MAPS: Mapping Access to Public Health Services

Geographic Access to HIV/AIDS Services in Manhattan: Proximity Analysis of Needle Exchange Programs to Injecting Drug Use Populations and Suitability Analysis of Potential Needle Exchange Locations

Amy Welton[1], Ken Patterson & David Gilbert

Center for Health Education and Research
University of Washington, Seattle, Washington, USA
Phone: 1-206-685-5303 Fax: 1-206-421-4944
Email: wamy@u.washington.edu

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ABSTRACT

Objectives: This study assessed the geographic proximity of needle exchange programs to the injecting drug user (IDU) populations they serve in the borough of Manhattan (New York, NY) and the suitability of new needle exchange locations in Manhattan.
Methods: Spatial and tabular data was collected regarding needle exchange locations, IDU population locations and Manhattan school locations. This data was analyzed with a geographic information system (GIS), using spatial analysis.
Results: There was a lack of access to services in Washington Heights and Central Harlem, two neighborhoods in Upper Manhattan.
Conclusions: New needle exchange programs could be opened to decrease the gap in service provision and increase geographic access to the programs.
Recommendations: The researchers recommend an expanded study of the high risk populations in Washington Heights and Central Harlem to determine (a) what other prevention services are needed, (b) where new needle exchanges would have the greatest impact and (c) ways to synthesize multiple types of prevention services to better serve the needs of the existing populations.

Key words and phrases: Intravenous Drug User (IDU), human immunodeficiency virus (HIV), acquired immunodeficiency syndrome (AIDS), needle exchange programs, syringe exchange programs, access to health care services, GIS, prevention, accessibility

1.0 INTRODUCTION

The sparse assemblage of needle exchange locations in New York City barely serves a quarter of injecting drug users' (IDUs) needs. Injecting drug users in New York City typically go through an average of 3-4 needles per day, at a rate of 255 million needles per year (Paone et al., 1997). The New York City needle exchange programs serve 30,000 IDUs annually and as of 1998, distribute less than 2% of needed syringes (Finkelstein et al., 2000). In a city with both the highest urban drug epidemic in the world and the largest AIDS epidemic in the United States, where injecting drug users account for nearly a quarter of persons infected with the human immunodeficiency virus (HIV), one thing is clear: there are not enough needle exchanges to sufficiently match the demand from the IDU population.

1.1.1 Background

For nearly fifteen years, the debate has continued unabated about the effectiveness of needle exchange programs in reducing HIV transmission among IDUs. Ever since injecting drug users were identified as a high risk group

for the acquired immunodeficiency virus in 1982, researchers have waded against a stream of funding bans to perform research on harm reduction for IDUs (Vlahov et al., 2001). A number of studies show that the most effective efforts in harm reduction have incorporated needle exchange programs into a broad spectrum of prevention activities, such as substance abuse referrals, education, counseling and testing (Valente et al., 2001; Des Jarlais et al., 2000; Schoenbaum et al., 1996; Hurley et al., 1997; Strathdee et al., 1997). These studies open a window onto the factors that influence the effectiveness of public health practices around harm reduction. Multiple levels of operation influence the system of harm reduction as well as the individual organizations that practice harm reduction techniques. The levels examined in this paper represent components of the policy, operations, public health, and geographic issues of needle exchange programs.

Why has the needle exchange system failed to expand to meet the IDU population's demand? Despite a well supported effort by the first publicly supported needle exchange in Tacoma, Washington in 1988 (Scherman et al., 2001), needle exchange programs nation-wide have struggled to develop and coordinate their services. This is due in part to the dynamics of federal policy on needle exchange programs, whereby both federal funding of needle exchange programs and research to evaluate the safety and efficacy of those programs were banned (Vlahov et al., 2001). For example, in the late 80s the federal government placed a ban on two types of research: research utilizing fetal tissue and research on needle exchanges (Moss, 2000). The lack of research on the safety and efficacy of such programs contributed to political decision making that lacked an empirical basis (Ibid). The first politician to break this pattern was the Surgeon General who, under President Bill Clinton in the year 2000, acknowledged the benefits of needle exchange programs, but continued to support the ban on federal funding for needle exchange services (Vlahov et al., 2001). The moral and scientific conflicts regarding research on a national level create a financially and politically unstable environment within which needle exchange programs must operate.

