Temporal Trends in HIV Incidence in Baltimore City

An Ecologic Analysis of the Needle Exchange Program

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Agenda

• Highlight the background behind HIV/AIDS and the Needle Exchange Program in Baltimore City

• Identify the research question and the public health significance of the study

• Discuss the methodology and statistical analysis used to address the research question

• Present the results and discuss limitations, interpretations, and conclusions
Background

- Baltimore, MD has the second highest reported AIDS rate among major metropolitan areas in the U.S.
  - In 2005, there were 40.4 cases per 100,000 people

- Injection drug use was the leading risk factor for HIV infection from 1994 - 2004:
  - Accounted for 60% of incident HIV and AIDS cases reported in 1994

Source: Maryland AIDS Administration
In 1994, a needle exchange program (NEP) was established in Baltimore to address the HIV epidemic among injection drug users

The program has been repeatedly evaluated in areas such as:
- Facilitating drug treatment and health service utilization for clients
- Associations with crime trends
- Effect on volume of discarded needles
The primary goal of the needle exchange program is to reduce IDU associated HIV incidence.

However, the association between the NEP and HIV incidence rates in Baltimore has not been studied.

This type of analysis is needed in order to comprehensively evaluate program outcomes.

Has the Needle Exchange Program had an effect on HIV incidence rates in Baltimore City?
Methodology

- Performed an ecologic analysis of the association between the Needle Exchange Program and HIV incidence rates in Baltimore City using:
  - HIV incidence data broken down by zip code
  - Number and location of NEP exchange sites
  - NEP enrollment data
  - 2000 census estimates

- Two outcomes were assessed to evaluate NEP effect:
  - Change in HIV incidence from 1995 - 2006
  - Change in IDU associated HIV incidence from 1995 - 2006
• NEP exposure was defined and analyzed in two distinct ways

• Out of the 28 zip codes with reported cases of HIV between 1995 - 2006:
  • Zip codes with a needle exchange site established prior to 2006 were considered exposed (NEP location analysis)
    OR
  • Zip codes with an average of 0.15% of the adult population enrolled in the program each year were considered exposed (NEP usage analysis)
• Negative binomial regression was used to model the number of HIV and IDU associated HIV cases as separate outcomes

• The base model included:
  • Dichotomized NEP exposure variable
  • Centered year variable
  • An interaction term to allow for changes in incidence rate ratios over time

• An overall assessment of temporal trends in HIV incidence at the city level was also performed
HIV incidence rates declined 3.3% annually

Temporal Trends in HIV Incidence in Baltimore, MD

1995

2006

Legend

* Needle Exchange Site

HIV Incidence Rates
Per 10,000 Persons

- 0 - 7
- 8 - 20
- >20

0 1 2 4 Miles
IDU HIV incidence rates declined 14.6% annually.

Temporal Trends in IDU HIV Incidence in Baltimore, MD

1995

2006

Legend
- Needle Exchange Site

IDU HIV Incidence Rates
Per 10,000 Persons
- 0 - 7
- 8 - 20
- >20

0 1 2 4 Miles
Dramatic decline in NEP incidence rates from 95-97 (NEP location analysis)

Overall HIV and IDU HIV Incidence Rates Comparing Zip Codes with NEP Sites to Zip Codes Without Sites

- NEP HIV Rate
- Non NEP HIV Rate
- NEP IDU Rate
- Non NEP IDU Rate
- # NEP sites
Overall, no significant difference in rate of decline

- **NEP location analysis:**
  - Zip codes without NEP sites observed a 2.7% annual decline in HIV incidence (p<0.001)
  - Zip codes with NEP sites observed a 4% annual decline in HIV incidence, but this was not statistically different from the unexposed group
  - However, zip codes with NEP sites had a 3.7% slower annual decline in IDU associated HIV incidence compared to zip codes without NEP sites (p=0.011)
Faster rate of decline in NEP exposed zip codes
(NEP usage analysis)

Overall HIV and IDU HIV Incidence Rates Comparing
NEP Exposed and Unexposed Zip Codes

NEP HIV Rate  -  Non NEP HIV Rate  
NEP IDU Rate  -  Non NEP IDU Rate  
# NEP sites
• **NEP usage analysis:**
  • Unexposed zip codes observed a 0.9% annual decline in HIV incidence, but it was not statistically significant ($p = 0.092$)
  • Conversely, NEP exposed zip codes observed a 5.0% annual decline in HIV incidence ($p < 0.001$)
  • The annual rate of decline in IDU associated HIV incidence, which was approximately 13%, was not statistically different between the two exposure groups
A catchment analysis was performed using NEP client enrollment data to validate the use of zip code level exposure.

- Found that clients enrolled at a site within their zip code of residence only 35.8% of the time.

- Overall, clients reported an address zip code equal to an NEP site zip code 60.1% of the time.
  - Lead to 40% misclassification during NEP location analysis.

- However, this does highlight the expansive reach of the Needle Exchange Program.
• **Zip code level comparisons have several limitations:**
  - NEP location analysis was based on the assumption that NEP clients are visiting sites within their zip code of residence
    – This assumption leads to 40% misclassification
  - Assumes effect of NEP would be reflected in zip code level HIV incidence rates
  - Possibility of ecologic fallacy
Limitations

- Exposure ascertainment
- Heterogeneity of IDU risk behavior
- Lack of HIV trend data prior to 1994
- Route of exposure only known in 57% of incident HIV cases
- Defining population at risk
  - In both total and IDU populations
- HIV diagnosis vs. HIV incidence
  - Potential lag time
**Key Messages**

- HIV and IDU associated HIV incidence have both declined significantly since 1995

- Based on the catchment analysis, the needle exchange program appears to have widespread coverage throughout the city

- Effects may not be detectable on the zip code level due to broad program reach

- More studies are needed in order to adequately characterize the association between the Needle Exchange Program and trends in HIV incidence
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• References