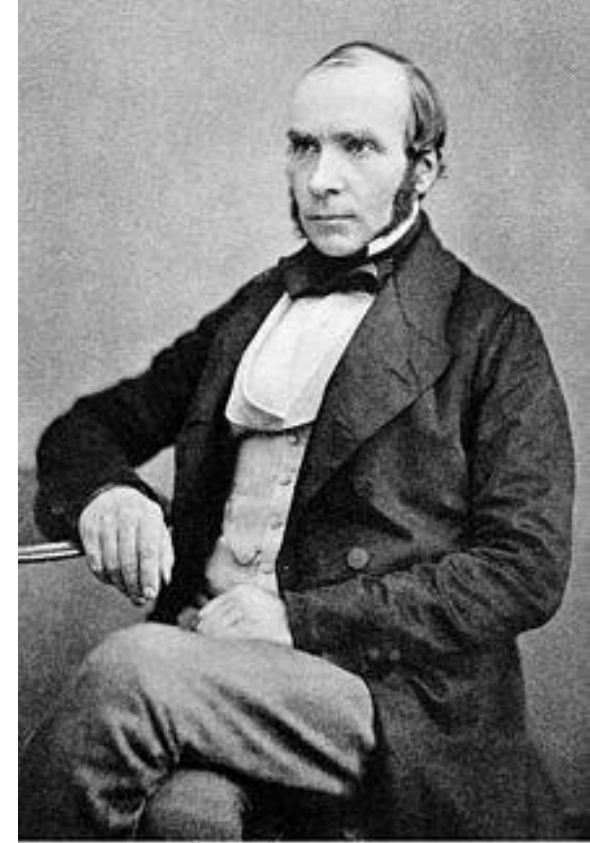


John Snow could not solve the Cholera Epidemic with current privacy laws

Associate Professor Neil Coffee
University of Canberra
Health Research Institute
Institute of Australian Geographers Conference
Hobart, 2019

John Snow

- 1854, the Soho district in London was in the grip of a cholera outbreak with thousands sick and 600 deaths.
- John Snow a surgeon and general practitioner, used what is now referred to as the start of spatial epidemiology, to solve the cholera outbreak in Soho, London.
- One of the most used examples of spatial methods to solve a health problem.
- John Snow mapped the cholera cases/deaths and reportedly used this to pinpoint the Broad Street pump as the likely source.



John Snow

John Snow Map*



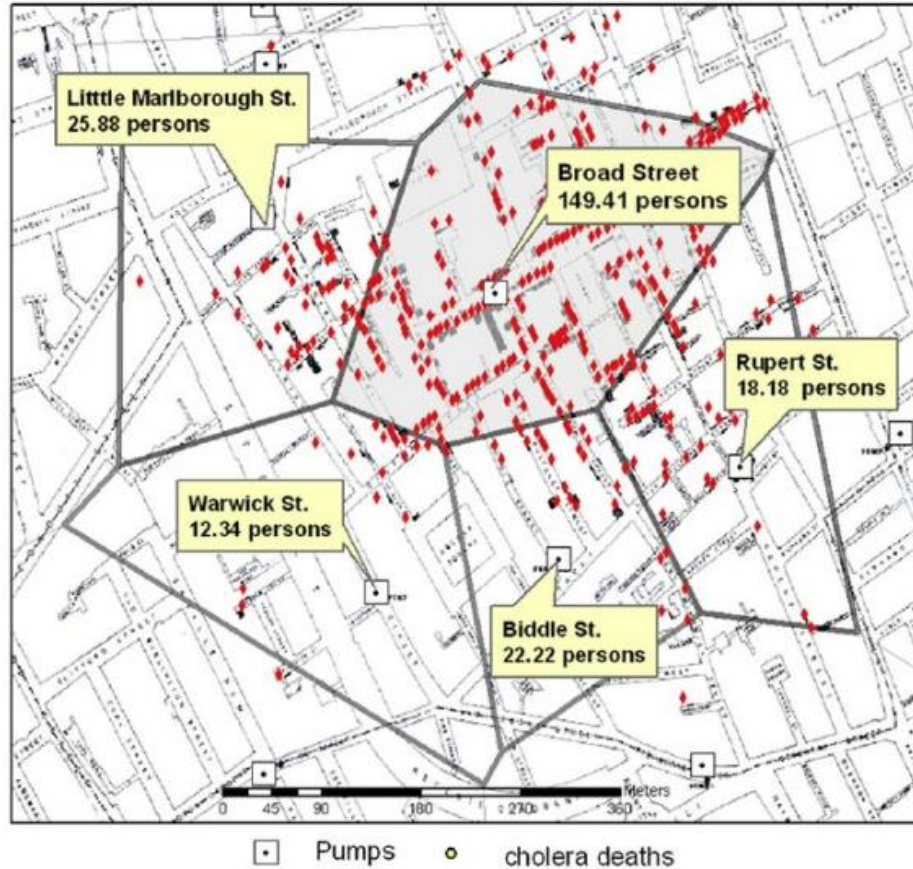
*John Snow's map of cholera deaths in London 1854. Deaths are marked by dots and water pumps by crosses. Version of Gilbert [294]. c 1958 Blackwell Publishing.

Use GIS to look at deaths

- Geo-register the John Snow image.
- Heads-up digitize the pumps and deaths.
- Access London streets (OSM).
- Run some analysis.

Remaking Snow's 1855 Map

Cholera Mortality per 1,000 persons



Cholera Mortality per 1,000 persons for central pump catchments.

A Dirichlet tessellation was used to create pump service areas in the area most affected by the 1854 cholera outbreak. Often called Thiessen polygons in a Voronoi network, each service area includes all cholera deaths nearer to it than any other public water source.

Mortality per 1000 persons is calculated by dividing the reported deaths in each service area by the number of houses on streets in that segment and multiplying that number by 10 persons per house.

Figure

Caption

Fig. 2. Mortality per 1000 persons was calculated for the central water service catchments by taking the number of deaths per area, dividing by the number of houses on street segments in each area, and multiplying by an estimated 10 persons per house.

This figure was uploaded by [Tom Koch](#)
Content may be subject to copyright.

[Article](#) [Full-text available](#)

Crediting his critics' concerns: Remaking John Snow's map of Broad Street cholera, 1854

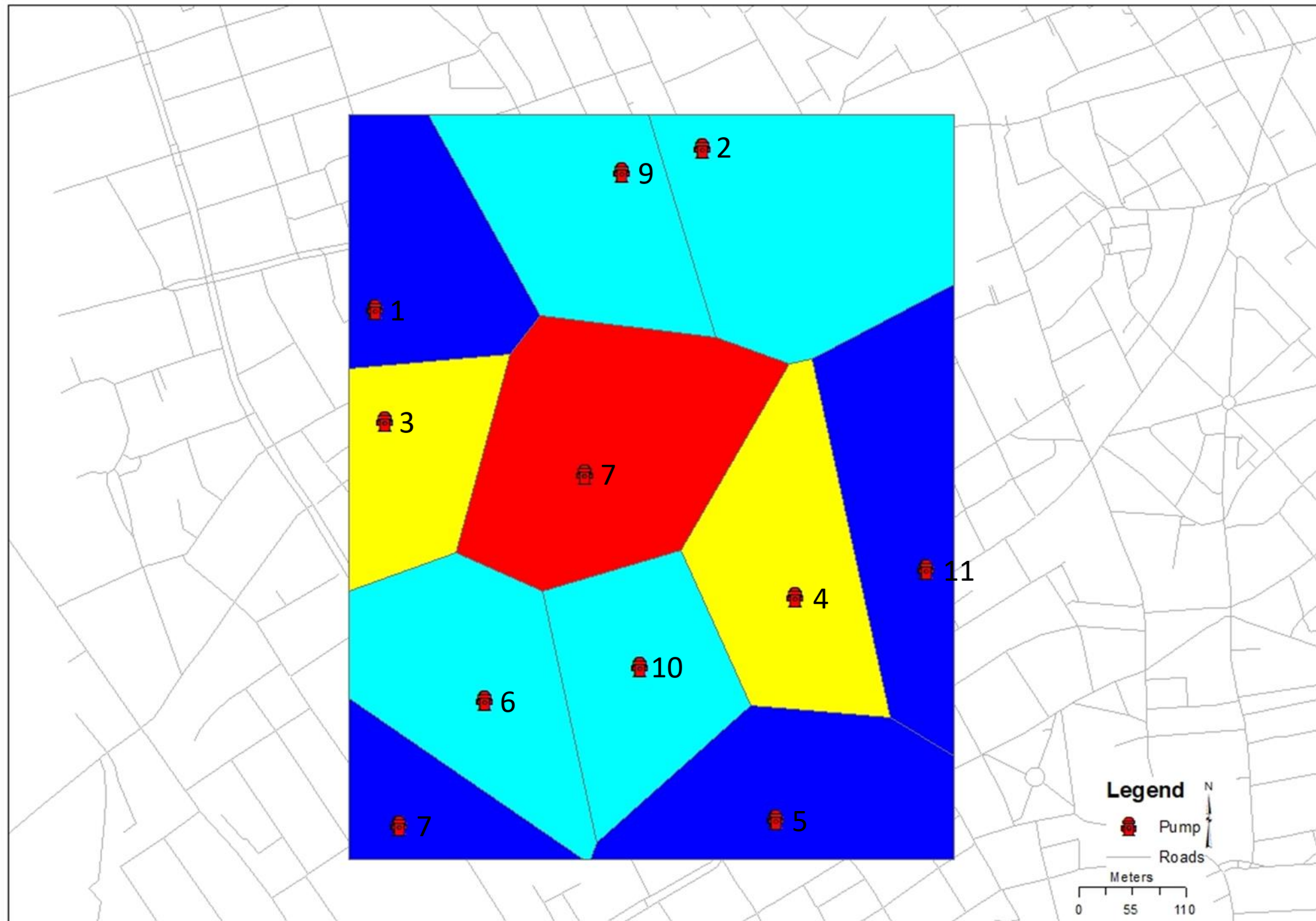
September 2009 · Social Science [?] Medicine 69(8):1246-51

