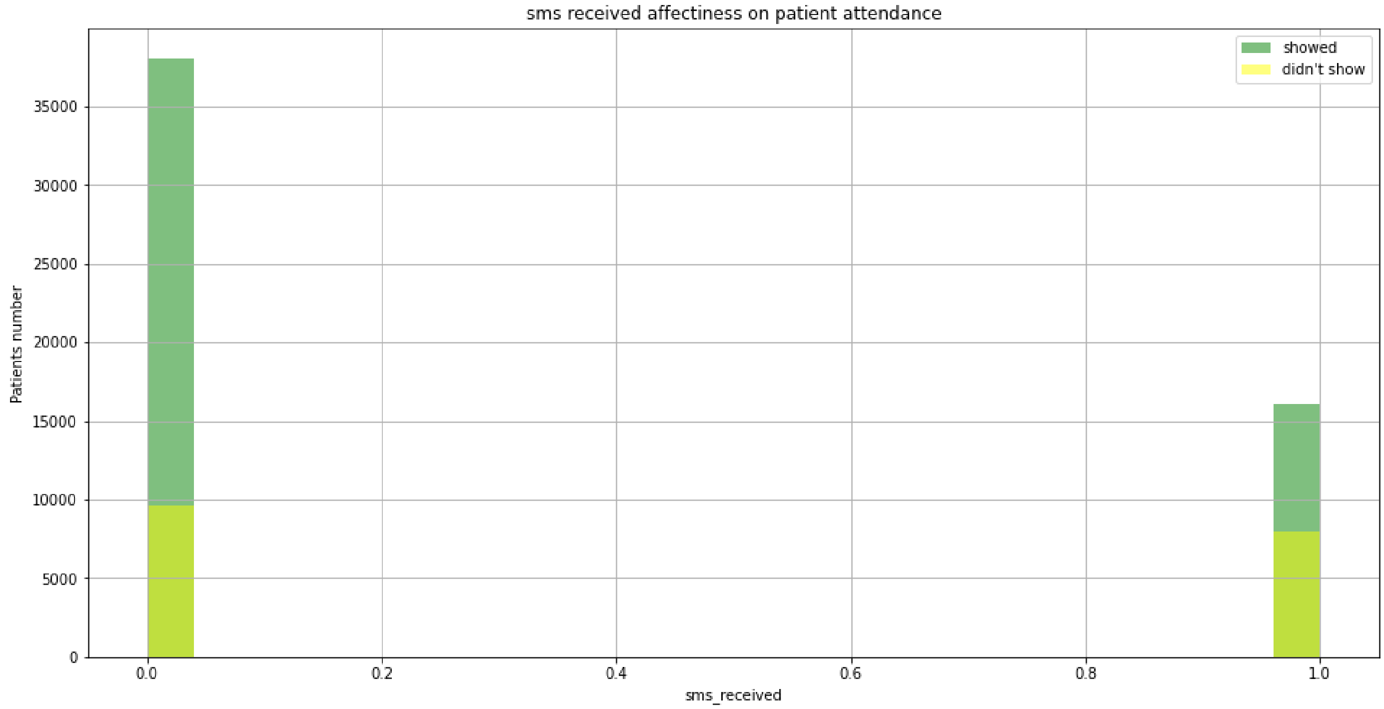
In [42]:
```
plot_hist(df,'alcoholism',showed,didnt_show,'Alcoholism affectiness on patient attendanc
```



