In [1]:

```
import pandas as pd
import numpy as np
import re
import seaborn as sns
import matplotlib.pyplot as plt
import datetime as dt
import math

#pd.set_option('display.max_colwidth', 1)
```

Data Prep

In [10]:

```
df = pd.read_excel('Data/Revised Main.xlsx')
#temp = pd.read_excel('Clinical Trial Data Pull.xlsx',sheet_name='Sheet3')
```

In [11]:

```
df.shape
```

Out[11]:

```
(56, 2)
```

In [ ]:

```
df.isna().sum()
```

In [ ]:

```
df = df.drop(columns=['Unnamed: 34','Unnamed: 35'],axis=1)
```

In [ ]:

```
df = df.drop_duplicates(subset='NCT Number')
df['Locations'] = df['Locations'].fillna('Not Provided')
```

In [ ]:

```
df['New end date'][df['New end date']=='Not provided']=pd.NaT
```

In [ ]:

```
df['New Start date'] = pd.to_datetime(df['New Start date'])
df['New end date'] = pd.to_datetime(df['New end date'])
```

In [ ]:

```
df['Study Duration'] = df['New end date'][(df['End date']!=0)&(df['End date'].dt.year!='1900')] - df['New Start date'][df['Start Day']!=0 &(df['Start Day'].dt.year!='1900')]
```

In [ ]:

```
#!python -m pip install pycountry
import pycountry

cntry = []

for country in pycountry.countries:
    cntry.append(country.name)
cntry.remove('United States')

df['Outside US'] = df['Locations'].str.contains('|'.join(cntry))
df['US'] = df['Locations'].str.contains('United States')

df['Both'] = df['US'] & df['Outside US']

df['Country'] = ''

df['Country'] = np.where(df['Locations'].str.contains('|'.join(cntry)),'Outside US',df['Country'])
df['Country'] = np.where(df['Locations'].str.contains('United States'),'US',df['Country'])
df['Country'] = np.where((df['US'] & df['Outside US']),'Both US and outside',df['Country'])
df['Country'] = np.where(df['Locations']=='Not Provided','Not Provided',df['Country'])
df['Country'] = np.where(df['Locations']==' ','Not Provided',df['Country'])
df['Country'][(~df.Country.isin(['US','Outside US','Both US and outside','Not Provided']))] = 'Not
Provided'
```

In [ ]:

```
df['Age Category'] = ''

df['Age Category'] = np.where(df['Children']=='Yes','Child',df['Age Category'])
df['Age Category'] = np.where(df['Adult']=='Yes','Adult',df['Age Category'])
df['Age Category'] = np.where(df['Older Adult']=='Yes','Older Adult',df['Age Category'])
df['Age Category'] = np.where((df['Older Adult']=='Yes')&(df['Adult']=='Yes'),'Adults, Older
Adult',df['Age Category'])


df['Age Category'] = np.where((df['Older
Adult']=='No')&(df['Adult']=='Yes')&(df['Children']=='Yes'),'Child, Adult',df['Age Category'])
df['Age Category'] = np.where((df['Older
Adult']=='Yes')&(df['Adult']=='Yes')&(df['Children']=='No'),'Adult, Older Adult',df['Age Category'
])
df['Age Category'] = np.where((df['Older
Adult']=='Yes')&(df['Adult']=='No')&(df['Children']=='Yes'),'Child, Older Adult',df['Age Category'
])
df['Age Category'] = np.where((df['Older
Adult']=='Yes')&(df['Adult']=='Yes')&(df['Children']=='Yes'),'Child, Adult, Older Adult',df['Age C
ategory'])
```

In [ ]:

```
df['location_center']= df['locations'].str.contains('Center')
df['location_hospital'] = df['locations'].str.contains('Hospital')
df['location_institute'] = df['locations'].str.contains('Institute')
df['location_university'] = df['locations'].str.contains('University|College|University
Hospital|School')
#df[['Locations','Location - Center','Location - Hospital','Location - University']]
```

In [ ]:

```
df['Study Type'][~df['Study Type'].isin(['Interventional','Observational'])] = 'Expanded Access'
```

In [ ]:

```
df.columns = df.columns.str.replace(' ', '_')
df.columns = df.columns.str.lower()

df.rename(columns={'start_date':'old_start_date','completion_date':'old_completion_date',
                   'new_start_date':'start_date','new_end_date':'completion_date',
                   'sponsor/collaborators':'sponsors_collaborators'},inplace=True)
```

In [ ]:

```
df['study_designs'].fillna('Not Provided')

df['randomized_study'] = 'Not Provided'
df['randomized_study'] = np.where((df['study_designs'].str.find('Randomized')>0)|(df['study_designs
'].str.find('Random')>0),'Randomized',df['randomized_study'])
df['randomized_study'] = np.where(df['study_designs'].str.find('Non-Randomized')>0,'Non Randomized'
,df['randomized_study'])
```

In [ ]:

```
df['study_model'] = 'Not Provided'
df['study_model'] = np.where(df['study_designs'].str.find('Intervention Model')>0,'Interventional',
df['study_model'])
df['study_model'] = np.where(df['study_designs'].str.find('Observational Model')>0,'Observational',
df['study_model'])
```

