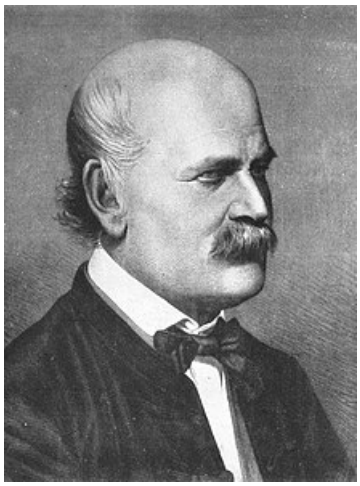
1. This is Dr. Ignaz Semmelweis discover of handwashing



Dr Ignaz is was a Hungarian physician and scientist, now known as an early pioneer of antiseptic procedures. Described as the "saviour of mothers", Semmelweis discovered that the incidence of puerperal fever (also known as "childbed fever") could be drastically cut by the use of hand disinfection in obstetrical clinics. Puerperal fever was common in mid-19th-century hospitals and often fatal.*childbed fever*: A deadly disease affecting women that just have given birth. In the early 1840s at the Vienna General Hospital as many as 10% of the women giving birth die from it. Dr Ignaz believed the cause of childbed fever was the contaminated hands of the doctors delivering the babies.

In this notebook, I want to reanalyze the data that made Semmelweis discover the importance of *handwashing*. As we all know covid19 is the hot health issue around the world currently. I would like to use this analysis to emphazie the importance of washing your hands. Understand that a simple act of washing your hands could be the line between life and death. Dr Ignaz was nice enough to help us with some data to back up his claim and we will analyze Dr Ignaz's data to help him prove he was right.
If you are interested in learning more about the good Dr kindly follow this wikipedia link

In [9]:

```
#The first thing i will do is to import all the modules a.k. random stuffs to perform the analysis
import pandas as pd
import numpy as np
import seaborn as sns
#importing the yearly data observed by the DR
yearly = pd.read_csv('datasets/yearly_deaths_by_clinic.csv')
```

In [13]:

```
#exploratory analysis
print(yearly)
yearly.describe()
```

```
    year  births  deaths    clinic
0   1841    3036     237  clinic 1
1   1842    3287     518  clinic 1
2   1843    3060     274  clinic 1
3   1844    3157     260  clinic 1
4   1845    3492     241  clinic 1
5   1846    4010     459  clinic 1
6   1841    2442      86  clinic 2
7   1842    2659     202  clinic 2
8   1843    2739     164  clinic 2
9   1844    2956      68  clinic 2
10  1845    3241      66  clinic 2
11  1846    3754     105  clinic 2
```

Out[13]:

	year	births	deaths
count	12.000000	12.000000	12.000000
mean	1843.500000	3152.750000	223.333333
std	1.783765	449.078476	145.383089
min	1841.000000	2442.000000	66.000000
25%	1842.000000	2901.750000	100.250000
50%	1843.500000	3108.500000	219.500000
75%	1845.000000	3338.250000	263.500000
max	1846.000000	4010.000000	518.000000

What can we observe from this data?

1) The Doctor gathered data from two clinics and we can see clinic 1 and clinic 2 specifying the data for each clinic.
2)The highest number of death was recorded in the year 1846 at clinic 1
3)If we simply eyeball the data we can notice how clinic 2 has a lower death rate compared to clinic 1, but lets take a deep dive and validate this.

In [46]:

```
#lets get the percentage rate of death to births

yearly['death rate'] = yearly.deaths/yearly.births

#for every 100 births around 8 of them died in 1841(scary)
#lets break down the data into their respective clinics

clinic1 = yearly[yearly['clinic']=='clinic 1']
clinic2 = yearly[yearly['clinic']=='clinic 2']

clinic1
```

Out[46]:

	year	births	deaths	clinic	death rate
0	1841	3036	237	clinic 1	0.078063
1	1842	3287	518	clinic 1	0.157591
2	1843	3060	274	clinic 1	0.089542
3	1844	3157	260	clinic 1	0.082357
4	1845	3492	241	clinic 1	0.069015
5	1846	4010	459	clinic 1	0.114464

