

GIS_Asignment

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Geographical Information Systems

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1.0 Introduction

During this paper a geographical map will be created to show themes and ideas based around the subject of COVID vaccination levels within Wales and its potential affects on herd immunity. Various themes will be demonstrated and discussed to hypothesis if these have a noticeable impact on the uptake of COVID vaccination.

2.0 Task 1

This part of the paper will highlight the different data sources and mapping layers used.

2.1 Development Log

2.1.1 Boundary Data

To form the base location data to show an overall image of Wales a data set from the UK Data service was used to show boundaries of each local health board. This was downloaded in a tab format which is natively supported by MapInfo.

Additional boundary data was also downloaded to show middle super output areas for Powys specifically to allow for the author to compare the deprivation of each MSOA to understand if this has an impact on the rate of vaccination. This again was natively imported into MapInfo and downloaded via the UK Data service as part of the census data set.

2.1.2 Thematic Data

In order to show some thematic data the provided excel sheet was imported to show vaccination uptake by health board or unitary authority. This data was supplemented with percentage values to make themes easier to compare areas without relying on total numbers as this would skew results and show some areas as underperforming due to the much lower population. Percentages in this instance take populations into account and easily shows areas where herd immunity may be at risk due to overall percentage being low.

Deprivation data was also imported from the UK census information to allow for comparison of different MSOA within Powys.

2.1.3 Topographic Data

To aid understanding of the themes being explored and allow for conclusions to be drawn additional topographic information was added to the map. This includes minor roads, major roads and waterways. This was originally downloaded from digimap which is run by the university of Edinburgh and was available in a tab format which made for easy ingestion into MapInfo. This data set originally includes information for the entire UK based on the ordnance survey data which was more than required for this comparison, therefore the map for Wales was selected and saved into a separate file to allow for focus to be on Wales for this exercise.

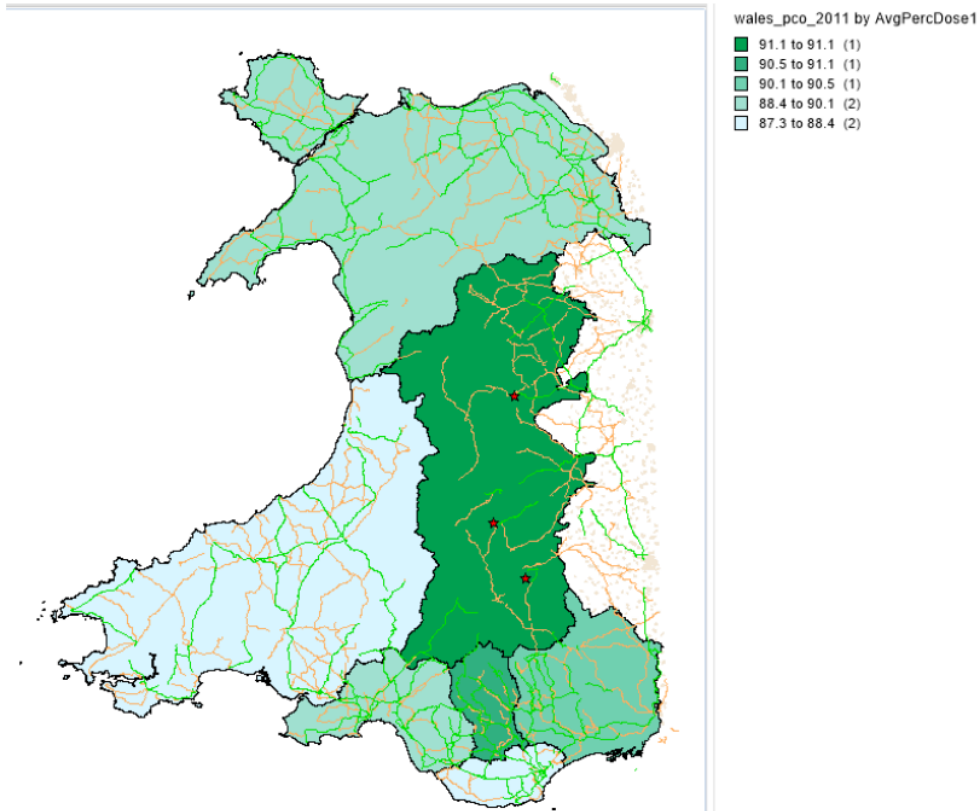
It was also important to understand if access to facilities aided in a large uptake of the vaccine in certain areas, the demonstrate this additional topographic information was added via a geopackage for the mass vaccination site at Bronllys. This is then highlighted to show the MVC and the available parking on site which can be used to draw some conclusions around access being a key component of high vaccine uptake. Alongside this geopackage a simple excel sheet was imported to show some point data for the different mass vaccination sites within Powys and how they are spread throughout the county. In order for this to be shown within the map both longitude and latitude were included within the excel file.

