

# Exploring and identifying potential healthcare holes in Victoria

Group Three

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# Project description

Identifying areas of population growth in Victoria and the health services available to the corresponding areas. Visualizing the relationship between population growth and corresponding health outcomes and mortality rate.

## Research questions

1. Identifying areas of population growth in Victoria as defined by LGAs
2. Health services are defined by Tertiary (hospitals)and primary healthcare services (GP clinic and pharmacy) available.
3. Comparing patient wait time at hospitals in Victoria whilst analyzing trends in population growth.
4. Compare access to healthcare services and mortality rates (deaths per 100,000) in Victorian LGAs.
5. Identify the percentage of the population that have higher health care needs (e.g., population-dense in 0-4-year-olds and >70-year-olds ) in our top 14 LGAs.

# Target audience

- State / national government - to help them decide where to direct healthcare funding
- City planners to help them identify areas that need more healthcare infrastructure

# Data sources used

- Australian Bureau of Statistics
- DEWLP
- Medicare
- Australian Institute of Health

# Cleaning process

```
In [2]: file = "Data/Q1_rebased_2021_erp.xlsx"

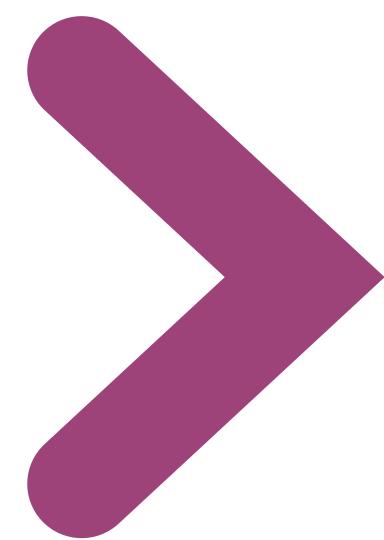
In [3]: #Read the file
pop_df = pd.read_excel(file, decimal=',')
pop_df

Out[3]:
```

	LGA code	Local Government Area	2001	2002	2003	2004	2005	2006	2007	2008	...
0	20110	Alpine	12709.0	12655.0	12581.0	12432.0	12372.0	12260.0	12227.0	12156.0	...
1	20260	Ararat	11544.0	11566.0	11536.0	11510.0	11452.0	11422.0	11363.0	11344.0	...
2	20570	Ballarat	82333.0	83168.0	84190.0	84775.0	85663.0	86647.0	87796.0	89531.0	...
3	20660	Banyule	117967.0	117559.0	117313.0	116661.0	117149.0	117963.0	119362.0	120580.0	...
4	20740	Bass Coast	25243.0	25809.0	26224.0	26476.0	26894.0	26941.0	27408.0	27981.0	...
...	...	...	...	...	...	...	...	...	...	...	
82	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
83	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
84	Source: Regional population, 2021	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
85	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
86	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...

87 rows × 27 columns

```
<ipython-input-3-1234567890>
```



```
In [2]: Change in pop - 16-21    dtype: object

In [3]: #TOP 14th growth cities

In [9]: #Find top Population growth
pop_top5_df = pop_new_df.sort_values(by=["Change in pop - 16-21"], ascending=False)
pop_top5_df

out[9]:
```

	Local Government Area	2016	2021	Change in pop - 16-21
75	Wyndham	227008.0	296193.0	69185.0
13	Casey	312789.0	369453.0	56664.0
32	Hume	207041.0	246850.0	39809.0
44	Melton	141420.0	181223.0	39803.0
26	Greater Geelong	239529.0	270776.0	31247.0
...	...	...	...	...
63	Stonnington	111003.0	106278.0	-4725.0
17	Darebin	155126.0	150335.0	-4791.0
58	Port Phillip	108627.0	103508.0	-5119.0
8	Boroondara	177276.0	169901.0	-7375.0
9	Brimbank	204190.0	196712.0	-7478.0

80 rows × 4 columns

```
In [10]: #Find top population growth by Percentages
pop_top5_df["Percentage(%) of Growth"] = round((pop_top5_df["Change in pop - 16-21"]/pop_top5_df["2016"])*100)
pop_top5_df.head()
```

# **Question one**

Identifying areas of population growth in Victoria as defined by LGAs (Local Government Area)

## **Data used**

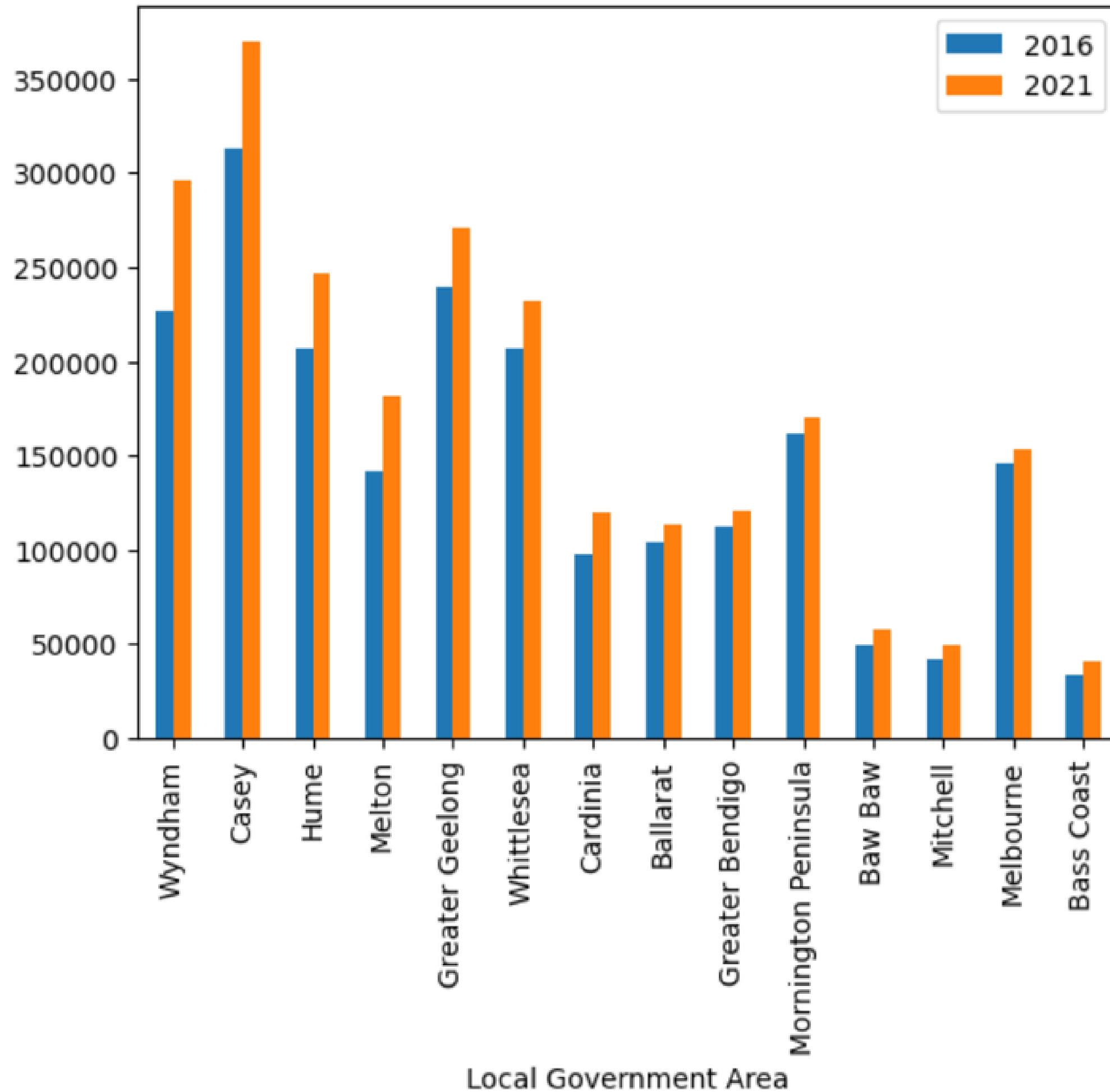
1. Population data from the Australian Bureau of Statistics (ABS) 2016 and 2021- to identify the areas of the largest population growth