DOI: 10.1016/j.socscimed.2009.07.046

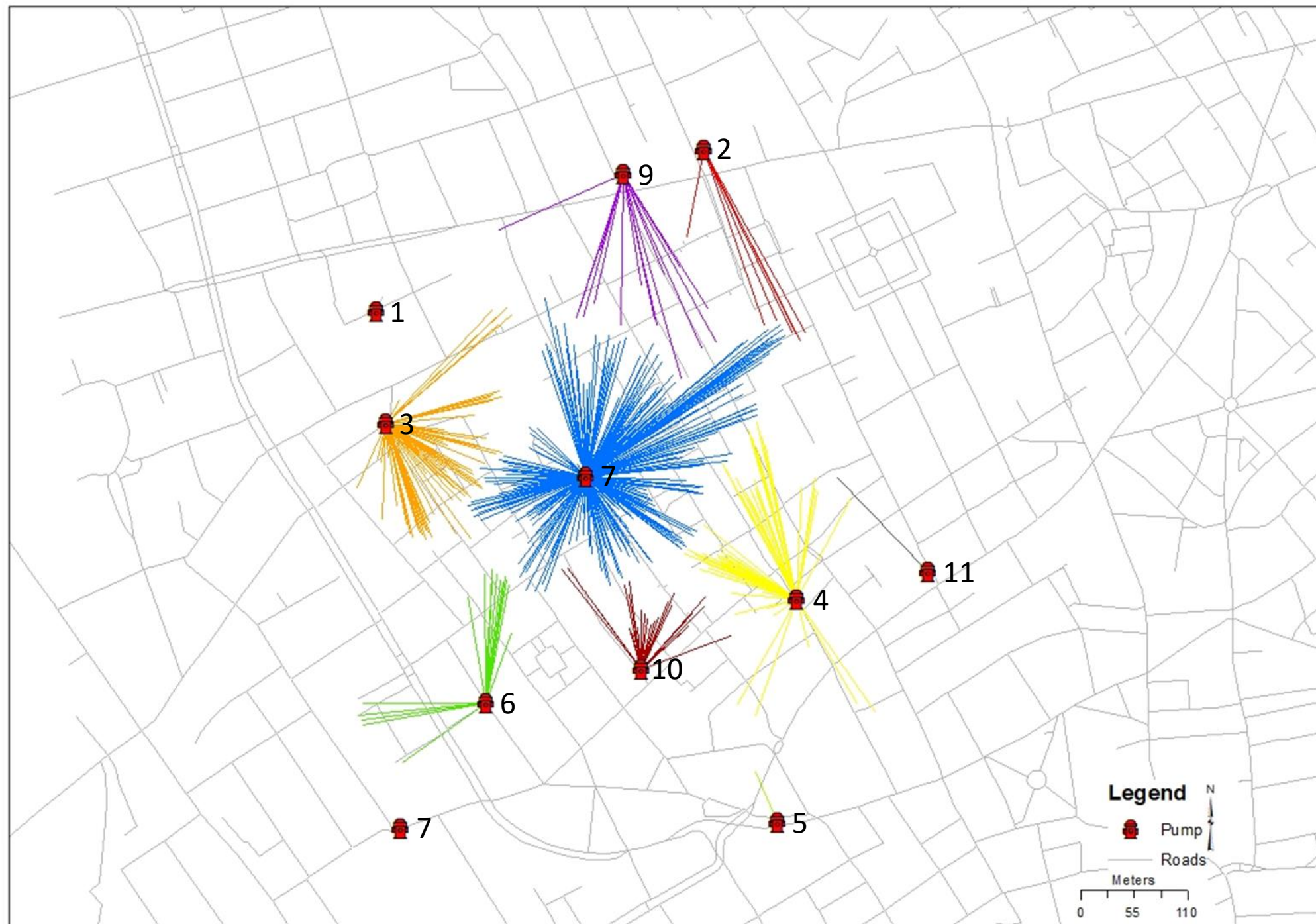
Source · [PubMed](#)

Tom Koch · [Kenneth Denike](#)

