

# **GIS ANALYSIS OF ENVIRONMENTAL, SOCIO- DEMOGRAPHICAL & BEHAVIOURAL RISK**

2015 ESRI User Conference  
Session: Disease Surveillance  
Thursday, July 23, 2015

Presented by: Suzanne McGuire  
Health Informatics Institute – Algoma University

# INTRODUCTION

- The idea that geography has an impact on health has been largely overlooked in the past
- One of the earliest records of the connection between geography and health was made by Dr. John Snow during the 1854 outbreak of Cholera in London, England



# INTRO CON'T

- Data that can be mapped through GIS and collected in different databases can be layered to explore connections between different geographic attributes and population characteristics.
- This provides the opportunity to analyze health issues in a different way – how geographic attributes contribute to the impact of an individualized chronic disease care plan.





# PURPOSE

- √ Understand how chronic disease risk factors in different areas of the Algoma Region may affect nurse practitioner patients based on their location of residence.

# RESEARCH QUESTION

- How can patient health information, layered with behavioral, environmental & sociodemographic information, facilitate individualized health promotion & disease prevention care plans for patients suffering from, or at risk of, developing chronic disease?

# PARTICIPANT RECRUITMENT

- Comprehensive health & wellness survey mailed to 1250 patients who had had an appointment at the Clinic between 2012-2014 or recruited in the Clinic waiting room
- Patients who didn't consent after the first mailing were mailed another invitation.
- Patients who had not yet participated were followed-up with a phone call.
- 1100 follow-up phone calls made & a second mailing was completed
- This increased the response rate by 100%

# DATA COLLECTION

## DEC. 2013-FEB. 2014

- Geographic data extracted from Environment Canada, Statistics Canada & Manifold Data Mining Inc.
- Patient data extracted from surveys & Clinic patient records in Nightingale
- Patients asked to identify all past & present places of residence – This provided a demographic history of potential areas of risk
- Longitude & latitude of patients' home addresses obtained from Google Maps & entered into GIS

# HEALTH & WELLNESS SURVEY

Addressed the following variables:

- Demographics
- Overall health condition
- Socioeconomic characteristics
- Health status
- Health insurance coverage
- Beliefs about health conditions
- Social support
- Attitudes towards medications





# HEALTH & WELLNESS SURVEY

Data extracted from the patient's electronic medical record included:

- Smoking
- Alcohol consumption
- Medical conditions
- Drug use
- Height, weight, blood pressure
- Cardiovascular disease risk
- BMI



# ANALYSIS

- GIS analysis was applied to the following health risk factors:

**A) Behavioural** (tobacco & alcohol use, fruit/vegetable consumption, inactivity, obesity)

**B) Socio-demographical** (income, education level, employment status)

**C) Environmental** (air & water quality)

# RESULTS

- n=220 adult and n=15 child surveys were completed and returned with signed consent
- Participants provided a significant response to surveys & allowed access to their personal information



MAP EXAMPLES:

## Walkability of Sault Ste. Marie



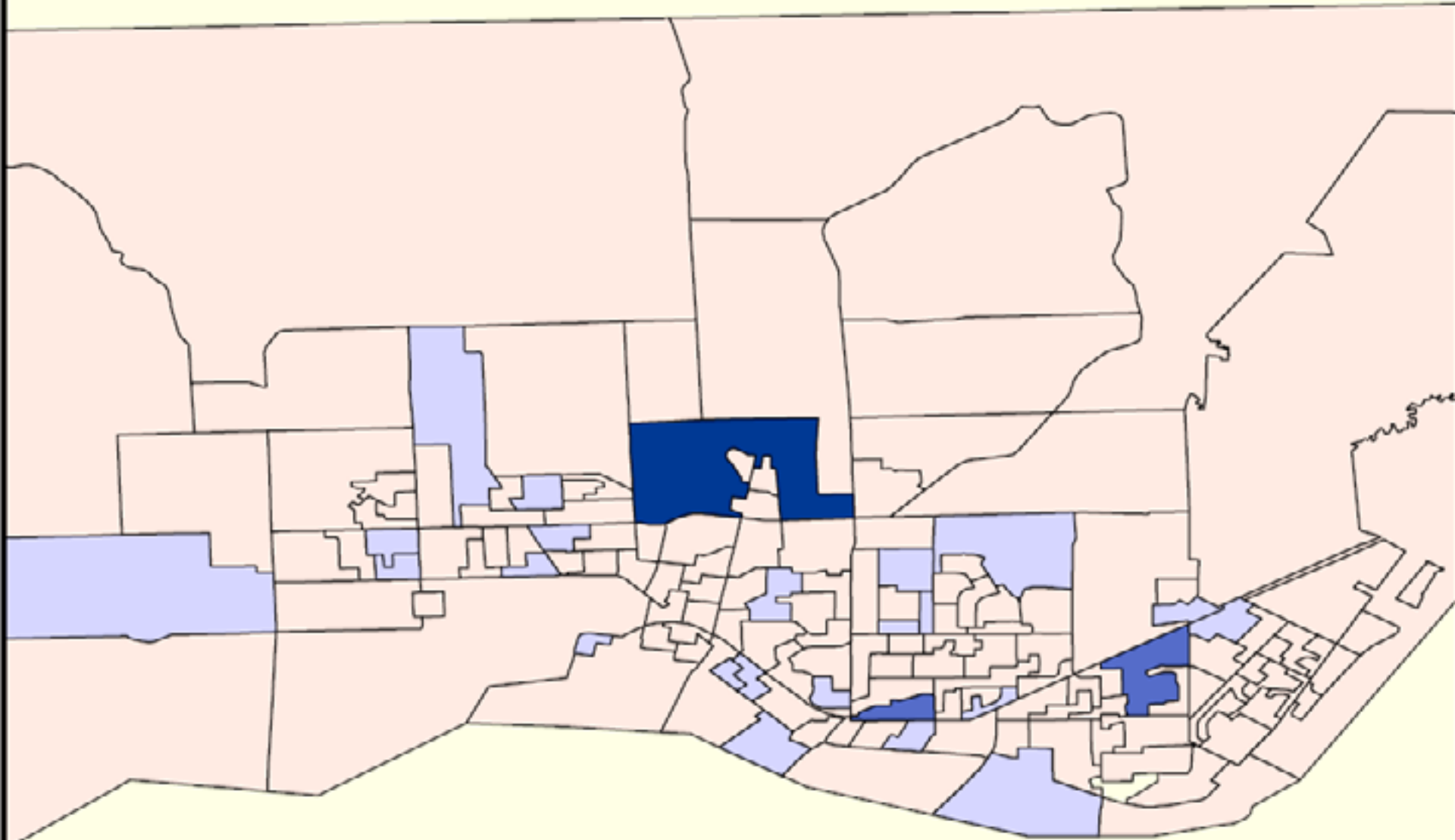
**Walkability Scores** are based on the walking distance an address is from different amenities. These amenities are from 7 categories: Dining & Drinking, Groceries, Shopping, Errands, Parks, Schools, and Culture & Entertainment. Maximum points for a 5 minute walk to an amenity and no points for an over 30 minute walk. The points are added to give an addresses a walkability score. ([www.walkscore.com](http://www.walkscore.com))

### Walkability Score

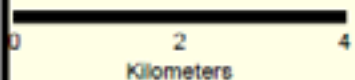
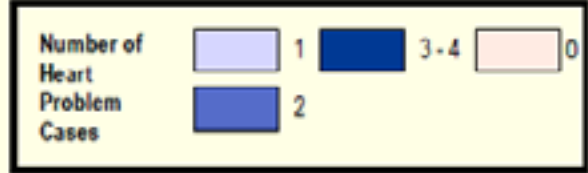
- 0 - 24 (Car-Dependent)
- 25 - 49 (Car-Dependent)
- 50 - 69 (Somewhat Walkable)
- 70 - 89 (Very Walkable)
- 90 - 100 (Walker's Paradise)

The areas shown are based on data from a Clinical Study done by the Algoma Nurse Practitioner Led Clinic and the Health Informatics Institute at Algoma University.