# All cleaned up..

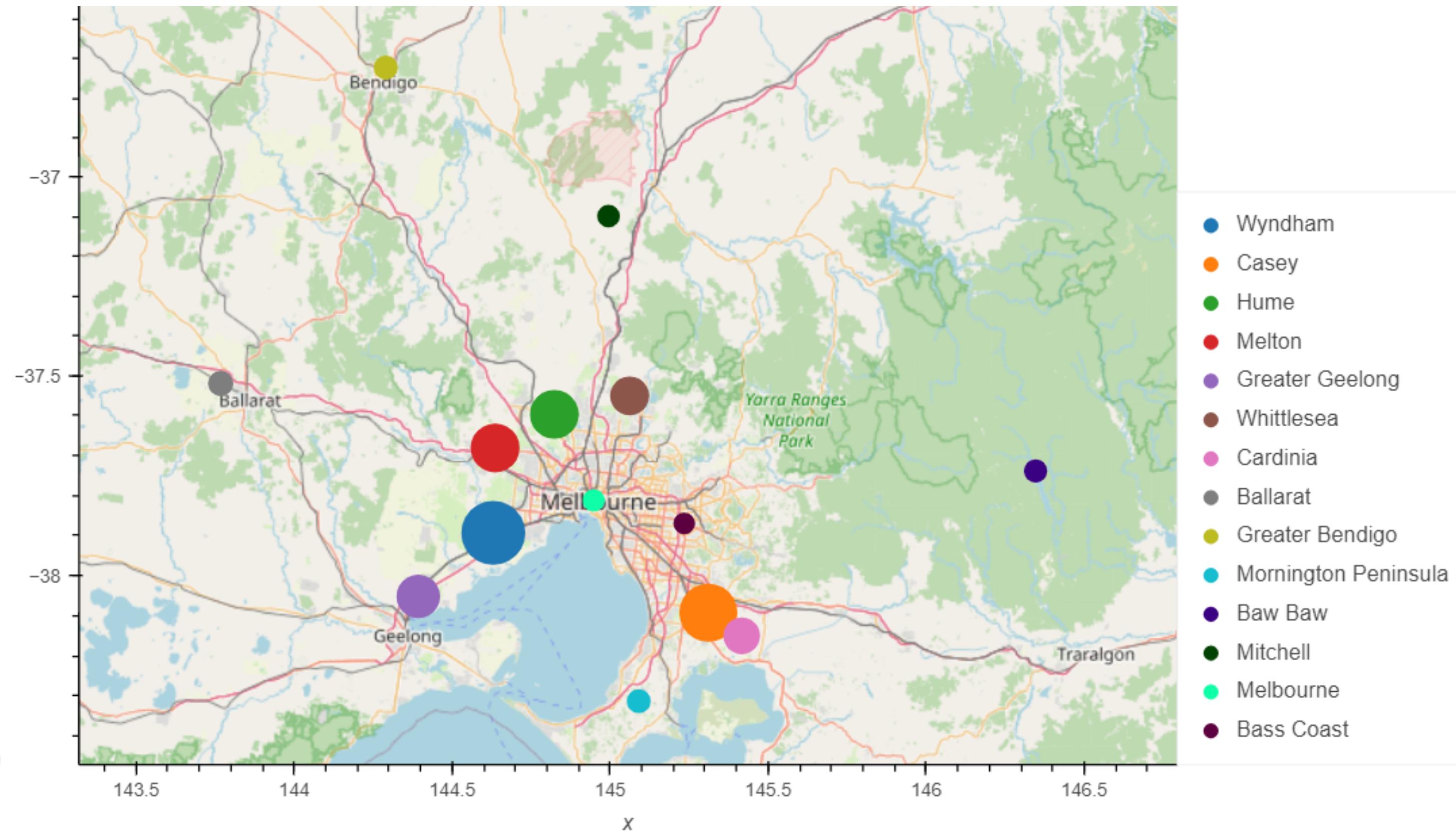
<b>Local Government Area</b>	<b>2016</b>	<b>2021</b>	<b>Change in pop - 16-21</b>	<b>Percentage(%) of Growth</b>
Wyndham	227008.0	296193.0	69185.0	30.48
Casey	312789.0	369453.0	56664.0	18.12
Hume	207041.0	246850.0	39809.0	19.23
Melton	141420.0	181223.0	39803.0	28.15
Greater Geelong	239529.0	270776.0	31247.0	13.05
Whittlesea	207058.0	231799.0	24741.0	11.95
Cardinia	97573.0	119521.0	21948.0	22.49
Ballarat	103500.0	113482.0	9982.0	9.64
Greater Bendigo	112267.0	121221.0	8954.0	7.98
Mornington Peninsula	161528.0	170390.0	8862.0	5.49
Baw Baw	49296.0	57580.0	8284.0	16.80
Mitchell	41795.0	49684.0	7889.0	18.88
Melbourne	146096.0	153674.0	7578.0	5.19
Bass Coast	33464.0	40641.0	7177.0	21.45

- The areas are identified as LGAs (local government areas )
- Classifying areas into either greater Melbourne or regional Victoria
- Population growth was observed in both groups and was not limited to just one area

# Identifying regions of population growth



# Depicting the growth



# Question two

Health services as defined by Tertiary (hospitals)and primary healthcare services ( pharmacy and GP services) available in the identified population growth areas.

## Data used

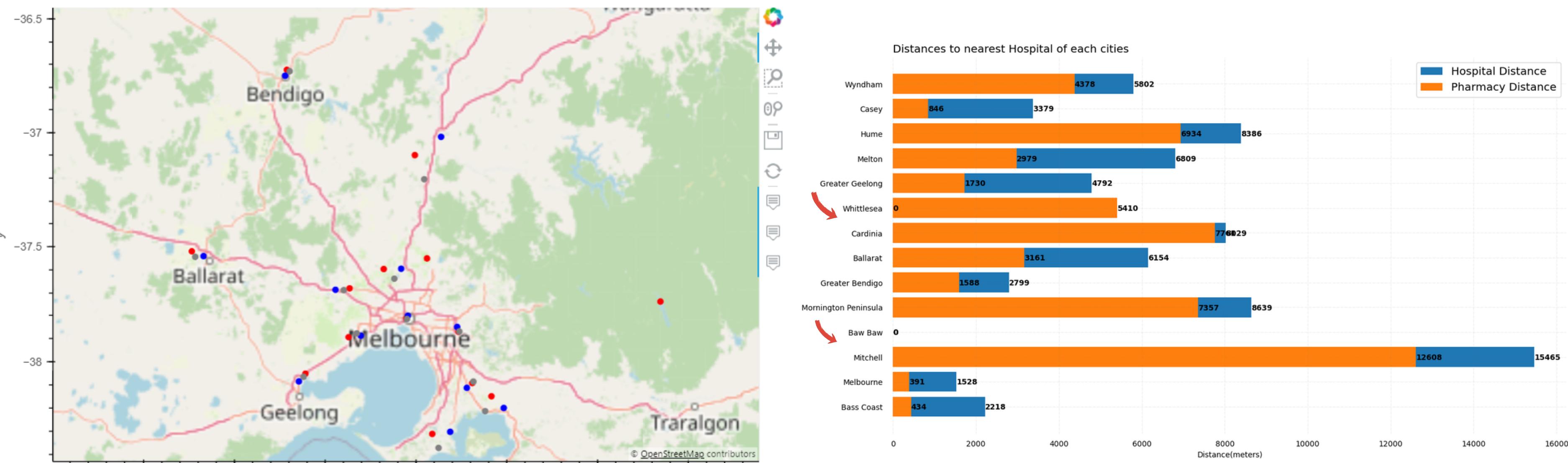
- My hospital planning data from the ABS website which provides the longitude and latitudes of hospitals in Victoria

# All cleaned up ...

Local Government Area	Longitude	Latitude	Hospital name	Hospital Distance	Hospital Latitude	Hospital Longitude	Pharmacy name	Pharmacy Distance	Pharmacy Latitude	Pharmacy Longitude
Wyndham	144.630237	-37.893689	Werribee Mercy Hospital	5802	-37.887128	144.697714	Chemist Warehouse	4378	-37.877084	144.675553
Casey	145.310842	-38.092627	Cranbourne Integrated Care Centre	3379	-38.113481	145.281069	Chemist Warehouse	846	-38.086505	145.316905
Hume	144.823708	-37.597152	Craigieburn Health Service	8386	-37.595697	144.919647	Direct Chemist Outlet Greenvale	6934	-37.639117	144.881884
Melton	144.635969	-37.681295	Melton Health	6809	-37.687464	144.558226	Chemist Warehouse	2979	-37.688967	144.603601
Greater Geelong	144.392813	-38.052098	Barwon Health North	4792	-38.085682	144.356768	Chemist Warehouse	1730	-38.065679	144.382886
Whittlesea	145.061881	-37.550731	No Hospital found	0	0.000000	0.000000	Chemist Warehouse	5410	-37.593884	145.090357