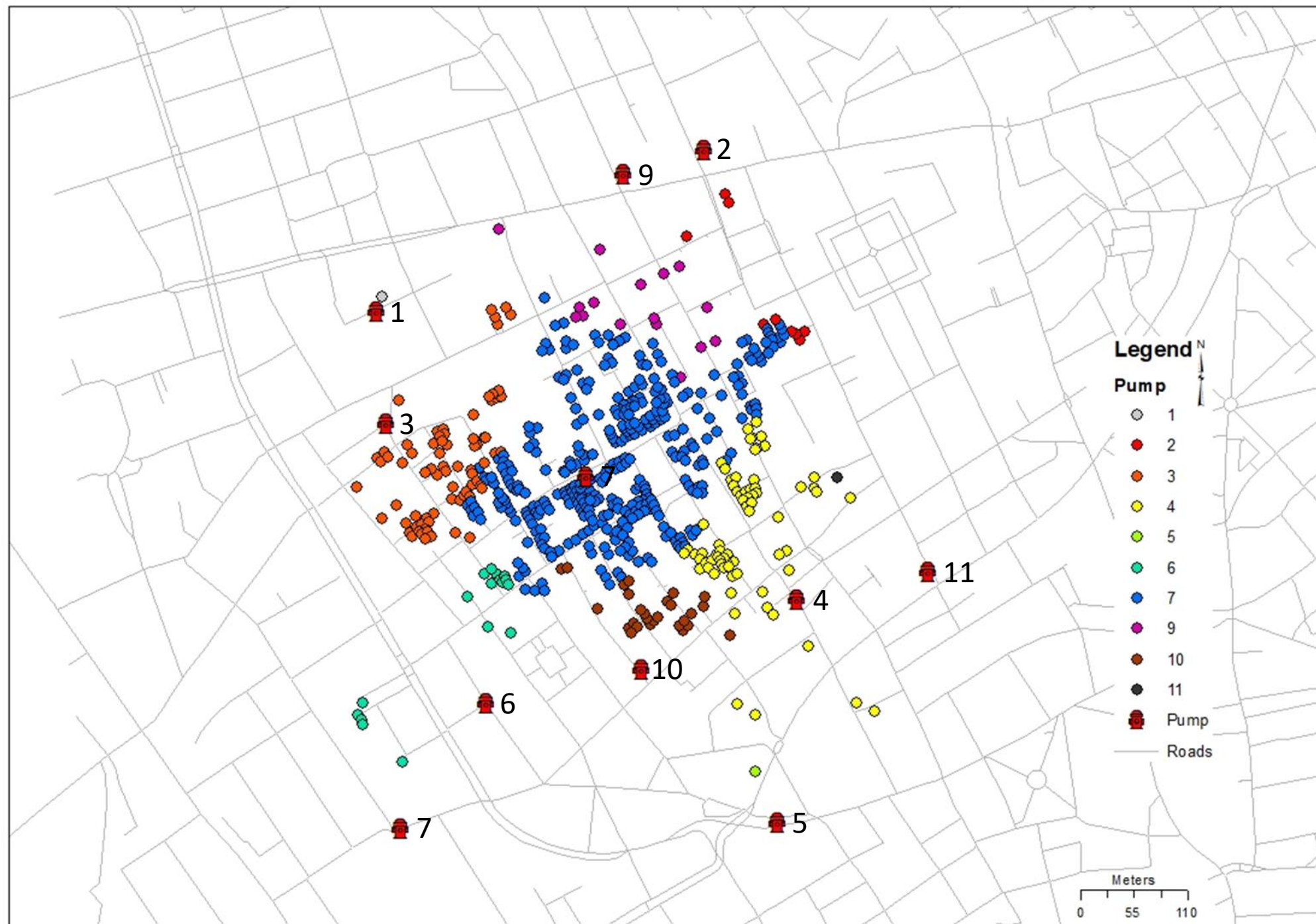
Thiessen Polygons



Network Analysis: closest pump



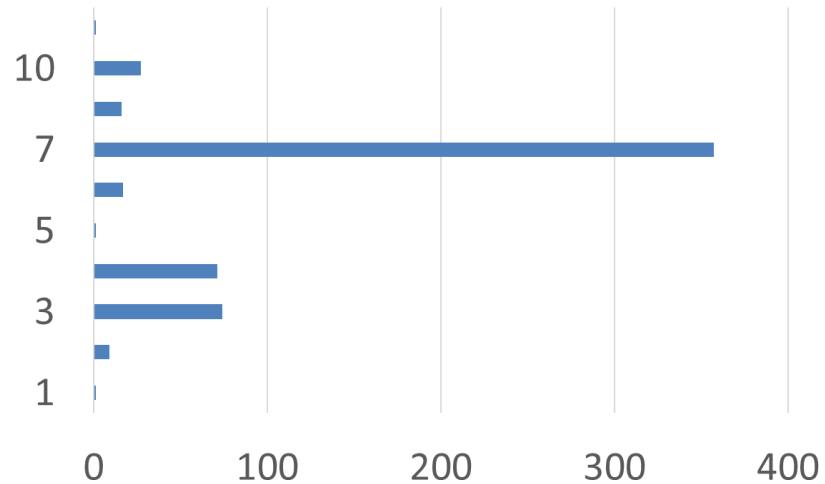
Network Analysis: closest pump



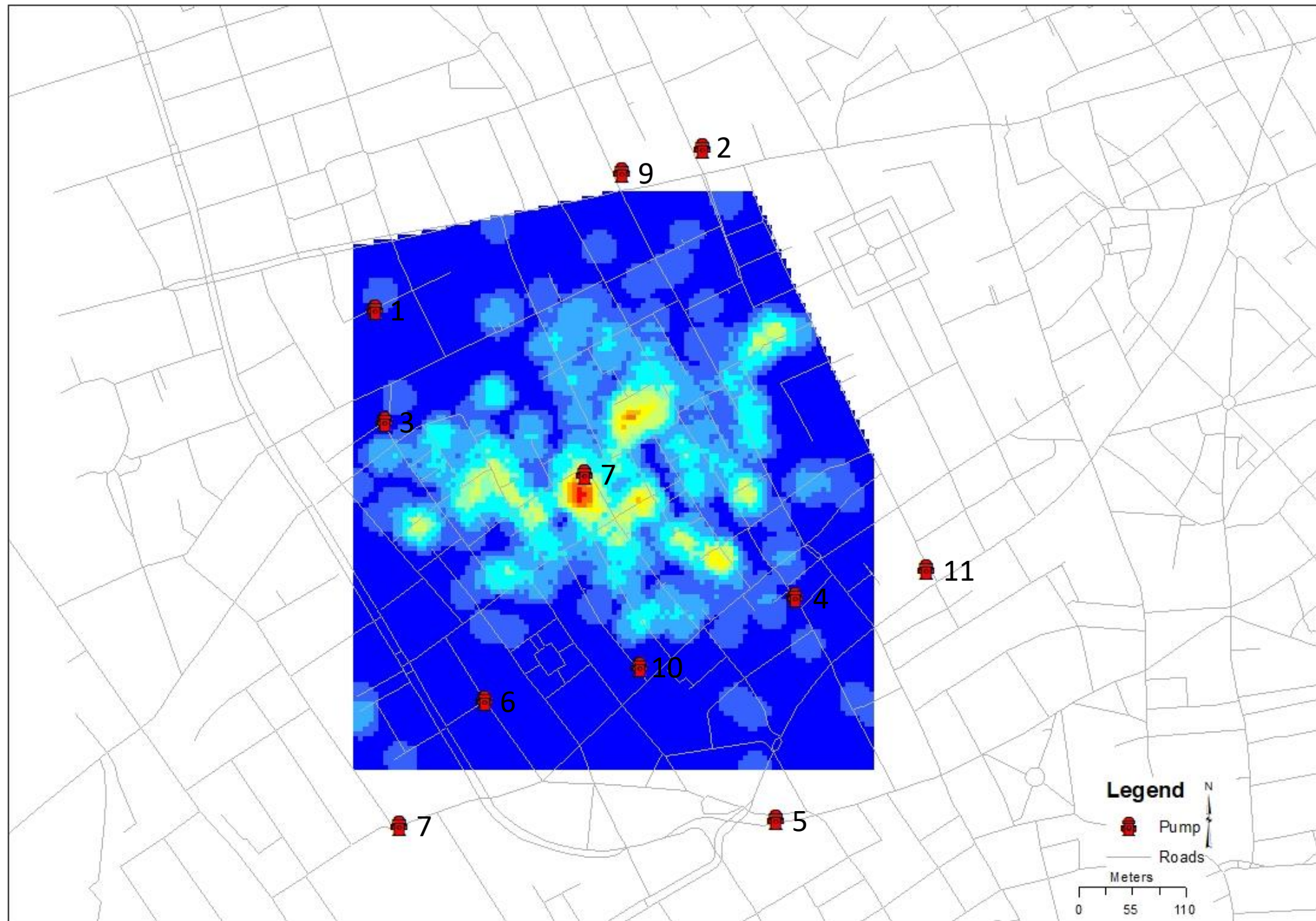
Closest Pump

Pump ID	Closest Count	Mean Distance (m)	SD (m)	Min (m)	Max (m)
1	1	11.5		11.5	11.5
2	9	182.9	87.3	50.0	267.0
3	74	117.6	39.0	24.7	186.0
4	71	132.6	40.6	31.0	215.0
5	1	98.2		98.2	98.2
6	17	163.3	19.2	106.6	181.0
7	357	119.8	63.9	3.2	268.0
9	16	173.2	34.8	111.8	242.0
10	27	113.3	17.5	76.9	142.0
11	1	175.5		175.5	175.5

Closest Count



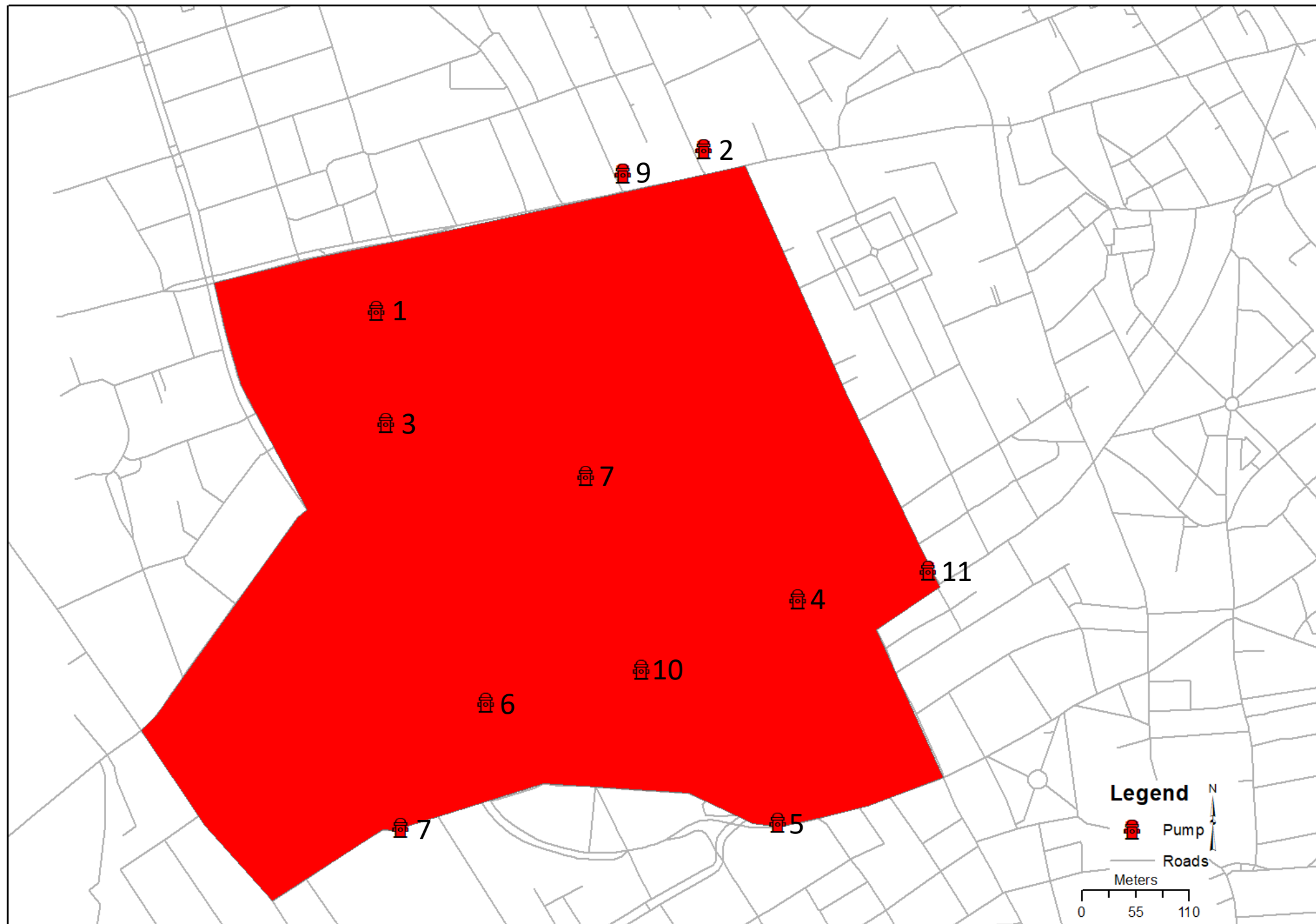
Density Analysis: using death points.