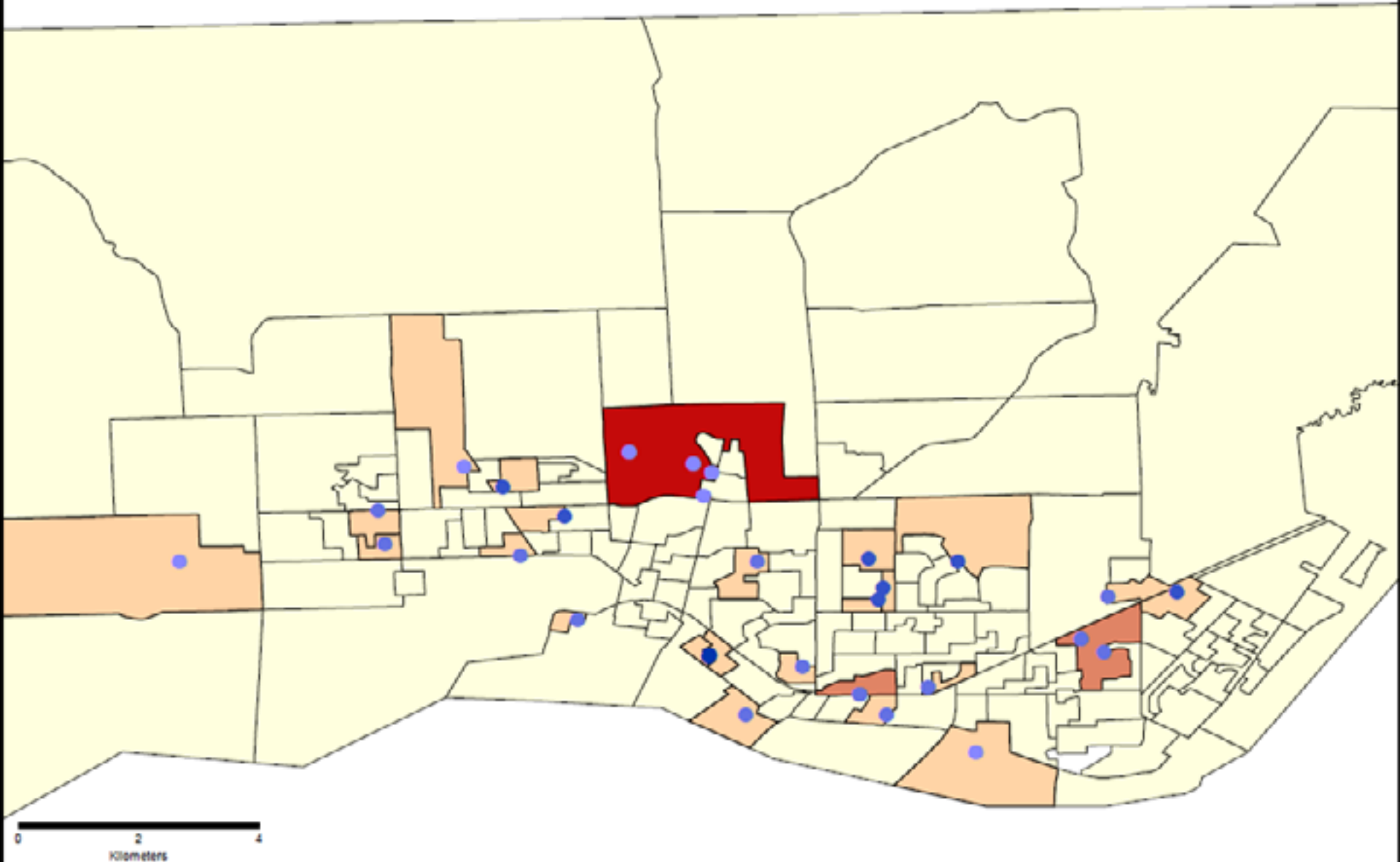
# Heart Problem Cases in Sault Ste. Marie



The data stating the number of Heart Problem cases in Sault Ste. Marie are based on a Clinical Study done by the Algoma Nurse Practitioner Led Clinic and the Health Informatics Institute at Algoma University.



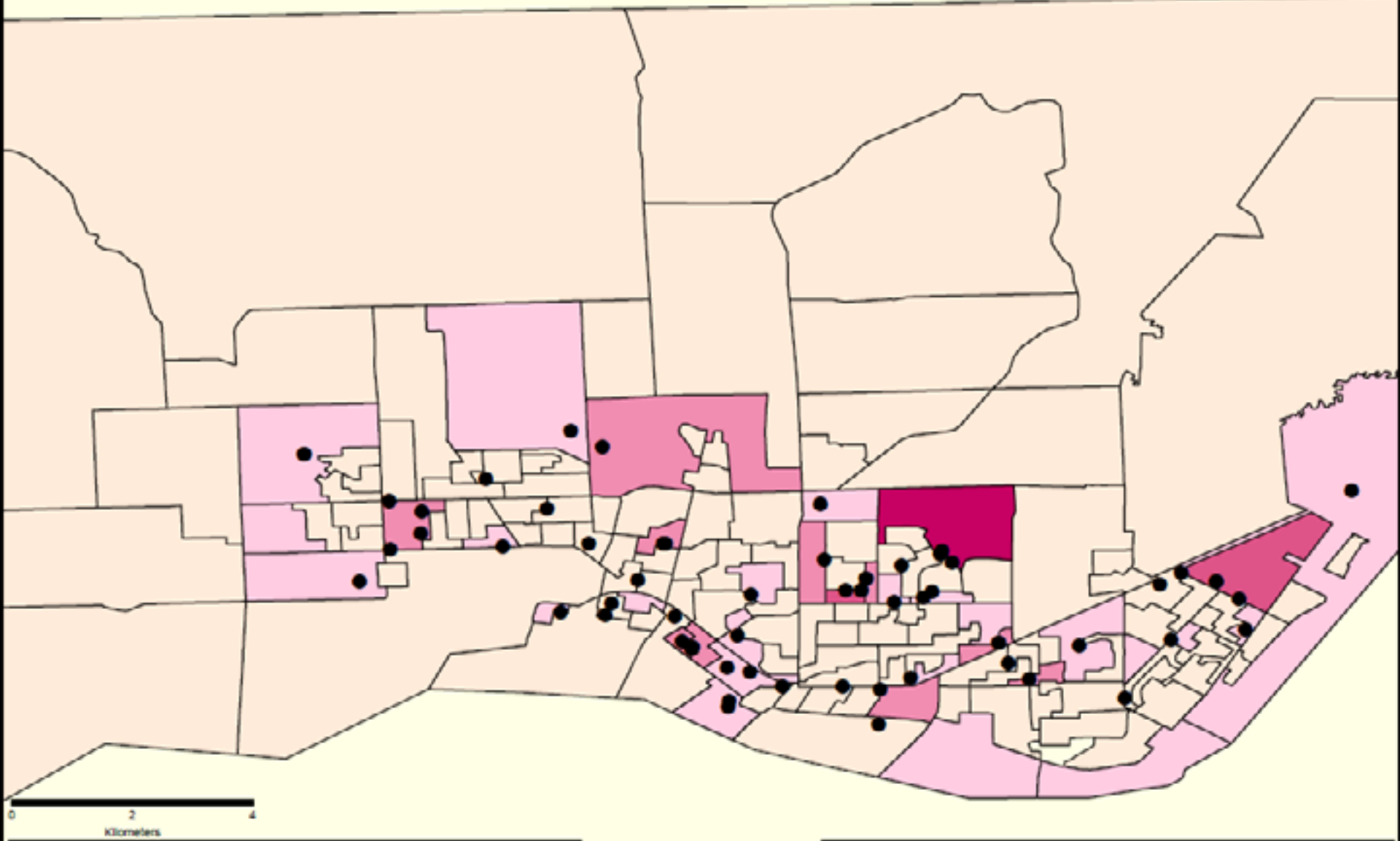
# Heart Problem Cases and Address Walkability in Sault Ste. Marie