- We isolated the LGAs and their corresponding hospitals and pharmacies and we were able to map their location using their longitudes and latitudes

# Top LGA's in terms of Population growth and their access to Medical Resources



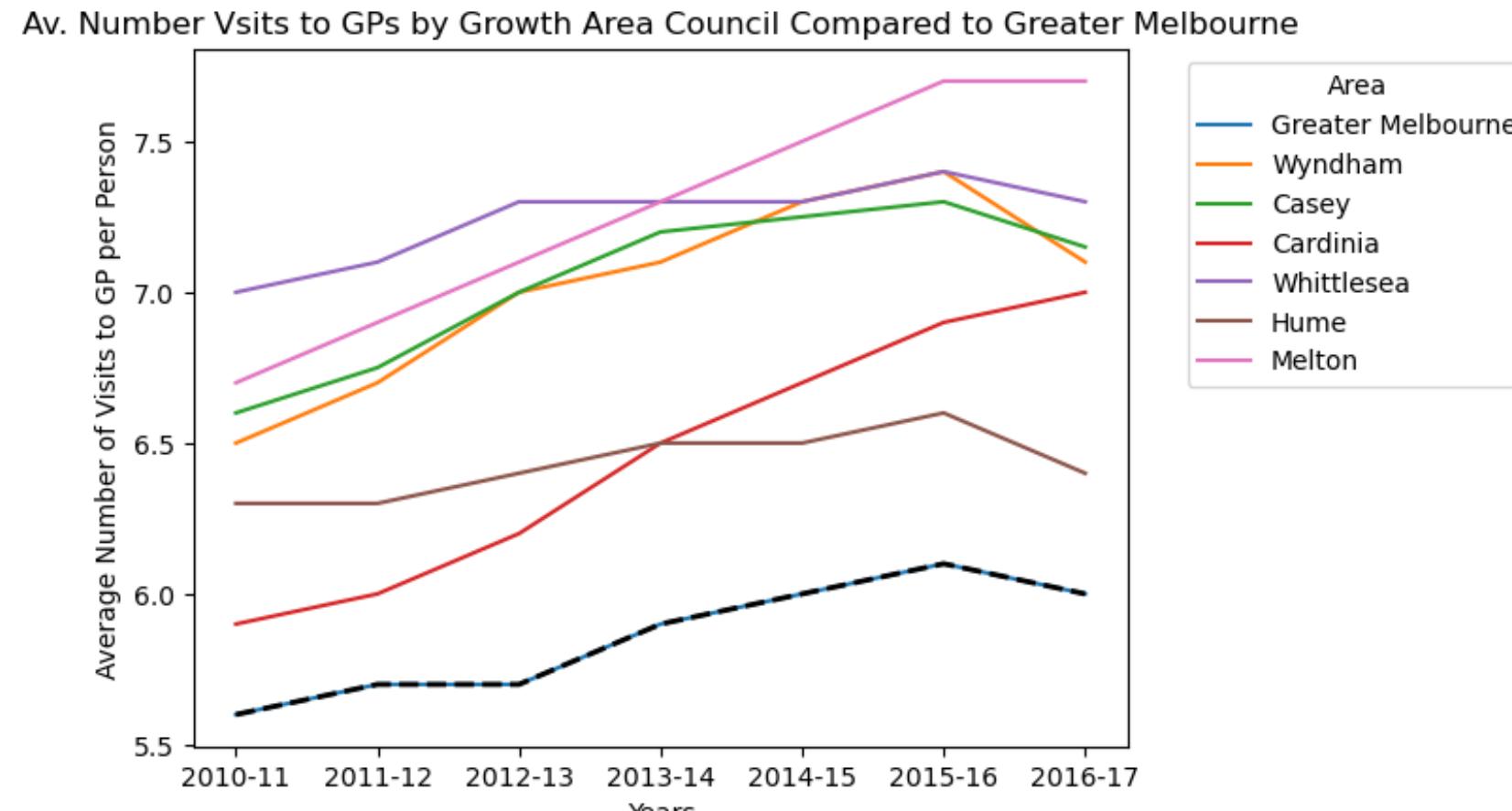
Access to Hospitals and Pharmacies for LGAs

Hospitals: Blue

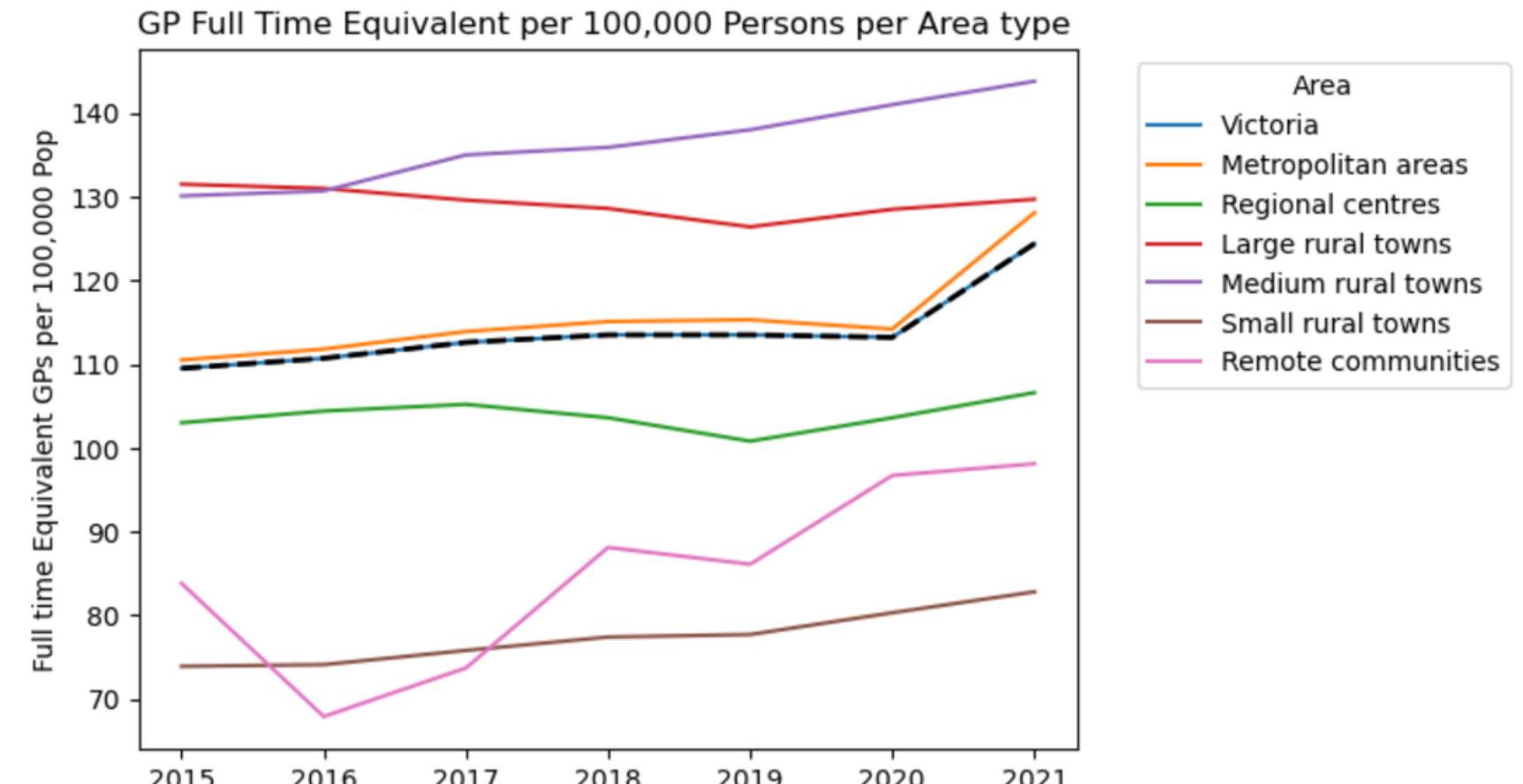
Pharmacies: Grey

LGA's: Red

# Number of GP visits over the years



Empirical Testing of GP Visits per Vic Resident Across Time  
Data Limitation: Time Frame