**Aggregated
to area of
analysis.**

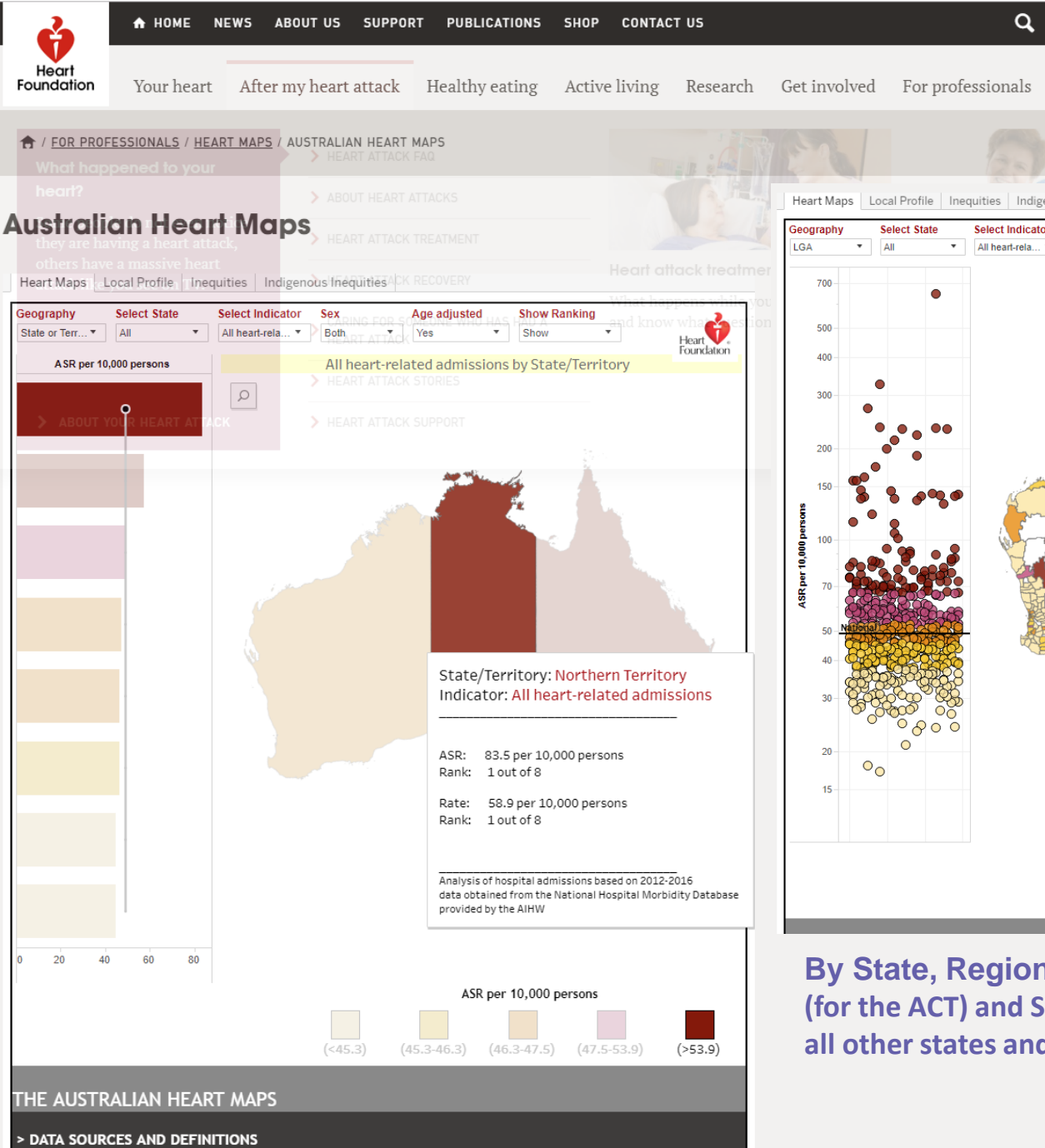
**More akin
to what we
get now!**

**Cholera
problem
not solved.**

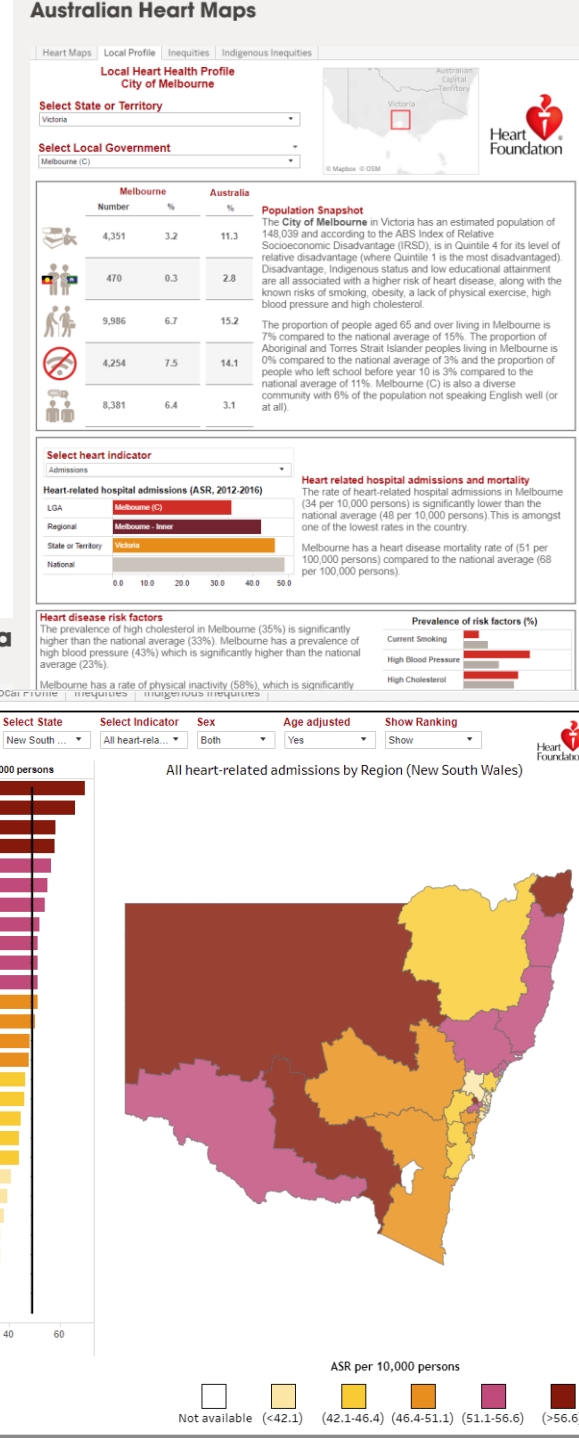


Now!

- Fast forward to the 21st century and would this be possible?
- Health data [in Australia] are provided for research based on administrative spatial units
- These spatial units may not identify patterns and distribution of health outcomes to target interventions.



Heart Maps



By State, Region = statistical Area Level 3 (for the ACT) and Statistical Area Level 4 (for all other states and Territories) or LGA.

SOCIAL HEALTH ATLASES



TOPICS, INDICATORS
AND NOTES ON THE
DATA

View the indicators list for eithe...




MAPS

View the latest Social Health Atla...



DATA

View the latest Social Health Atla...



GRAPHS

View the Social Health Atlas data ...



DATA ARCHIVE

View Social Health Atlas data for ...

Social Health Atlas of Australia: Queensland Local Government Areas (2016 ASGS), Published 2019

Select dataFilter to an areaData notes

Male population, 5 year age groups, 2017 ERP - Per cent

Female population, 5 year age groups, 2017 ERP - Per cent

Total population, 5 year age groups, 2017 ERP - Per cent

Male population, broad age groups, 2017 ERP - Per cent

Female population, broad age groups, 2017 ERP - Per cent

Total population, broad age groups, 2017 ERP - Per cent

Male Aboriginal population, 2016 URP - Per cent who are aged

Female Aboriginal population, 2016 URP - Per cent who are aged

Total Aboriginal population, 2016 URP - Per cent who are aged

Indigenous status, 2016 URP

Indigenous status by age, 2016 URP

Birthplace and non-English speaking (NES) residents, 2016 - Per cent

Top ten birthplaces of people from non-English speaking countries, 2016 - Per cent

Fertility

Education

Early childhood development: Australian Early Development Census, 2015 - Per cent

Learning or Earning, 2016 - Per cent

Families, 2016 - Per cent

Child care, 2016 - Per cent

Housing and transport, 2016 - Per cent

Housing rent assistance, June 2017 - Per cent

Income support recipients, June 2017 - Per cent

Internet access at home, 2016 - Per cent

Labour force - Per cent

Summary measure of disadvantage, 2016

Community strength

Personal and financial stressors (modelled estimates), 2014 - Age-standardised rate per 100

Barriers to accessing transport and healthcare services (modelled estimates), 2014 - Age-standardised rate per 100

Mothers and babies

Child and youth health

Screening programs: National Bowel Cancer Screening Program, 2014/15 - Per cent

Cancer incidence, males, 2006 to 2010 - Standardised rate

Cancer incidence, females, 2006 to 2010 - Standardised rate

Cancer incidence, persons, 2006 to 2010 - Standardised rate

Colorectal cancer

Melanoma of the skin

Lung cancer

Lymphoma

Self-assessed health (modelled estimates), 2014-15 - Age-standardised rate per 100

Prevalence of selected chronic diseases and conditions (modelled estimates), 2011-12 - Age-standardised rate per 100

Prevalence of selected health risk factors, adults (modelled estimates), 2014-15 - Age-standardised rate per 100

Prevalence of selected health risk factors, children (modelled estimates), 2014-15 - Age-standardised rate per 100

Selected composite indicators (modelled estimates), 2014-15 - Age-standardised rate per 100

Disability, 2016 - Per cent

Median age at death, 2010 to 2014 - Years

Premature mortality by sex, 2011 to 2015 - Standardised rate

Premature mortality by selected cause, 2011 to 2015 - Standardised rate

Available mortality by sex, 2011 to 2015 - Standardised rate

Available mortality by selected cause, 2011 to 2015 - Standardised rate

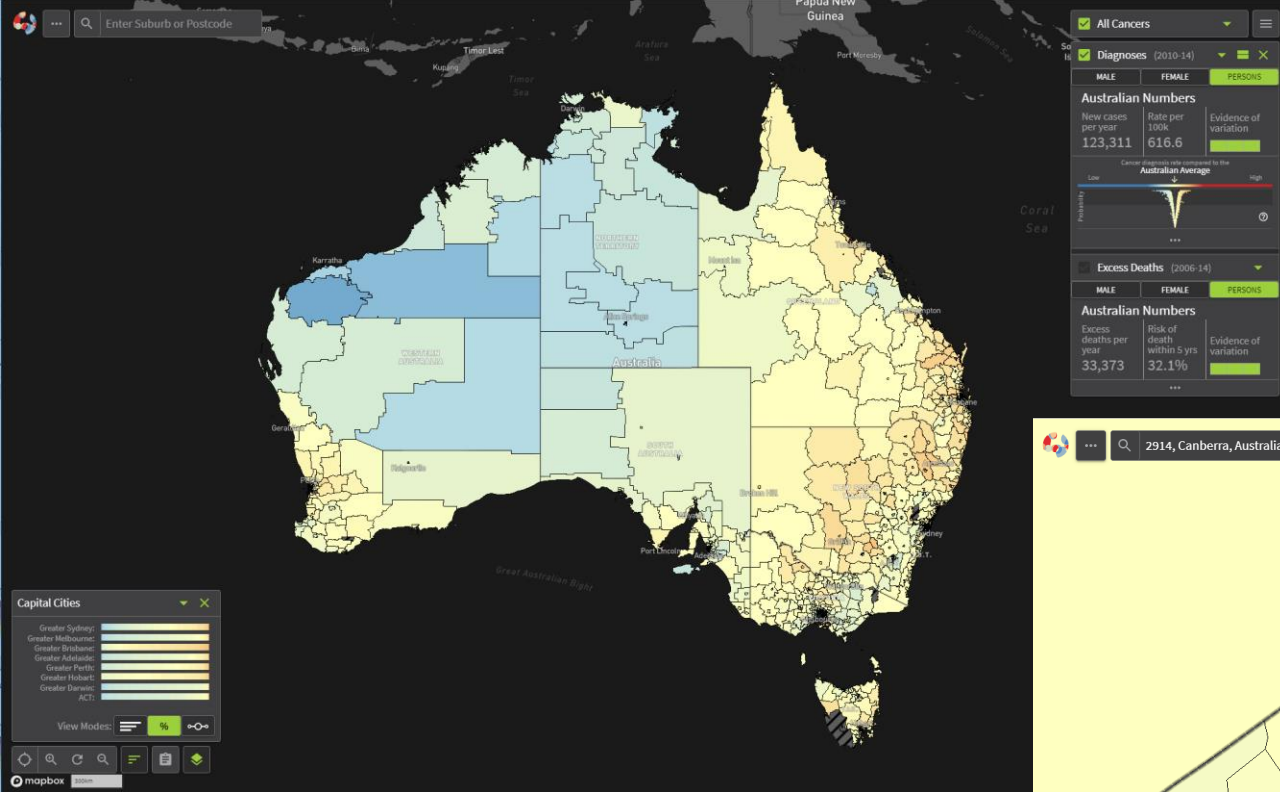
Residential aged care places, 30 June 2016 - Rate per 1,000