The data stating the number of Heart Problem cases in Sault Ste. Marie are based on a Clinical Study done by the Algoma Nurse Practitioner Led Clinic and the Health Informatics Institute at Algoma University.

<b>Heart Problem Cases</b>	1	2	3 - 4	0
<b>Walkability Score</b>	25 - 49	50 - 69	70 - 89	90 - 100
	0 - 24			

# Anxiety and Depression Cases in Sault Ste. Marie

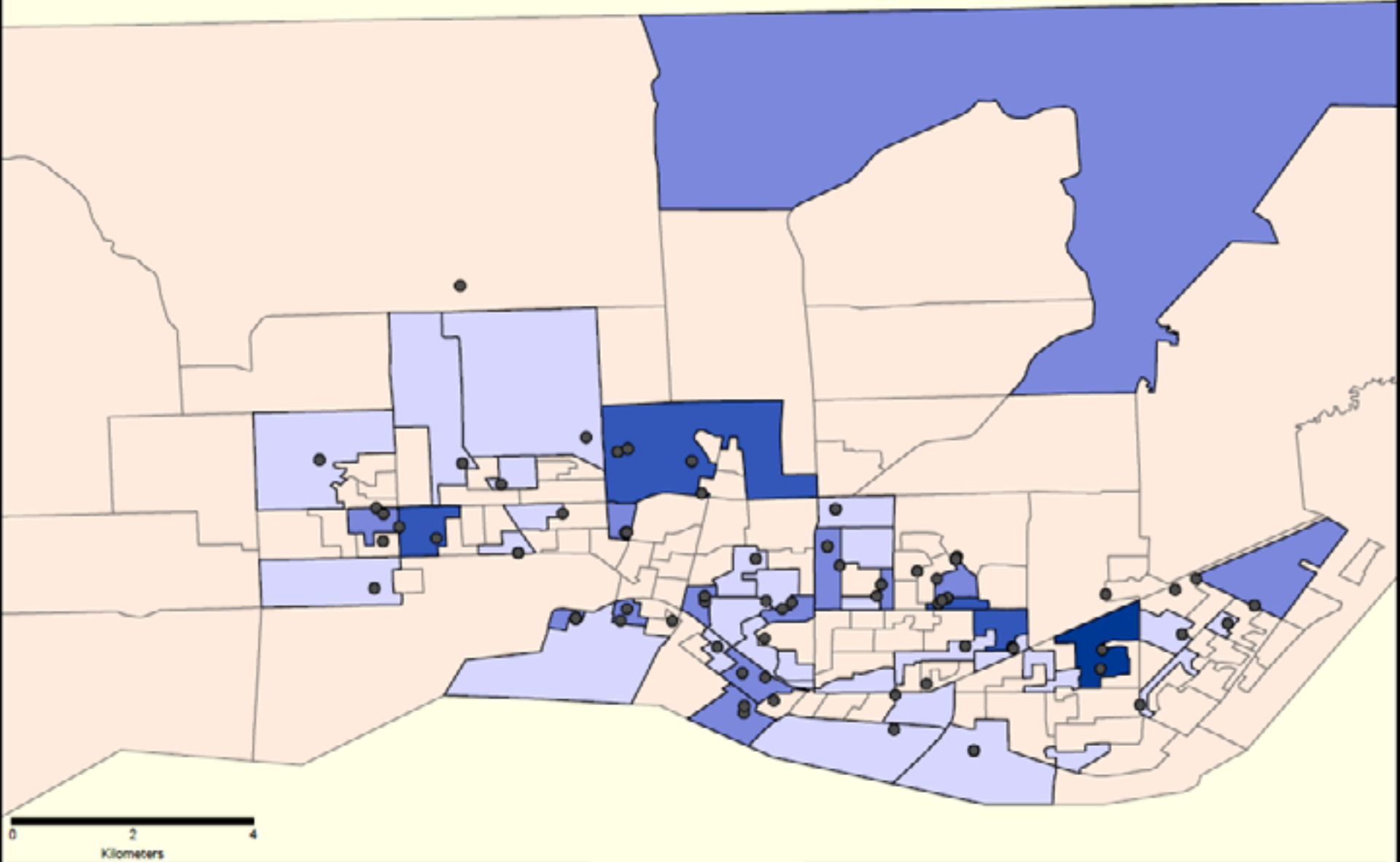


The data stating the number of Anxiety and Depression cases in Sault Ste. Marie are based on a Clinical Study done by the Algoma Nurse Practitioner Led Clinic and the Health Informatics Institute at Algoma University.

● Depression Cases	Number of Anxiety Cases	1	2	3	4	0



# High Cholesterol and Hypertension Cases in Sault Ste. Marie



The data stating the number of High Cholesterol and Hypertension cases in Sault Ste. Marie are based on a Clinical Study done by the Algoma Nurse Practitioner Led Clinic and the Health Informatics Institute at Algoma University.





# DISCUSSION

- Through analysis of spatial data, the Algoma Nurse Practitioner Led Clinic was provided with a picture of their patient population
- Application of GIS analyses to this data provided an opportunity for increased efficiency of health care and individualization of patient care

# CONCLUSIONS

- Information from this study was used to guide the Algoma Nurse Practitioner Led Clinic towards more personalized patient care
- This study shows that a significant number of patients are willing to disclose sensitive information in exchange for more personalized care