3.0 Task 2

This section of the paper will look at the thematic data produced in task one and discuss what this may indicate such as low vaccine uptake due to deprivation or transport links.

3.1.1 First Vaccine Uptake

One key element to consider when looking at herd immunity within a community is to look at the overall uptake of the first COVID-19 vaccine as according to official government figures the efficacy of the first dose is 72% within health care workers [1]. This level of protection is a key within a healthcare setting as it would mean less absence due to the need to isolate due to infection.

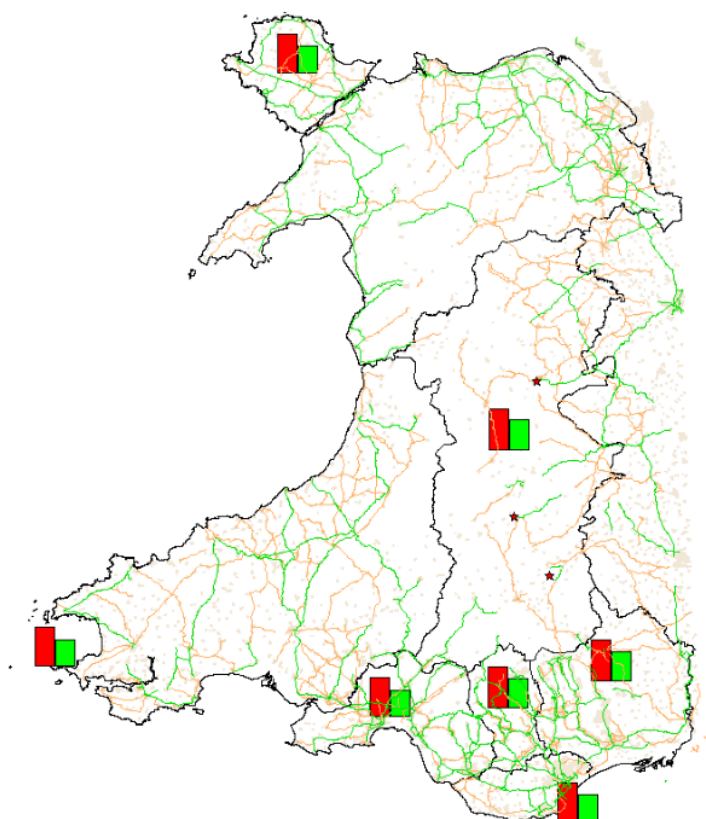


The above image shows the overall uptake of the initial COVID vaccine for each Health Board within Wales. The figures show every health board in Wales achieved at least 87.3% which may suggest a level of herd immunity but this is dependant on the individual disease and at present it is unknown what this level is for COVID. According to the World Health Organization [2] for measles the level of vaccination required is 95% which is above the level of that achieved by Powys Teaching Health Board. However if we compare this to polio which has a required percentage of only 80% which every site achieved on the first dose.

3.1.2 First Vaccine Uptake 80+ vs 18-29

Another really interesting marker to investigate when looking at vaccination data is to compare two different risk groups initial uptake. The below image shows the different first dose uptake between

those aged 80 and over and those aged between 18 and 29. The red bar shows uptake for those in the higher age group.