Empirical Testing of GP Full Time Equivalent per 100,000  
Persons per Area Type

# Question three

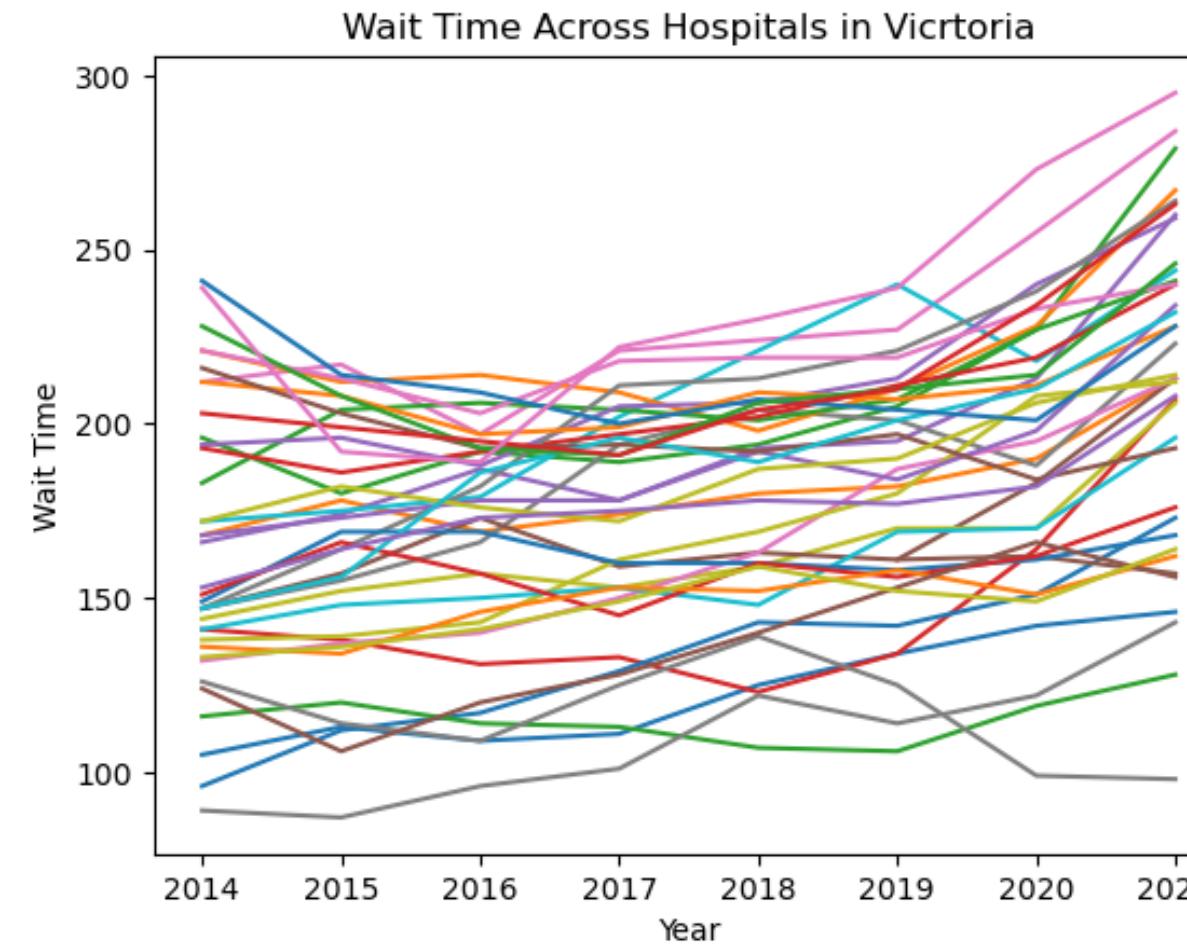
Comparing patient wait times at hospitals in Victoria and identifying correlations to population growth.

## Data used:

1. Hospital Wait time data from the Australian Institute of Health "Time Spent in Emergency Departments. "
2. Population data from the Australian Bureau of Statistics (ABS) 2016 and 2022 - to conduct Hypothesis Testing on Population Growth
3. Forecast Data from DEWLP to conduct Hypothesis Testing on Population Projections



# The average wait times across Hospitals in Victoria



- Albury Wodonga Health [Wodonga Campus]
- Angliss Hospital
- Austin Hospital [Heidelberg]
- Bairnsdale Regional Health Service
- Ballarat Health Services [Base Hospital]
- Bass Coast Health
- Box Hill Hospital
- Casey Hospital
- Central Gippsland Health Service [Sale]
- Dandenong Hospital
- Echuca Regional Health
- Latrobe Regional Hospital [Traralgon]
- Maroondah Hospital [East Ringwood]
- Mercy Hospital for Women
- Mildura Base Hospital
- Monash Medical Centre [Clayton]
- Northeast Health Wangaratta
- Rosebud Hospital
- Royal Children's Hospital [Parkville]
- Royal Melbourne Hospital [City Campus]
- Royal Women's Hospital [Parkville]
- Sandringham Hospital
- Sunshine Hospital
- Swan Hill District Health [Swan Hill]
- The Alfred
- The Bendigo Hospital
- The Northern Hospital [Epping]
- The Royal Victorian Eye & Ear Hospital
- University Hospital Geelong
- Werribee Mercy Hospital
- West Gippsland Healthcare Group [Warragul]
- Western District Health Service [Hamilton]
- Western Hospital [Footscray]

# Hypothesis Testing:

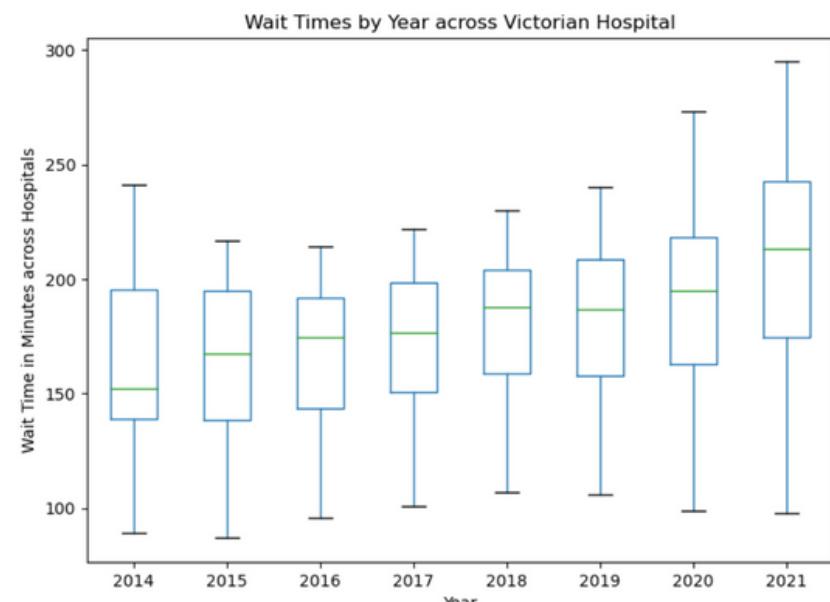
Test 1: Significant increase in emergency room wait times across Victoria between 2016 and 2021.

H0: No increase in wait time  
H1: Significant increase in wait time

```
#Results Test 1
var1 = filtered_df2["2016"]
var2 = filtered_df2["2021"]
t_stat, p_val = ttest_ind(var1, var2)
print("t-statistic: ", t_stat)
print("p-value: ", p_val)

t-statistic: -4.933441868247608
p-value: 4.829172627677075e-06
```

As the p-value is less than 5%, we reject the Null Hypothesis.



Test 2: Significant increase population growth across Victoria between 2016 and 2021.

H0: No increase in population.  
H1: Significant Increase in population

```
#Results Test 2
var1 = pop_new_df["2016"]
var2 = pop_new_df["2021"]
t_stat, p_val = ttest_ind(var1, var2)
print("t-statistic: ", t_stat)
print("p-value: ", p_val)

✓ 0.0s

t-statistic: -0.38968978529287657
p-value: 0.6972907268423381
```

As the p-value is greater than 5%, we ACCEPT the Null Hypothesis.



