



## Research Article

# Looking Downstream to Find Upstream Health Improvement Opportunities: A Place-Based Framework for Population Health Management

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**Citation:** Bhatt J, Ghamsari F, Bhuyan S (2018) Looking Downstream to Find Upstream Health Improvement Opportunities: A Place-Based Framework for Population Health Management. J Community Med Public Health: CMPH-148. DOI: 10.29011/2577-2228 /100048

**Received Date:** 20 November, 2018; **Accepted Date:** 14 December, 2018; **Published Date:** 21 December, 2018

### Abstract

**Objectives:** A Place-Based Framework utilizing geographic information system (GIS) data in conjunction with public health data will be used to track the associated and contributing factors of end stage complications of particular diseases in order to develop more targeted interventions.

**Methods:** Using statewide claims data to determine the prevalence of Lower Extremity Amputations (LEAs) in Illinois, geographic concentrations were identified and public CHNA data was utilized to work backwards, uncovering insights into its progression.

**Results:** Union County, IL has a notable amount of LEAs; upon further investigation, a high prevalence of co-morbidities and unfavorable County characteristics, such as a high number of liquor stores and a zero recreational facilities, were also present in this area.

**Conclusions:** The framework allowed for the understanding of the context and progression from diabetes to LEAs; targeted interventions can now be developed to mitigate this progression.

**Policy Implications:** This framework is an approach to using GIS data that goes beyond its traditional use. The knowledge gained through targeting extreme conditions, can be utilized by health professionals to develop additional disease-targeting interventions.

### Introduction

It is no secret that the complex web of social factors, including socioeconomic status and location of residence, can correlate to the prevalence of chronic disease states. Using Geographic Information Systems (GIS), previous research has aggregated large datasets, both public and private, and tied them to physical locations, discovering novel spatial associations which inform policies and clinical interventions [1-3]. Despite methodological advancements, GIS is not widely used at the population level to understand patients' outcomes. Instead of using traditional applications of GIS to track the prevalence of disease, consider the end state complications of a condition or a cluster of adverse

outcomes and work backwards to determine how a condition advances towards an end state. In other words, utilize existing tools and data to look at social factors that influence the worst possible outcomes of chronic disease (e.g., blindness, amputation, death). The goal of this study is to reduce the financial impact of chronic disease on the healthcare system; the biggest impact will be made surrounding emergency visits which emanate from end-stage complications. A more specific analysis at the population level must then center around end-stage outcomes, allowing for a higher resolution of results, more targeted interventions, more specific research, and more public health interventions that are targeted not only improve outcomes but are also cost-effective.

Persuading the health ecosystem to adapt GIS technology requires the engagement of policy, system and environmental levers. Over the past decade, a number of published papers have validated the impact of spatial modelling on understanding regional social determinants of health and developing corresponding strategies [4-7]. For example, Geraghty et al. discovered that a neighborhood's socioeconomic status was associated with the difficulty to control glucose levels, but not lipids, for their diabetic patient population [2]. Their GIS work led to the immediate development of increased diabetes self-management education, which resulted in improved patient outcomes in underserved counties.

Although these are excellent reflections of the untapped capacity of GIS, it is worth mentioning that identifying factors associated with disease rates are not a new concept. For the most part, the drivers of disease are well known and ubiquitous however; there are still gaps in understanding the progression of disease particularly chronic diseases at a population level and associated spatial factors.

What sets this study apart is that the use of GIS is focused on factors associated with later stage disease outcomes which are far costlier, significant and unique. Homing in on these extreme outcomes and then working backwards, contributing factors can be identified that will ultimately lead to the understanding of why these diseases are progressing to the extreme and what we can do to prevent them—a process termed the Place-Based Framework.

This actionable data can help organizations address the notion that zip codes can impact health outcomes.

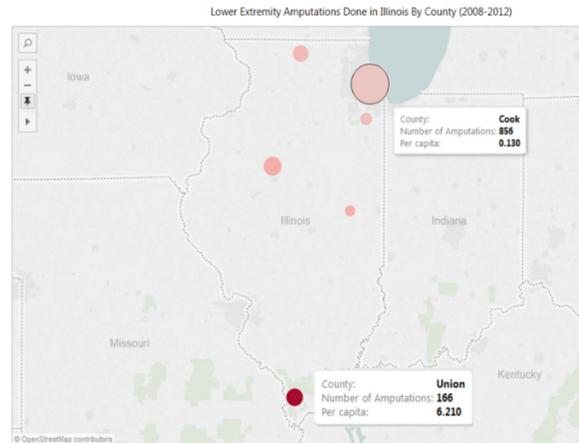
Cases of diabetes will be utilized for the testing of this framework. Mapping prevalence shows a small amount of variation and fails to provide context as to the severity of the disease. Switching focuses to end state complications of diabetes, Lower Extremity Amputations (LEAs) were examined for the following reasons: LEAs are costly, have innumerable effects on patients and their families, and LEAs illuminate how quickly a condition can progress, thereby identifying clinical, systemic and environmental factors that affect its progression.

## Methods

The data for the following GIS visualizations were identified through state-wide claims and public data. 2008-2012 claims data was obtained through the Illinois Hospital Association's (IHA) COMP data platform. The 2012-2013 CHNA data was also utilized from communitycommons.org to obtain characteristics of the counties of interest, including demographics, risk factors and community characteristics. The Place-Based Framework was then applied to guide the analysis which utilized Tableau Desktop 9.3.

