

GIS Analysis of Environmental, Socio-demographical & Behavioural Risk Factors for Algoma Nurse Practitioner Patients with Chronic Disease

2015 Big Data (HISA)

Session: Population Health

Wednesday, 21st October 2015

Presented by: Dr. Nicola (Nikki) Shaw, FBCS, CITP

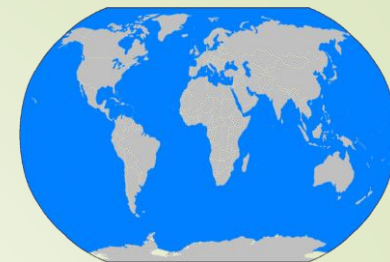
Co-author: Suzanne McGuire

(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



Introduction

- ▶ 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:
 - ▶ Exploring how geographic attributes contribute to the impact of an individualized chronic disease care plan.

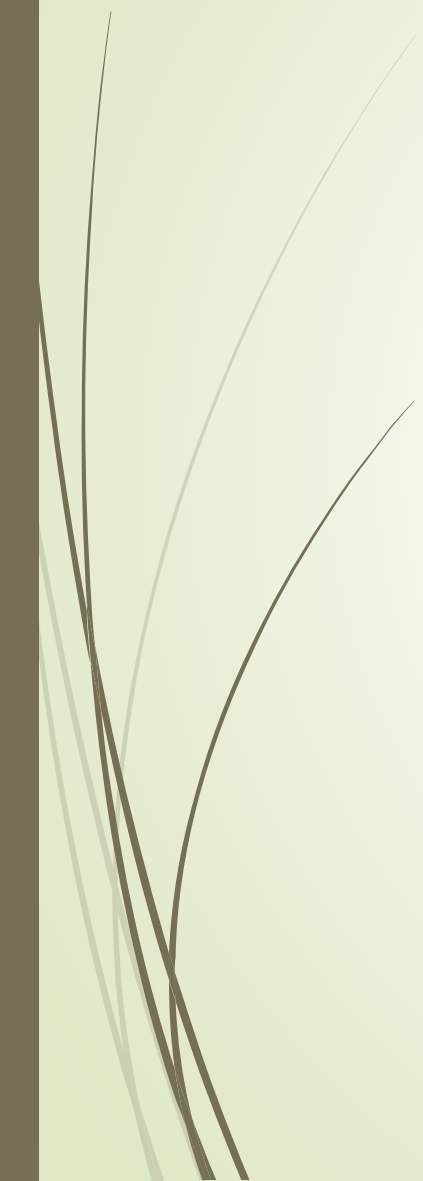


Purpose

- ❖ **To 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 either had an appointment at the Clinic between 2012-2014
 - ▶ or were recruited in the Clinic waiting room during random times/days (Dec. 2013-Feb. 2014)
- ▶ Patients who didn't consent/participate after the first mailing were mailed another invitation.
- ▶ Patients who had not yet participated, after the second mailing, were followed-up with a phone call.
- ▶ 1100 follow-up phone calls were made
 - ▶ This increased the response rate by 100%



Data Collection

Dec. 2013-Feb. 2014

- ▶ Geographic data extracted from Environment Canada, Statistics Canada & provided by 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 (EMR) included:

- Recent Height, weight, blood pressure measurements
- Cardiovascular disease risk assessments
- BMI (calculated from height/weight)
- Smoking status
- Alcohol consumption
- Medical conditions
- Drug use





Analysis

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

A) Behavioural

- Tobacco, drug & alcohol use
- Fruit / vegetable consumption
- Inactivity
- BMI (Clinical obesity)

B) Socio-demographical

- Income
- Education level
- Employment status

C) Environmental

- Air & water quality



Results

- ▶ n=220 adult and n=15 child surveys were fully completed and returned with signed consent
 - ▶ 18.8% response rate
- ▶ Participants provided a significant response to surveys
- ▶ Participants allowed access to their personal information (to be extracted from their EMR record)



Map examples:

Walkability of Sault Ste. Marie



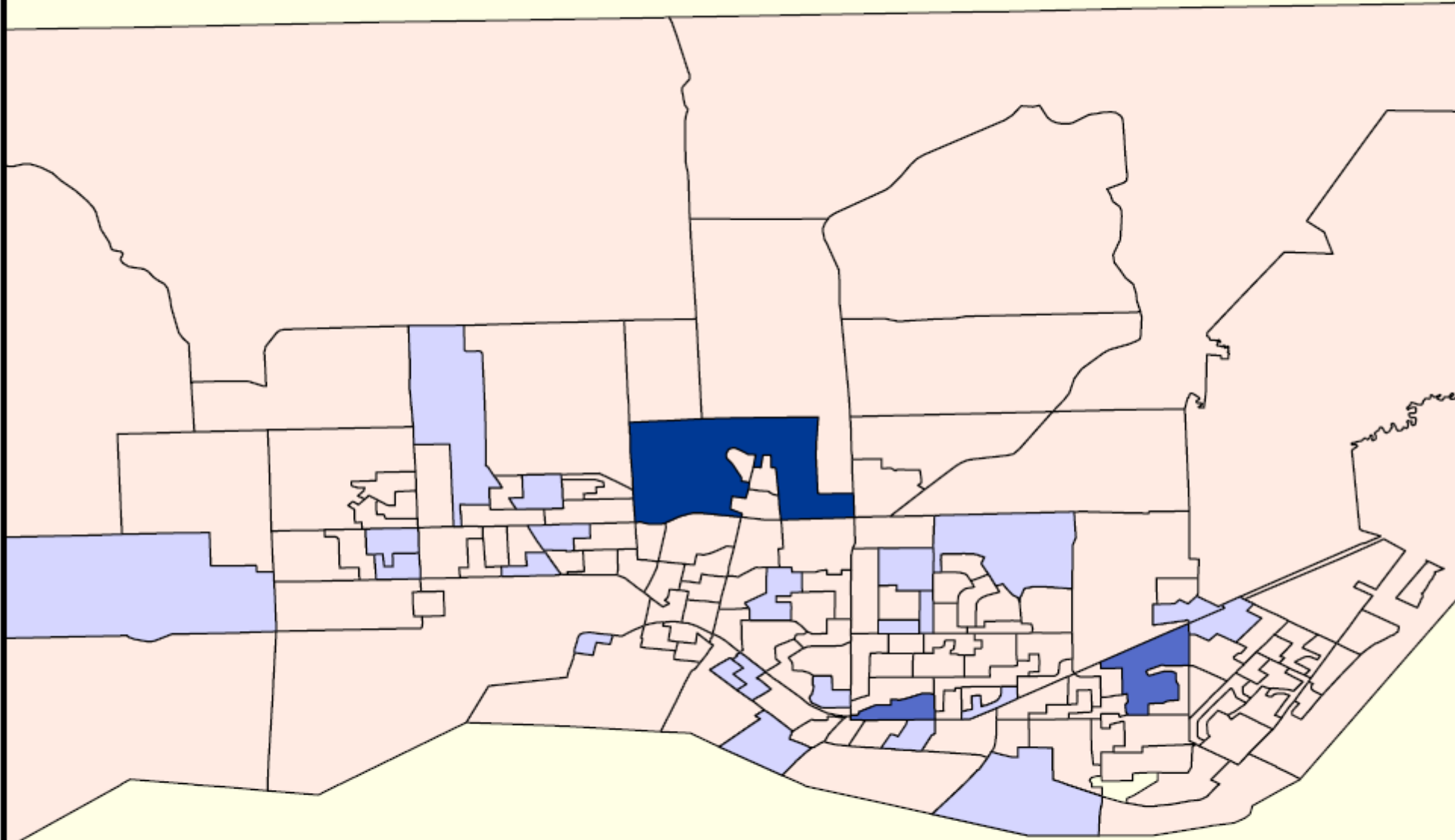
Walkability Scores are based on the walking distance an address is from different amenities. These amenities are from 7 categories: Dining & Drinking, Groceries, Shopping, Errands, Parks, Schools, and Culture & Entertainment. Maximum points for a 5 minute walk to an amenity and no points for an over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

Walkability Score

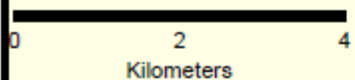
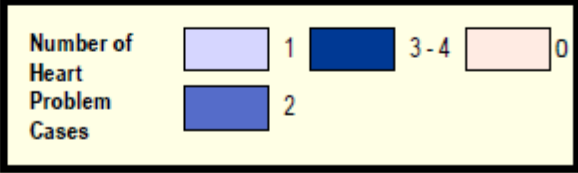
- 0 - 24 (Car-Dependent)
- 25 - 49 (Car-Dependent)
- 50 - 69 (Somewhat Walkable)
- 70 - 89 (Very Walkable)
- 90 - 100 (Walker's Paradise)

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.