Test 3: Significant increase in population growth based on population projections btw 2016 and 2036

H0: No increase in projected population.  
H1: Significant Increase in projected population

```
#Results Test 3
var1 = projections_df["2016"]
var2 = projections_df["2036"]
t_stat, p_val = ttest_ind(var1, var2)
print("t-statistic: ", t_stat)
print("p-value: ", p_val)

✓ 0.0s

t-statistic: -2.09675936097621
p-value: 0.03760773080828961
```

As the p-value is less than 5%, we reject the Null Hypothesis.

This test came as a result of a limitation in test two where the 5-year difference in time failed to display a significant result in population growth

# Question Four:

Compare access to healthcare services and mortality rates (deaths per 100,000) in Victorian LGAs.

## Cleaned Data (from AIHW, using Jupyter Notebooks):

LGA Name	Council Seat	2016	2017	2018	2019	2020	Latitude	Longitude	Hospitals Count
Alpine (S)	Bright	577.58725	605.61581	583.11752	661.90792	436.90781	-36.728533	146.960772	3
Ararat (RC)	Ararat	600.02239	655.33077	540.50037	613.57958	479.59467	-37.284344	142.930621	1
Ballarat (C)	Ballarat	585.72869	593.06919	561.19884	633.37889	559.05232	-37.562303	143.860565	7
Banyule (C)	Ivanhoe	436.39145	462.37968	440.14928	506.36081	444.07029	-37.769031	145.043081	117
Bass Coast (S)	Wonthaggi	515.42624	573.58395	539.76999	538.90156	512.18662	-38.604366	145.591343	2
Baw Baw (S)	Warragul	530.12068	501.78193	520.52948	544.5596	538.8695	-38.158867	145.933629	2
Bayside (C)	Sandringham	430.75811	421.84162	388.8283	432.89781	419.74013	-37.953335	145.013931	103
Benalla (RC)	Benalla	573.28239	652.6398	565.98842	625.50367	585.29129	-36.548971	145.988352	1
Boroondara (C)	Camberwell	429.60169	415.63379	387.67728	415.13123	357.24911	-37.838462	145.074077	120
Brimbank (C)	Sunshine	543.63383	536.96005	502.0408	554.27149	501.51213	-37.789332	144.83427	85

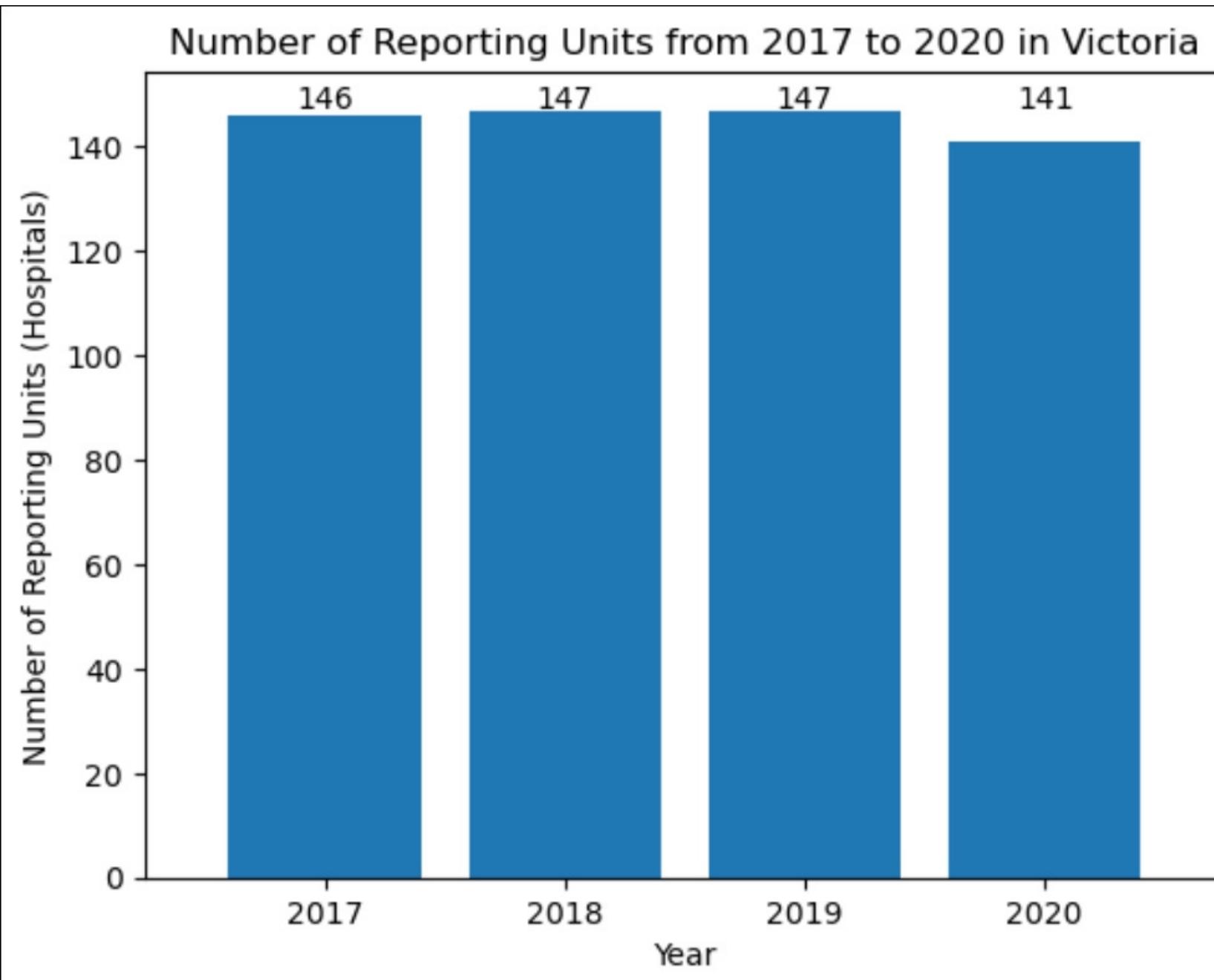
LGAs

Yearly Age-Standardised Adult Deaths (per 100,000)