The above shows visually the stark difference in uptake between the two groups but its difficult to understand this in actually percentage values so below is the excel data to reflect this.

code	Health board of residence	80Plus1stDose	18To291stDose
W11000028	Aneurin Bevan University Health Board	95.4	70.1
W11000023	Betsi Cadwaladr University Health Board	94.6	66.4
W11000029	Cardiff and Vale University Health Board	93	65.5
W11000027	Cwm Taf Morgannwg University Health Board	95.2	70.8
W11000025	Hywel Dda University Health Board	94	63.8
W11000024	Powys Teaching Health Board	95.9	74.2
W11000026	Swansea Bay University Health Board	94.6	64

This table shows that in a number of health board areas that the over 80 age group actually met the higher herd immunity threshold set out by the WHO [2] but this is in stark contrast to the lower age group where even the highest percentage vaccinated is 74.2% which is more than 5% lower than even the lowest expected figure. This highlights an interesting trend that will be explored later in this paper but may indicate a difference in perceptive risk involved with contracting COVID or if this is

due to time difference in when these two age groups were offered the first vaccine dose and what government guidelines were at that time.

3.1.3 All Doses Given

The next set of information to consider is the overall percentage of people who have had all three doses of the vaccine providing the maximum efficacy of 95% if receiving either the Pfizer or Moderna injections [3].

code	Health board of residence	AvgPercDose1	AvgPercDose2	AvgPercBooster
W11000028	Aneurin Bevan University Health Board	90.1	86.6	81.4
W11000023	Betsi Cadwaladr University Health Board	88.8	83.9	77.5
W11000029	Cardiff and Vale University Health Board	87.3	83.2	77.2
W11000027	Cwm Taf Morgannwg University Health Board	90.5	87.2	81.2
W11000025	Hywel Dda University Health Board	88	83.9	75.4
W11000024	Powys Teaching Health Board	91.1	87.7	82.9
W11000026	Swansea Bay University Health Board	88.4	83.8	77.2

The above data set shows that there is a steady decline in the overall population being vaccinated at each stage with Hywel Dda seeing the lowest overall number being fully vaccinated against COVID-19 and therefore impacting the overall herd immunity level that is possible within Wales. If the same level immunity is required to polio then it can be assumed that herd immunity was not achieved within Wales due to the overall population receiving all three doses being 78.97%.

Similar trends as seen with the single dose is likely to be seen due to the scheduling of the vaccinations being staggered amongst age groups and therefore it may be likely this data unfairly shows a really low number of younger vaccinations due to not be eligible for all three doses to date.

3.2 Understanding the Themes

When viewing thematic data in this way it is key to understand the potential causes of the themes, below will explore various topographic and societal data to try and explore and explain these themes of low vaccination uptake.

3.2.1 Deprivation Data

The first piece of social data to be reviewed in this document is deprivation data provided by the Office for National Statistics [4] with deprivation score being assigned to each MSOA based on the below definition [5]

“Deprivation, classification of household [E][S][W]”

The dimensions of deprivation used to classify households are indicators based on four selected household characteristics. A household is deprived in a dimension if they meet one or more of the following conditions:

Employment: Where any member of a household, who is not a full-time student, is either unemployed or long-term sick.