A recent study of the New York City needle exchange program suggests that needle exchanges need to work on an operational level more closely with the rest of the healthcare network in order to build capacity and operational effectiveness (Strike et al., 2002). There are currently nine legal needle exchange programs that operate in New York City, with two different formats (storefront operations and street-based operations). Storefront operations provide a safe space for users, longer hours, and a space for on-site medical care, support groups and other services. Street-based operations offer syringes and support in a variety of ways—door to door, in vans or on street corners. Street-based exchanges reach out to people that do not usually come to the storefront operations (Finkelstein et al., 2000). While some of the programs have ties to other healthcare service providers, for the most part, needle exchange programs operate independently with little outside collaboration. This is mostly due to the following: (a) lack of resources to work on organizational development and strategic planning, (b) IDU/AIDS related stigma from the collaborating service-providers and (c) no coordinating body to provide vision and connection services (Finkelstein et al., 2000; Weiss et al., 2000). The inconsistent support spurred by an ongoing debate about needle exchange effectiveness in reducing HIV transmission hinders operational effectiveness of individual needle exchange programs.

The opponents of needle exchanges argue that needle exchange programs facilitate and increase public health risks and crime rates in their surrounding areas. While this argument has been used to fuel public debate, studies have shown that needle exchange programs do not increase crime or public health risks within their proximity (Marx et al., 2000; Galea et al., 2001). Russell Rockwell likened opposition to needle exchange programs to the NIMBY (Not In My Back Yard) approach of dealing with unfavorable social welfare and public health initiatives (Rockwell et al., 1999). NIMBYism refers to the organization of citizens at a grass roots level around an unfavorable activity occurring close to their home or place of work. Since needle exchange programs are viewed by many as unfavorable, their location is a hotly debated topic.

Does the location of a needle exchange program influence its effectiveness in HIV prevention? Studies in Glasgow, Scotland and New York City have tackled the location question. Both studies found that strategic geographic placement of needle exchange locations proved essential to the effectiveness of the needle exchange program and subsequent HIV prevention efforts (Rockwell et al., 1999; Hutchinson et al., 2000). These resource-constrained organizations need tools to identify where their services should be placed in order to attain optimal levels of service provision for affected populations.

The questions on the public health level, the geographic level, the political level and the operational level all intersect in this project. Through spatial analysis, a computerized geographic information system can synthesize geographic, political, public health and operational layers. The researchers of this project aimed to (1) map the existing needle exchanges in Manhattan; (2) map the high risk populations (IDUs living with AIDS); (3) map

potential political constraints towards placement; (4) identify any holes in service provision; and (5) identify potential needle exchange locations.

1.1 Methods

1.1.1 Data Collection

Statistics for the total cases of HIV/AIDS among injecting drug users were collected from the New York City Department of Health. Under Dr. Susan Forlenza, the director of the Office of HIV/AIDS in New York City, the Department of Health published a report entitled, "AIDS in Boroughs and Neighborhoods of New York City" (NYCDOH, 1999). The data in the report reflects data collected in New York City between 1994 and 1999. The data was categorized by the United Hospital Fund Neighborhoods in each borough. Physicians, infection control practitioners, AIDS coordinators and other health care professionals throughout the city provided the data through a network of hospitals, clinics and private offices. This is the most recent report published with geographic data by neighborhood on injecting drug users living with AIDS. This document and the semi-annual AIDS surveillance publication are produced in alternate years (NYCDOH, 2000).

Throughout New York City, there are nine legal organizations that provide needle exchange services: ADAPT, CitiWide, Comrades in ARMS, Housing Works, From Our Streets with Dignity (FROST'D), Lower East Side Harm Reduction Center (LESHRC), New York Harm Reduction Educators, Inc. (NYHRE), Positive Health Project (PHP), and St. Ann's Corner of Harm Reduction (SACHR) (Finkelstein et al., 2000). Every organization, except for SACHR operates services in Manhattan. The researchers entered the needle exchange program addresses into a database file. They marked street-based clinics within the block range of operation. One mobile clinic was not included due to the expansive geographic area of operation. The mobile clinic operated in the general areas of Essex, Delancy, and Pike Streets; under the Manhattan Bridge, Lower East Side (Finkelstein et al., 2000).