In [47]:

```
#view clinic 2
clinic2
```

Out[47]:

	year	births	deaths	clinic	death rate
6	1841	2442	86	clinic 2	0.035217
7	1842	2659	202	clinic 2	0.075968
8	1843	2739	164	clinic 2	0.059876
9	1844	2956	68	clinic 2	0.023004
10	1845	3241	66	clinic 2	0.020364
11	1846	3754	105	clinic 2	0.027970

Average yearly date for each clinics

We want to see the average deaths yearly for this clinics over 6 years

In [65]:

```
#lets get the average death for the differnet clinics
average_death1 = np.mean(clinic1.deaths)
average_death2 = np.mean(clinic2.deaths)

print('the average yearly death for clinic 1 is ' + str( int(average_death1)))
print('the average yearly death for clinic 2 is ' + str( int(average_death2)) )
```

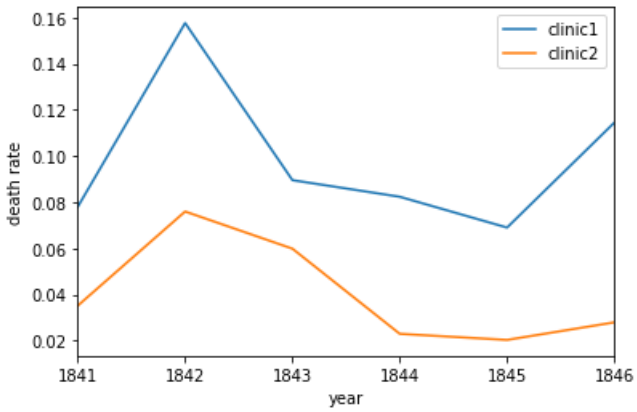
```
the average yearly death for clinic 1 is 331
the average yearly death for clinic 2 is 115
```

In [73]:

```
#let us plot this to get a better view
%matplotlib inline
ax = clinic1.plot(x="year", y="death rate",
                  label="clinic1")
clinic2.plot(x="year", y="death rate",
             label="clinic2", ax=ax)
ax.set_ylabel("death rate")
```

Out[73]:

```
Text(0, 0.5, 'death rate')
```



Explanation for the low death rate in clinic 2

the difference between the two clinics was that many medical students served at Clinic 1, while mostly midwife students served at Clinic 2. While the midwives only tended to the women giving birth, the medical students also spent time in the autopsy rooms examining corpses. Dr Ignaz suspected that something on the corpses, spread from the hands of the medical students, caused childbed fever. So he suggested people start Washing their hands! But like we are all doing right now no one listened to the Dr.

let us check out the monthly data gathered by Dr Ignaz

In [87]:

```
#loading the monthly data showing monthly death rates and birth
monthly = pd.read_csv('datasets/monthly_deaths.csv',
    parse_dates=["date"])

monthly.head(10)
```

Out[87]:

	date	births	deaths
0	1841-01-01	254	37
1	1841-02-01	239	18
2	1841-03-01	277	12
3	1841-04-01	255	4
4	1841-05-01	255	2
5	1841-06-01	200	10
6	1841-07-01	190	16
7	1841-08-01	222	3
8	1841-09-01	213	4
9	1841-10-01	236	26

In [88]:

```
#let us get death rate for monthly
monthly['death rate'] = monthly.deaths/monthly.births
monthly
```

Out[88]:

	date	births	deaths	death rate
0	1841-01-01	254	37	0.145669
1	1841-02-01	239	18	0.075314
2	1841-03-01	277	12	0.043321
3	1841-04-01	255	4	0.015686
4	1841-05-01	255	2	0.007843
...	...	...	...	...
93	1848-11-01	310	9	0.029032
94	1848-12-01	373	5	0.013405
95	1849-01-01	403	9	0.022333
96	1849-02-01	389	12	0.030848
97	1849-03-01	406	20	0.049261