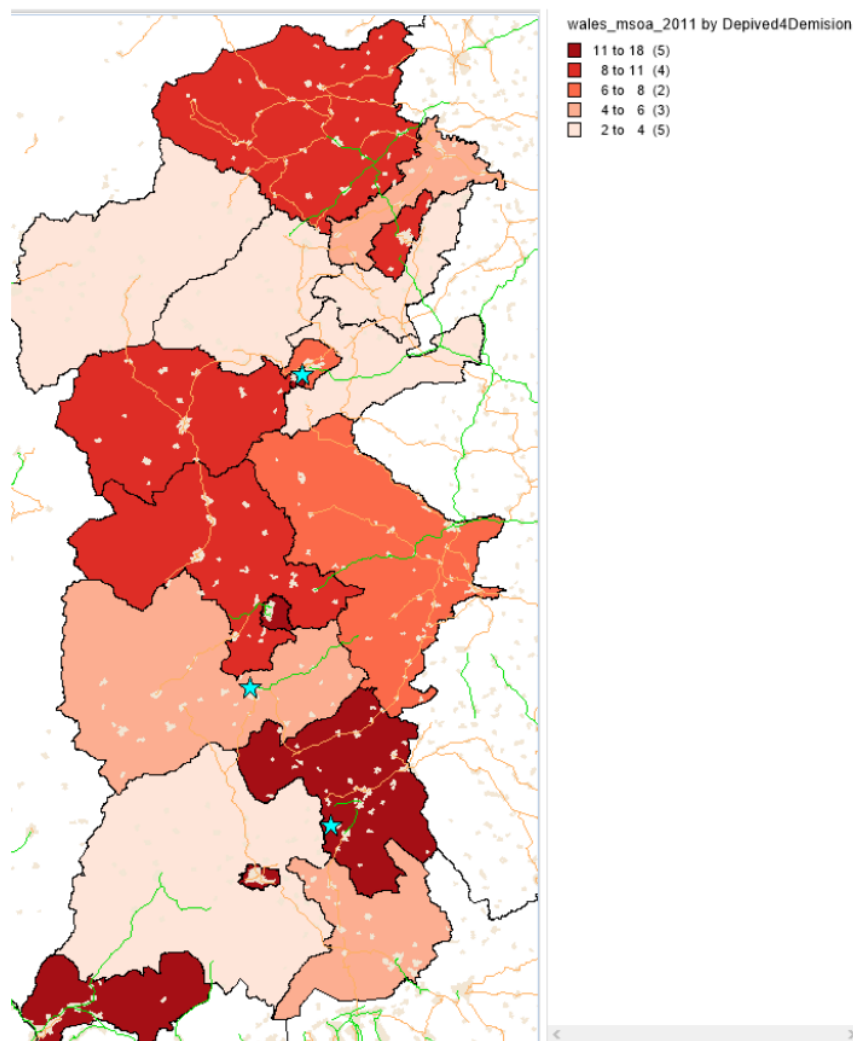
Education: No person in the household has at least Level 2 education (see highest level of qualification), and no person aged 16 to 18 is a full-time student.

Health and disability: Any person in the household has general health that is 'bad' or 'very bad' or has a long-term health problem.

Housing: The household's accommodation is either overcrowded, with an occupancy rating - 1 or less, or is in a shared dwelling, or has no central heating.

A household is classified as being deprived in none, or one to four of these dimensions in any combination."

Using this a thematic picture is created for Powys to show the varying deprivation of each MSOA and its position relative to each of the three mass vaccination centres shown by blue stars.