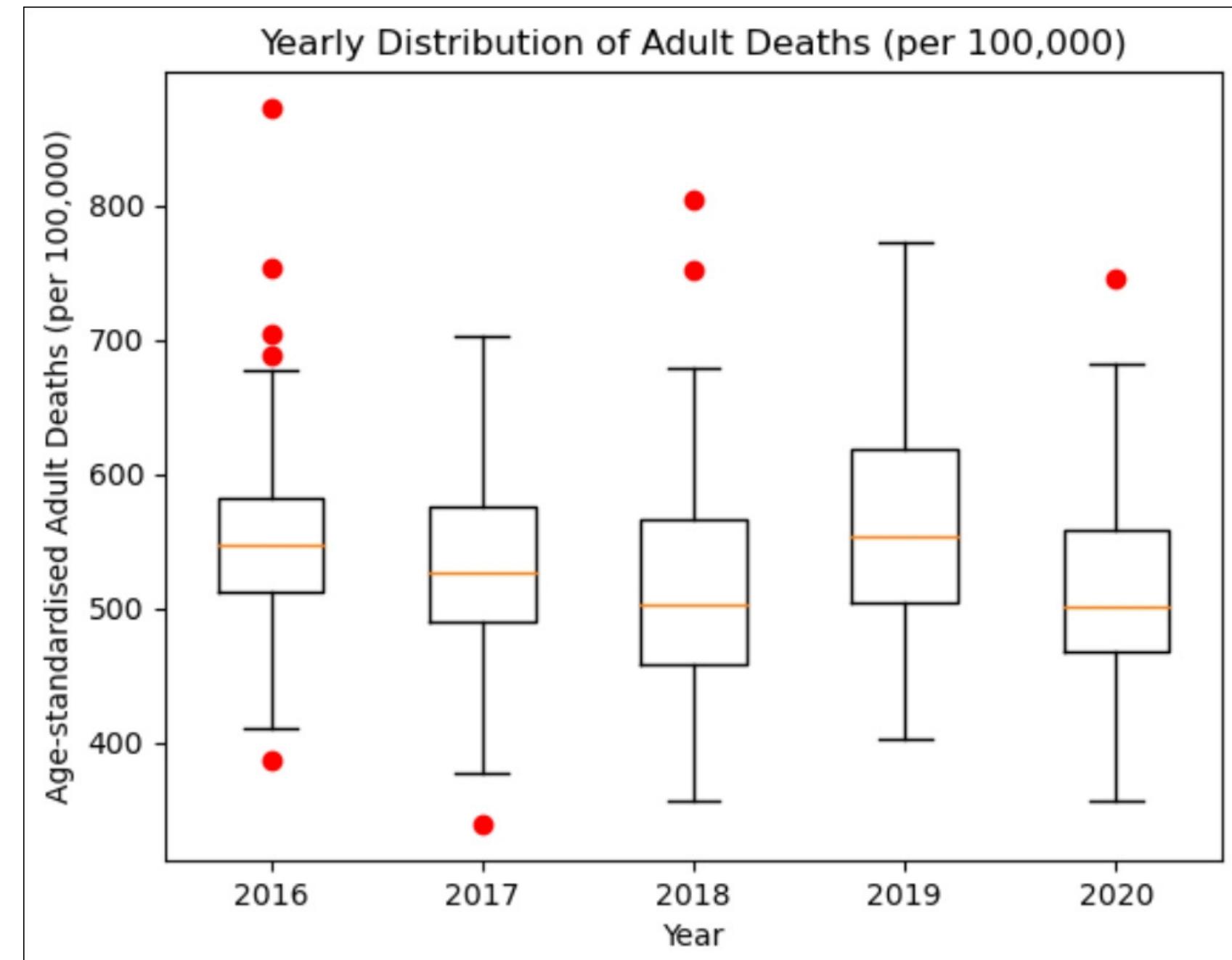
Geo-coordinates

Hospitals within 25km of LGA

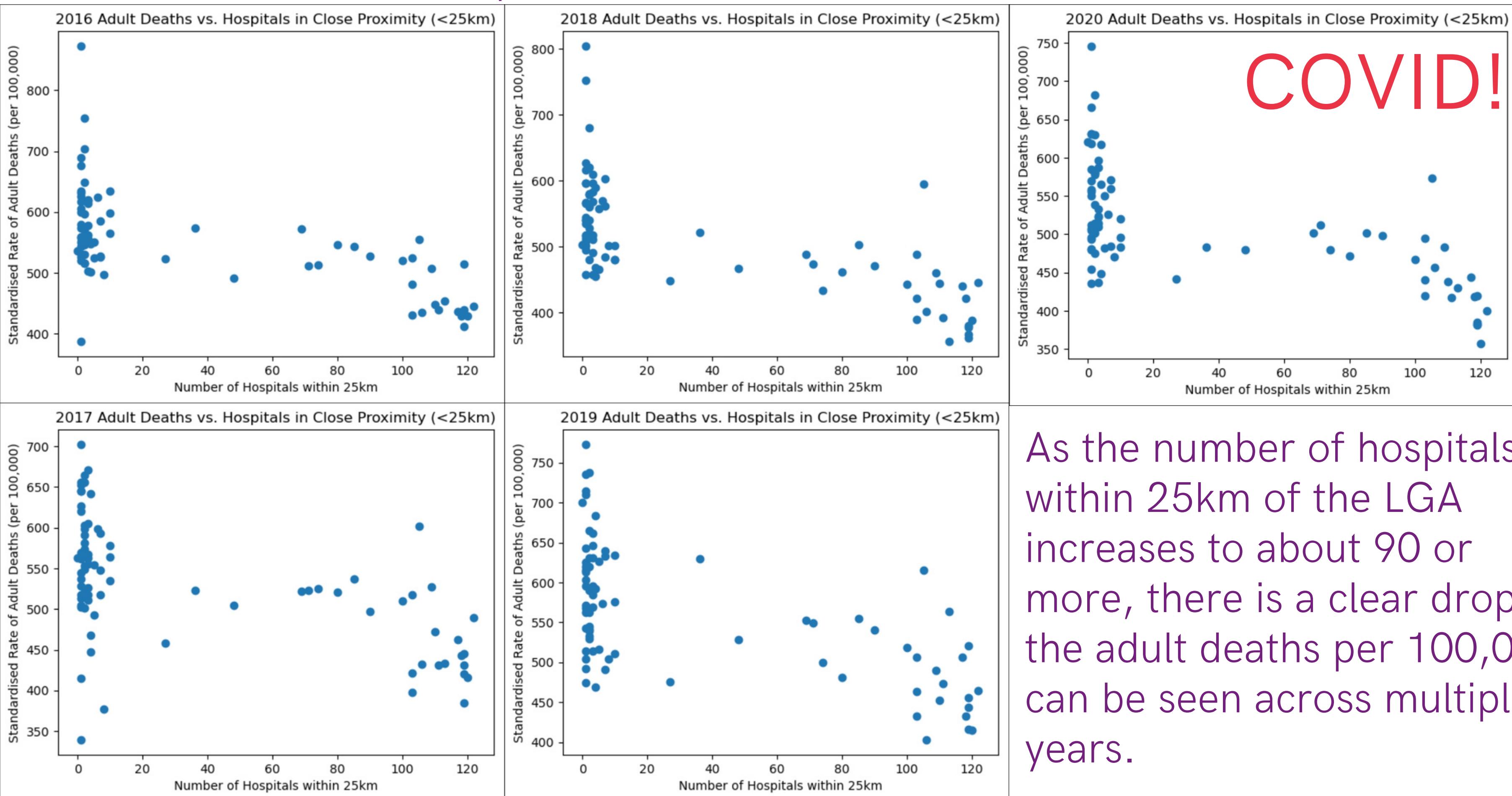
Assumption:  
Number of hospital resources is  
more/less the same over the years  
being investigated allowing hospital  
counts to be applied to all years for  
the death rates relationship.



Distribution of Adults Deaths Data:  
>> Medians are not vastly different.  
>> Skewness is consistent over the  
years.  
>> Yearly data is comparable with  
one another