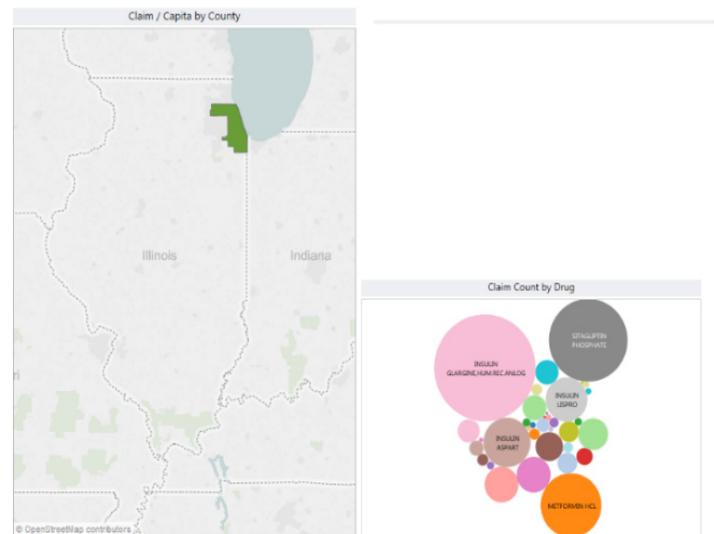
## Results

The total number of LEA cases in Illinois (Figure 1)



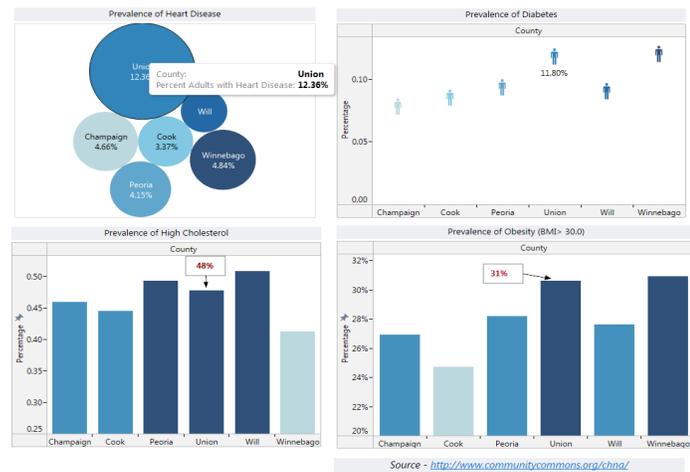
**Figure 1:** The total number of LEA cases in Illinois.

Reveals that Union County has a 50 times higher per capita rate of LEAs than Cook County. After identifying a population experiencing a significant degree of an end stage complication, contributing factors were identified by working backwards. Looking at the number of prescriptions filled in each of these communities (Figure 2).



**Figure 2:** Union County has a 50 times higher per capita rate of LEAs than Cook County.

It was determined that Cook County has many more diabetes-related prescriptions filled than any other Illinois county, thus suggesting that there is a greater burden of disease and possibly greater medication adherence. Additional comorbidities and risk factors which are present in Cook County were also identified (Figure 3).



**Figure 3:** Determined that Cook County has many more diabetes-related prescriptions filled than any other Illinois county.

It was determined that Union County suffers from high rates of diabetes, obesity, cholesterol, and the highest prevalence of heart disease in Illinois. Further analysis provided data to suggest adequate public health services, environmental circumstances, reduced health literacy, and poor access to care and healthy food options were the cause of these poor health circumstances (Figure 4).



**Figure 4:** Research revealed that Union County has zero recreational facilities and 38 percent of Union County residents lack access to primary care services. The County is home to the state’s largest number of liquor stores per capita—a factor that can play a significant role in premature mortality.

**Acknowledgement:**

The authors would like to acknowledge and thank Dr. Joshua Sharfstein for his comments on the manuscript.

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**Discussions**

The Place-Based Framework shows that GIS analysis of health outcomes, with a focus on end state complications, can provide specific community information and high-quality data to public health officials to drive interventions. Ultimately, this data can be used to design tailored health interventions, generating significant health improvements in specific geographic locations. For example, recent studies have shown a strong association between the number of health clubs per capita within a city and lower rates of diabetes. By focusing on LEA-related risk factors, one strategy involves the development of recreational activity infrastructure in Union County, including opening health clubs, fitness centers, outdoor gyms, and other similar facilities.

**Public Health Implications**

This study highlights mapping the prevalence of disease, as well as mapping the consequences of diseases. Shifting the focus from the prevalence of a disease to its consequences may lead to more meaningful and specific insights. This added level information may allow for more targeted interventions, as opposed to blanket approaches. With targeted interventions, each subpopulation can be addressed individually and ultimately its health as well as the greater population around it.

It is clear that marginalized populations display place-based inequities and as a result, more common occurrences of poor health. Given their high impact on healthcare spending, they also hold the key to significant improvements in quality and value. Interventions targeting these high-risk subpopulations will deliver direct benefits and also produce large improvements at the local, regional, and nationwide levels.

This framework can be applied to other chronic diseases, and its application could be further expanded to look at the intersection of behavioural health and chronic disease. Utilization of this framework is encouraged on a global scale for geocoding of data and production of high quality health interventions.

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