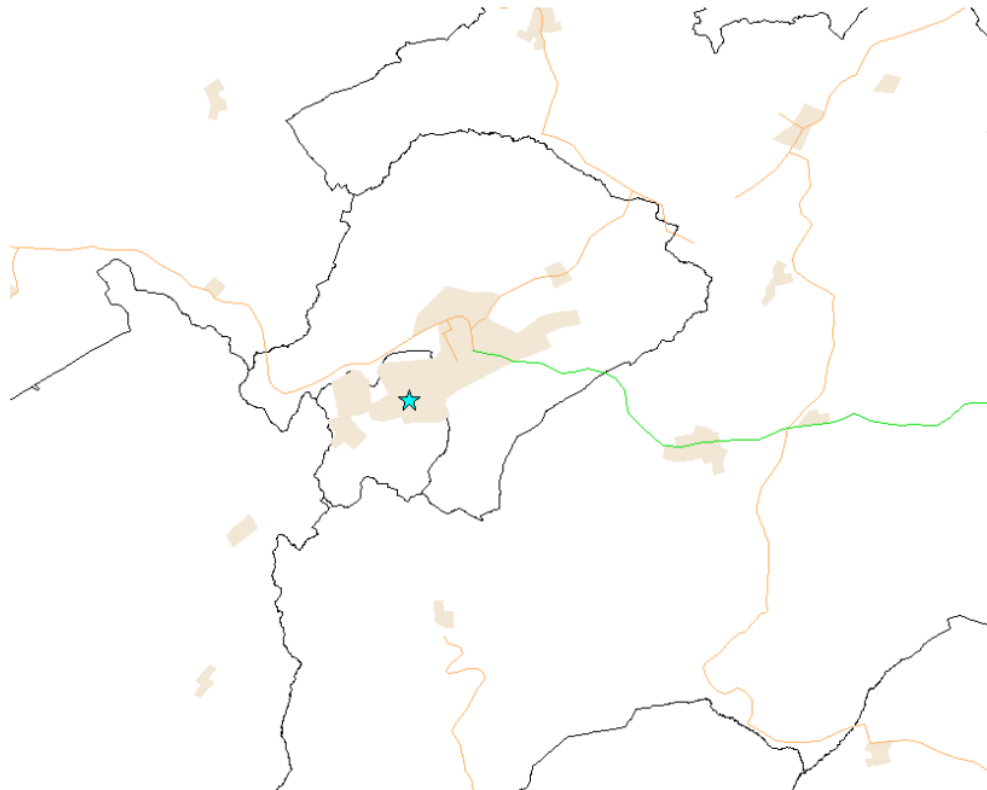


From the above it is evident that quite large areas of Powys are considered to be very deprived using the methodology, despite this is vaccinated the highest percentage of its population in all measures.

It is interesting to note that the three mass vaccination centres are either in or adjacent to the most deprived areas which may have had a positive impact on the vaccination levels as the lack of transport would not have a detrimental impact in the same way as if the centres were located central to an affluent area.

3.2.2 Road Access

Aiding in the higher uptake in Powys alongside the positioning of the mass vaccination centres close to deprived areas is the road access available to those centres. This would mean that areas that are more affluent and have access to transport are easily able to attend the centres. This is shown below with a closer view to the centre in Newtown supplemented with the road network data supplied by Ordnance Survey via EDINA [6]



Using the above data it may be correct to say the positioning of the MVC's within Powys had an impact on the high vaccine uptake as there are good road links for those areas able to travel but are very close to the areas of high deprivation.

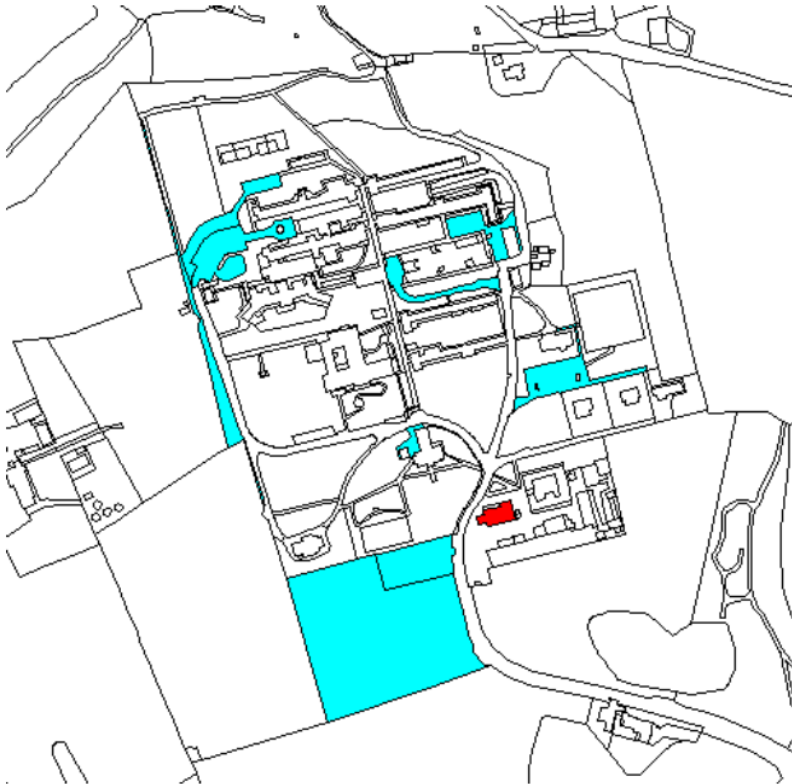
3.2.3 Alternative Deprivation Measure

Whilst in this paper a deprivation measure from the 2011 census was used it is only one way that can be used for measuring deprivation and alternative methods may present a different argument. One such other method of measuring deprivation that is used widely is the Townsend index which uses similar census data to determine a value. This method was created by Prof Peter Townsend in 1987 and provides a consistent methodology for comparing data across the various census dates [7].