In [ ]:

```
df['time_category_retrospective'] = ''
df['time_category_prospective'] = ''
df['time_category_other'] = ''
df['time_category_longitudinal'] = ''
df['time_category_cross_sectional'] = ''

df['time_category_retrospective'] = np.where(df['study_designs'].str.find('Time Perspective:
Retrospective')>0,True,False)
df['time_category_prospective'] = np.where(df['study_designs'].str.find('Time Perspective:
Prospective')>0,True,False)
df['time_category_other'] = np.where(df['study_designs'].str.find('Time Perspective: Other')>0,True
,False)
df['time_category_longitudinal'] = np.where(df['study_designs'].str.find('Time Perspective:
Longitudinal')>0,True,False)
df['time_category_cross_sectional'] = np.where(df['study_designs'].str.find('Time Perspective:
Cross-Sectional')>0,True,False)

df['time_category'] = 'Not Provided'

df['time_category'] =
np.where(df['time_category_retrospective'],'Retrospective',df['time_category'])
df['time_category'] = np.where(df['time_category_prospective'],'Prospective',df['time_category'])
df['time_category'] = np.where(df['time_category_other'],'Other',df['time_category'])
df['time_category'] = np.where(df['time_category_longitudinal'],'Longitduinal',df['time_category']
)
df['time_category'] =
np.where(df['time_category_cross_sectional'],'Cross_Sectional',df['time_category'])
```

In [ ]:

```
df['study_designs'].fillna('Not Provided')

df['masking'] = 'Not Provided'
df['masking'] = np.where(df['study_designs'].str.find('Masking: None')>0,'None',df['masking'])
df['masking'] = np.where(df['study_designs'].str.find('Masking: Single')>0,'Single',df['masking'])
df['masking'] = np.where(df['study_designs'].str.find('Masking: Double')>0,'Double',df['masking'])
df['masking'] = np.where(df['study_designs'].str.find('Masking: Triple')>0,'Triple',df['masking'])
df['masking'] = np.where(df['study_designs'].str.find('Masking: Quadruple')>0,'Quadruple',df['maski
ng'])
```

In [ ]:

```
a = df['study_designs'].str.extract('(Primary Purpose: [a-zA-z\s\-]*)')#|(Masking: [A-Za-z\s\(\)]*
)|(Time Perspective: [a-zA-z\s]*)')

df['primary_purpose'] = 'Not Provided'
for purpose in a[0].value_counts().index:
    df['primary_purpose'] = np.where((df['study_designs'].str.find(str(purpose))>0),purpose.split('
:')[1].strip(),df['primary_purpose'])
```

In [ ]:

```
df['number_of_sponsors'] = df['sponsors_collaborators'].str.split('|').apply(lambda x: len(x))
df['number_of_locations'] = df['locations'].str.split('|').apply(lambda x: len(x))
```

In [ ]:

```
# b = {}
# for disease in df['conditions'].value_counts().index:
#     b['{}'.format(disease)] = (df['conditions'].str.find(disease)>=0).sum()
# import operator
# sorted_x = sorted(b.items(), key=operator.itemgetter(1),reverse=True)

# c = pd.DataFrame(sorted_x)

c = pd.read_csv('Disease_count.csv')
c.head(20)
```

In [ ]:

```
df['completion_date'] = pd.to_datetime(df['completion_date'])
df['start_date'] = pd.to_datetime(df['start_date'])

# df['completion_date'] =
pd.to_datetime(np.where(df['completion_date'].dt.year!=1800,df['completion_date'],pd.NaT))
# df['start_date'] =
pd.to_datetime(np.where(df['start_date'].dt.year!=1900,df['start_date'],pd.NaT))

df['study_duration'] = df['completion_date'] - df['start_date']
```

Analysis

In [4]:

```
#df.to_csv('Data/Final Data.csv')
df = pd.read_csv('Data/Final Data.csv',index_col=0)
```

In [13]:

```
df.shape
```

Out[13]:

```
(64698, 55)
```

In [2]:

```
df1 = pd.read_csv('Data/Final Data.csv',index_col=0)
```

In [5]:

```
df['completion_date'] = pd.to_datetime(df['completion_date'])
df['start_date'] = pd.to_datetime(df['start_date'])
df['last_update_posted'] = pd.to_datetime(df['last_update_posted'])


df['study_duration'] = df['completion_date']-df['start_date']
df['study_duration'][df['study_duration'].notnull()]  = (df['study_duration'][df['study_duration'].
notnull()] / np.timedelta64(1, 'D')).astype(int)
```

```
C:\Users\Sarvesh Shah\Anaconda3\lib\site-packages\ipykernel_launcher.py:7: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-
docs/stable/indexing.html#indexing-view-versus-copy
  import sys
```

In [ ]:

```
df['start_date'][df['status']=='Approved for marketing'] = df['old_start_date']
[df['status']=='Approved for marketing']
```

In [ ]:

```
df['study_duration'].isna().sum()
```

In [ ]:

```
df.groupby(['primary_purpose','age_category'])[['nct_number']].agg({'count'}).unstack()
```

In [ ]:

```
# data = pd.concat([data,pd.get_dummies(data['status'],prefix='status')],axis=1)
# data = pd.concat([data,pd.get_dummies(data['study_results'],prefix='study_results')],axis=1)
# data = pd.concat([data,pd.get_dummies(data['funded_bys'],prefix='funded_by')],axis=1)
# data =
pd.concat([data,pd.get_dummies(data['randomized_study'],prefix='randomized_study')],axis=1)
# data = pd.concat([data,pd.get_dummies(data['masking'],prefix='masking')],axis=1)
# data = pd.concat([data,pd.get_dummies(data['primary_purpose'],prefix='primary_purpose')],axis=1)
# data = pd.concat([data,pd.get_dummies(data['gender'],prefix='gender')],axis=1)
# data = pd.concat([data,pd.get_dummies(data['age_category'],prefix='age')],axis=1)
# data = pd.concat([data,pd.get_dummies(data['study_designs'],prefix='study_designs')],axis=1)
# data = pd.concat([data,pd.get_dummies(data['study_type'],prefix='study_type')],axis=1)


#data = data.drop(columns=
['status','study_results','funded_bys','masking','primary_purpose','gender','randomized_study','age
egory','study_designs','study_type'])
```