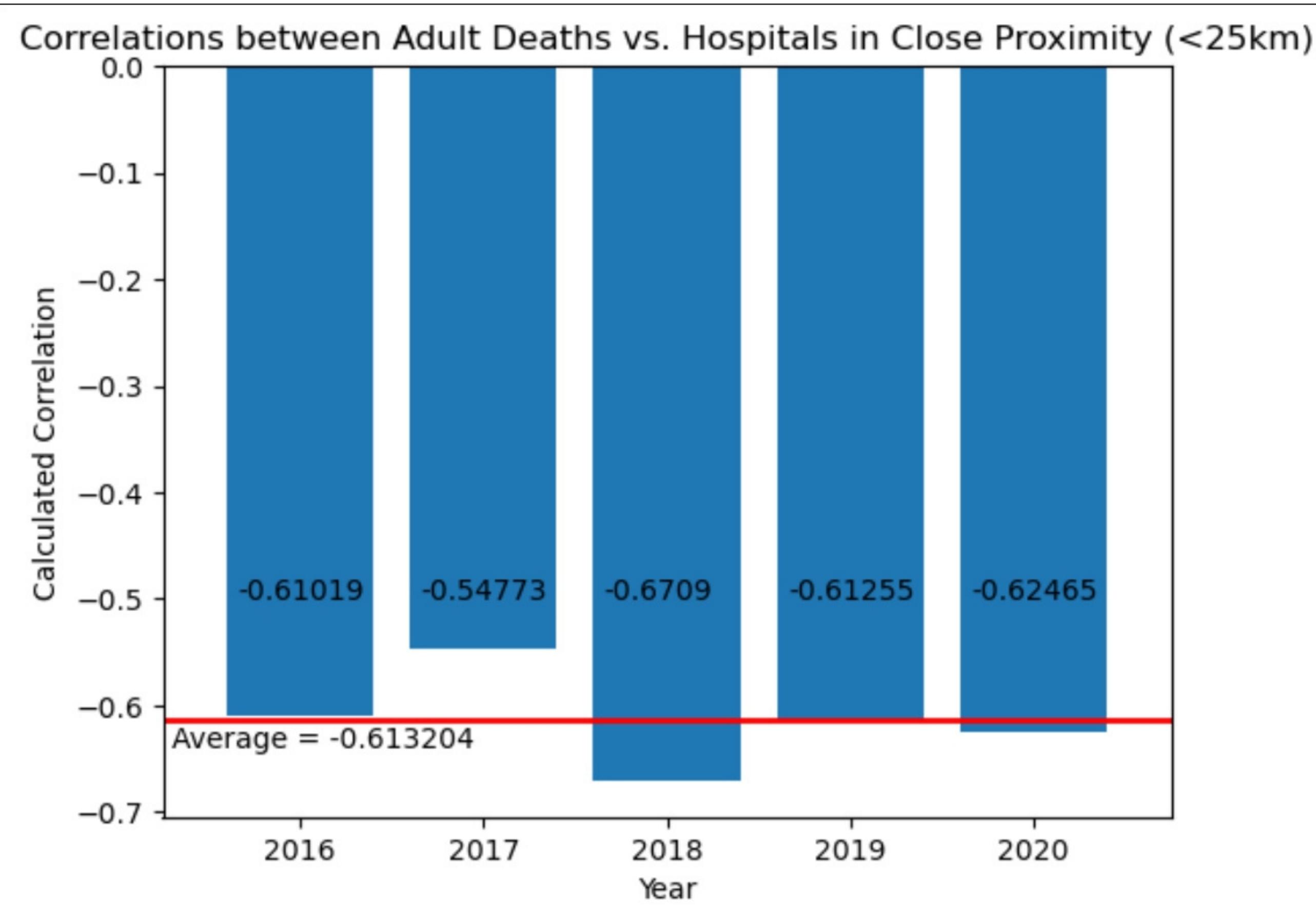


# Scatter Plots to show relationship between access to hospitals and age-standardised adult deaths (per 100,000)



# Correlation between access to hospitals and age-standardised adult deaths (per 100,000)

## More Hospitals = Less Death!



THE AVERAGE CORRELATION ACROSS THE YEARS IS ABOUT -0.613. IN CONCLUSION, THE NEGATIVE VALUE INDICATES AND INVERSE RELATIONSHIP. THE CONSISTENCY OF THESE MAGNITUDES SHOWS A PREVALENT RELATIONSHIP.

# Question five

Identify the percentage of the population that have higher health care needs (e.g., population-dense in 0-4-year-olds and >70-year-olds ) in our top 14 LGAs.

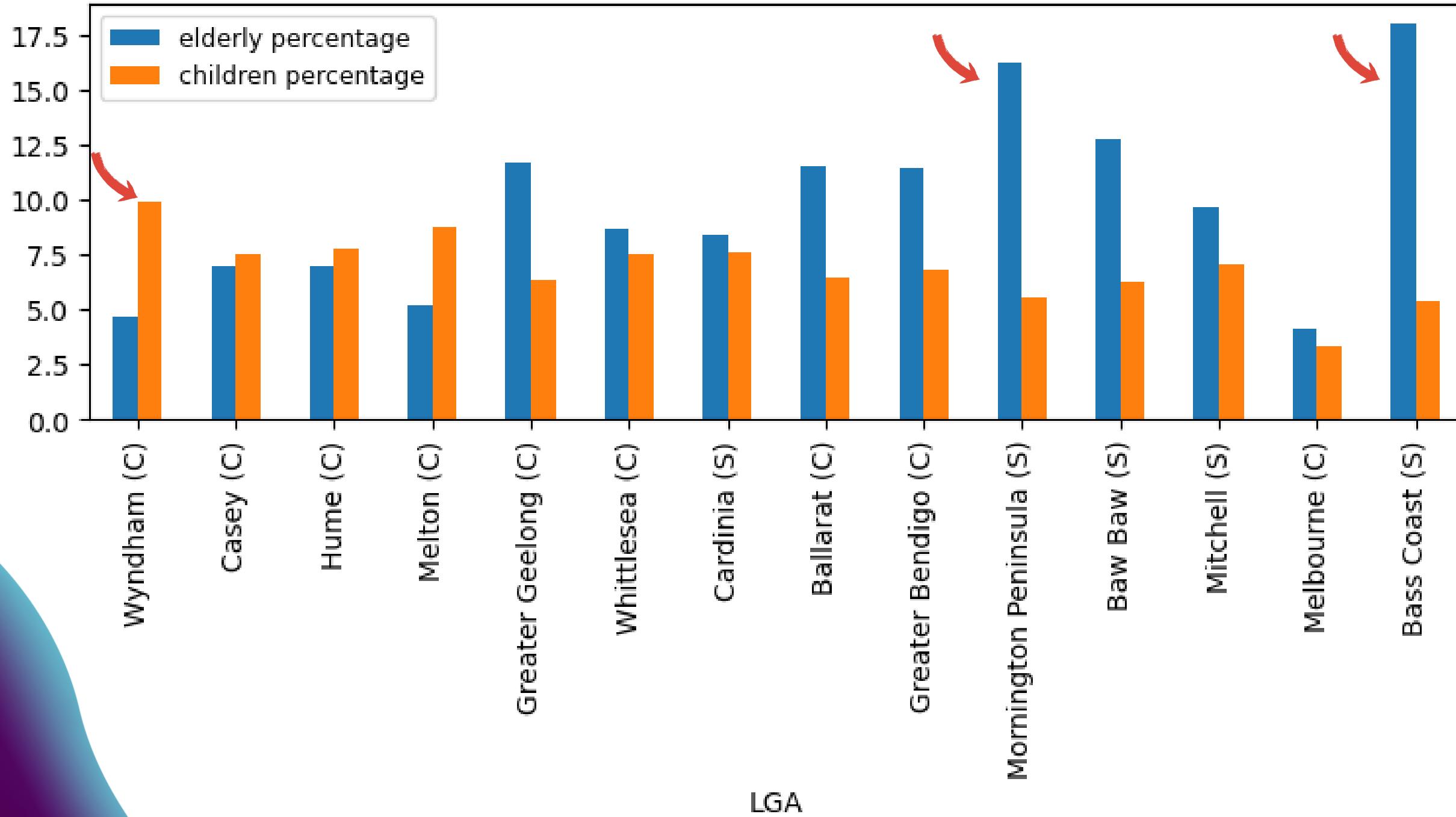
## Data used

- Population grouped into age by LGAs from the ABS website - to help calculate the percentage population over the age of 70 and under 4 in the top 14 LGAs identified in question one.
- Public hospitals geocoordinates data across Victoria
- Hospital resources data - Utilise hospital beds data to define hospital size

