Examining the role of HIV lab surveillance data to help track engagement in HIV care

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Chicago site presentation
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The National HIV/AIDS Strategy (NHAS) lays out three goals:

- decreasing HIV incidence
- improving access and quality of care for people living with HIV/AIDS (PLWHA)
- reducing HIV-related health disparities

2015 NHAS HIV care cascade goals re: linkage/retention

- Increase proportion linked to care from 65% to 85%
- Increase Ryan White patients in continuous care from 73% to 80%

The HIV care cascade allows us to gauge how we are doing with respect to NHAS goals

Continuum of Care - Chicago, 2010 with 2015 targets
Measures for retention/engagement-in-care

- IOM report:
  - Proportion of people with diagnosed HIV infection who are in continuous care (two or more visits for routine HIV medical care in the preceding 12 months at least 3 months apart)
  - Proportion of people with diagnosed HIV infection who received two or more CD4 tests in the preceding 12 months
  - Proportion of people with diagnosed HIV infection who received two or more viral load tests in the preceding 12 months

- HHS-endorsed core indicator:
  - Numerator: Number of people with an HIV diagnosed who had at least one HIV medical care visit in each six-month period of the 24-month measurement period.
  - Denominator: Number of people with an HIV diagnosis with at least one HIV medical care visit in the first six months of the 24 months measurement period

- NHAS goals:
  - Proportion in continuous care defined as two or more visits for routine HIV medical care in the preceding 12 months, with visits at least 3 months apart.

- Harmonize?
ECHPP/CFAR Chicago site year 2 aims

1. Analyze 2011 Chicago Department of Public Health (CDPH) CD4 and HIV viral load (VL) surveillance data in order to characterize those living with HIV/AIDS who are not linked to care, retained in care, or virally suppressed based on lab-based definitions for linkage and retention in care.

2. Assess the usefulness of HIV surveillance laboratory data to track engagement-in-care.

   A. Identify barriers to enhanced use of CD4/VL data to supplement engagement in clinical care outreach efforts.

   B. Compare clinic visit vs. HIV surveillance lab-based definitions for engagement-in-care in order to estimate performance characteristics for lab-based measures of patient engagement-in-care.

Barriers to use of HIV lab surveillance data for improving engagement in HIV care in the 12 metropolitan statistical areas most affected by HIV/AIDS. K Finnegan, R Lubelchek, N Prachand, Nanette Benbow, MAS; Patricia Murphy. ID Week, 2013, San Francisco, Oct. 2-6. abstract 685.
Methods: Aim 1

- Used HIV lab surveillance data reported to CDPH via the electronic HIV/AIDS Reporting System (eHARS) to assess linkage-to-care and engagement-in-care, using 2011 data.

- Definitions utilized:
  - Linkage-to-care:
    - Definition 1: CD4 and/or viral load performed within 90 days of diagnosis from an outpatient facility, excluding VL/CD4 done +/- 3 days from date of HIV diagnosis.
    - Definition 2: CD4 and/or VL performed within 90 days of diagnosis
  - Engagement-in-care:
    - Definition 1: 2 CD4 and/or VL performed at least 3 months apart
    - Definition 2: 2 CD4 and/or VL performed at least 3 months apart from the same facility

- We also examined factors that correlated with linkage and engagement in-care via comparing $\chi^2$-values for various co-variates such as age, sex, race, ethnicity, transmission category.
### Aim 1: Results
Linkage-to-care

<table>
<thead>
<tr>
<th>Chicago cases linked to care based on HIV lab surveillance data</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linked to Care</strong></td>
<td>N</td>
</tr>
<tr>
<td><strong>Total number of cases</strong></td>
<td>1003</td>
</tr>
<tr>
<td><strong>Total excluding deceased cases</strong></td>
<td>990</td>
</tr>
<tr>
<td><strong>Cases with cd4/vl within 3 months of diagnosis (excluding labs +/- 3 days from HIV diagnosis date and those definitively from inpatient facility±)</strong></td>
<td>572</td>
</tr>
<tr>
<td><strong>Cases with cd4/vl within 3 months of diagnosis (INCLUDING labs +/- 3 days from HIV diagnosis date and those definitively from inpatient facility±)</strong></td>
<td>783</td>
</tr>
</tbody>
</table>
### Aim 1: Results