The geographic boundaries for neighborhoods were provided by the United Hospital Fund. The United Hospital Fund is a health services research and philanthropic organization that creates policies and supports programs that promote accessible healthcare for everyone (United Hospital Fund Home Page, 2002). In 1982, The United Hospital Fund began aggregating groups of 3-10 contiguous NYC zip codes into neighborhood boundaries (NYCDOH, 2002). These neighborhood boundaries are used universally throughout the city for public health and statistical analyses. They identify smaller areas than boroughs, but larger areas than zip codes. They are the smallest geographic unit for which data is available (NYCDOH, 1999). The United Hospital Fund updated the UHF neighborhood system as of October 1998 (Ibid).

There are 455 schools in Manhattan. The school addresses were obtained from the Basic Educational Data System (BEDS) Unit which is a subdivision of the Elementary, Middle, Secondary and Continuing Education (EMSC) Division of the New York State Education Department (New York State Education Department, 2002). This list was updated as of 2002 and used to geocode all of the school locations in Manhattan.

The zip codes, borough boundaries, streets, and base map comprised the spatial data. Most of these features are provided by geographically referenced databases, or geodatabases. Geodatabases are physical stores of spatial information (ESRI, 2000). The zip codes and borough boundaries are from the Environmental Systems Research Institute (ESRI) CD-ROM of domestic data (ESRI, 1999). ESRI provides this CD of domestic and limited international spatial data with the purchase of one of their software packages. The CD was most recently updated in 2002. The streets were from the U.S. Department of Commerce, Bureau of the Census, Geography Division. The street information was last updated in 2000 (U.S. Department of Commerce, 2001). The background map was from mapciti (mapciti.com, 2002). This project and all of its components are projected in state-plane 1983 Long Island, New York.

2.1 Data analysis

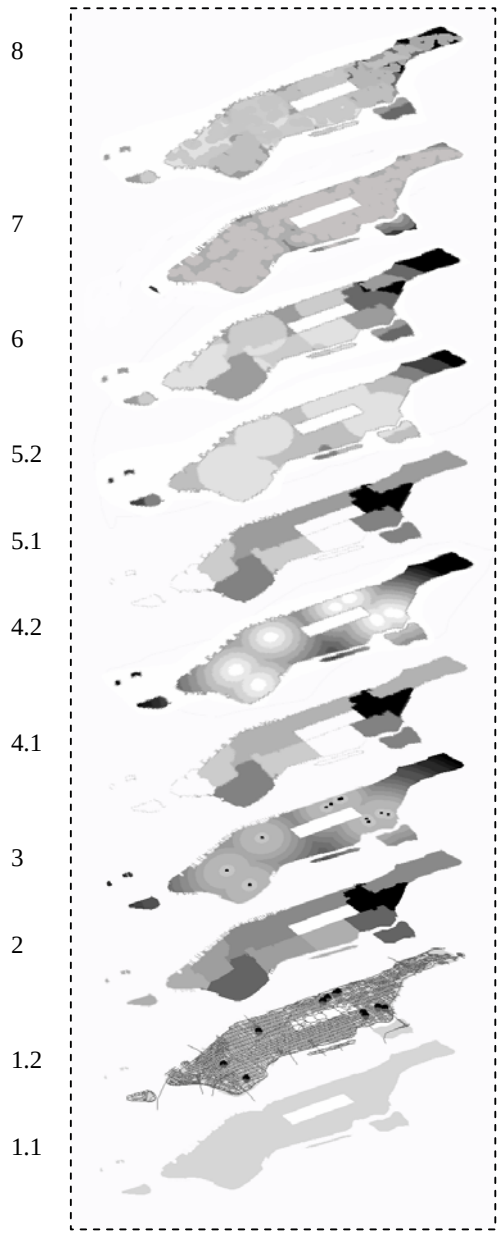
2.1.1 Suitability analysis model

Suitability analysis is a widely used analytical technique when working with a GIS. It is predominantly used for environmental science and planning purposes. During suitability analysis, there are three basic steps. First, the researchers create new data sets from existing data. Second, they reclassify the data to identify an area with high suitability. Finally, they aggregate these different layers into one logical assessment of optimal suitability (ESRI,

2001). The researchers in this study used the technique and theory behind suitability analysis to look at geographic access to needle exchange services in Manhattan.

Proximity analysis was incorporated into the overall suitability analysis through the use of buffers. By using buffers around the needle exchange programs, the researchers could account for distance between a high risk area and the closest needle exchange. Therefore, the researchers could analyze the proximity of needle exchange programs to the IDU population with AIDS that they serve.

The researchers examined multiple layers of spatial and tabular information using the functionalities of GIS to answer the question-- how accessible are needle exchange programs in Manhattan to the populations they aim to serve?



Layer 8: Suitability model with school buffer

Layer 7: 1000 ft school buffer

Layer 6: Map calculation (suitability model)

Layer 5.2: Reclassification of needle exchange location buffer (grid)

Layer 5.1: Reclassification of IDUs with AIDS by UHF neighborhood (grid)

Layer 4.2: Needle exchange location buffer (grid)

Layer 4.1: IDUs with AIDS by UHF neighborhood (grid)

Layer 3: Needle exchange location buffer (shapefile)

Layer 2: IDUs with AIDS by UHF neighborhood (shapefile)

Layer 1.2: Needle exchange locations—geocoded (shapefile)

Layer 1.1: United Hospital Fund Neighborhood boundaries (shapefile)

Figure 1: The layers of suitability analysis

2.1.2 Step 1: Create new data from existing data sets

Spatial Data: The spatial data of Manhattan streets and zip codes formed the baseline layer of data for the project and anchored the geographic analysis (layer 1.1). The researchers had to modify these shapefiles prior to incorporation into the project. The street file was constrained to show only the Manhattan perview. The zip codes were joined in accordance with the UHF neighborhood boundaries (NYCDOH, 1999).

Geocoding: After creating the database of needle exchange programs, researchers referenced them spatially by geocoding them (layer1.2). Each needle exchange was represented on the map with latitude and longitude coordinates. The location of needle exchange programs forms one of the key layers of the project analysis.

High Risk Population: The tabular data on IDUs living with AIDS was joined to the spatial data, by UHF neighborhood areas so that it could be mapped with a graduated color scheme and a unique value of total cases of IDUs living with AIDS. This newly formed data set comprises layer 2.

Proximity Data: The researchers placed buffers around the needle exchange locations to create another layer of data (layer 3). Buffers are artificial boundaries that encircle a point, line or polygon; the distance between buffers and the number of buffers are established at the users' discretion. The buffers in this project delineated specific distances away from the needle exchange. Prior research finds appropriate proximity as living within a 10 minute walk (Rockwell, 1999). The buffers radiated out from the needle exchanges in rings of 1500 feet and extended across the surface area of Manhattan. A city block is approximately 264 feet and it takes approximately 2-4 minutes to walk the length of the block (The Encyclopaedia of New York City, date unavailable). Therefore, at 1500 foot intervals, the buffers demarcate walking distance times of 10 to 22 minutes, per ring. These operations had to be performed on the existing datasets in order for them to be incorporated readily into the spatial analysis.

2.1.3 Step 2: Reclassify data

All of the data until this point was vector data, displayed by points, lines and polygons. To continue with the suitability analysis, the shapefiles of the distance buffer (layer 3) and the distribution of IDUs living with AIDS (layer 2) had to be converted to raster data, or cell based grids. The cell values of the grids were then reclassified from a scale of 1-5 to indicate levels of suitability. The cell values of the IDUs living with AIDS grid (layer 4.1) were reclassified to indicate that those UHF neighborhoods with the highest number of IDUs living with AIDS were the most suitable for additional services. This reclassification comprised layer 5.1. The cell values for the distance buffers to the needle exchange locations (layer 4.2) were reclassified to indicate that the further the cells were from the existing needle exchange, the more suitable that area would be for a potential needle exchange. The reclassified data exists in layer 5.2.