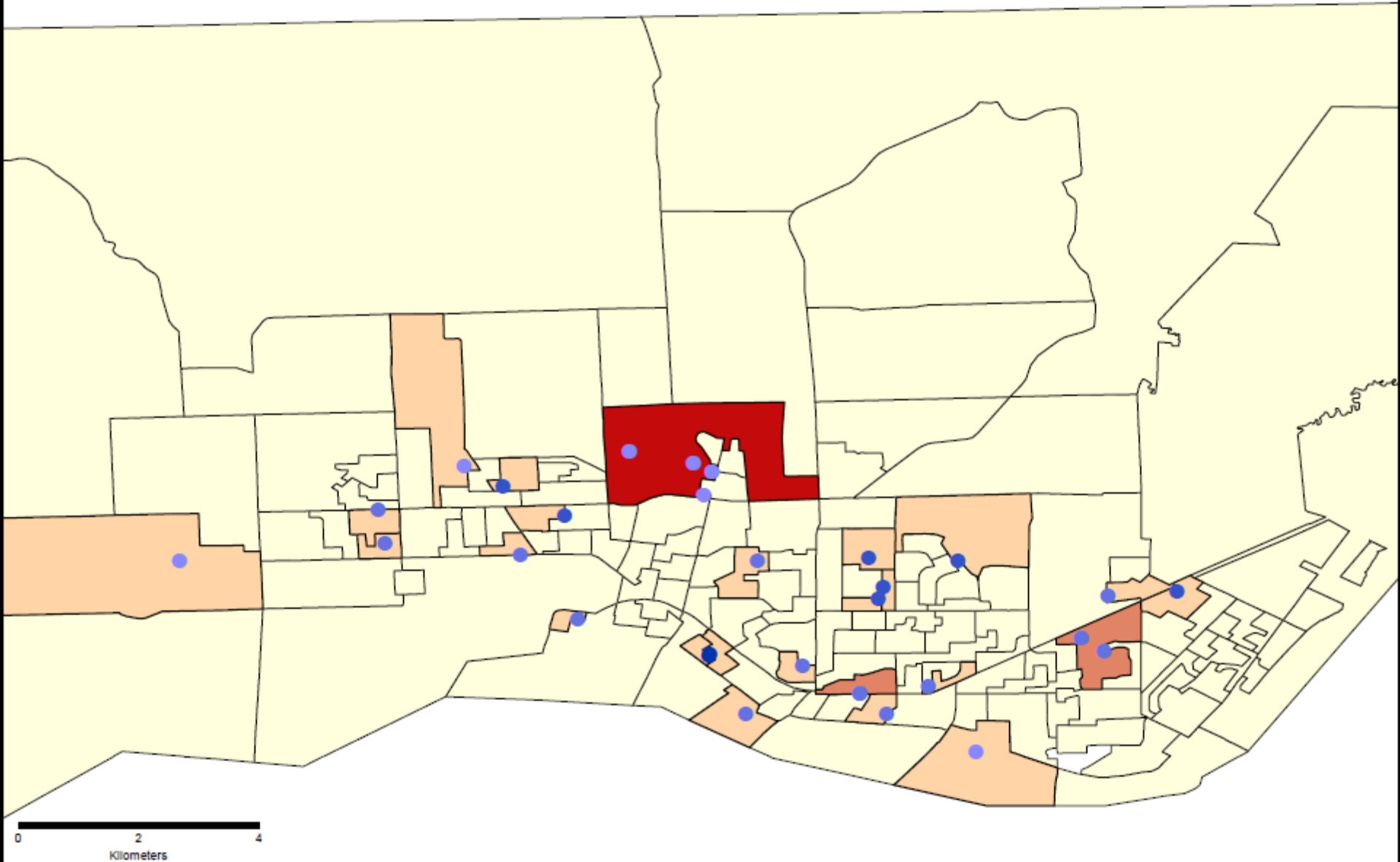
Heart Problem Cases in Sault Ste. Marie



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.