Social Health Atlas

OPEN ALLCLOSE ALL

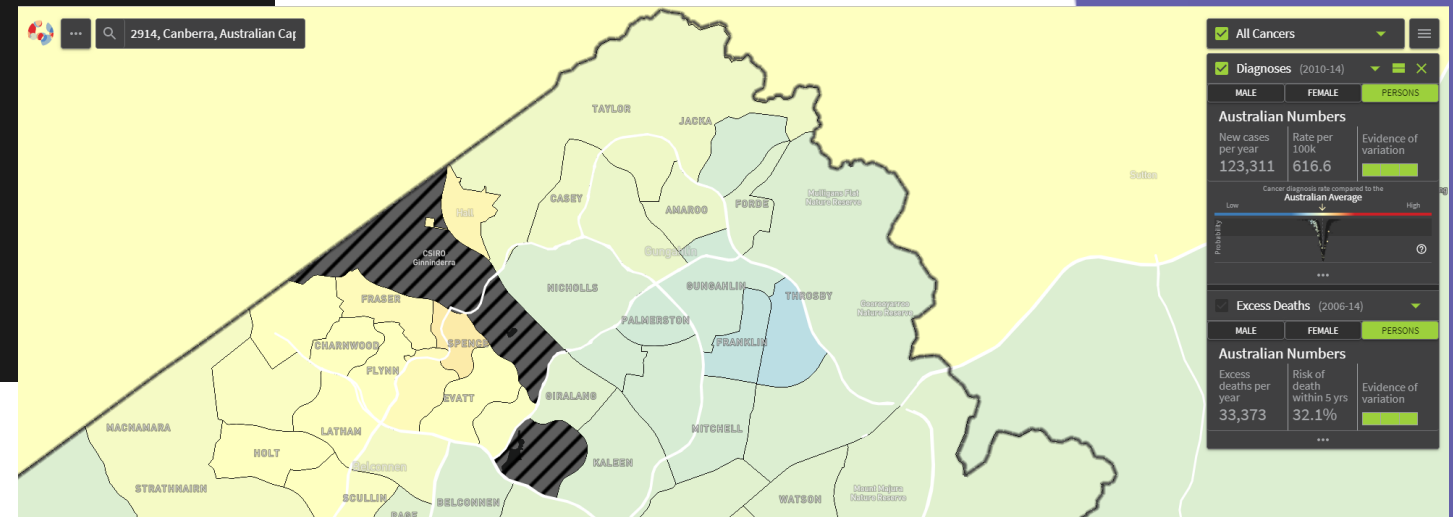
- Social Health Atlases of Australia: Population Health Areas
- Social Health Atlases of Australia: Local Government Areas
- Social Health Atlas of Australia: Primary Health Networks





Cancer Maps

By Statistical Areas Level 2 (SA2) .



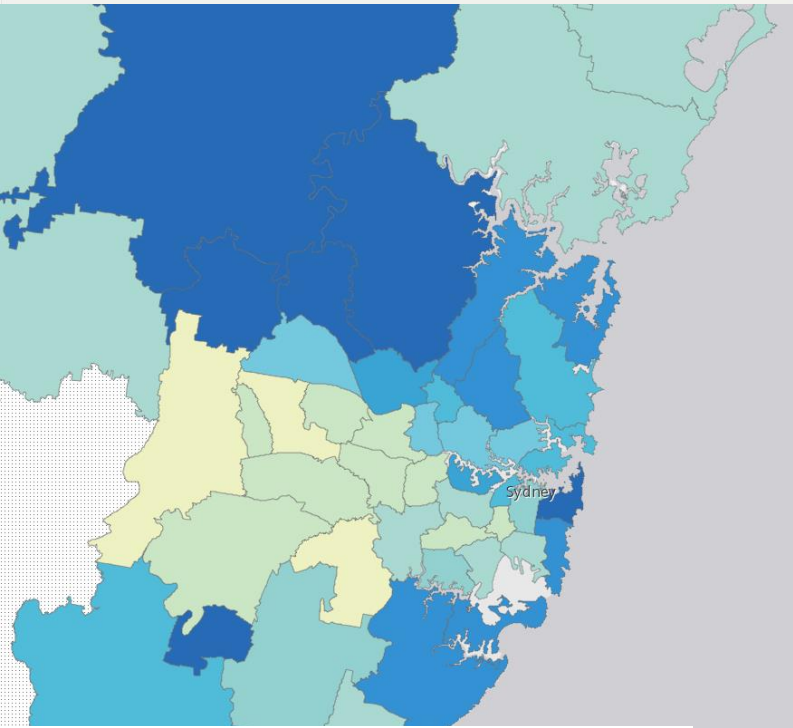
Cancer registries use address information of usual residence at the time of diagnosis to determine the SA2 information. The method by which each cancer registry allocates this varies. Cancer Registries in New South Wales, Australian Capital Territory, Tasmania, Victoria and Western Australia apply geocoding methods to the full street address. In Queensland and South Australia, the combination of suburb and postcode were used to map to SA2 areas, either through geocoding or using a concordance file. In Northern Territory, suburb name is used in the urban areas (Darwin and Alice Springs) while a range of location information is used for areas in rural and remote areas. Additional manual checks and verification are conducted on an ongoing basis by Registry staff to increase the completeness and accuracy of the processes.

The Australian Atlas of Healthcare Variation

The First Australian Atlas of Healthcare Variation
2015

The Second Australian Atlas of Healthcare Variation
2017

The Third Australian Atlas of Healthcare Variation
2018



2.1 Colonoscopy hospitalisations, all ages - Map

Figure 2.4: Number of hospitalisations for colonoscopy per 100,000 people of all ages, age and sex standardised, by Statistical Area Level 3 (SA3) of patient residence, 2016–17

<https://acsqhc.maps.arcgis.com>; <https://health.nt.gov.au/professionals/remote-health-atlas>; <https://victorianwomenshealthatlas.net.au/#/>;
<https://www.cesphn.org.au/preview/mental-health-1/1713-the-integrated-mental-health-atlas-of-the-central-and-eastern-sydney-phn/file>



NORTHERN TERRITORY
GOVERNMENT

Department of Health

Home > For health professionals and NGOs > Remote Health Atlas


This site provides remote health resources for n

- Clinical Protocols
- Emergency Kits
- Evacuation Centre Management
- Health Record Guidelines
- Health Record Application Forms
- Medical Students
- Men's Business
- Pathology Stores Order Forms
- Pharmacy Guidelines
- Pharmacy Forms
- Pharmacy Resources
- Point of Care Pathology
- Remote Alcohol and Other Drugs Workforce Program
- Research Proposals
- Specialist and Clinical Services Outreach

Contact:

For further information e-mail: CAPProfPracNurse.THS@nt.gov.au

Last updated: 02 November 2018



Victorian Women's
HEALTH ATLAS

Violence Against Women > Sexual Offences > Rate (per 10,000) > 2018

Sexual Offences

Sexual offences include rape, indecent assault, and other acts of a sexual nature against another person, which are non-consensual or where the person is deemed incapable of giving consent because of youth or temporary / permanent incapacity. In Victoria, sexual violence is overwhelmingly perpetrated by men against women, and female victims of sexual offences outnumber male victims by 4 to 1. In 2018 there were 8,831 reports of sexual offences logged by Victoria Police comprising 7,351 female victims, and 1,399 male victims. Compared with 2017, the number of sexual offence victim reports increased by 5% for females (from 6,989) and decreased by 13% for males (from 1,604). The sexual offences population rate is 14 per 10,000 persons for female victims, compared with 3 per 10,000 persons for male victims (average of Victorian local government areas).

Gender Analysis

The stigma surrounding sexual assault makes it harder for victims to disclose their experience. In Victoria about one third of reported sexual offences are related to family violence. About a quarter relate to historical sexual assaults that are more than 10 years old. Less than one quarter of reported sexual offences progress to court, and even fewer result in a conviction. Women victims may experience discrimination from the justice system itself (in terms of being believed, or in the nature or level of questioning they receive). Sexual assault has profound effects on the wellbeing of victims/survivors, including emotional, psychological, legal, health, spiritual, and socioeconomic impacts.

Rate (per 10,000)

The rate equals the number of victim reports received in the year period 2016, per LGA, per 10,000 total persons of the corresponding LGA.

Source

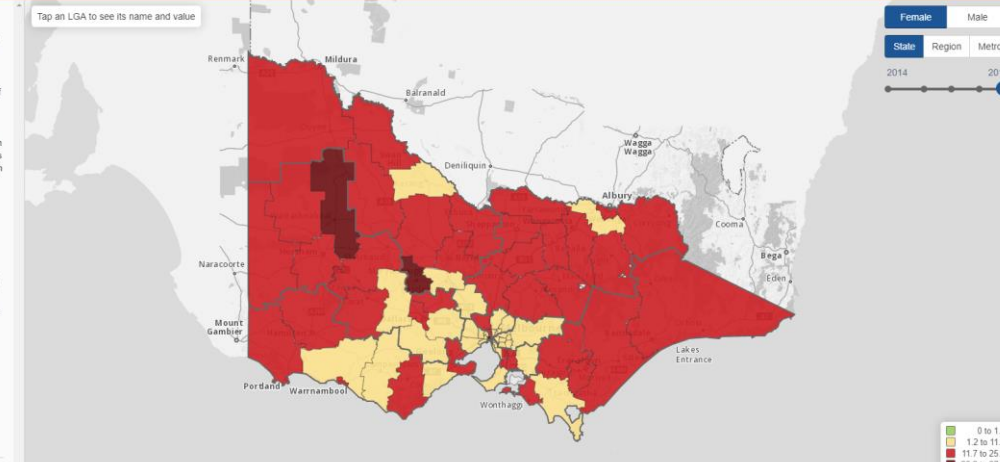
Crime Statistics Agency Victoria, Victim reports for selected offences by region, LGA and sex of victim - January to December 2018, Category: A30 Sexual offences. Data extracted from LEAP on 18 January 2019, ABS Census 2016.