Another method to measure deprivation is the use of the English Indices of Deprivation 2019 which includes additional metrics such as crime, training deprivation and barriers to housing. This is used mainly by the ministry of housing, communities and local government [8] in England but highlights that using a single methodology has the possibility of providing bias information based on the metrics used within the calculation.

3.2.4 Bronllys A Closer Look

To further improve knowledge when looking at thematic data it is possible to drill down to a single data point to attempt to draw some conclusions or add additional weight to already established hypothesis. Below is a zoomed in image of Bronllys Hospital where the vaccination centre was run. The additional topographic data is provided by OS Mastermap via EDINA [9]



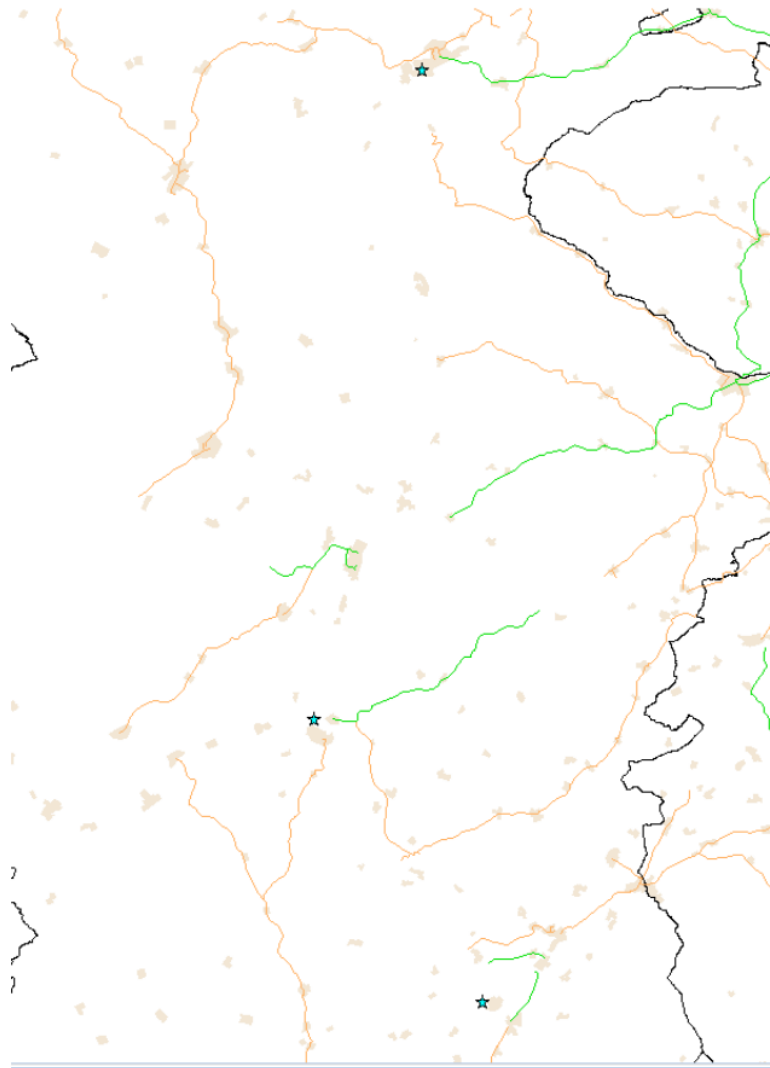
Having access to the additional topographic information shows the area in blue as available parking on the hospital site to be used whilst attending the mass vaccination centre with the centre highlighted in red. Is it possible to suggest that the abundance of parking on site made travelling to site less stressful or intimidating for older residents who may be apprehensive of driving into a heavily populated area due to mobility of other issues.