In [ ]:

```
cols = ['drug',
 'biologic',
 'behavioral',
 'other',
 'procedure',
 'device',
 'genetic',
 'dietary',
 'radiation',
 'location_center',
 'location_hospital',
 'location_institute',
 'location_university',
 'time_category_retrospective',
 'time_category_prospective',
 'time_category_other',
 'time_category_longitudinal',
 'time_category_cross_sectional']

for col in cols:
    #print(col)
    df['{}'.format(col)] = df['{}'.format(col)].astype(int)

#data['study_duration']  = (data['study_duration'] / np.timedelta64(1, 'D')).astype(int)

p = ['drug',
 'biologic',
 'behavioral',
 'other',
 'procedure',
 'device',
 'genetic',
 'dietary',
 'radiation',
 'outside_us',
 'us',
 'both',
 'location_center',
 'location_hospital',
 'location_institute',
 'location_university',
 'time_category_retrospective',
 'time_category_prospective',
 'time_category_other',
 'time_category_longitudinal',
 'time_category_cross_sectional']

for q in p:
    df['{}'.format(q)] = np.where(df['{}'.format(q)]=='TRUE',1,df['{}'.format(q)])
    df['{}'.format(q)] = np.where(df['{}'.format(q)]=='FALSE',0,df['{}'.format(q)])
    df['{}'.format(q)] = np.where(df['{}'.format(q)]=='FALSE',0,df['{}'.format(q)])
    df['{}'.format(q)] = np.where(df['{}'.format(q)]=='True',1,df['{}'.format(q)])
    df['{}'.format(q)] = np.where(df['{}'.format(q)]=='False',0,df['{}'.format(q)])
    df['{}'.format(q)] = np.where(df['{}'.format(q)]=='Yes',1,df['{}'.format(q)])
    df['{}'.format(q)] = np.where(df['{}'.format(q)]=='No',0,df['{}'.format(q)])

for q in p:
    print(q)
    df['{}'.format(q)] = df['{}'.format(q)].astype(int)
```

In [22]:

```
a = df[df['status']=='Approved for marketing'][['nct_number','start_date','last_update_posted','drug', 'biologic', 'behavioral', 'other', 'procedure', 'device', 'genetic', 'dietary', 'radiation']]
a['difference'] = a['last_update_posted'] - a['start_date']

a['difference'] = (a['difference'] / np.timedelta64(1, 'D')).astype(int)
```

In [23]:

```
a.sort_values(by='difference')
```

Out[23]:

	nct_number	start_date	last_update_posted	drug	biologic	behavioral	other	procedure	device	genetic	dietary	radiation
49030	NCT03955679	2019-05-20	2019-06-05	0	0	0	0	0	0	1	0	0
48956	NCT03177005	2017-06-06	2017-07-31	0	1	0	0	0	0	0	0	0
48927	NCT03025867	2017-01-20	2017-04-17	1	0	0	0	0	0	0	0	0
47968	NCT01683110	2012-09-11	2013-01-16	1	0	0	0	0	0	0	0	0
48336	NCT02136511	2014-05-13	2014-10-28	1	0	0	0	0	0	0	0	0
46875	NCT00786058	2008-11-05	2009-06-15	1	0	0	0	0	0	0	0	0
48937	NCT03079687	2017-03-14	2017-10-25	1	0	0	0	0	0	0	0	0
47686	NCT01381289	2011-06-27	2012-02-09	1	0	0	0	0	0	0	0	0
46481	NCT00484991	2007-06-12	2008-04-15	1	0	0	0	0	0	0	0	0
48112	NCT01858103	2013-05-21	2014-04-02	1	0	0	0	0	0	0	0	0
48953	NCT03154437	2017-05-16	2018-03-29	0	1	0	0	0	0	0	0	0
48960	NCT03245424	2017-08-10	2018-07-24	1	0	0	0	0	0	0	0	0
25777	NCT02589717	2015-11-15	2016-11-02	1	0	0	0	0	0	0	0	0
48964	NCT03278314	2017-09-11	2018-11-02	1	0	0	0	0	0	0	0	0
48340	NCT02141087	2014-05-19	2015-07-13	1	0	0	0	0	0	0	0	0
48979	NCT03501615	2018-04-18	2019-06-21	1	0	0	0	0	0	0	0	0
46805	NCT00730444	2008-08-08	2009-11-09	1	0	0	0	0	0	0	0	0
48970	NCT03400098	2018-01-17	2019-08-05	1	0	0	0	0	0	0	0	0
48527	NCT02368301	2015-02-23	2016-10-06	1	0	0	0	0	0	0	0	0
48890	NCT02939820	2016-10-20	2018-08-14	1	0	0	0	0	0	0	0	0

	nct_number	start_date	last_update_posted	drug	biologic	behavioral	other	procedure	device	genetic	dietary	radiation
48562	NCT02437019	2015-05-07	2017-03-20	1	0	0	0	0	0	0	0	0
48731	NCT02705313	2016-03-10	2018-04-09	1	0	0	0	0	0	0	0	0
48219	NCT01995734	2013-11-27	2015-12-29	1	0	0	0	0	0	0	0	0
48666	NCT02577562	2015-10-16	2017-11-24	0	0	0	0	0	1	0	0	0
48897	NCT02961491	2016-11-11	2019-01-30	1	0	0	0	0	0	0	0	0
48673	NCT02592941	2015-10-30	2018-02-28	1	0	0	0	0	0	0	0	0
48370	NCT02171156	2014-06-24	2017-05-08	1	0	0	0	0	0	0	0	0
46427	NCT00454753	2007-04-02	2010-05-12	1	0	0	0	0	0	0	0	0
47049	NCT00905593	2009-05-20	2012-07-18	1	0	0	0	0	0	0	0	0
47182	NCT00989807	2009-10-06	2012-12-13	1	0	0	0	0	0	0	0	0
48581	NCT02477891	2015-06-23	2019-01-15	1	0	0	0	0	0	0	0	0
48594	NCT02496689	2015-07-14	2019-03-29	0	1	0	0	0	0	0	0	0
46507	NCT00499720	2007-07-11	2011-08-02	1	0	0	0	0	0	0	0	0
47124	NCT00954460	2009-08-07	2014-02-21	1	0	0	0	0	0	0	0	0
45119	NCT00040625	2002-07-04	2007-03-15	1	0	0	0	0	0	0	0	0
48126	NCT01869803	2013-05-24	2018-03-02	1	0	0	1	0	0	0	0	0
47916	NCT01632826	2012-07-03	2017-04-25	1	0	0	0	0	0	0	0	0
48085	NCT01833039	2013-04-16	2018-11-07	1	0	0	0	0	0	0	0	0
48207	NCT01983722	2013-11-14	2019-07-11	1	0	0	0	0	0	0	0	0
47710	NCT01410500	2011-08-05	2017-05-02	1	0	0	0	0	0	0	0	0
47884	NCT01592136	2012-05-07	2018-02-06	1	0	0	0	0	0	0	0	0
46017	NCT00293098	2006-03-06	2012-02-09	1	0	0	0	0	0	0	0	0
48117	NCT01861834	2013-05-24	2019-05-07	1	0	0	0	0	0	0	0	0
47755	NCT01464762	2011-11-04	2017-11-27	1	0	0	0	0	0	0	0	0
46549	NCT00520143	2007-08-23	2014-02-06	0	1	0	0	0	0	0	0	0
46475	NCT00481559	2007-06-01	2014-01-17	1	0	0	0	0	0	0	0	0
33776	NCT00130897	2005-07-05	2012-03-09	1	0	0	0	0	0	0	0	0
47762	NCT01476163	2011-11-22	2019-01-23	1	0	0	0	0	0	0	0	0
46393	NCT00438789	2007-02-22	2014-05-06	1	0	0	0	0	0	0	0	0
30930	NCT00094029	2004-09-04	2012-03-09	1	0	0	0	0	0	0	0	0
47575	NCT01297933	2011-02-17	2019-04-12	1	0	0	0	0	0	0	0	0
5337	NCT00074919	2003-12-03	2014-02-05	0	1	0	0	0	0	0	0	0

In [ ]:

```
df[df['status']=='Approved for marketing']
```

In [ ]:

```
pd.DataFrame(df['outcome_measures'].value_counts()).to_csv('keywords.csv')
```

In [ ]:

```
df[(df['study_results']=='Has Results')&(df['status']=='Completed')]
```

In [ ]:

```
df.head()
```

In [ ]:

```
df['start_year'] = df['start_date'].dt.year
```

In [ ]:

```
df.groupby(['start_year'])[['enrollment']].mean().plot()
```

In [ ]:

```
plt.figure(figsize=(10,10*2.68))
df[df['gender']=='Male'].groupby(['start_year'])[['nct_number']].sum().plot()
df[df['gender']=='Female'].groupby(['start_year'])[['nct_number']].sum().plot()
df[df['gender']=='All'].groupby(['start_year'])[['nct_number']].sum().plot()
```

In [ ]:

```
plt.figure(figsize=(10,10*2.68))
df[df['gender']=='Male'].groupby(['start_year'])[['enrollment']].mean().plot()
df[df['gender']=='Female'].groupby(['start_year'])[['enrollment']].mean().plot()
df[df['gender']=='All'].groupby(['start_year'])[['enrollment']].mean().plot()
```

In [ ]:

```
df['gender'].value_counts()
```

In [ ]:

```
a = df[df['gender']!='All'].groupby(['start_year','age_category'])[['nct_number']].count().unstack
()
# a['nc_count'] = a.nct_number.shift(-1)
# a['dif'] = (a['nc_count']-a['nct_number'])*100./a['nct_number']
a
```

In [ ]:

```
df[(df['age_category']=='Adult')].groupby(['start_year'])[['enrollment']].mean().plot()
```

In [ ]:

```
df[(df['age_category']=='Older
Adult')&(df['nct_number']!='NCT02612688')&((df['nct_number']!='NCT03365050'))].groupby(['start_year
'])[['enrollment']].mean()
#plt.ylim(0,1000)
```

In [ ]:

```
(-164.125000 + 444.745763)*100./164.125000
```

In [ ]:

```
df[(df['age_category']=='Older Adult')&(df['start_year']==2018)][['nct_number','enrollment']].sort
_values(by='enrollment',ascending=False)
```

In [ ]:

```
df['sponsors_collaborators'].value_counts()
```

In [ ]:

```
df['funded_bys'].value_counts()
```

In [ ]:

```
df[df['funded_bys'].str.match('NIH')].groupby(['start_year','funded_bys'])[['nct_number']].count()
.unstack()['nct_number'][['NIH']].loc[[2000,2018]]
#df[df['funded_bys'].str.match('Industry')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['Industry']].loc[[2000,2018]]
#df[df['funded_bys'].str.match('Other')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['Other']].loc[[2000,2018]]
#df[df['funded_bys'].str.match('U.S. Fed')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['U.S. Fed']].loc[[2000,2018]]
```