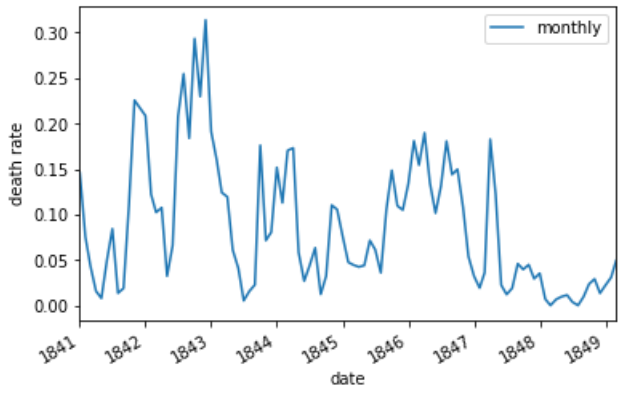
98 rows × 4 columns

In [89]:

```
#let us plot this to get a better view
%matplotlib inline
ax = monthly.plot(x="date", y="death rate",
                  label="monthly")
ax.set_ylabel("death rate")
```

Out[89]:

```
Text(0, 0.5, 'death rate')
```



Effect of handwashing

We can see around mid year 1847 the death rate reduced and this was due to the implementation of the hand washing rule

Segment plot into before and after handwashing

Let us break the plot into two so we can visualize the effects of handwashing better.
Handwashing started mid year 1847, lets segment our data

In [99]:

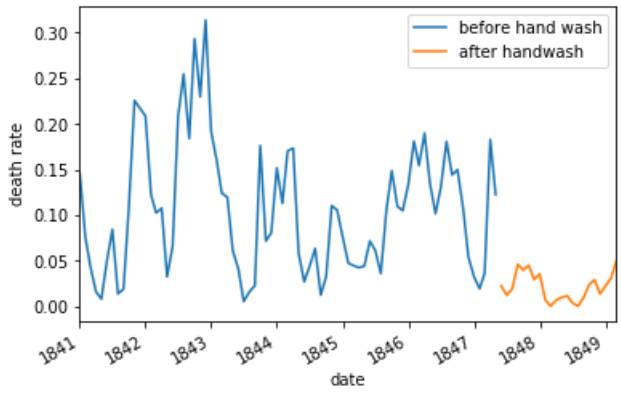
```
monthly.head(10)
handwashing_start = pd.to_datetime('1847-06-01')
```

```
before_handwash = monthly[monthly['date'] < handwashing_start]
After_handwash = monthly[monthly['date'] >= handwashing_start]

ax = before_handwash.plot(x="date", y="death rate",
              label="before hand wash")
After_handwash.plot(x="date", y="death rate",
         label="after handwash", ax=ax)
ax.set_ylabel("death rate")
```

Out[99]:

```
Text(0, 0.5, 'death rate')
```



In [118]:

```
#Difference in the deat average before and after handwashing
```

Out[118]:

```
0.10504998260908793
```

In [137]:

```
before_proportion = before_handwash['death rate']
after_proportion = After_handwash['death rate']
mean_diff = np.mean(after_proportion) - np.mean(before_proportion)
mean_diff
```

Out[137]:

```
-0.0839566075118334
```

A Bootstrap analysis

for inference problems like this result of a single measurement might not really prove our point so lets get a more general reperesentaion by simulating data.

In [140]:

```
# A bootstrap analysis of the reduction of deaths due to handwashing
boot_mean_diff = []
for i in range(3000):
    boot_before = before_proportion.sample(frac=1, replace=True)
    boot_after = after_proportion.sample(frac=1, replace=True)
    boot_mean_diff.append( boot_after.mean() - boot_before.mean() )

# Calculating a 95% confidence interval from boot_mean_diff
confidence_interval = pd.Series(boot_mean_diff).quantile([0.025,0.975])
confidence_interval
```

Out[140]:

```
0.025   -0.100444
0.975   -0.067420
dtype: float64
```

dtype: float64

This shows that handwashing reduces the proportion of deaths by between 6.7 and 10 percentage points

In [ ]: