Identifying Pockets of Need:
Evaluation of Selected Socioeconomic Variables and Flu Vaccination

District of Columbia, 2001 – 2006

Submitted by:

George N.F. Siaway, PhD, John O. Davies-Cole, PhD, MPH, Chevelle, Glymph, MPH, and
Tracy Garner

D.C. Department of Health

November 2009

Objectives

- Flu vaccination rates in the District of Columbia range from about 32% in 2005 to about 85% in 2006, and represents a 53% increase in flu vaccination rates in the District during this time period (2001 – 2006).
- However, this improvement is limited to certain zip codes and census tracts.
- Geocoding to a census tract level has been found to be a practical method for state or city health departments in identifying pockets of need and for directing resources appropriately.
- This study used the geostatistical and three-dimensional visualization approach to investigate the association between the overall spatial patterns of flu vaccinations and quantify the spatial relationship between flu vaccinations and selected socio-demographic variables.
- The effects of peaks and depressions in a surface combined with color effects provide an excellent medium for analysis purposes.
- The goal is to improve our understanding of the trend in the spatial distribution of flu vaccination coverage and help identify areas of high and low flu vaccination coverage areas.
- This study seeks to explore spatial trends in self-reported flu vaccinations and evaluate the association between flu vaccination rates and selected socio-demographic variables.

Hypotheses Testing

- In order to explore the association between flu vaccination rates and location, we advance the following hypotheses:
- For spatial pattern analysis, flu vaccination recipients are evenly distributed across the study area.
- The largest predictive factors for flu vaccination are having attained a higher education, having insurance, being on Medicaid, head-of-household, and urban living.
- Influenza vaccination rates increase with Medicaid and insurance coverage.
- The aim in some disease surveillance applications should be to detect the emergence of statistically significant clusters.
- This study uses the Z score Rendering to identify those clusters of points with values higher in magnitude than we might expect to find by random chance. The Z score represents the statistical significance of clustering for a specified distance.

Results of Year 2005-2006 Flu Vaccination and Selected Socioeconomic Variables

- Figure 1 is a three-dimensional (3D) visualization of the spatial distribution of year 2001-2006 flu vaccinations in the District.
- The highest flu vaccination rates for the period under review occurred in the northwest-southwest direction at more than 67 percent (Dark Red).
- Flu vaccination rates of about 31% - 67% are generally found in parts of the northwest, northeast and southwest (Brown) .
- Flu vaccination rates between about 18% - 31% are dispersed all over the rest of the District (Tan), and flu vaccination rates between about 14% - 18% are found in parts of Wards 1,2, 5, 6, 7 and 8 (Yellow).

Figure 1. Zip Code and Ward Three Dimensional View of Flu Vaccinations, Ages 18-64+ Years, Washington, D.C, 2001 – 2006

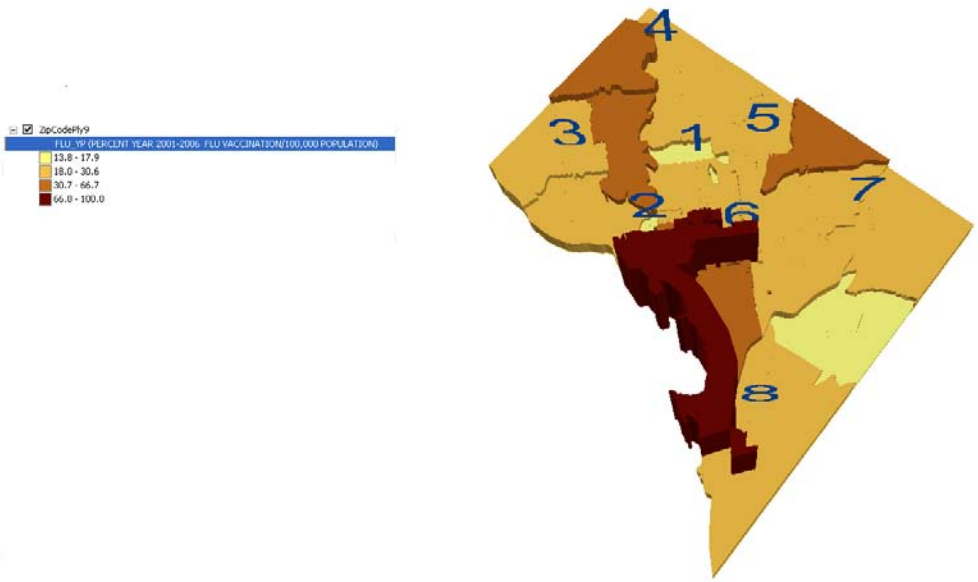


Figure 2. Directional Distribution of Year 2001-2006 Flu Vaccinations for the 18-64+ Age Groups

- The green arc represents the east-west distribution of flu vaccinations in which flu vaccination rates start up low in the east and gradually rise in the west.
- The blue arc represents the north-south distribution of flu vaccinations in which flu vaccination rates start up high in the north, decrease in the middle and gradually increase in the south.
- This suggests a directional trend in the spatial distribution of flu vaccination recipients, and flu vaccination recipients are not evenly distributed across the study area (First Hypothesis).

Figure 2. Directional Distribution of Flu Vaccinations- Ages 18-64+ Years, Washington, D.C, 2001-2006

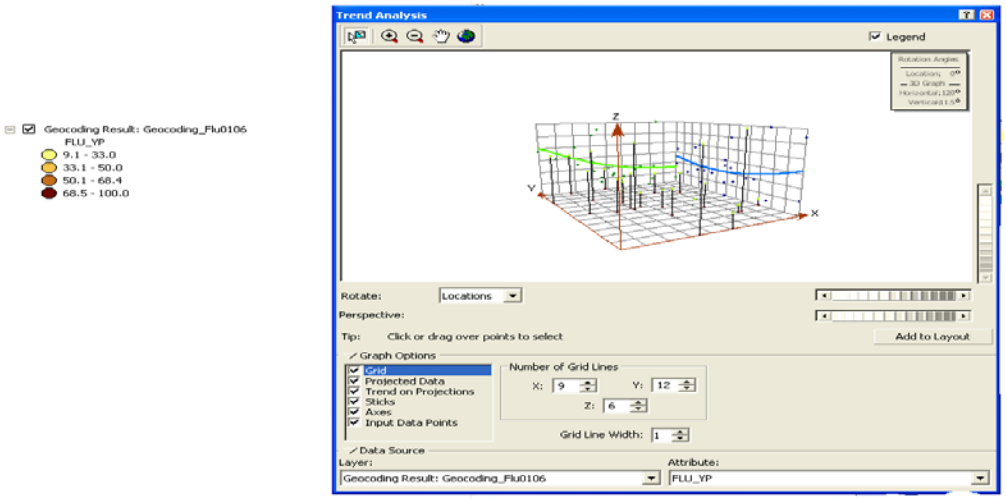


Figure 3. Spatial Pattern Analysis of Year 2001-2006 Flu Vaccination, Ages 18-64+ Years

- The light blue (turquoise) polygons represent flu vaccination rates that are low and similar and located in Wards 1, 4 and 5, and the blue polygons are low, dissimilar and concentrated in Wards 1 and 2.
- The lime dust polygons represent low flu vaccinations that are not statistically significant (at the significance level of 0.05) and are dispersed across the District (i.e., parts of Wards 1 – 8).
- The polygons in electron gold represent flu vaccination rates that are high and dissimilar, and are only found in sections of Wards 7 and 8.
- The polygons in fire red represent flu vaccination rates that are high, similar, statistically significant ($p = 0.05$), and concentrated in parts of Wards 2, 6 and 8.
- The polygons in electron gold and fire red indicate the apparent similarity (or dissimilarity) in values between flu vaccination rates is greater than one would expect simply by chance at these locations within the District.

Figure 3. Three Dimensional View of Flu Vaccination Clusters, Ages 18-64+ Years, Washington, D.C, 2001-2006

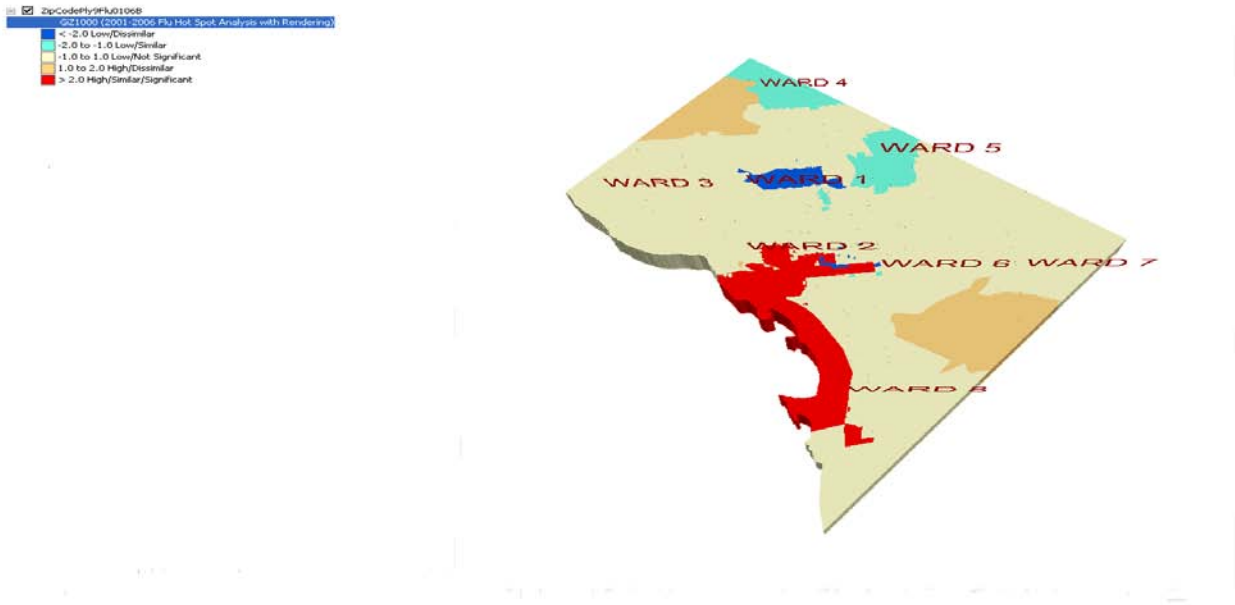


Figure 4. Spatial Autocorrelation Analysis

- Evaluate the second hypothesis that the largest predictors for flu vaccination are having attained a higher education, access to insurance, being on Medicaid, population density and marital status.
- Figure 4 presents an example of how we determine the magnitude of the dependency between flu vaccination rates and selected variables.
- The Moran's I (at the top) is < 0 and means that self-reported flu vaccination recipients are dispersed (i.e., high and low flu vaccination values are interspersed).
- The Z-score (under Moran's I) of 1.23 standard deviations falls inside the critical values (-1.65 and +1.65 standard deviations). This means that at the 0.1 confidence level, we are 99 percent certain the somewhat clustered distribution pattern for flu vaccinations may be due to random chance.
- Based on the pattern of flu vaccinations (color bar), we fail to reject the null hypothesis that flu vaccinations and population density are evenly distributed and have a random pattern across the study area.
- Based on the pattern of married residents and flu vaccinations, we can reject the null hypothesis that married residents and flu vaccinations are evenly distributed and have a random pattern across the study area.

Figure 4. Spatial Autocorrelation Results for Flu Vaccinations, Ages 18-64+ Years, Washington, D.C, 2001 – 2006

Figure 5. Distribution of Flu Vaccinations and the Uninsured, Ages 18-64+ Years, Washington, D.C, 2001-2006

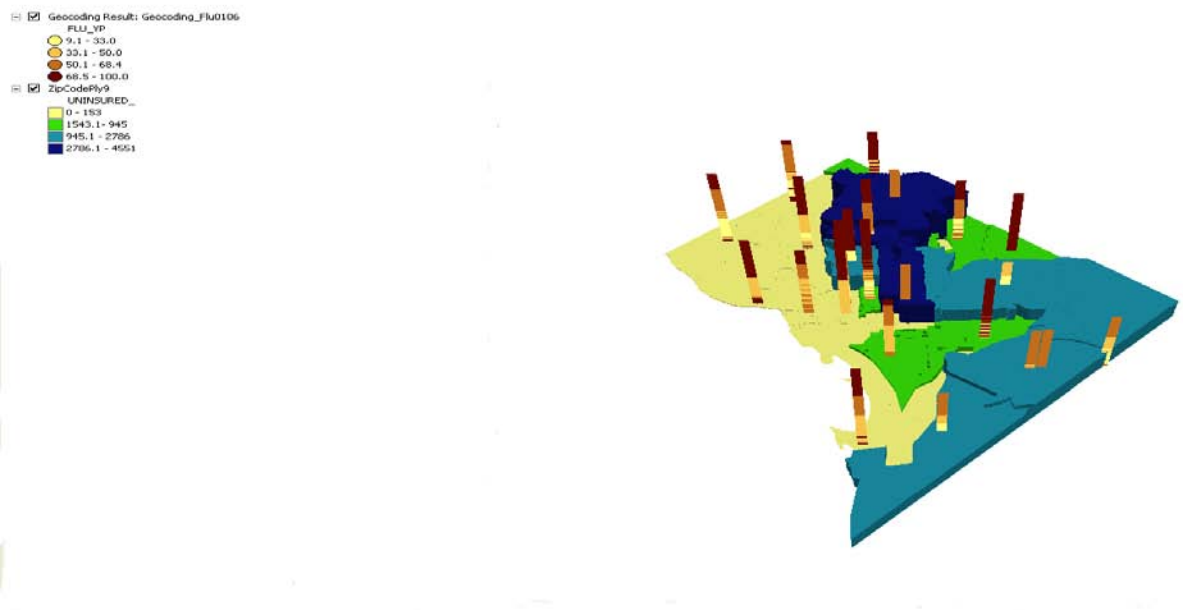
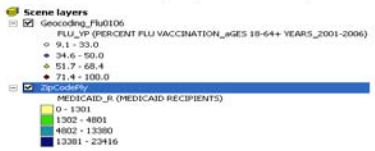


Figure 6. Flu Vaccinations vs. Medicaid

- Flu Vaccination rates greater than 52% are in zip code areas with low Medicaid recipients (≤ 4801 Medicaid recipients), and flu vaccination rates below 52% are in zip code areas with a high number of Medicaid recipients (13381 – 23416 Medicaid recipients).



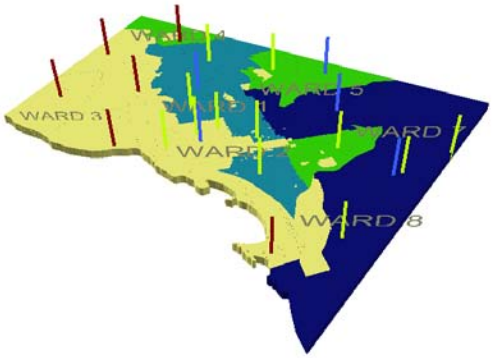


Figure 7. Flu Vaccinations vs. Population Density

- Flu vaccination rates between 51.7% - 100% are generally found in tracts and zip codes with population density between 7497 – 16269 persons/mi^2.
- That is, lower population density is generally associated with high flu vaccination rates.

Figure 7. Three Dimensional View of Flu Vaccination and Population Density, Ages 18-64+ Years, Washington, D.C, 2001-2006

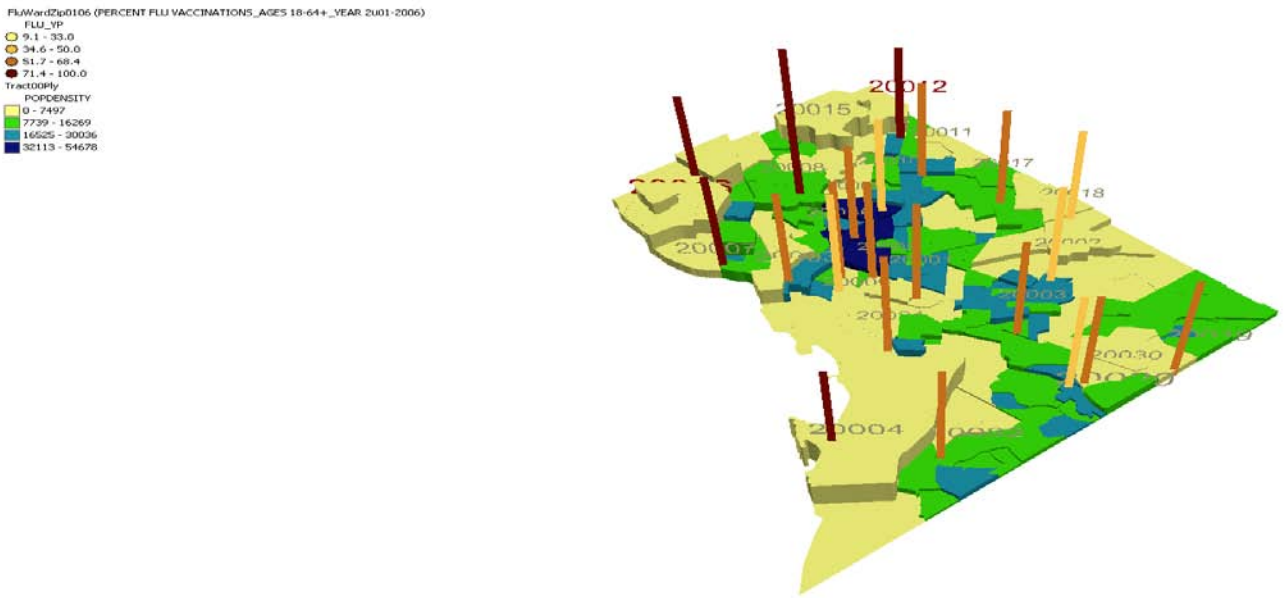
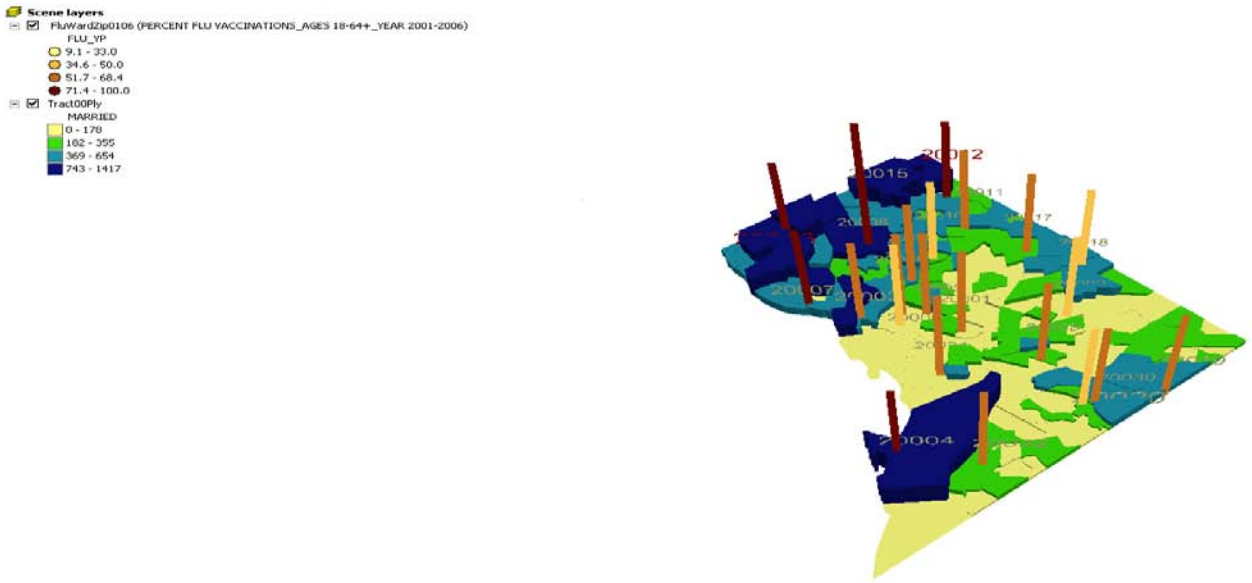


Figure 8. Flu Vaccination vs. Marital Status

- Flu vaccination rates are represented by color-coded “sticks” (yellow, gold, violet and brown), and numbers of married residents are color-coded polygons (yellow, green, light blue and blue).
- The highest rates of married residents are found in zip codes 20003, 20004, 20007, 20008, 20012, 20015, and 20016 zip code areas with 743 – 1417 married residents and are generally associated with flu vaccination rates between 71.4% - 100%.
- Zip codes with 369 – 654 married residents are generally found in areas with flu vaccination rates between 51.7% - 68.4%.
- That is, generally high flu vaccination rates are found in zip codes with more married residents.

Figure 8. Three-Dimensional View of Flu Vaccinations and Married Residents, Ages 18-64+ Years, Washington, DC, 2001-2006



Figures 9 - 11. Identifying Pockets of Flu Vaccinations

- Figure 9 shows zip codes within Wards that have flu vaccination rates >/ 66.7 percent and are found in the lower southeast section of Ward 2, the southeast and northeast sections of Ward 8, and the southeast section of Ward 7. Zip Codes in light blue generally have flu vaccinations below 66.7 percent.

- Figure 10 shows zip codes within Wards that have flu vaccination rates between 30.3 – 42.9 percent and are found in sections of all the Wards that are easily identifiable.

- Figure 11 shows zip codes within Wards that have flu vaccination rates </ 30.3 percent and are found in sections of all the Wards that are easily identifiable.

Figure 9. Distribution of Flu Vaccinations >/ 66.7 Percent Zip Code Areas per Wards – BRFSS Year 2001 – 2006, Ages 18-64+

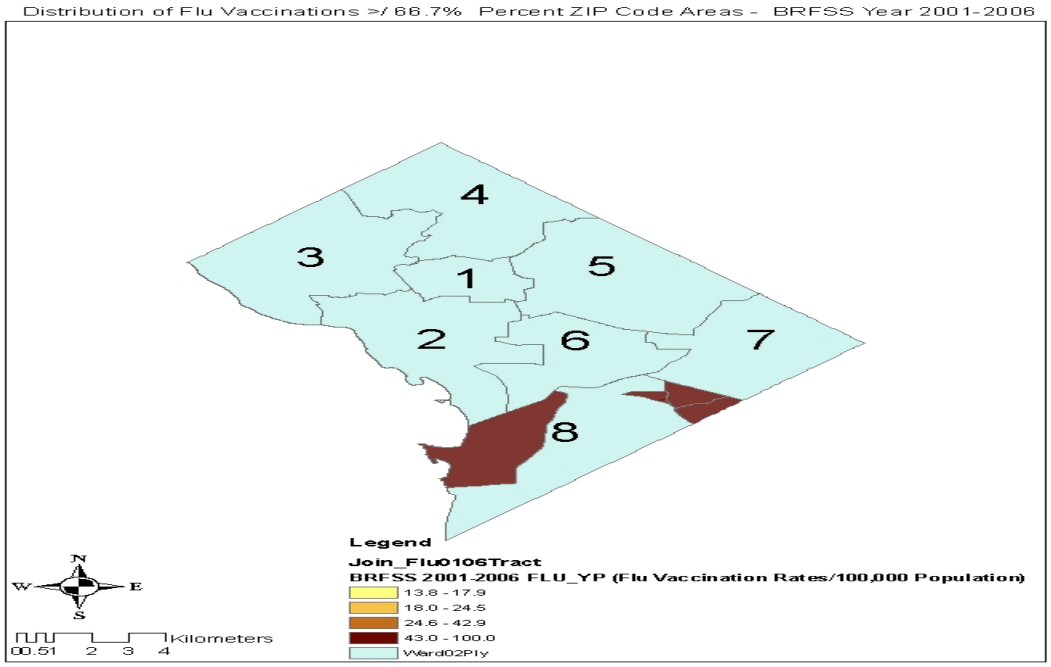


Figure 10. Distribution of Flu Vaccinations between 30.3 – 42.9 Percent Zip Code Areas per Wards – BRFSS Year 2001 – 2006, Ages 18-64+

- Figure 10 shows zip codes within Wards that have flu vaccination rates between 30.3 – 42.9 percent and are found in sections of all the Wards that are easily identifiable.

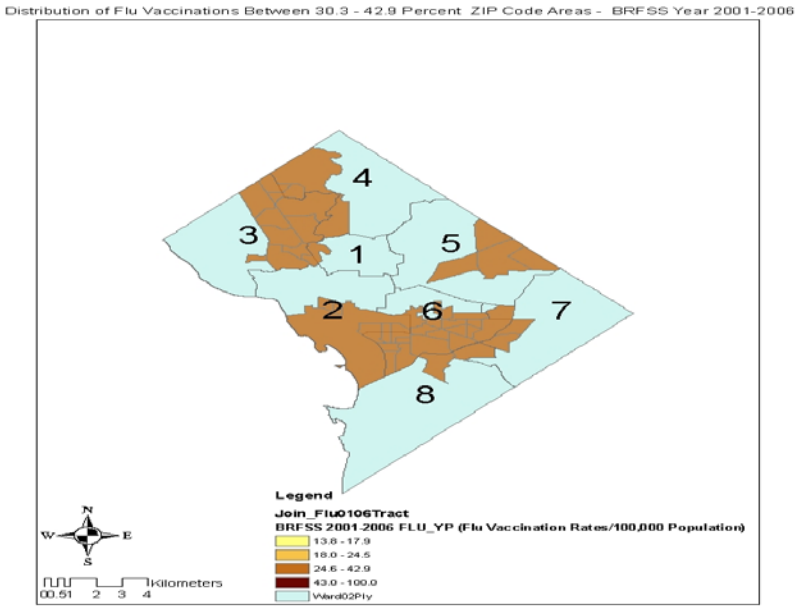
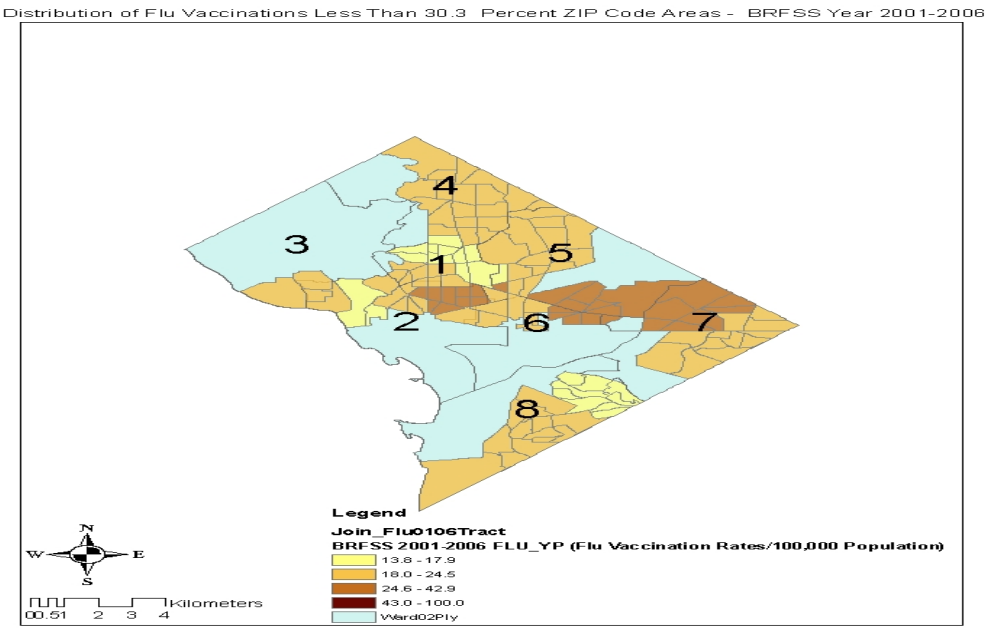


Figure 11. Distribution of Flu Vaccinations </ 30.3 Percent Zip Code Areas per Wards – BRFSS Year 2001 – 2006, Ages 18-64+

- Figure 11 shows zip codes within Wards that have flu vaccination rates </ 30.3 percent and are found in sections of all the Wards that are easily identifiable.



Limitations of the Study

- The data used does not include census tracts and street addresses.
- This would provide a much finer scale for the spatial analysis of the variables.
- Determine pockets of flu vaccination needs and direct resources appropriately.
- Including data from 2001 – 2008 would provide a more accurate picture of the spatial distributions of flu vaccinations.
- The BRFSS relies on information reported directly by the respondent. As such, this self-reported data may be subject to errors. The manner in which questions are worded and the ability of individuals to recall details may result in inaccuracies.

Conclusions: Lessons Learned from the Spatial Analysis of Year 2001 – 2006 Flu Vaccination Data

- Cluster analysis results suggest that location (at the zip code level) seems to play a significant role in getting flu vaccination.
- The highest flu vaccination rates for the period under review occurred in the northwest-southwest direction at greater than 67 percent.
- Generally, higher flu vaccination rates are mostly associated with high insurance coverage.
- Higher flu vaccinations seem to be associated with low numbers of Medicaid recipients.
- Lower population density seems to be generally associated with high flu vaccination rates.
- High flu vaccination rates are generally found in zip code areas with more married households.

Conclusions: Lessons Learned from the Spatial Analysis of Year 2001 – 2006 Flu Vaccination Data

- Only Zip codes 20007, 20008, 20016, 20015 in the northwest, zip code 20012 in the northeast, and zip code 20004 in the southwest have the highest flu vaccination rates at about 71.4% - 100%.
- When the data is projected at the census tract level, there seems to be significant variations in flu vaccination rates within the same Ward.
- Overlays, spatial pattern analysis, directional trends and cluster analysis can be used to identify pockets of needs for flu vaccinations.