In [ ]:

```
plt.figure(figsize=(10*1.68,10))
plt.plot(df[df['funded_bys'].str.match('NIH')].groupby(['start_year','funded_bys'])[['nct_number']
].count().unstack()['nct_number'][['NIH']],label='NIH',linewidth=2.5)
plt.plot(df[df['funded_bys'].str.match('Industry')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['Industry']],label='Industry',linewidth=2.5)
plt.plot(df[df['funded_bys'].str.match('Other')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['Other']],label='Other',linewidth=2.5)
plt.plot(df[df['funded_bys'].str.match('U.S. Fed')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['U.S. Fed']],label='U.S. Fed',linewidth=2.5)


plt.legend(fontsize=20)
plt.xlabel('Start Year',fontsize=20)
plt.ylabel('No. of Studies',fontsize=20)
plt.title('Number of studies funded by funders over the years',fontsize=20)
plt.xticks(fontsize=15)
plt.yticks(fontsize=15)
```

In [ ]:

```
df.groupby(['study_type','funded_bys'])[['nct_number']].count().unstack()
```

In [ ]:

```
list(df)
```

Successful Trials

In [6]:

```
dfs = df[(df['study_results']=='Has Results')&(df.study_designs.str.find('Single Group Assignment'
)<0)&((df['status']=='Completed')|(df['status']=='Approved for marketing'))&(df['randomized_study']
=='Randomized')&(df['masking']!='None')]


dfns = df[~((df['study_results']=='Has Results')&(df.study_designs.str.find('Single Group
Assignment')<0)&((df['status']=='Completed')|(df['status']=='Approved for marketing'))&(df['randomi
zed_study']=='Randomized')&(df['masking']!='None'))]
```

In [ ]:

```
dfs.shape[0]/df.shape[0]
dfns.shape[0]/df.shape[0]
```

In [ ]:

```
dfs.masking.value_counts()
```

In [ ]:

```

```

In [25]:

```
b = {}
for disease in dfs['conditions'].value_counts().index:
    b['{}'.format(disease)] = (dfs['conditions'].str.find(disease)>=0).sum()

import operator
sorted_x = sorted(b.items(), key=operator.itemgetter(1),reverse=True)

c = pd.DataFrame(sorted_x)

# c = pd.read_csv('Data/Disease_count.csv',index_col=0)
# c.head(20)
# c['per'] = c['1']*100/c['1'].sum()
# c
```

In [65]:

```
(df_rare['study_duration'][df_rare['study_duration']>0].mean()/365) #- df['study_duration'][df['study_duration']>0].mean()/365 )*100 / (df['study_duration'][df['study_duration']>0].mean()/365)
```

Out[65]:

```
5.151104381720155
```

In [66]:

```
pd.DataFrame(df_rare['age_category'].value_counts()*100/df_rare['age_category'].value_counts().sum())
```

Out[66]:

	age_category
Adult, Older Adult	77.174440
Child, Adult, Older Adult	10.811597
Child, Adult	7.175410
Adult	2.424125
Older Adult	1.415689
Child	0.998739

In [68]:

```
df_rare['enrollment'][df_rare['enrollment']<1500].mean()
```

Out[68]:

```
106.77139949109414
```

In [ ]:

```
63.528010+7.270560-100
```

In [69]:

```
pd.DataFrame(df_rare['number_of_locations'].value_counts()*100/df_rare['number_of_locations'].value_counts().sum()).head()
```

Out[69]:

	number_of_locations
1	62.843014
2	7.097838
3	3.548919
4	2.307767
5	1.948996

In [70]:

```
temp = pd.DataFrame(df_rare['funded_bys'].value_counts()*100/df_rare['funded_bys'].value_counts().sum()).reset_index()
temp['a'] = temp['index'].str.split('|').apply(lambda x: len(x))
temp.groupby('a')[['funded_bys']].sum()
```

Out[70]:

	funded_bys
a	
1	69.698439
2	29.176767
3	1.115097
4	0.009696

In [71]:

```
pd.DataFrame(df_rare['gender'].value_counts()*100/df_rare['gender'].value_counts().sum()).head()
```

Out[71]:

	gender
All	94.787420
Female	5.096098
Male	0.116482

In [72]:

```
pd.DataFrame(df_rare['randomized_study'].value_counts()*100/df_rare['randomized_study'].value_counts().sum()).head()
```

Out[72]:

	randomized_study
Not Provided	60.806749
Non Randomized	19.848735
Randomized	19.344517

In [73]:

```
pd.DataFrame(df_rare['masking'].value_counts()*100/df_rare['masking'].value_counts().sum()).head()
```

Out[73]:

	masking
None	79.559779
Not Provided	16.038010
Double	1.318724
Quadruple	1.270241
Single	1.076311

In [74]:

```
pd.DataFrame(df_rare['study_results'].value_counts()*100/df_rare['study_results'].value_counts().sum()).head()
```

Out[74]:

	study_results
No Results Available	84.262581
Has Results	15.737419

In [48]:

```
pd.DataFrame(df_nrare['country'].value_counts()*100/df_nrare['country'].value_counts().sum()).head()
```

Out[48]:

	country
Outside US	43.652513
US	32.084055
Both US and outside	14.818024
Not Provided	9.445407

In [49]:

```
pd.DataFrame(df_nrare['status'].value_counts()*100/df_nrare['status'].value_counts().sum()).head()
```

Out[49]:

	status
Completed	42.201040
Recruiting	21.707106
Active, not recruiting	9.943674
Terminated	9.575390
Unknown status	7.279029

In [75]:

```
pd.DataFrame(df_rare['number_of_sponsors'].value_counts()*100/df_rare['number_of_sponsors'].value_counts().sum()).head()
```