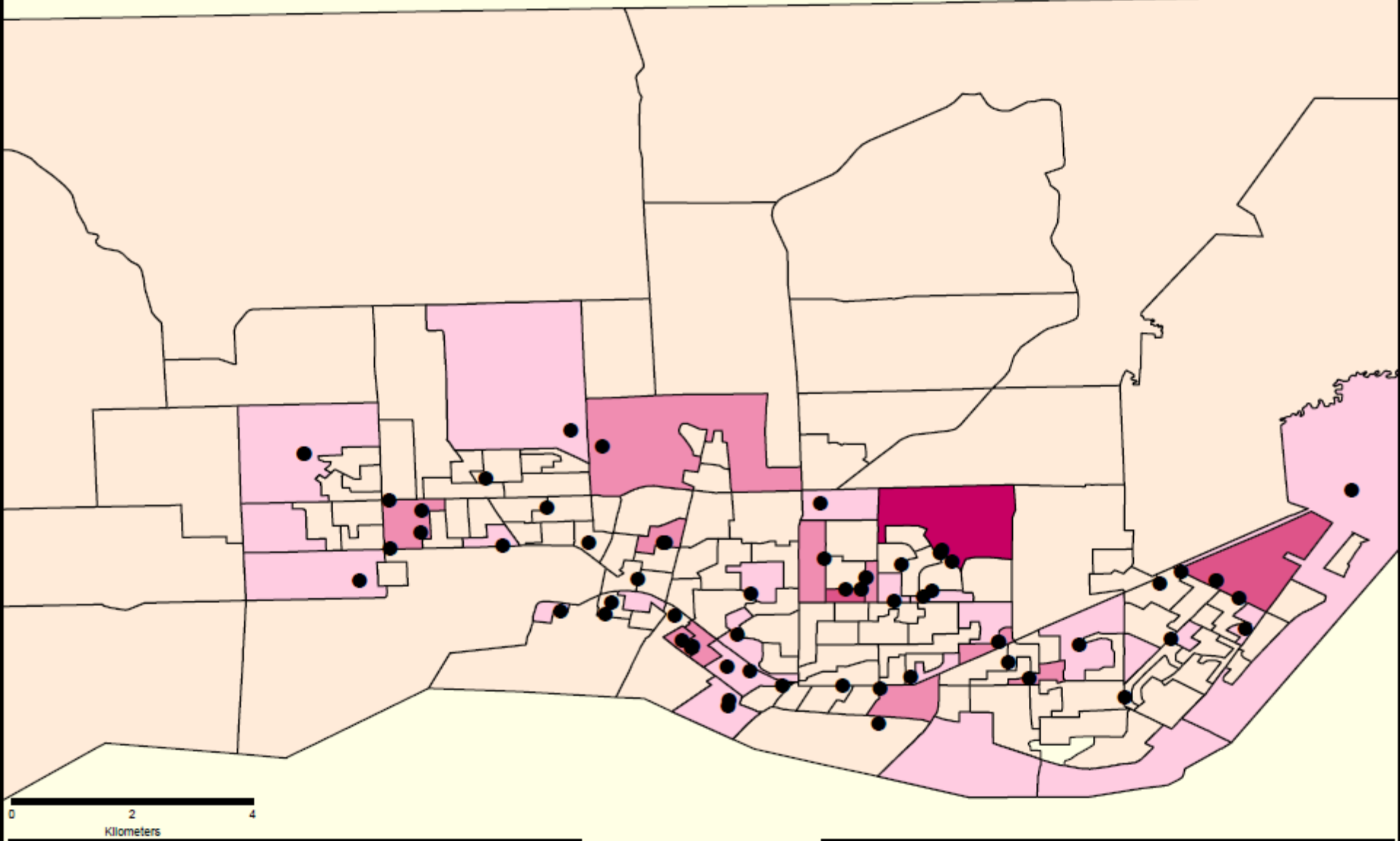
Heart Problem Cases and Address Walkability in Sault Ste. Marie