Currency

2018

Data Source

<http://www.crimestatistics.vic.gov.au/>



Tap an LGA to see its name and value

Female Male

State Region Metro

2014 2018

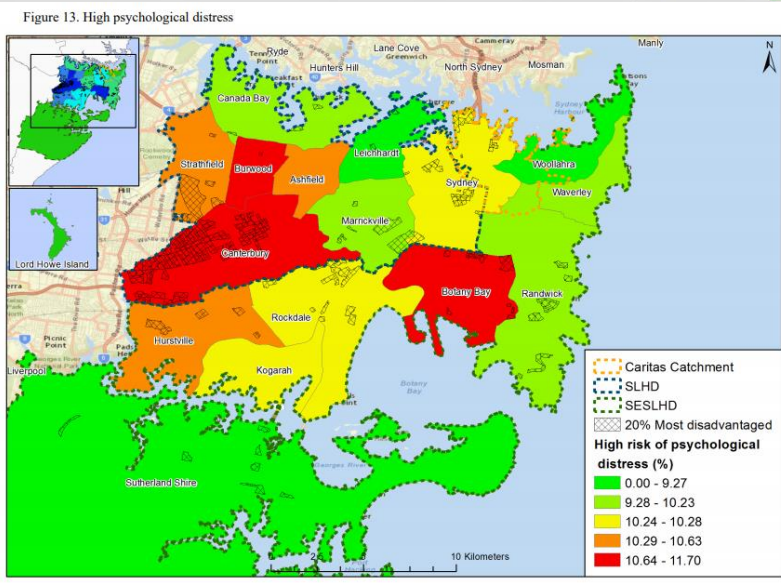
37.84 35.00 30.00 25.00 20.00 15.00 10.00 5.00 0.00

Rate

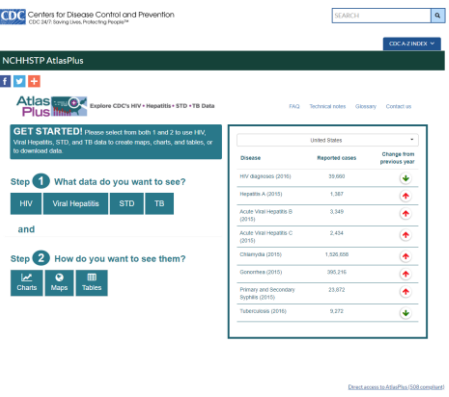
female male state average

© 2019 Women's Health Victoria | Disclaimer | Terms of Use | version: 1.3.61

Data synced at Jun 25, 2019 12:02:45 PM



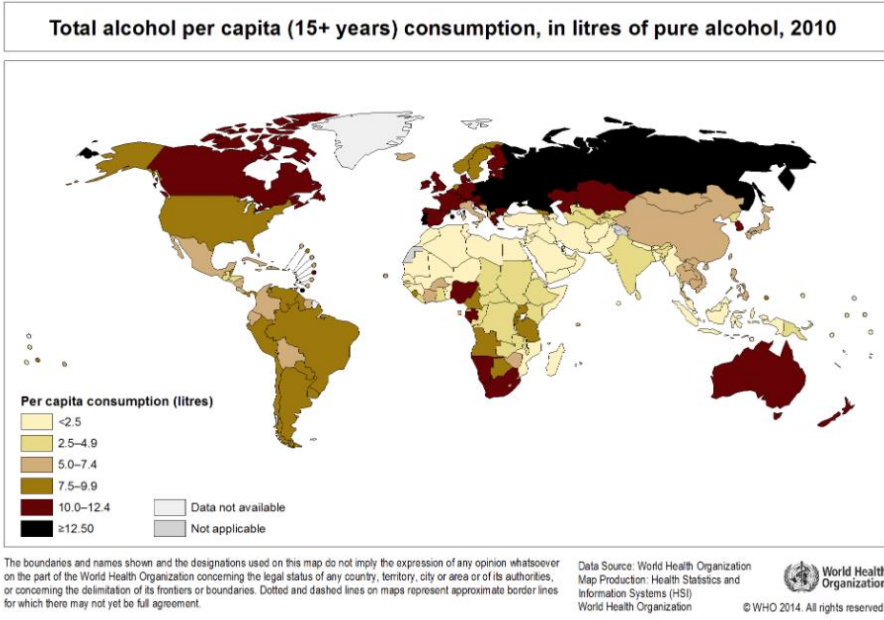
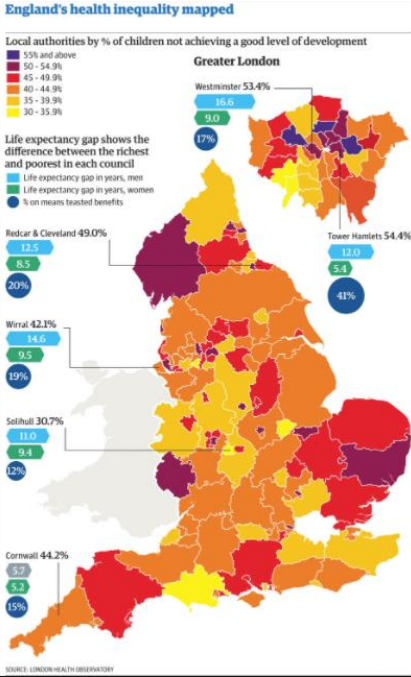
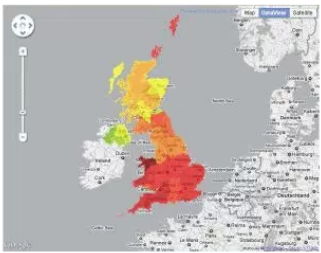
World Examples



New map shows undiagnosed dementia cases in UK

March 8, 2011 Sachiye Day

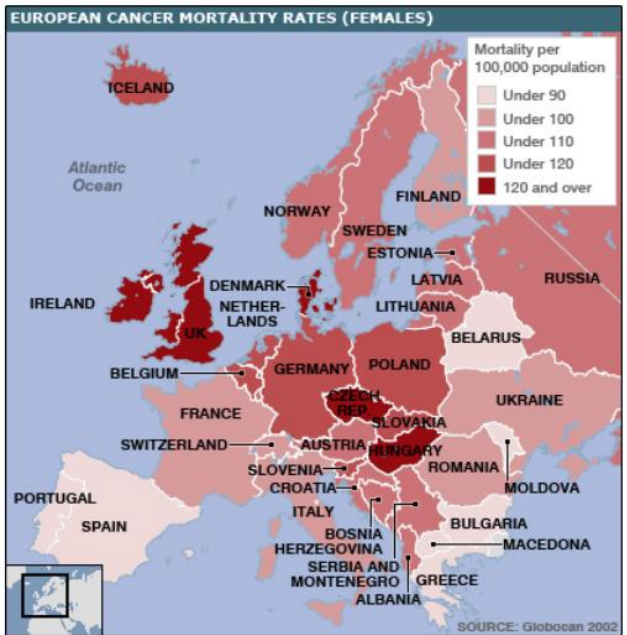
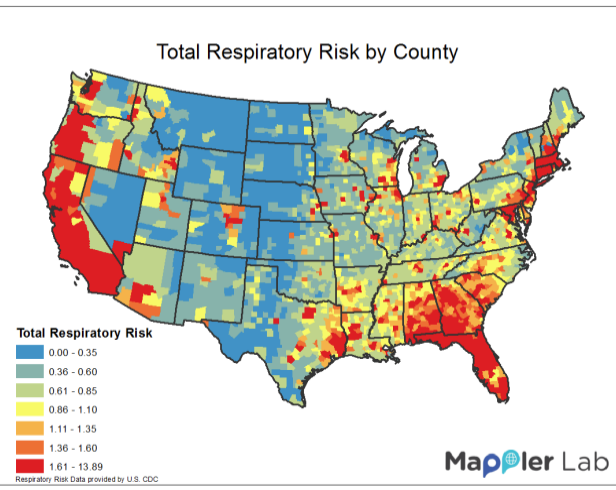
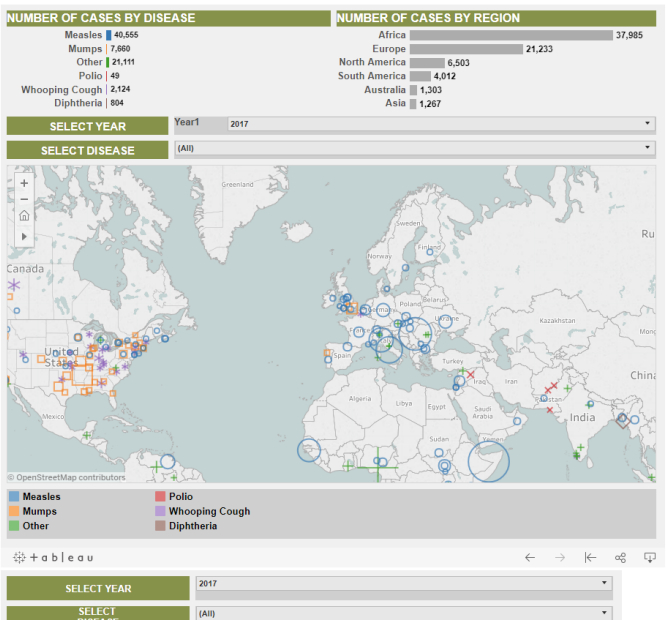
A study of dementia diagnosis in UK produced by The Alzheimer's Society and Alzheimer's Scotland with the help of the supermarket chain Tesco predicts that more than a million people will suffer from dementia by 2021 in the UK. The researchers say their figures show that half a million people are now living without a diagnosis.



Vaccine-preventable disease outbreaks

Browse our interactive map to track outbreaks of vaccine-preventable diseases around the globe.