Out[75]:

	number_of_sponsors

	number_of_sponsors
1	49.403665
2	37.486667
3	8.125667
4	2.472607
5	1.076311

In [454]:

```
df_rare[df_rare['funded_bys'].str.match('NIH')][['nct_number']].count()
```

Out[454]:

```
nct_number    1150
dtype: int64
```

In [76]:

```
#display(pd.DataFrame(df_rare['funded_bys'].value_counts()*100/df_rare['funded_bys'].value_counts(
()))
display(pd.DataFrame(df_rare['funded_bys'].value_counts()*100/df_rare['funded_bys'].value_counts()
.sum()))
```

	funded_bys
Other	35.925531
Industry	26.073887
Other|NIH	13.836905
Other|Industry	12.605449
NIH	7.689324
Industry|Other	1.997479
Other|NIH|Industry	0.630272
NIH|Other	0.339377
Other|Industry|NIH	0.329681
Industry|NIH	0.164840
Other|U.S. Fed	0.087268
NIH|Industry	0.077572
Industry|NIH|Other	0.048482
Industry|Other|NIH	0.038786
Industry|Other|U.S. Fed	0.029089
Industry|U.S. Fed	0.029089
U.S. Fed|Other	0.019393
Other|U.S. Fed|Industry	0.019393
Other|Industry|U.S. Fed	0.009696
Other|NIH|U.S. Fed	0.009696
U.S. Fed|Industry	0.009696
U.S. Fed	0.009696
NIH|U.S. Fed	0.009696
Industry|Other|NIH|U.S. Fed	0.009696

In [ ]:

```
plt.figure(figsize=(10*1.68,10))
plt.plot(dfs[dfs['funded_bys'].str.match('NIH')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['NIH']],label='NIH',linewidth=2.5)
plt.plot(dfs[dfs['funded_bys'].str.match('Industry')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['Industry']],label='Industry',linewidth=2.5)
plt.plot(dfs[dfs['funded_bys'].str.match('Other')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['Other']],label='Other',linewidth=2.5)
plt.plot(dfs[dfs['funded_bys'].str.match('U.S. Fed')].groupby(['start_year','funded_bys'])
[['nct_number']].count().unstack()['nct_number'][['U.S. Fed']],label='U.S. Fed',linewidth=2.5)


plt.legend(fontsize=20)
plt.xlabel('Start Year',fontsize=20)
plt.ylabel('No. of Studies',fontsize=20)
plt.title('Number of studies funded by funders over the years',fontsize=20)
plt.xticks(fontsize=15)
plt.yticks(fontsize=15)
```

In [10]:

```
dfs['successful'] = 1
dfns['successful'] = 0
```

```
C:\Users\Sarvesh Shah\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: 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: http://pandas.pydata.org/pandas-
docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
C:\Users\Sarvesh Shah\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: 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: http://pandas.pydata.org/pandas-
docs/stable/indexing.html#indexing-view-versus-copy
```

In [11]:

```
list(df)
```

Out[11]:

```
['nct_number',
 'title',
 'acronym',
 'status',
 'study_results',
 'conditions',
 'interventions',
 'drug',
 'biologic',
 'behavioral',
 'other',
 'procedure',
 'device',
 'genetic',
 'dietary',
 'radiation',
 'outcome_measures',
 'sponsors_collaborators',
 'gender',
 'age',
 'children',
 'adult',
 'older_adult',
 'enrollment',
 'funded_bys',
 'study_type',
 'study_designs',
 'old_start_date',
 'start_date',
 'old_completion_date',
 'completion_date',
 'study_duration',
 'last_update_posted',
 'locations',
 'outside_us',
 'us',
 'both',
 'country',
 'age_category',
 'location_center',
 'location_hospital',
 'location_institute',
 'location_university',
 'randomized_study',
 'intervention_model',
 'time_category_retrospective',
 'time_category_prospective',
 'time_category_other',
 'time_category_longitudinal',
 'time_category_cross_sectional',
 'time_category',
 'masking',
 'primary_purpose',
 'number_of_sponsors',
 'number_of_locations']
```

In [14]:

```
pd.DataFrame(dfs['sponsors_collaborators'].value_counts()*100/dfs['sponsors_collaborators'].value_c
ounts().sum())
```

Out[14]:

	sponsors_collaborators
GlaxoSmithKline	4.886770
Novartis Pharmaceuticals|Novartis	3.575685
Sanofi Pasteur, a Sanofi Company|Sanofi	2.205006
Merck Sharp & Dohme Corp.	2.085816
Pfizer	2.026222
Alcon Research	1.668653
Shire	1.668653
National Cancer Institute (NCI)	1.370679
Novartis Vaccines|Novartis	1.132300
Vertex Pharmaceuticals Incorporated	1.013111
Allergan	1.013111
AstraZeneca	0.953516
Hoffmann-La Roche	0.953516
Celgene	0.834327
Eli Lilly and Company	0.834327
Boehringer Ingelheim	0.774732
Amgen	0.774732
Gilead Sciences	0.774732
Sanofi	0.715137
National Institute of Allergy and Infectious Diseases (NIAID)	0.595948
Aerie Pharmaceuticals	0.595948
Actelion	0.595948
Genentech, Inc.	0.595948
Alliance for Clinical Trials in Oncology|National Cancer Institute (NCI)	0.595948
Wyeth is now a wholly owned subsidiary of Pfizer	0.476758
Genzyme, a Sanofi Company|Sanofi	0.476758
Bristol-Myers Squibb	0.476758
Grifols Therapeutics LLC	0.417163
BioMarin Pharmaceutical	0.417163
National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK)	0.417163