There is some missing data that would provide some additional evidence that access to the site aided in the high uptake of the vaccine and that is bus stations or other public transport methods. In the example given above the closest bus station is around 0.3 miles away which is significant for the elderly population of Powys [10]. The availability of trains within Powys is also very lacking with the nearest train station to the MVC in Bronllys being in Abergavenny which is 21.5 miles away noting

that no other services in Powys have a train that goes direct to this station. Anecdotally this would suggest access or lack of does not seem to have a significant impact on vaccine uptake in this scenario.

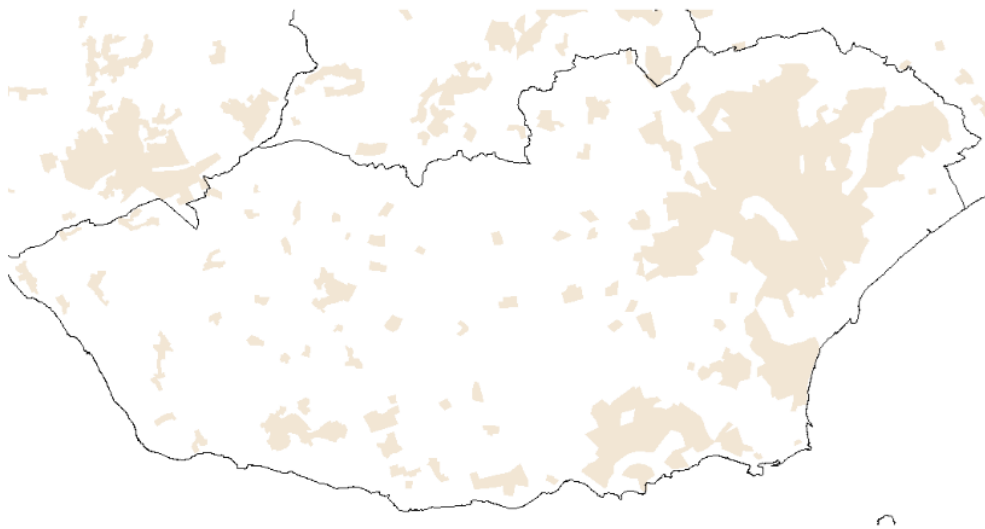
3.2.5 Urban Centres

A final thought for this particular task is to look at the urban centres within Powys and determine if this had an impact on the placement of MVC which resulted in the high uptake of vaccine within Powys.



The above image shows the urban centres located in Powys highlighted in brown with the MVC's again highlighted in blue. This image shows two different trends that influenced the placement of the MVC's and also the high uptake of the vaccine within Powys. It shows the very sparse population of Powys and that the centres were located next to most major population centres. This may have

had an impact on the high vaccine uptake but this is difficult to justify if compared to the population centres of Cardiff and Vale who had a much lower percentage uptake.



As Cardiff and Vale has a much greater population density but lower vaccine uptake it would suggest there is not a direct correlation between urban centres and overall vaccine uptake.

4.0 Conclusion

The overall conclusion of this paper as it relates to herd immunity of COVID 19 is that it is not possible to confirm or deny this with any certainty due to the varying percentage requirement for herd immunity depending on the disease. What it is possible to conclude from this report is that due to the factors explored such as vaccination centre placement, road networks and deprivation measures these have a high likely to influence the vaccine uptake as Powys achieved the highest in Wales. In order to gain a higher confidence level in some of the conclusions being drawn would be to compare multiple health boards against in each other in every metric to remove any bias or the possibility of Powys being an outlier in terms of conditions for uptake.

5.0 References

- [1] M. Ramsay, "COVID-19: analysing first vaccine effectiveness in the UK," 23 12 2021. [Online].
] Available: <https://ukhsa.blog.gov.uk/2021/02/23/covid-19-analysing-first-vaccine-effectiveness-in-the-uk/>. [Accessed 28 04 2022].
- [2] World Health Organization, "Coronavirus disease (COVID-19): Herd immunity, lockdowns and COVID-19," 31 12 2020. [Online]. Available: <https://www.who.int/news-room/questions-and-answers/item/herd-immunity-lockdowns-and-covid-19>. [Accessed 28 04 2022].
- [3] K. Katellea, "Comparing the COVID-19 Vaccines: How Are They Different?," 30 03 2022. [Online].
] Available: <https://www.yalemedicine.org/news/covid-19-vaccine-comparison>. [Accessed 28 04 2022].