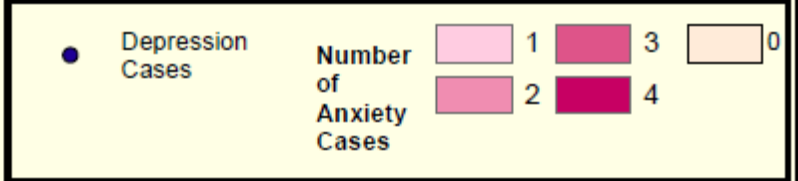
The data stating the number of Heart Problem cases in Sault Ste. Marie are based on a Clinical Study done by the Algoma Nurse Practitioner Led Clinic and the Health Informatics Institute at Algoma University.

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

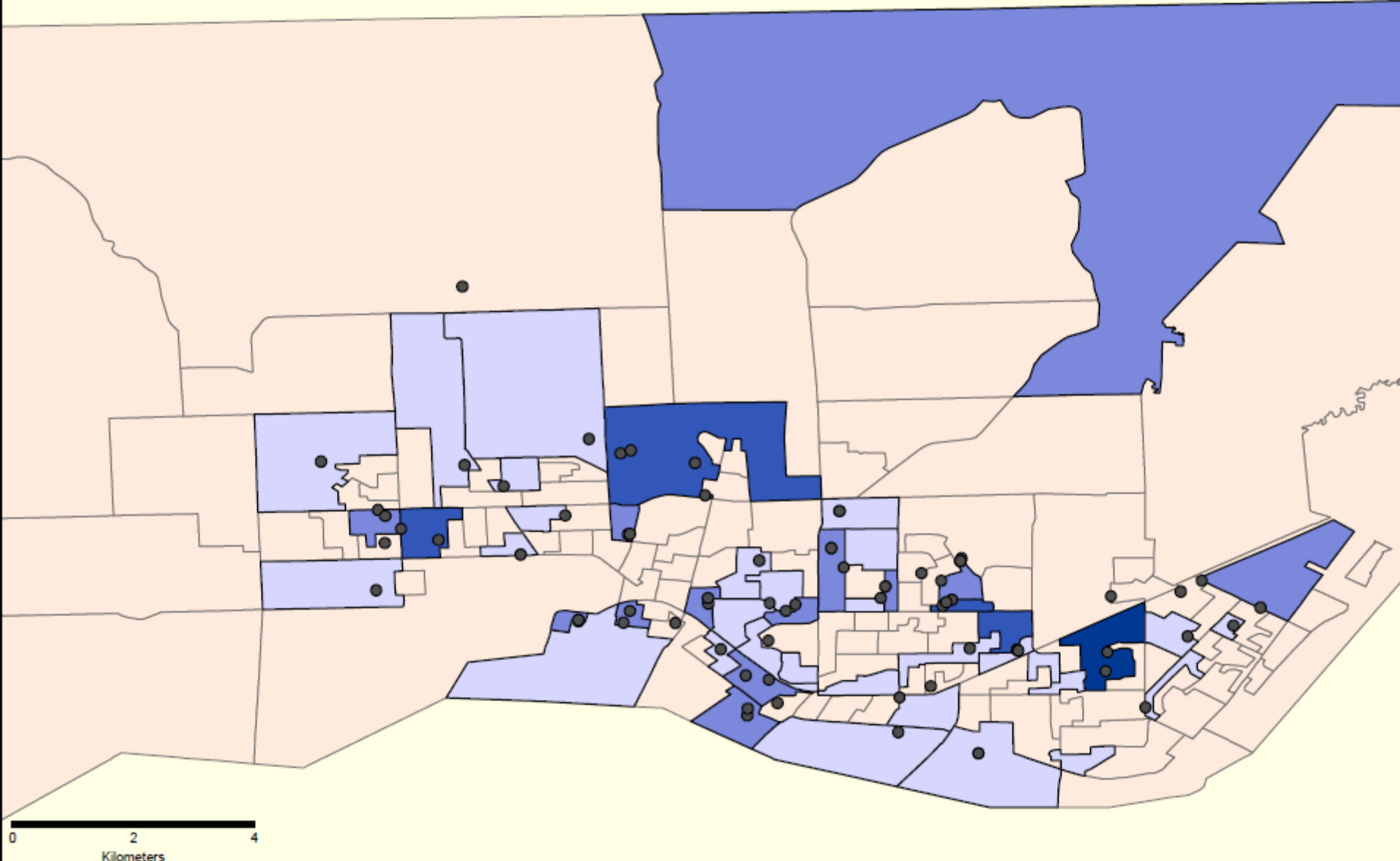
Anxiety and Depression Cases in Sault Ste. Marie



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.