# FUTURE DIRECTIONS

- Findings will be used at the individual level as well as in health promotion and disease prevention activities for public health
- Future studies should attempt to replicate successful patient recruitment

# REFERENCES

- Broemeling, A.M., Watson, D.E. & Prebtani, F. (2008). Population patterns of chronic health conditions, co-morbidity and healthcare use in Canada: Implications for policy and practice. *Healthcare Quarterly*, 11, 70-76.
- Kamel Boulos, M.N., Roudsari, A. & Carson, E. (2001). Health geomatics: An enabling suite of technologies in health and healthcare. *Journal of Biomedical Informatics*, 34(3), 195-219. doi:10.1006/jbin.2001.1015.
- Lyseen, A.K., Nøhr, C., Sørensen, E.M., Gudes, O., Geraghty, E.M., Shaw, N.T. & Bivona-Tellez, C. (2014). A review and framework for categorizing current research and development in health related geographical information systems (GIS) studies. *IMIA Yearbook of Medical Informatics*, 9(1), 110-124.
- Morgan, M.W., Zamora, N.E. & Hindmarsh, M.F. (2007). An inconvenient truth: A sustainable healthcare system requires chronic disease prevention and management transformation. *Healthcare Papers*, 7, 6-23.
- Pfeiffer, D.U., Robinson, T.P., Stevenson, M., Stevens, K.B. & Rogers, D.J. (2008). *Spatial analysis in epidemiology*. United Kingdom: Oxford University Press; 2008.
- Schultz, S.G. (2007). From a pump handle to oral rehydration therapy : A model of translational research. *Advances in Physiology Education*, 31(4), 288-293. doi:10.1152/advan.00068.2007.



QUESTIONS?