2.1.4 Step 3: Aggregate the layers

Conversion of the shapefiles to grids and reclassification prepared the layers for one of the final steps of suitability analysis—the aggregation of the layers through map calculation (layer 6). Using the map calculator, a tool that allows the user to perform mathematical functions on grids, the researchers added the layers of the reclassified grid data together. This operation added the value of the cells in each of the grids. The higher the number of IDU'S the higher the cell value, and the farther away a cell was from a needle exchange the higher the cell value. The map calculator adds the values for each cell in each of the reclassified grids and produces an output grid.

The resulting map and output grid depicts the continuum of geographic locations with the lowest suitability to the highest suitability. Areas with a high concentration of high suitability cells became optimal targets for new needle exchange locations.

2.1.5 Additional factors

After such analysis many locations appear feasible. Adding additional factors can narrow the search. The researchers added Drug Free Zones around schools in Manhattan as a factor for the placement of new needle exchanges. All of the elementary, middle and high schools in Manhattan were geocoded and then a 1000 ft buffer was placed around each school. This formed an overlay layer that could potentially constrain the

placement of needle exchanges. Drug Free Zones are any areas particularly close to children and other vulnerable communities where there is a perceived risk of substance abuse. Citizens can take action in a variety of ways to declare the area a Drug Free Zone. Typically, the laws stipulate that substance abuse offenses will carry a harsher penalty if committed within 1000 feet of a school than outside of that Drug Free Zone (CA Department of Justice). Drug Free Zones might impact a decision-maker's choices regarding the placement of a new needle exchange.

3.1 Results

The analysis completed with the factors of proximity to existing needle exchange locations, Drug Free Zones surrounding schools and number of IDUs living with AIDS, indicates that there is a lack of access to needle exchange programs in Upper Manhattan. The addition of the Drug Free Zones surrounding each school in Manhattan, drastically limits the possible needle exchange locations, due to the number of schools in Manhattan. The majority of most suitable sites reside within the UHF neighborhoods of Central Harlem/Morningside Heights and Washington Heights. Figure 2 demonstrates the gaps in access to services as well as potential needle exchange locations.

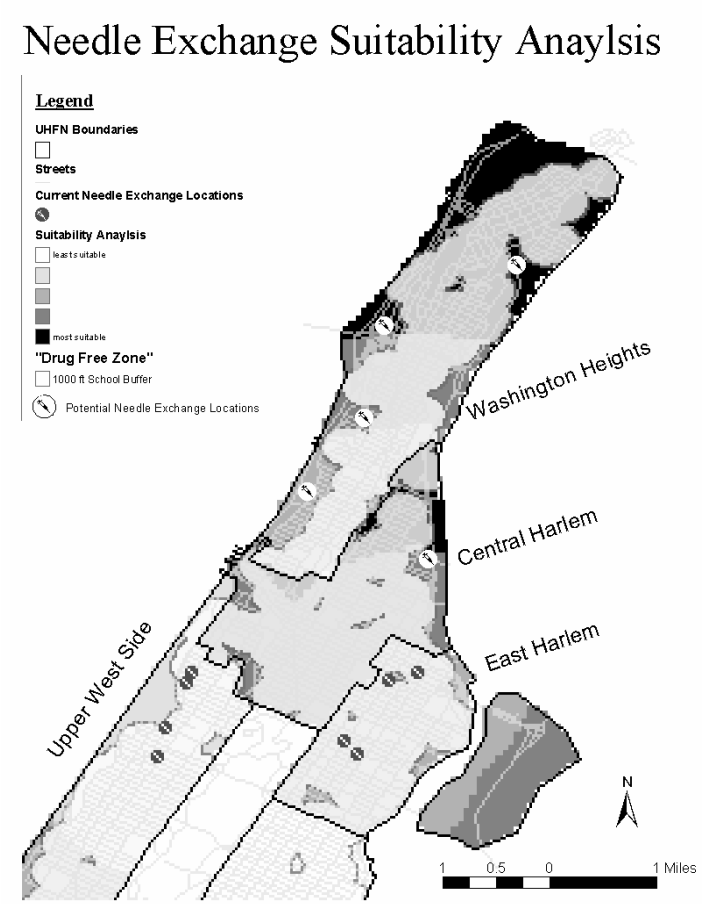


Figure 2: Needle exchange suitability analysis results, potential needle exchange sites included