High Cholesterol and Hypertension Cases in Sault Ste. Marie

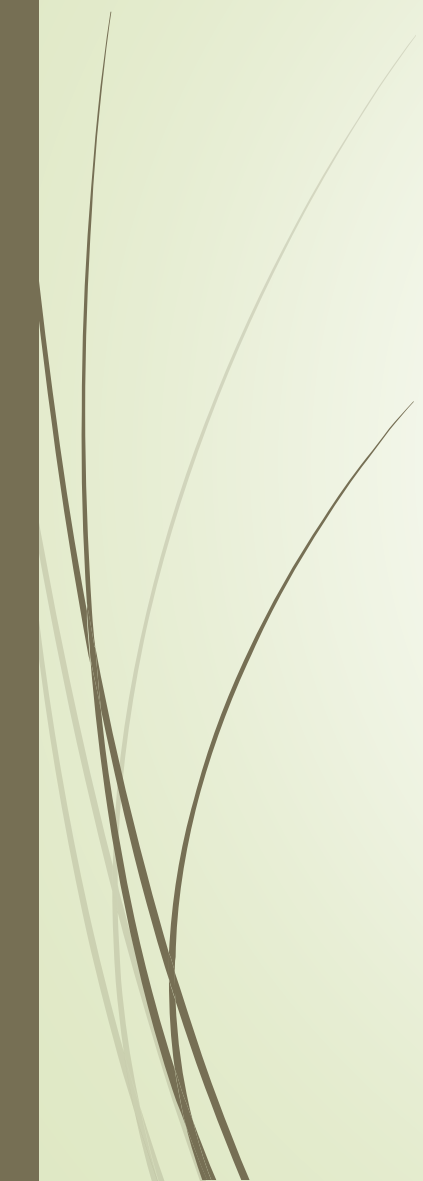


The data stating the number of High Cholesterol and Hypertension cases in Sault Ste, Marie are based on a Clinical Study done by the Algoma Nurse Practitioner Led Clinic and the Health Informatics Institute at Algoma University.





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 providing 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
- Findings are being used at the individual level as well as in health promotion and disease prevention activities for public health



Future Directions

- Future studies should explore patient consent as an explicit component of patient enrolment with the clinic
- EMR vendors need to allow for multiple addresses to be recorded and additional geographical information to augment the clinical record
- Documentation within the EMR was extremely variable & consistent record keeping / policies and practices need to be developed & used
- Bill Davenhall's work "Your health depends on where you live" TedMed Talk 2009 should be further explored
 - https://www.ted.com/talks/bill_davenhall_your_health_depends_on_where_you_live?language=en



Questions?

Nicola.Shaw@Algomau.ca

Acknowledgements

- ▶ Suzanne McGuire
 - ▶ Co-author of this paper and prepared the first iteration of this presentation for the ESRI User Conference in San Diego, July 2015
- ▶ Manifold Data Mining, Inc. & MGP
 - ▶ Industry Research Partners
- ▶ Ann Ficociello (Research Assistant), Mike Boychuck, Paul Beduhn, Rejeanne MacLeod (GIS Interns), Richard Dunn, Karrie McCormack, Nicole Levesque, Amy Harasymiw (Nursing Co-Op Students)
- ▶ **Algoma Nurse Led Practitioner Clinic**
 - ▶ **Staff & patients!**
- ▶ Health Informatics Institute, Algoma University (2010-2015)
 - ▶ ESRI Canada, NOHFC, & FedNor.



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. & Biyona-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.
- Shaw, N.T., McGuire, S. (anticipated 2016) GIS analysis of environmental, socio-demographical and behavioral risk factors for Algoma nurse practitioner patients with chronic disease. *Journal of Innovation in Health Informatics* Currently in Revision