The map uses information published by news, governments and global health organisations to plot outbreaks of vaccine-preventable disease over time, including measles, mumps, polio, rubella and whooping cough (pertussis). Originally created and published by the US-based Council on Foreign Relations in 2008, this interactive tool is widely recognised by the global health community for its role in raising awareness of the continued prevalence of easily preventable diseases.



Five interesting things ... from the postcode health atlas

by Guest Author on 28 Apr 2014

A new [environment and health atlas](#) unveiled last week allows you to type in a postcode and see the community-level risk for developing 14 diseases, as well as the levels of common environmental agents. Here Dr Anna Hansell of Imperial College London explains five of the most interesting — and surprising — findings from the atlas.

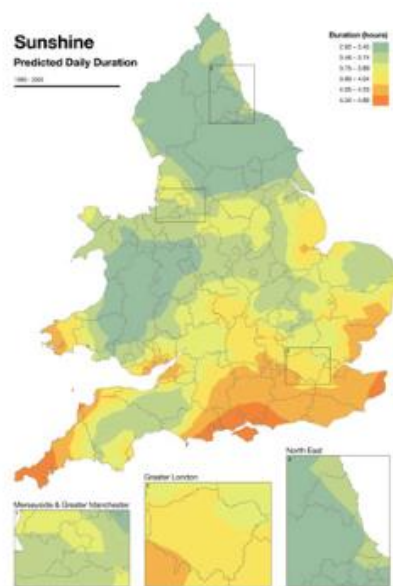


Image copyright: Imperial College London

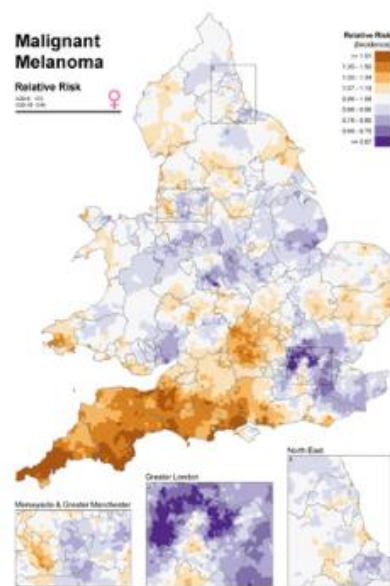


Image copyright: Imperial College London

One of the most


1. Some diseases produce 'flat maps'. Some diseases such as lung cancer, skin cancer, liver cancer, COPD and mesothelioma showed high levels of geographical variation (high levels in some areas and low in others). But common cancers such as breast cancer and prostate cancer showed very little geographical variation — a 'flat map'. This suggests that environmental factors that vary between areas are unlikely to play a large role in determining the risk for prostate or breast cancer.
2. It's not 'grim up north'. We didn't find that health risks were uniformly worse in northern areas. While heart disease risks tended to be higher than average in northern compared with southern areas, breast cancer risks were lower, and lung cancer risks were higher in urban centres in both north and south of England. The health risks were adjusted for deprivation, so this shouldn't be the explanation for our findings.
3. Skin cancer isn't all down to hours of sunshine. The atlas shows that malignant melanoma skin cancer risk is greatest in south west England even though sunshine duration is highest in south east England. This suggests that despite a lower level of sunlight in the south west people may be more exposed, which could trigger further research into behavioural differences between the areas.
4. Merseyside has a significantly higher risk of liver cancer. The highest liver cancer risk was seen in the Merseyside area and this was one of the most striking geographical patterns. This might be partly related to differences in coding of this type of cancer between cancer registries across England and Wales. We also know that there's a higher prevalence of hepatitis C infections, a risk factor for liver cancer, in Merseyside, which may also partly account for the increased risk.
5. We really are dealing with small numbers. The print version of the atlas provides information on how many cases were seen in a census ward for each of the 14 health conditions. The rarest cancers were leukaemia, brain cancer and mesothelioma (a cancer related to past asbestos exposure). Over a 25 year period, the average number of new cases in a ward was around 14 for leukaemia, nine for brain cancer and two for mesothelioma. By comparison, breast cancer, the commonest cancer we looked at, the average number of cases was approximately 84.

We hope the atlas will not only help stimulate more research, but also provide useful information about health and the environment. We produced the atlas as a resource not just for people working in public health and public health policy but also for the general public — we spent two years working with Sense About Science (a charity promoting better understanding of science) to help us communicate to all of these audiences. We have had over 200,000 people access the website in the first three days, which has been a phenomenal response!

Anna Hansell

<https://mrc.ukri.org/news/blog/five-interesting-things-from-the-postcode-health-atlas/>

exciting things about the atlas is the fine scale that we've managed to achieve by drilling down into small area-level data (around 6,000 people per area). People have mapped disease risk and environment factors before, but never at such a fine scale. While it shouldn't be used to see what an individual's risk is, it does allow us to see some surprising patterns, some of which are ripe for more research ...



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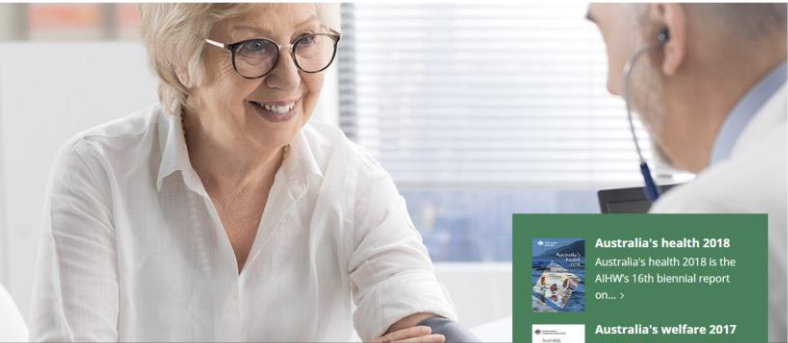
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Stronger evidence, better decisions, improved health and welfare



Australia's health 2018

Australia's health 2018 is the AIHW's 16th biennial report on... >

Australia's welfare 2017

Australia's welfare 2017 is the 13th biennial welfare report of... >

Cardiovascular disease in women—a snapshot of national statistics >

News & media

Cardiovascular disease affects half a million Aussie women >

18 Jun 2019

Consulting on building the evidence on primary health care >

14 Mar 2019

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•Primary Health Network (PHN) areas—PHNs boundaries defined by the Australian Government Department of Health. There are 31 PHN areas that cover the whole of Australia.

•Statistical Areas—Statistical Areas are a geographical classification defined by the Australian Bureau of Statistics: Statistical Areas Level 1 (SA1s); Statistical Areas Level 2 (SA2s); Statistical Areas Level 3 (SA3s); and Statistical Areas Level 4 (SA4s).

Due to the smaller number of results in these smaller areas, and the strict privacy and confidentiality controls applied to data, results are sometimes unable to be reported for all areas in Australia.

National minimum data sets and data set specifications: typically SA2

<https://www.aihw.gov.au/>
<https://meteor.aihw.gov.au/content/index.phtml/itemId/676382>

AIHW

AIHW data by geography

HEALTHY COMMUNITY Indicators

The latest information for people in a PHN area.

EXPLORE THE DATA >

Primary topic	Report ¹ or resource	Geography reported
Alcohol, Smoking, Illicit use of drugs	National Drug Strategy Household Survey 2016: detailed findings	PHN area, SA4
Alcohol & other drug treatment services	Alcohol and Other Drug Treatment Services in Australia 2016–17	PHN area, SA2
Behaviours & risk factors	Health risk factors in 2014–15	PHN areas
Cancer	Cancer Incidence and Mortality Across Regions (CIMAR) books	GCCSA, PHA, PHN area, SA3, SA4
Cancer	Cancer incidence and mortality in Australia by small geographic areas	PHN area, SA3
Cancer	Cancer screening in Australia by small geographic areas 2015–2016	PHN area, SA3
Cancer	Incidence of selected cancers in 2009–2013	PHN area, SA3, SA4
Cancer	Participation in national cancer screening programs in 2015–2016	PHN area, SA3
Diabetes	Incidence of insulin-treated diabetes in Australia	PHN area, SA3
Expenditure, Primary health care	Medicare Benefits Schedule GP and specialist attendances and expenditure in 2016–17	PHN area, SA3
Expenditure	Patients' out-of-pocket spending on Medicare services	PHN area, SA3
Chronic kidney disease	Geographical variation in chronic kidney disease	PHN area
Homelessness services	Specialist homelessness services annual report 2017–18	SA4
Homelessness services	Specialist Homelessness Services Collection data cubes 2011–18	SA2, SA3, SA4, LG ad PHN
Hospitals, Primary health care	Potentially preventable hospitalisations in Australia by small geographic areas	PHN area, SA3
Hospitals	Potentially preventable hospitalisations in 2015–16	PHN area, SA3
Hospitals, Primary health care	Use of emergency department and GP services in 2015–16	PHN area, SA3
Indigenous Australians	Indigenous eye health measures 2017	PHN area
Indigenous health & welfare services	Indigenous health check (MBS 715) data tool	PHN area
Indigenous health & welfare services	Spatial distribution of the supply of the clinical health workforce 2014: relationship to the distribution of the Indigenous population	PHN area, SA3

Health Data

- Health data [in Australia] are provided for research based on administrative spatial units.
- SA2 is the required supply unit to AIHW.
- Even with data linkage SA1 can be difficult to source.
- These spatial units may hide patterns and distributions of health outcomes.
- Without detailed data how can we provide locations for targeted interventions?



Is walkability associated with a lower cardiometabolic risk?

Neil T. Coffee^{a,b,*}, Natasha Howard^a, Catherine Paquet^{a,c}, Graeme Hugo^b, Mark Daniel^{a,d}



- **Lower CMR score was associated with higher WI for the road buffers built environment:**
 - a 3% reduction in relative risk for the 500 m road buffer,
 - 6% for the 1000 m and 1600 m road buffers.
 - No statistical relationship was found for either of the two predetermined administrative spatial unit.
- These results indicate that the choice of spatial unit used and its scale influence the nature of relationships estimated between the built environment and clinical risk factors.