4.1 Discussion

When decision makers assess geographic access to services, two important areas of analysis stand out. The first area of analysis addresses the issue of need. What are the existing services and what is the need for more services? How are these issues indicated geographically? The second area of analysis corresponds to placement. What are the factors that will influence the geographic placement of a new service? The researchers demonstrate in this project that both suitability analysis and proximity analysis provide the tools and methods to determine where the need for better geographic access to services exists, as well as where the placement of new services is feasible.

In the context of a declining HIV epidemic among IDUs, (Des Jarlais, Marmor et al., 2000) a proven record of needle exchange effectiveness and the importance of proximity to services for needle exchange clients, this research affirms that there is limited access to services for those that are most in need. While there are 1,399 AIDS cases among IDUs in Washington Heights that comprise 40% of AIDS cases in Washington Heights, there are currently zero needle exchange locations in the neighborhood (NYCDOH, 1999). Central Harlem presents a population where 59% of its AIDS cases were spread through injection drug use (Ibid). In Central Harlem, HIV is the number one cause of death in males (18-64 yo) and the number two cause of death in females (18-64 yo) (United Hospital Fund, 2002). A number of needle exchanges exist on the border between Central Harlem and East Harlem, however, they are not accessible to the entire population that is in need. Mapping these disparities brings the issue of geographic accessibility to the forefront, as well as highlights the existing need.

The suitability and proximity analyses clearly pinpoint geographic areas that are lacking in service provision. It is a model that can easily be adapted to account for different factors depending on who is completing the analysis. The factors in this project have a 1:1 ratio. If more complex relationships were to be developed, a statistician would be needed to determine the relevant weighted ratios for the data used. Furthermore, the data that the researchers used, particularly in reference to the IDUs living with AIDS, is a starting point for the analysis of geographic access to needle exchange services. By examining this population, as opposed to all IDUs, the researchers are looking at secondary as opposed to primary prevention. Layers with new factors can be added to the analysis as deemed appropriate.

In combination with the assessed geographic need for needle exchange services, the potential existence of Drug Free Zones guided the placement of new services. It is unclear how the Drug Free Zones effect needle exchange services currently, as all of the existing locations intersect with a Drug Free Zone. However, the Drug Free Zones serve as an example of a policy related matter that could effect the placement of a new needle exchange site.

Presently, needle exchange programs are not the only source for free, sterile needles. Pharmacy syringe services became available in 2001. Pharmacy syringe programs were excluded from the analysis, because they appeared after our most recent population data and because of questions surrounding their efficacy in HIV prevention. Researchers so far have questioned whether pharmacy services will aid in decreasing transmission rates without the additional prevention services that are offered at needle exchange locations (Finkelstein et al., 2000).

It was not possible in our analysis to incorporate all of the factors that might determine accessibility to services for distinct populations. Accessibility means different things for different people. For some, accessibility means geographic accessibility and for others it means psychological accessibility or financial accessibility. In this study, the researchers focused on factors that would influence geographic accessibility for the populations that the needle exchanges are targeting. People working as healthcare administrators, as politicians, as policy-makers, and as clinicians all are likely to find a tool like this useful for making policy, public health and strategic planning decisions.

The GIS method described here enables decision-makers to coordinate and synthesize tabular data into one visual location--a map. Using GIS simplifies the process of research and the presentation of trends in public health in large populations as well as the trends in system or city-wide organizational development. Decision-makers can use the suitability analysis model to document service provision and geographic access to services in their respective cities. It is a simple and viable option for both novice and advanced GIS users. This tool has the potential to significantly augment strategic planning efforts for HIV prevention through the analysis of geographic access to services.

AUTHOR'S CONTRIBUTIONS

Amy Welton was responsible for the research, writing and synthesis of this paper. Ken Patterson contributed data analysis, editorial input and research. Dave Gilbert contributed data analysis and editorial input. Ken, Dave and Amy contributed equally to the project analysis and presentation.

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