...	...
	sponsors_collaborators
Charite University, Berlin, Germany|Novartis Pharmaceuticals	0.059595
Dr Madeleine Wilwerth|Brugmann University Hospital	0.059595
Shirley Ryan AbilityLab|Nexstim Ltd	0.059595
Michael A. Rogawski, MD, PhD|United States Department of Defense|University of California, Davis	0.059595
Duke University|National Heart, Lung, and Blood Institute (NHLBI)	0.059595
Sunovion	0.059595
GlaxoSmithKline|PATH|Department of State for Health and Social Welfare, The Gambia|Medical Research Council Unit, The Gambia|London School of Hygiene and Tropical Medicine	0.059595
PD Dr Markus MÃ¶hler|Johannes Gutenberg University Mainz|Interdisciplinary Center for Clinical Trials (IZKS)	0.059595
Seoul National University Hospital|Korea OIAA	0.059595
University of Washington|National Cancer Institute (NCI)	0.059595
University of Florida|The University of Texas at San Antonio	0.059595
Johns Hopkins Bloomberg School of Public Health|National Eye Institute (NEI)|National Institute of Allergy and Infectious Diseases (NIAID)|Johns Hopkins University|University of Wisconsin, Madison|Baylor College of Medicine|Tulane University School of Medicine|Icahn School of Medicine at Mount Sinai|New York Presbyterian Hospital|New York University|Northwestern University|University of California, Los Angeles|University of California, San Francisco|University of California, San Diego|University of Miami|University of North Carolina, Chapel Hill|Memorial Sloan Kettering Cancer Center	0.059595
Ranjan Dohil|Meritage Pharma, Inc.|University of California, San Diego	0.059595
Mayo Clinic|Novartis|National Center for Research Resources (NCRR)	0.059595
The Center for Clinical Research, Winston-Salem, NC	0.059595
Vanderbilt University Medical Center|National Center for Research Resources (NCRR)	0.059595
University of Minnesota - Clinical and Translational Science Institute|Mbarara University of Science and Technology|Makerere University|National Institute of Allergy and Infectious Diseases (NIAID)|University of Cape Town	0.059595
Hospices Civils de Lyon	0.059595
Oxford University Hospitals NHS Trust|Baxter Healthcare Corporation	0.059595
University of Washington|National Institute on Aging (NIA)|Solvay Pharmaceuticals	0.059595
Seattle Institute for Biomedical and Clinical Research|National Institute on Aging (NIA)|VA Puget Sound Health Care System	0.059595
Medical College of Wisconsin|Pediatric Emergency Care Applied Research Network	0.059595
University of Colorado, Denver|Forest Laboratories	0.059595
Gynecologic Oncology Associates|Merck Sharp & Dohme Corp.	0.059595
Robert Silbergleit|Medical University of South Carolina|University of California, San Francisco|National Institute of Neurological Disorders and Stroke (NINDS)|University of Michigan	0.059595
Promius Pharma, LLC	0.059595
The University of Texas Health Science Center, Houston|National Heart, Lung, and Blood Institute (NHLBI)	0.059595
VA Office of Research and Development|Emory University	0.059595
University of Iowa|Eli Lilly and Company	0.059595
Weill Medical College of Cornell University|Novartis	0.059595

849 rows × 1 columns

In [30]:

```
df1 = dfs.append(dfns)
```

In [ ]:

```
data = df1[['drug','biologic', 'behavioral', 'other', 'procedure', 'device', 'genetic', 'dietary',
'radiation', 'gender', 'age_category',
 'enrollment', 'study_type', 'study_duration','outside_us', 'us', 'both', 'country', 'location_cent
er', 'location_hospital', 'location_institute', 'location_university',
 'randomized_study', 'time_category_retrospective', 'time_category_prospective',
'time_category_other', 'time_category_longitudinal', 'time_category_cross_sectional',
  'masking', 'number_of_sponsors', 'number_of_locations','successful']].dropna()
```

In [ ]:

```
data.to_csv('log1.csv')
```

In [ ]:

```
#data = pd.concat([data,pd.get_dummies(data['status'],prefix='status')],axis=1)
#data = pd.concat([data,pd.get_dummies(data['study_results'],prefix='study_results')],axis=1)
#data = pd.concat([data,pd.get_dummies(data['funded_bys'],prefix='funded_by')],axis=1)
data = pd.concat([data,pd.get_dummies(data['randomized_study'],prefix='randomized_study')],axis=1)
data = pd.concat([data,pd.get_dummies(data['masking'],prefix='masking')],axis=1)
#data = pd.concat([data,pd.get_dummies(data['primary_purpose'],prefix='primary_purpose')],axis=1)
data = pd.concat([data,pd.get_dummies(data['gender'],prefix='gender')],axis=1)
data = pd.concat([data,pd.get_dummies(data['age_category'],prefix='age')],axis=1)
#data = pd.concat([data,pd.get_dummies(data['study_designs'],prefix='study_designs')],axis=1)
data = pd.concat([data,pd.get_dummies(data['study_type'],prefix='study_type')],axis=1)


data = data.drop(columns=['age_category','masking','gender','randomized_study','study_type'])
```

In [ ]:

```
b = {}
for disease in dfs['conditions'].value_counts().index:
    b['{}'.format(disease)] = (dfs['conditions'].str.find(disease)>=0).sum()

import operator
sorted_x = sorted(b.items(), key=operator.itemgetter(1),reverse=True)

c = pd.DataFrame(sorted_x)
```

In [467]:

```
df_rare['successful'].describe()
```

Out[467]:

```
count    12416.000000
mean         0.006927
std          0.082940
min          0.000000
25%          0.000000
50%          0.000000
75%          0.000000
max          1.000000
Name: successful, dtype: float64
```