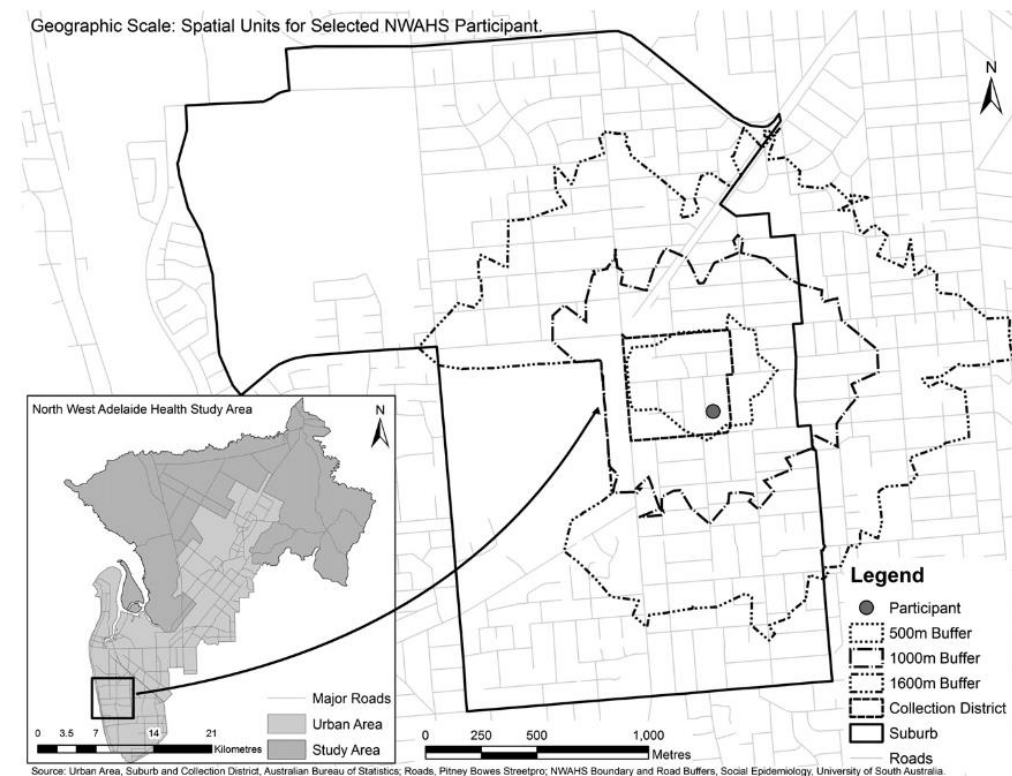


Fig. 2. Geographic scale variation, selected NWAHS participant.




Table 3

Parameter estimates for associations between cardiometabolic risk score and spatial unit walkability score ($n=3593$)^a.

Walkability score	RR		95% CI	P
500 m road buffer	0.97	0.94	1.00	0.04
1000 m road buffer	0.94	0.91	0.98	0.002
1600 m road buffer	0.94	0.90	0.97	< 0.001
Collection district	0.98	0.94	1.03	0.47
derived suburb	0.97	0.91	1.04	0.37

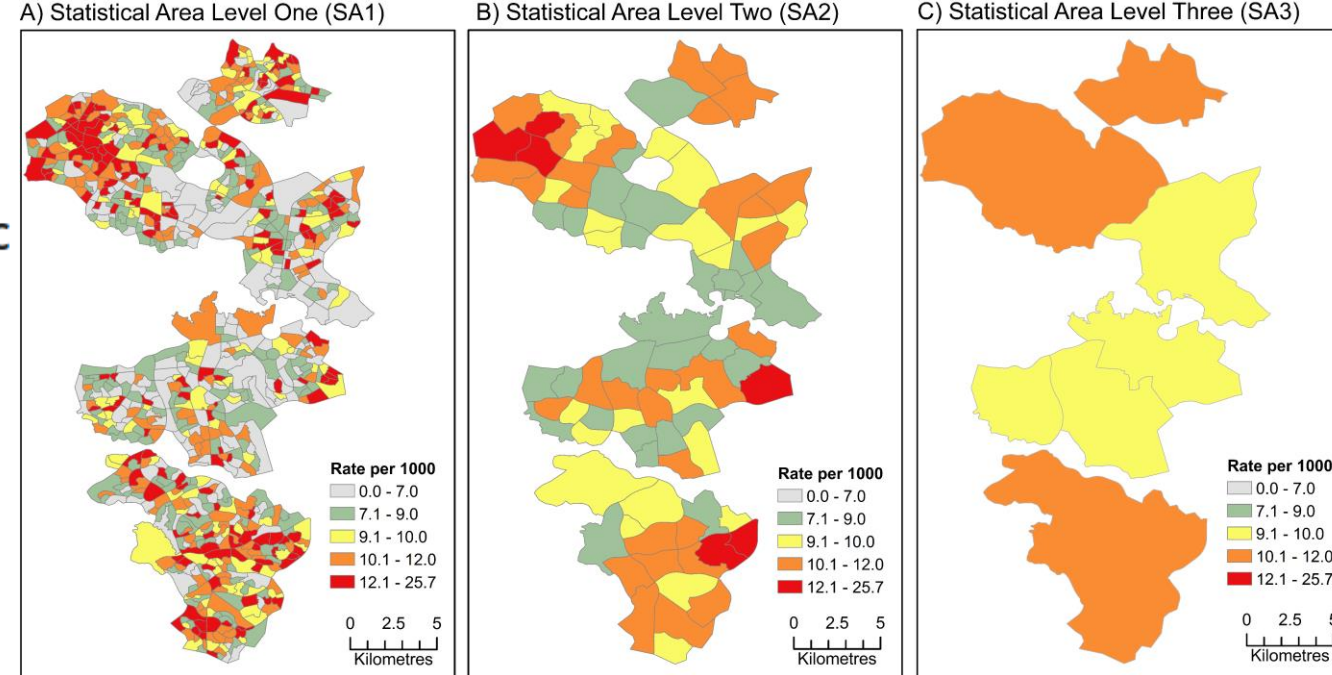
^a Adjusted for individual gender, age (< 55 or ≥ 55), education (no university or university degree), weekly income (0–19,999; 20,000–59,999, > 60,000) and suburb weekly median household income.

Impact of scale of aggregation on associations of cardiovascular hospitalization and socio-economic disadvantage

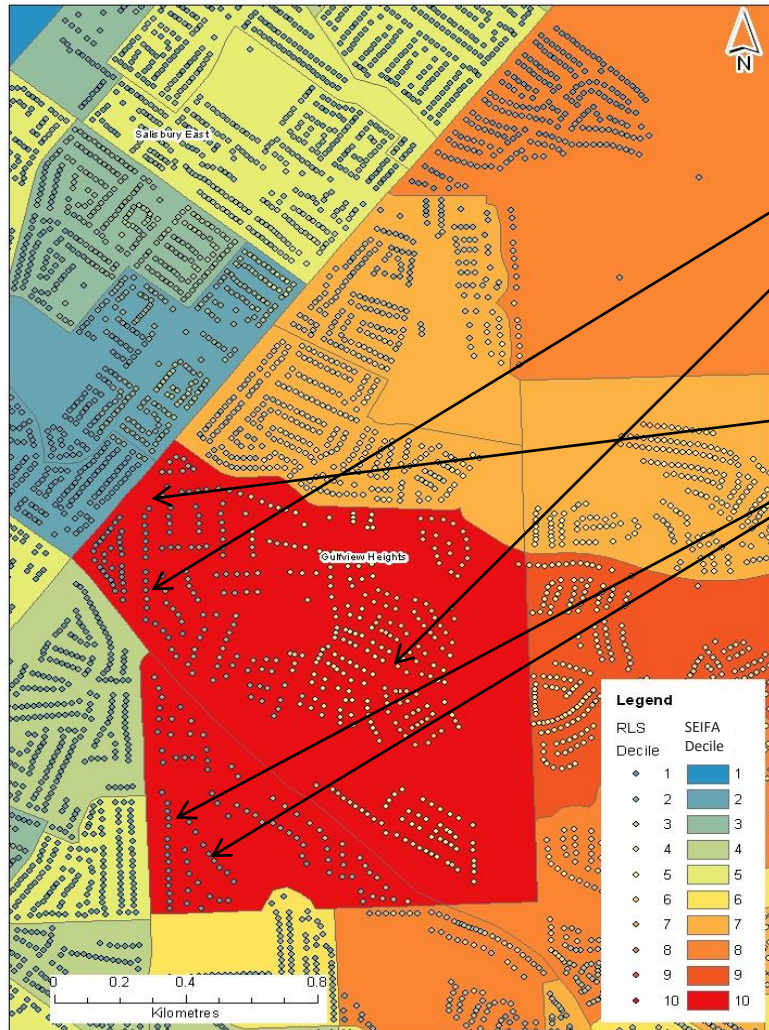
Ivan C. Hanigan , Thomas Cochrane , Rachel Davey 

Published: November 28, 2017 • <https://doi.org/10.1371/journal.pone.0188161>

- Disadvantage increases risk of cardiovascular disease.
- A difference in associations of cardiovascular disease rates with disadvantage scores between SA1 - SA2 – SA3.
- Scale of analysis does influence the understanding of geographic patterns of socio-economic disadvantage and cardiovascular disease morbidity.
- Health surveillance and interventions in Canberra should take into account the impact of the scale of aggregation on the association between disadvantage and cardiovascular disease observed.



RLF: Within CD variation



Spatial variation within the RED CD noted through the change in decile of the individual property scores

More aligned with neighbouring CDs which may suggest CD boundaries are inappropriate SES boundaries

Health Data

- Hard health outcomes difficult to access at a spatial scale that is meaningful
- Confidentiality problems
- We have the technology but generally lack the access to detailed spatially referenced data
- Data available for administrative units that are not meaningful!
- MAUP issues

Health Data

- Data linkage costs
- Poor quality data especially address data (standard addressing at data input required)
- Enormous cost and time to geocode health data
- Apart from these issues – it is very difficult to get data for research

Health Data Supply

- We could do so much!
- How can we improve supply?
- Why are we not more outraged!
- We see significant technology improvements
 - (3D Cadastre); LIDAR; Geoscape, but....
- Health spatial data provision is very constrained!
- If we cannot improve the scale of data provision – we should at least recognise that MAUP could be a limitation/factor in the research outcomes!
- Highlights the importance of health geography