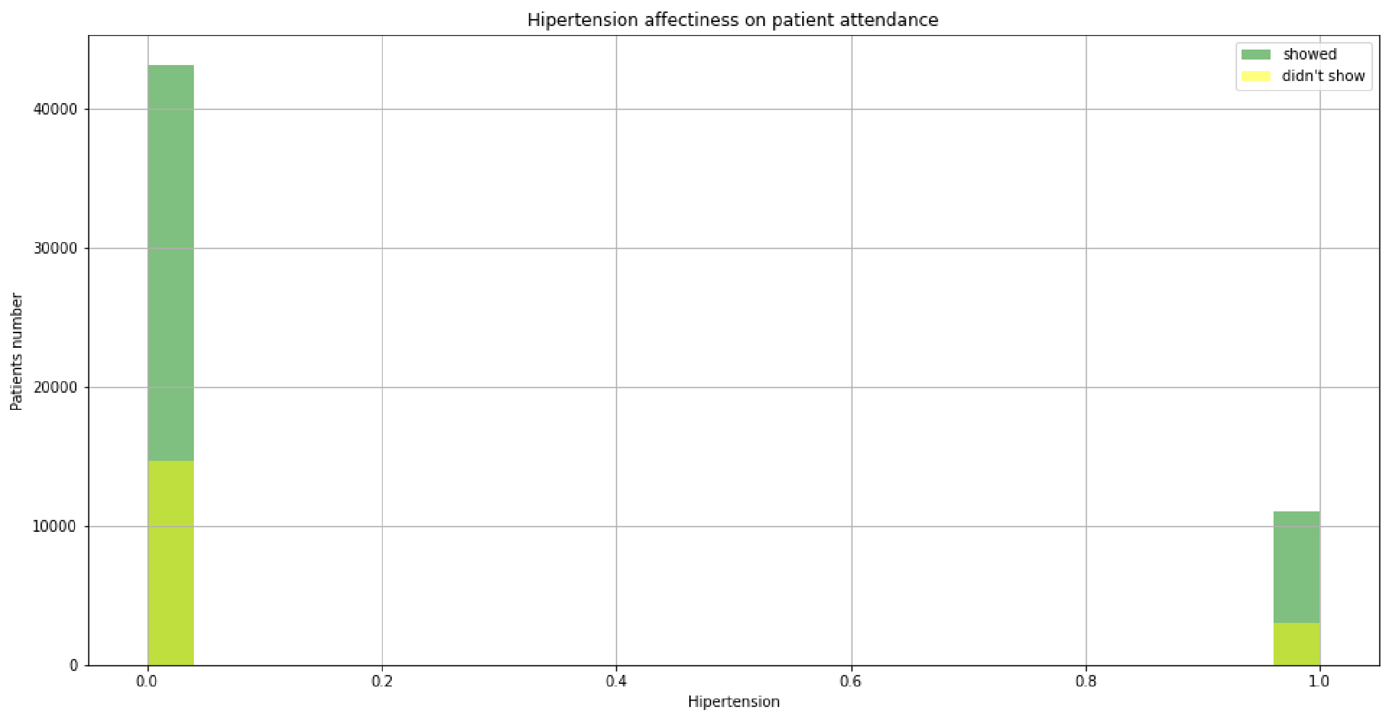
In [43]:
```
plot_hist(df,'handcap',showed,didnt_show,'Handcap affectiness on patient attendance','Ha
```



In [44]:
```
plot_hist(df,'sms_received',showed,didnt_show,'sms received affectiness on patient atten
```

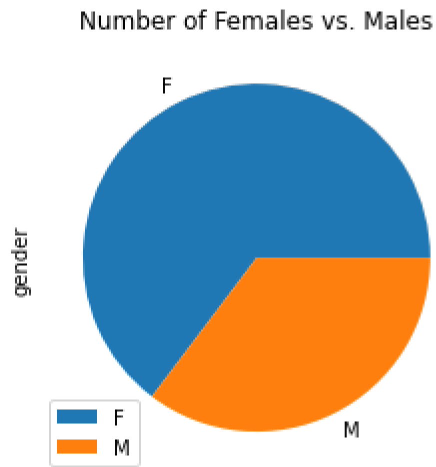


In [45]:
```
plot_hist(df,'hipertension',showed,didnt_show,'Hipertension affectiness on patient atten
```



Ploting a pie chart to see the difference of number between genders in the dataset

In [46]:
```
df.gender.value_counts().plot(kind='pie')
plt.legend();
plt.title('Number of Females vs. Males');
```



As we can see female patients are more than the males in this dataset

Conclusions

- **People who didnt recieve an sms has more attendance than the one who got one**
- **There is a correlation between the neighbourhood and patient attending and the most attending neighbourhood is JARDIM CAMBURI**
- **Maybe the most attending neighbourhood is close to the hospital and least attending are far from it (we cant be sure of that because we dont have the neighbourhood of the hospital)**
- **The most people attending between the age of (0-8) and then (51-65) and the least is (80-115)**
- **We cant assume that females attend more than males because the number of females in the dataset is almost the double of number of males**
- **Handcap people attend less than other people**

Limitations

- **There is no direct correlation other than neighbourhood in the dateset to predict if a patient will show up for their scheduled appointment**