In [7]:

```
rare_disease = ['Leukemia','Lymphoma','Ovarian Cancer','Myeloma','Melanoma']
s_rare_disease = ['Hypertension','Alzheimer\'s Disease','Glaucoma','Cystic
Fibrosis','Tuberculosis']
```

In [375]:

```
df[df['conditions'].str.find('Lymphoma')>0]['nct_number'].count()
```

Out[375]:

```
3847
```

In [8]:

```
df_rare = df1[(df1['conditions'].str.find('Leukemia')>0)|(df1['conditions'].str.find('Lymphoma')>0)
|(df1['conditions'].str.find('Ovarian Cancer')>0)
    |(df1['conditions'].str.find('Myeloma')>0)|(df1['conditions'].str.find('Melanoma')>0)]
```

In [9]:

```
df_nrare = df1[(df1['conditions'].str.find('Malaria')>0)|(df1['conditions'].str.find('Leukemia')>0)
|(df1['conditions'].str.find('Cystic Fibrosis')>0)
    |(df1['conditions'].str.find('Dengue')>0)|(df1['conditions'].str.find('Tuberculosis')>0)]
    |(df['conditions'].str.find('Dengue')>0)|(df['conditions'].str.find('Tuberculosis')>0)]
```

In [32]:

```
df_nrare['condition'] = ''
for disease in s_rare_disease:
    df_nrare['condition'] = np.where(df_nrare['conditions'].str.find('{}'.format(disease))>0,'{}'.f
ormat(disease),df_nrare['condition'])
```

```
C:\Users\Sarvesh Shah\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: 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: http://pandas.pydata.org/pandas-
docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
C:\Users\Sarvesh Shah\Anaconda3\lib\site-packages\ipykernel_launcher.py: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: http://pandas.pydata.org/pandas-
docs/stable/indexing.html#indexing-view-versus-copy
  This is separate from the ipykernel package so we can avoid doing imports until
```

In [64]:

```
df_nrare['condition'].value_counts()
```

Out[64]:

```
Leukemia           3913
Tuberculosis        337
Malaria             243
Cystic Fibrosis     111
Dengue               12
Name: condition, dtype: int64
```

In [57]:

```
df_rare.agg({
    'enrollment':'mean',
    'number_of_sponsors':'mean',
    'study_duration':'mean',
    'nct_number':'count'
    #'funded_bys': lambda x: x.str.strip('|').len(),
})
```

Out[57]:

```
enrollment            1.041091e+04
number_of_sponsors    1.777077e+00
study_duration       -6.822952e+18
nct_number            1.031300e+04
dtype: float64
```

In [58]:

```
df_rare['nct_number'].count()
```

Out[58]:

```
10313
```

In [ ]:

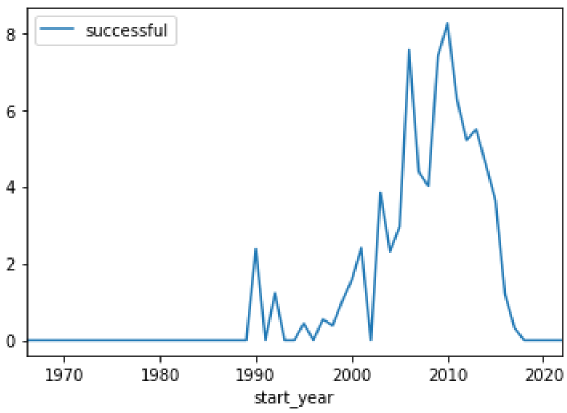
```
df[df['conditions'].str.find('Leukemia')>0]
```

In [434]:

```
(df1.groupby('start_year')[['successful']].mean()*100).plot()
```

Out[434]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x133a2fd3630>
```



In [475]:

```
n1 = 12416
n2 = 2041

n1 + n2 -2
```

Out[475]:

```
14455
```

In [482]:

```
p1 = 0.797
p2 = 0.697
q1 = 1-p1
q2 = 1-p2

 (p1 - p2)/math.sqrt((p1*q1/n1) + (p2*q2/n2))
```

Out[482]:

```
9.264617328216238
```

In [486]:

```
math.sqrt(1/n1 + 1/n2)
```

Out[486]:

```
0.02388508197771247
```

In [20]:

```
df['start_date'].sort_values()
```

Out[20]:

```
49068   1966-07-01
44063   1971-04-01
49206   1972-06-01
49042   1973-01-01
49056   1975-01-01
4289    1975-06-01
49069   1976-01-23
5137    1976-02-01
30585   1976-03-01
43865   1976-03-03
49118   1976-06-01
49119   1976-06-01
```

```
50992   1976-06-01
46249   1976-11-23
49053   1977-01-01
49133   1977-03-21
49054   1977-05-23
43866   1977-05-31
23920   1977-07-01
49125   1977-09-01
54314   1977-09-01
33042   1977-10-01
37114   1978-01-01
49315   1978-01-01
7734    1978-01-01
62650   1978-07-01
13779   1978-07-01
49143   1978-07-01
61679   1978-08-01
55580   1978-09-01
           ...
49006          NaT
49007          NaT
49008          NaT
49009          NaT
49010          NaT
49011          NaT
49012          NaT
49013          NaT
49014          NaT
49015          NaT
49016          NaT
49017          NaT
49018          NaT
49019          NaT
49020          NaT
49021          NaT
49022          NaT
49023          NaT
49024          NaT
49025          NaT
49026          NaT
49027          NaT
49028          NaT
49029          NaT
49031          NaT
49032          NaT
49033          NaT
49034          NaT
49035          NaT
49036          NaT
Name: start_date, Length: 64698, dtype: datetime64[ns]
```