[4 Office for National Statistics, "2011 Census Aggregate data".
]

[5 "InFuse 2011 Population Statistics," [Online]. Available:
] <https://infuse2011gf.ukdataservice.ac.uk/infusewizgeo.aspx>. [Accessed 28 04 2022].

[6 Ordnance Survey, 17 11 2015. [Online]. Available: <https://digimap.edina.ac.uk>. [Accessed 24 03
] 2022].

[7 National Centre for Research Methods, "Townsend Deprivation Index," [Online]. Available:
] <https://www.restore.ac.uk/geo-refer/36229dtuks00y19810000.php>. [Accessed 28 04 2022].

[8 D. M. e. al, "The English Indices of Deprivation 2019," 09 2019. [Online]. Available:
] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/833951/IOD2019_Technical_Report.pdf. [Accessed 28 04 2022].

[9 Ordnance Survey, "OS MasterMap® Topography Layer," 18 11 2021. [Online]. Available:
] <https://digimap.edina.ac.uk>. [Accessed 28 04 2022].

[1 Welsh Government, "Population estimates by local authority and age," 06 2021. [Online].
0] Available: <https://statswales.gov.wales/Catalogue/Population-and-Migration/Population/Estimates/Local-Authority/populationestimates-by-localauthority-age>.
[Accessed 28 04 2022].

FINAL GRADE

GENERAL COMMENTS

Instructor

79/100

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
2. Knowledge and Understanding Skills		
Although you clearly have a good in depth understanding of the software are seen with your PDF it would have been nice to have seen some of your visuals within your development log and perhaps some screenshots of the data cleansing that you alluded to for example perhaps a snapshot of the excel spreadsheet it's clear that you've used this data but from a	25	18

readability point of view it would have been nice to see it.		
3. Cognitive and Intellectual Skills		
Again, you have to have a clear understanding of the data acquisition requirements to build your workspace and I can see that evidenced in the PDF document provided however again perhaps some visuals within task one would help with the dialogue of your discussion and your log of how you built said visuals to support task 2.	25	21
4. Practical Application Skills		
Again having examined the PDFs you demonstrated good understanding of the mechanisms of the software and very much enjoyed the fact that you looked at the urban areas and other top of graphic information on top of the more sociodemographic type data. Also using the	40	35

master map data to zoom in on the hospital layout provides another level of visualisation for discussion on policy building. I think it's true to say that good parking spaces and the ability to drive to a vaccine centre easily was one of the factors influencing the elderly. For example the Swansea Bay mass vaccination centre is not only difficult to drive to the parking is also difficult to manoeuvre around and I know that was a factor concerning lots of elderly people and perhaps stop them getting their boosters at a timely fashion.		
5. Transferable Skills for Life and Professional Practice		
Again, because there were no visual supporting your development log I felt this section was a little bit brief.	10	5

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Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
suitable references throughout he reflected on the sociodemographic data available, and you have thought about what this would bring to the table in terms of analysis of said data.	25	18
2. Knowledge and Understanding Skills		
You demonstrate a sound understanding of the mix of data that one needs to discuss the many layers that could influence decision makers. You make some interesting points through the analysis of the placement of the mass vaccination centres in Powys perhaps other unitary authorities throughout Wales should have thought about similar placement's.	20	17

3. Cognitive and Intellectual Skills		
you have thought about other ways of bringing data into their workspace to help you with your overall analysis off the COVID vaccine update and herd immunity you have discussed this well.	25	21
4. Practical Application Skills		
you demonstrate excellent practical skills and you have looked at all of the functionality within MapInfo which has helped build some excellent visuals throughout your discussion. Your graphs looked good however you noted they didn't show the percentage you could have looked at the labelling rules within MapInfo for this.	20	16

5. Transferable Skills for Life and Professional Practice		
Well written paper throughout one thing I would note however is that you will need to label your images with suitable figure legends. For example fig 1.1 map showing imagery of etc. this improves the readability and is in line with academic write up.	10	7

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