# Cleaned Data...

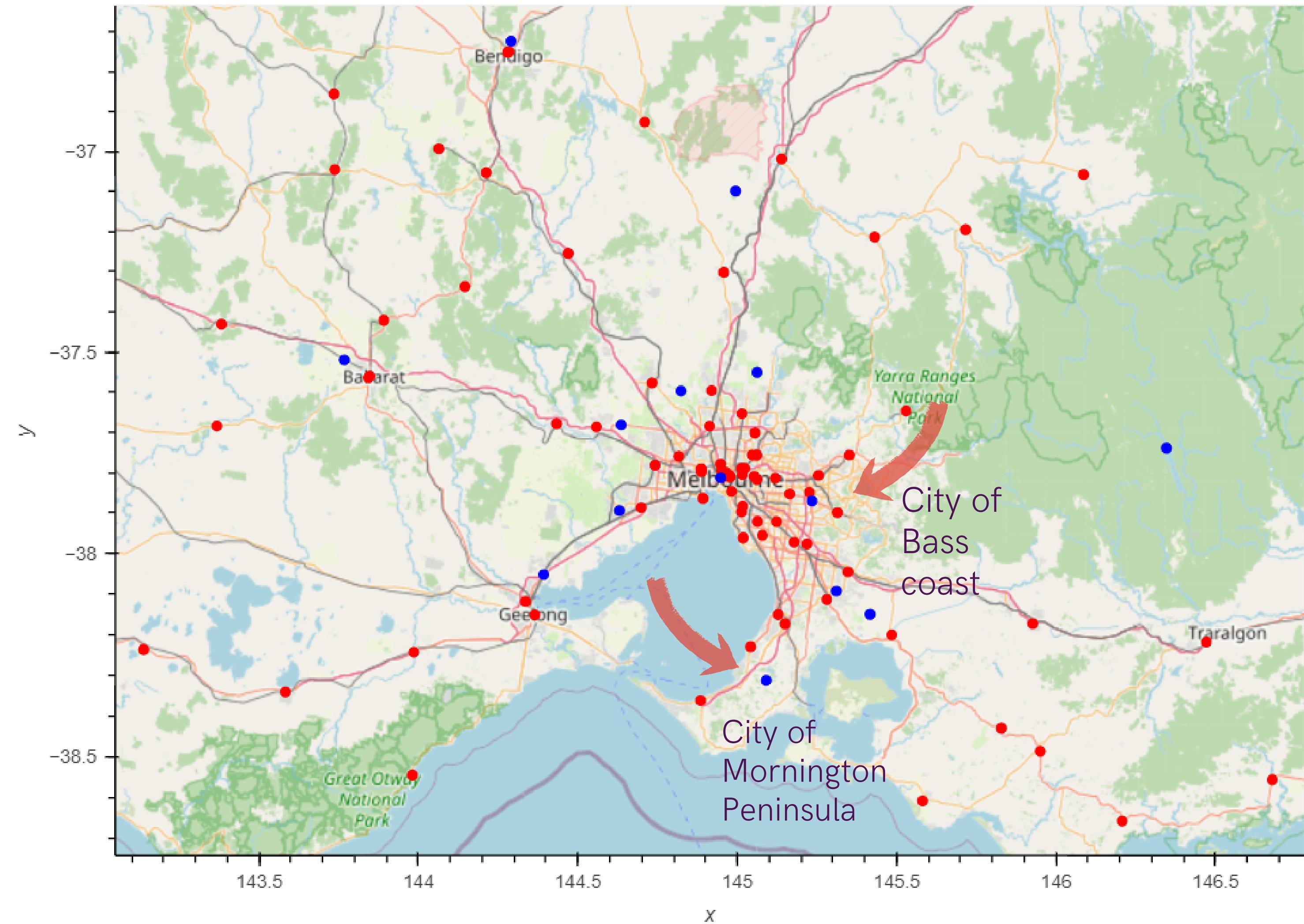
LGA	Age 70-74	Age 75-79	Age 80-84	Age 85 over	Age 0-4	elderly percentage	children percentage
Wyndham (C)	4232.0	2804.0	1708.0	1367.0	22812.0	4.633055	9.906282
Casey (C)	7690.0	5463.0	3602.0	3421.0	25476.0	6.985605	7.480659
Hume (C)	5364.0	3614.0	2369.0	1803.0	16777.0	6.959692	7.794563
Melton (C)	2991.0	1784.0	1110.0	853.0	12316.0	5.176095	8.768686
Greater Geelong (C)	10089.0	7594.0	5522.0	6361.0	15315.0	11.694407	6.348448
Whittlesea (C)	5778.0	4353.0	3067.0	2297.0	17354.0	8.684691	7.510509
Cardinia (S)	2931.0	1906.0	1184.0	1162.0	8383.0	8.373256	7.600148
Ballarat (C)	4106.0	3072.0	2261.0	2357.0	7029.0	11.480916	6.417908
Greater Bendigo (C)	4514.0	3483.0	2435.0	2670.0	7543.0	11.383604	6.742126
Mornington Peninsula (S)	9669.0	7207.0	4959.0	5081.0	8813.0	16.188966	5.495041
Baw Baw (S)	2488.0	1741.0	1125.0	1071.0	3147.0	12.746748	6.212679
Mitchell (S)	1453.0	947.0	634.0	560.0	3066.0	9.612407	7.077514
Melbourne (C)	2366.0	1492.0	977.0	1294.0	4903.0	4.131653	3.312700
Bass Coast (S)	2303.0	1557.0	1063.0	1155.0	1796.0	17.981945	5.342628

# Elderly and pediatric population in our LGAs



- We can have a small cross-section of the type of population that makes up our focused LGAs
- we observe that the largest growing population LGA also has large percentage of population

# Public hospitals across Victoria



Analysis of cities that have 0 distance to closest hospitals from Q1

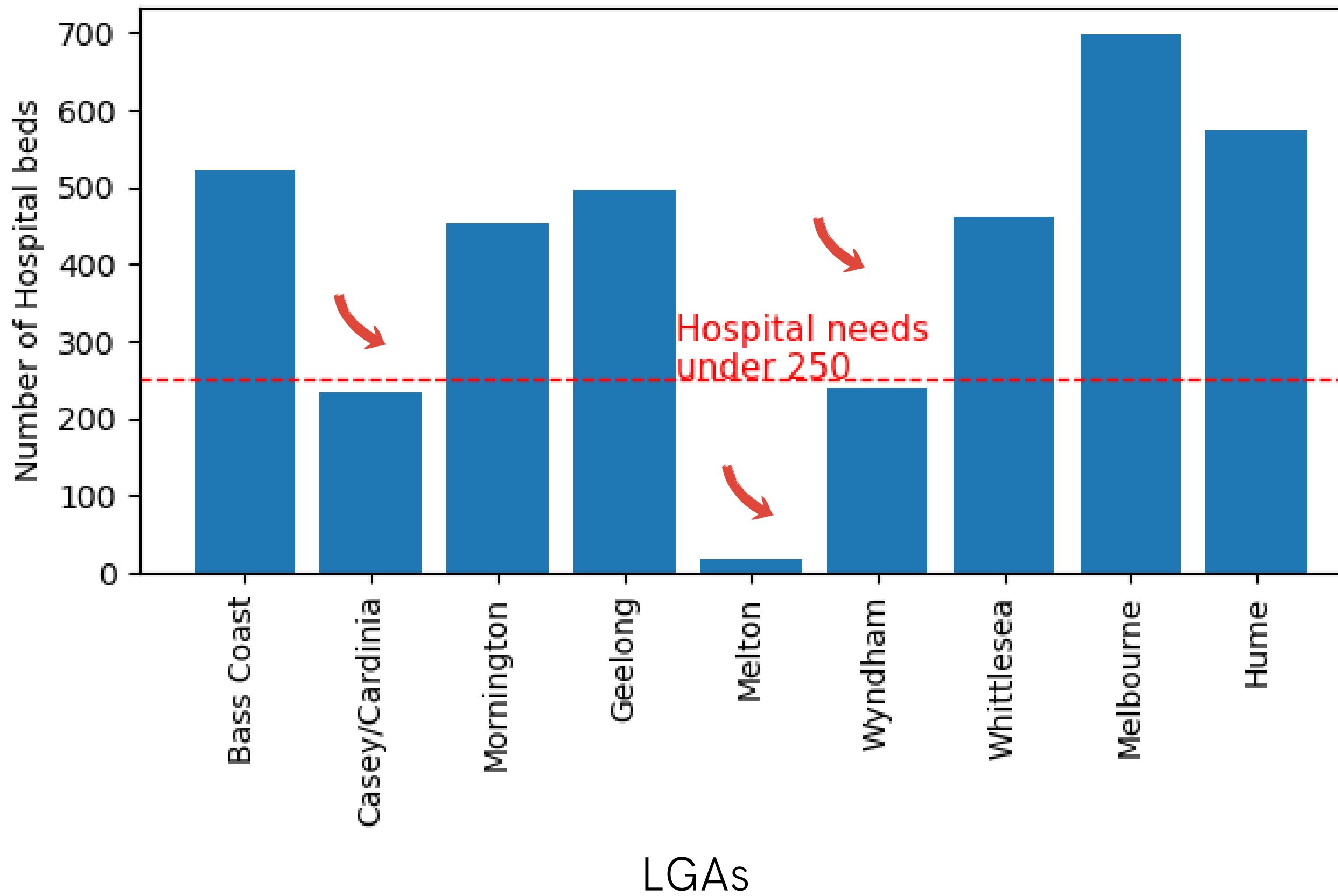
hospitals near of Baw Baw



hospitals near Whittlesea



# Number of hospital beds in the corresponding LGAs



# Conclusion

- There is an increase in population in Victoria.
- There is evidence to show as the population increases there are longer hospital wait times, and an increase in GP health services required.
- The greatest growth in Victoria is located in the outer ring suburbs of Melbourne.
- There is evidence that the mortality rate has a negative correlation to access to a hospital.
- Evidence that four of the top growth LGAs require resources as seen in the number of hospital beds available in these areas.
- Therefore, evidence of Gaps in the Victorian Health care system!

# Limitations of our data

- The data sets we have used are from different time periods.
- The data regarding hospitals is focused on public hospitals

# Further improvements

- Run a parallel analysis of the change in healthcare services to identify the trend in the number of health services in relation to population change to better identify the needs of the population
- Include both public and private hospital data
- Identify areas of increasing aging populations and expanding the age bracket to over the age of 65 to include the wider aging population

The goal is to turn data into information, and  
information into insight .

Carly Fiorina