#### Engagement-in-care

<table>
<thead>
<tr>
<th>Chicago cases engaged-in-care based on HIV lab surveillance data</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engaged-in-care</strong></td>
<td>N</td>
</tr>
<tr>
<td>Total number of cases diagnosed before Dec. 31, 2010</td>
<td>29,887</td>
</tr>
<tr>
<td>Total excluding deceased cases</td>
<td>19,319</td>
</tr>
<tr>
<td>Cases with ≥2 cd4/vl at least 3 months apart</td>
<td>6,588</td>
</tr>
<tr>
<td>Cases with ≥2 cd4/vl at least 3 months apart from same facility</td>
<td>5,998</td>
</tr>
</tbody>
</table>
Aim 2b: Methods

- Re-cap aim/objective:
  - Determine the utility of a HIV surveillance lab-based assessment of patient engagement/non-engagement-in-care

- Why?
  1. Lend insight to DOH as to how surveillance lab based assessment of engagement corresponds to clinic visit based assessment
  2. Help determine if surveillance based assessments of patient engagement can be useful to clinical care providers seeking to tract patient engagement
    - i.e. can DOH surveillance-based engagement data be used to inform clinical care providers which of their patients is truly lost-to-care vs. in care elsewhere.
Aim 2b Methods Cont.

- Use clinical visit data based definition for engagement as gold-standard and compare this with several surveillance lab-based definitions for patient engagement/non-engagement.
- Seek to characterize the sensitivity, specificity and receiver operator characteristics of surveillance lab-based assessments for identifying non-engaged patients.
- Use visit data as gold-standard against which to compare lab-salience-based definitions.
- Brief review of test performance characteristic parameters.
  - Sensitivity: Proportion with condition (non-engagement) detected by testing (or clinical rule/criteria).
  - Specificity: Proportion without condition (without non-engagement, e.g., engaged-in-care) who test negative.
  - Receiver operating characteristic (ROC) graphic plot illustrating the performance of a binary classifier system (i.e., engaged/non-engaged) as its discrimination threshold is varied (varying diagnostic/threshold criteria).
    - Area under the curve (AUC) as a global indicator of test performance.
      - Value of 0.5 suggests useless test/criteria.
      - Value of 1 = perfect test/criteria.

[Diagram showing sensitivity vs. false positive fraction (1 - specificity) with annotations for perfect observer, random guessing, and a straight line representing equal sensitivity and specificity.]

Perfect observer

Random guessing

False Positive Fraction (1 – Specificity)
Aim 2b methods continued

- Clinic visit data sets
  - Drawn from visit at the Ruth M. Rothstein CORE Center
    - Cook County Health and Hospital Systems ambulatory HIV clinic
    - Provides primary care to nearly 5500 PLWHA
  - Data set 1:
    - Engaged patients: Those whom meet DHHS definition for being in continuous care
      - At least 1 visit per consecutive 6 month periods over 24 months, with a minimum of 60 days between the first medical visit in the prior 6 month period and the last medical visit in the subsequent 6 month period between Jan. 2010 to Dec. 2011.
    - Non-engaged patients: Those with at least one visit in the second half of 2010 and no visit in 2011.
  - Data set 2:
    - Small data set of patients confirmed to be in jurisdiction, non-deceased, not in care elsewhere
    - CORE Center primary care patients lost to care prior to 2012 for whom outreach workers attempted to get back into care and for whom outreach workers listed disposition.
      - Excluded patients listed as:
        - Deceased
        - In care elsewhere
        - Out of jurisdiction
        - In corrections
Aim 2b methods cont.

- For each of the clinic visit data sets we matched patients with known clinic visit based engaged/non-engaged status against CORE lab data and CDPH eHARS lab surveillance data.
  - For the CDPH eHARS match we excluded the following patients:
    - Deceased
    - Moved out of jurisdiction
    - Not residing in Chicago
- We considered 3 different surveillance lab-based definitions for engaged-in-care:
  - $\geq 1$ CD4/HIV VL reported to eHARS for 2011
  - $\geq 2$ CD4/HIV VLs reported to eHARS for 2011
  - $\geq 2$ CD4/HIV VLs from same facility reported to eHARS for 2011
- We determined sensitivity, specificity and ROC AUC of these criteria for identifying patients as non-engaged compared against clinic visit data.
## Aim 2b results

### CORE Center lab data for monitoring CORE Center HIV patient engagement

<table>
<thead>
<tr>
<th></th>
<th>Clinically non-engaged</th>
<th>Clinically engaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>No lab reported in 2011</td>
<td>409</td>
<td>23</td>
</tr>
<tr>
<td>≥ 1 lab reported in 2011</td>
<td>32</td>
<td>2,441</td>
</tr>
<tr>
<td>Total</td>
<td>441</td>
<td>2,464</td>
</tr>
</tbody>
</table>

For non-engagement:

Sensitivity = \(\frac{409}{441} = 92.7\% \pm 2.4\%\)

Specificity = \(\frac{2,441}{2,464} = 99.1\% \pm 0.38\%\)

### CORE Center lab data for monitoring CORE Center HIV patient engagement

<table>
<thead>
<tr>
<th></th>
<th>Not in care</th>
<th>In Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 labs reported in 2011 at least 3 months apart</td>
<td>435</td>
<td>254</td>
</tr>
<tr>
<td>≥ 2 lab reported in 2011 at least 3 months apart</td>
<td>6</td>
<td>2,210</td>
</tr>
<tr>
<td>Total</td>
<td>441</td>
<td>2,464</td>
</tr>
</tbody>
</table>

Sensitivity = \(\frac{435}{441} = 98.6\% \pm 1.1\%\)

Specificity = \(\frac{2,210}{2,464} = 89.7\% \pm 1.2\%\)
Results of matching CORE patients with CDPH eHARS

CORE Center Patients for Analysis
N = 2,905

Non-engaged Patients
N = 441
Matched N = 284
Deceased N = 29
OOJ N = 55
TOTAL ANALYZED N = 200

Engaged Patients
N = 2,464
Matched N = 1,900
Deceased N = 14
OOJ N = 170
DX = 2012 N = 2
TOTAL ANALYZED N = 1,714
### Aim 2b: Results of CORE visit vs. CDPH eHARS lab data

Testing CDPH eHARS lab based surveillance data for monitoring CORE Center HIV patient engagement – Definition 1

<table>
<thead>
<tr>
<th></th>
<th>Not in care*</th>
<th>In Care**</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>No lab reported in 2011</td>
<td>107</td>
<td>53%</td>
<td>22</td>
</tr>
<tr>
<td>≥ 1 lab reported in 2011</td>
<td>93</td>
<td>47%</td>
<td>1,692</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100%</td>
<td>1,714</td>
</tr>
</tbody>
</table>

Testing CDPH eHARS lab based surveillance data for monitoring CORE Center HIV patient engagement – Definition 2

<table>
<thead>
<tr>
<th></th>
<th>Not in care*</th>
<th>In Care**</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>&lt; 2 labs reported in 2011</td>
<td>144</td>
<td>72%</td>
<td>144</td>
</tr>
<tr>
<td>≥ 2 labs reported from in 2011 at least 3 months apart</td>
<td>56</td>
<td>28%</td>
<td>1,570</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100%</td>
<td>1,714</td>
</tr>
</tbody>
</table>

Testing CDPH eHARS lab based surveillance data for monitoring CORE Center HIV patient engagement – Definition 3

<table>
<thead>
<tr>
<th></th>
<th>Not in care*</th>
<th>In Care**</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>&lt; 2 labs reported in 2011 from same facility</td>
<td>156</td>
<td>78%</td>
<td>158</td>
</tr>
<tr>
<td>≥ 2 labs reported from in 2011 from same facility at least 3 months apart</td>
<td>44</td>
<td>22%</td>
<td>1,556</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100%</td>
<td>1,714</td>
</tr>
</tbody>
</table>
Results for matching clinically engaged and non-engaged patients against CDPH eHARS lab data

<table>
<thead>
<tr>
<th>Definition</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No lab in 2011</td>
<td>53.5% (6.9%)</td>
<td>98.7% (0.5%)</td>
</tr>
<tr>
<td>&lt; 2 labs reported in 2011</td>
<td>72.0% (2.1%)</td>
<td>91.6% (1.3%)</td>
</tr>
<tr>
<td>&lt; 2 labs reported in 2011</td>
<td>78.0% (2.0%)</td>
<td>90.8% (1.4%)</td>
</tr>
</tbody>
</table>

ROC of lab based measures of non-engagement in care for clinically non-engaged CORE Center patients matched to eHARS database

\[ y = 0.1134 \ln(x) + 1.0264 \]

\[ R^2 = 0.9621 \]

AUC = 0.913
Match of “definitely out of care patients” with CDPH eHARS

Non-engaged Patients (Outreach)  
N = 28

Matched  
N = 21

Not Matched  
N = 7

Deceased  
N = 2

OOJ  
N = 2

TOTAL ANALYZED  
N = 17
Sensitivity and specificity of lab based measures of non-engagement in care for clinically non-engaged CORE Center patients matched to eHARS database – definitely out of care data set

<table>
<thead>
<tr>
<th>Definition</th>
<th>Sensitivity (95% CI)</th>
<th>Specificity (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition 1: No lab in 2011</td>
<td>47.1% (23.7%)</td>
<td>98.7% (0.5%)</td>
</tr>
<tr>
<td>Definition 2: &lt; 2 labs reported in 2011</td>
<td>70.6% (21.7%)</td>
<td>91.6% (1.3%)</td>
</tr>
<tr>
<td>Definition 3: &lt; 2 labs reported in 2011 from same facility</td>
<td>82.4% (18.1%)</td>
<td>90.8% (1.4%)</td>
</tr>
</tbody>
</table>

ROC of lab based measures of non-engagement in care for *clinically non-engaged* CORE Center patients matched to eHARS database - Outreach

\[
y = 0.1558 \ln(x) + 1.145 \\
R^2 = 0.9164 \\
AUC = 0.9892
\]
Limitations

- Patients in the CDPH eHARS database include only those cases which reside in the city of Chicago at their date of diagnosis which resulted in fewer CORE Center patients being matched to the database.

- No true gold standard when considering which patients are engaged-in-care. Patients we deemed as out of care based on clinic visits, may have been in care else where.

- Patients may have received labs in ED/urgent care and labs a lone do not equate to engagement/retention-in-care
  - This is why we looked at labs from same facility definition

- Experience highlighted some inherent challenges of working with lab surveillance data.
Conclusions:

- Use of lab-based surveillance to gauge patient engagement-in-care can be informative
  - Has high sensitivity and specificity for identifying non-engaged patients compared to clinic visit-based definitions for patient engagement-in-care.
- System for bi-directional data sharing between DOH and clinical providers (e.g. CORE Center) may have the potential to improve engagement and retention activities for HIV patients.
- Creating HIV public health information exchange could facilitate the process of identifying and re-engaging out of care PLWHA.
- This work has served as a feasibility study of sharing surveillance data with providers to impact re-engagement in care that will now be implemented city-wide.
- Helped explore security and confidentiality concerns around data sharing with community stakeholders and others interested in sharing data.
- Helped validate engagement-in-care performance measures that can be used to track local progress.
Acknowledgements

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  - CDPH
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  - Audrey French – Clinical core director
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