A 21st Century Public Health Model of HIV Prevention:

Integrating Traditional and Molecular Methods for Case-finding and Monitoring Access to Care
San Francisco

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New HIV infections
San Francisco 1977-Present

Rise
Fall
Nadir
Resurgence
Plateau

Willi McFarland, SFDPH Seroepidemiology Section
AIDS cases, deaths, and prevalence
San Francisco 1980-2006

Figure 1.1 AIDS cases, deaths, and prevalence, San Francisco, 1980-2006

Percent per year

Anonymous Test Site

STD Clinic

HIV Prevalence by Age, MSM, SF, 2004 NHBS
Annualized Number of Deaths By 10 Leading Causes 1990-1995 vs. 2003-2004, San Francisco

Aragon TJ et al, SFDPH, 2007
City’s HIV epidemic said to be over

by Matthew S. Bajko
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Speaking at the San Francisco AIDS Foundation gala in May, the agency’s executive director did not mince words. Two sentences into his speech that night, Mark Cloutier made a startling announcement.

"The HIV epidemic is over. Yes, The HIV"
Transmission rate by awareness of HIV status

RR = 6.4

Transmission rate per 100 p-y

Unaware

Aware

Prevalence of HIV infection
Gay Men, 2002-3, San Francisco

- 1976 gay men surveyed by telephone
  - 492 (24.9%) reported HIV infection
  - 8 (0.8%) HIV+ of 1049 “HIV-” tested
- 1.6% unknown

TABLE 1. HIV prevalence and proportion of unrecognized HIV infection among men who have sex with men, by city, age group, and race/ethnicity — five NHBS* cities, June 2004–April 2005

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total tested</th>
<th>HIV prevalence No. (%)</th>
<th>HIV prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>City</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baltimore</td>
<td>462</td>
<td>186 (40)</td>
<td>115 (62)</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>382</td>
<td>73 (19)</td>
<td>31 (42)</td>
</tr>
<tr>
<td>Miami</td>
<td>222</td>
<td>41 (18)</td>
<td>19 (46)</td>
</tr>
<tr>
<td>New York City</td>
<td>336</td>
<td>62 (18)</td>
<td>32 (52)</td>
</tr>
<tr>
<td>San Francisco</td>
<td>365</td>
<td>88 (24)</td>
<td>20 (23)</td>
</tr>
<tr>
<td><strong>Age group (yrs)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–24</td>
<td>410</td>
<td>57 (14)</td>
<td>45 (79)</td>
</tr>
<tr>
<td>25–29</td>
<td>303</td>
<td>53 (17)</td>
<td>37 (70)</td>
</tr>
<tr>
<td>30–39</td>
<td>585</td>
<td>171 (29)</td>
<td>83 (49)</td>
</tr>
<tr>
<td>40–49</td>
<td>367</td>
<td>137 (37)</td>
<td>41 (30)</td>
</tr>
<tr>
<td>≥50</td>
<td>102</td>
<td>32 (31)</td>
<td>11 (34)</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong>†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>616</td>
<td>127 (21)</td>
<td>23 (18)</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>444</td>
<td>206 (46)</td>
<td>139 (67)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>466</td>
<td>80 (17)</td>
<td>38 (48)</td>
</tr>
<tr>
<td>Multiracial</td>
<td>86</td>
<td>16 (19)</td>
<td>8 (50)</td>
</tr>
<tr>
<td>Other§</td>
<td>139</td>
<td>18 (13)</td>
<td>9 (50)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,767</td>
<td>450 (25)</td>
<td>217 (48)</td>
</tr>
</tbody>
</table>

*National HIV Behavioral Surveillance.
†Numbers for HIV prevalence do not add to 450 because of missing data in three records.
§Because of small sample sizes, category includes Asian/Pacific Islander, Native American/Alaska Native, and other.

HIV prevalence
24% positive
23% unknown
Prevalence of HIV infection
County Hospital ED, March 2007

- 1820 consecutive patients with blood collected for clinical care
- 146 (8.0%) known HIV infection
- 14 (0.8%) of 1674 HIV-infected
  - 1 acute HIV infection
- 10% unknown

Zetola et al, Public Health Reports, in press, 2008
Adult HIV Prevalence by Sex
San Francisco, 2006

Male: 4.6%
Female: 0.18%

SF Population 2000 Census: 394828 male, 381905 female; 58,000 MSM (25% HIV+)
Disease Control

- Case-detection
- Treatment
- Follow-up
- Partner management

Thomas Parran, MD
HIV Case Finding

• Screening
  – Sensitivity of current tests
  – RNA pooled screening
  – Routine HIV testing

• Partner Services
HIV Case Finding

• Screening
  – Sensitivity of current tests
  – RNA pooled screening
  – Routine HIV testing

• Partner Services
## Current HIV EIA Tests

<table>
<thead>
<tr>
<th>Generation</th>
<th>Antigen</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Viral lysate</td>
<td>+</td>
</tr>
<tr>
<td>Second*</td>
<td>Synthetic proteins</td>
<td>+ +</td>
</tr>
<tr>
<td>Third</td>
<td>Synthetic proteins + anti-IgM</td>
<td>+ + +</td>
</tr>
<tr>
<td>Fourth</td>
<td>Synthetic proteins + anti-IgM + anti-p24</td>
<td>+ + + +</td>
</tr>
</tbody>
</table>

*Includes currently available rapid tests*
Rapid HIV Testing

- City Clinic: Rapid tests offered to select patients at very high risk of HIV infection
  - Gay men and other men who have sex with men
  - Patients who report injection drug use
  - Patients with known HIV-infected partners
S.F. clinics getting high false-positive rate on oral HIV test

Sabin Russell, Chronicle Medical Writer, December 9th, 2005

Investigation of False Positive Results with an Oral Fluid Rapid HIV-1/2 Antibody Test

Krishna Jafa1,2, Pragna Patel1, Duncan A. MacKellar3, Patrick S. Sullivan1, Kevin P. Delaney1, Tracy L. Sides2, Alexandra P. Newman3,4, Sindy M. Paul5, Ewen M. Cadoff6, Eugene G. Martin7, Patrick A. Keenan7, Bernard M. Branson1, for the OraQuick Study Group

Performance of an oral fluid rapid HIV-1/2 test: experience from four CDC studies

Kevin P. Delaney8, Bernard M. Branson8, Apurva Uniyal8, Peter R. Kerndt9, Patrick A. Keenan9, Krishna Jafa8,9, Ann D. Gardner9, Denise J. Jamieson10 and Marc Bulterys11
Oraquick Advance Test Performance
City Clinic 2007

1148 Rapid Tests

88 (7.7%) HIV+
1048 HIV-

13 HIV RNA+
1035 HIV RNA-

Rapid testing missed 13 of 101 HIV+ cases
Sensitivity for HIV infection = 87%

Philip et al, CROI 2007
HIV Case Finding

• Screening
  – Sensitivity of current tests
  – RNA pooled screening
  – Routine HIV testing
• Partner notification and contact tracing
• Social network interventions
HIV RNA Screening

• HIV RNA detected 7-12 days after exposure
• HIV RNA+/HIV Ab- specimens identify those with acute infection
  – Staging of HIV infection allows for targeted medical care and prioritization of public health response
HIV infectivity by stage of infection

Pilcher et al, JID, 2004

Wawer et al, JID, 2005
HIV Testing Protocol
SF City Clinic

- All persons informed HIV RNA testing part of HIV test
  - Pooled testing at SFDPH (Bayer VERSANT bDNA 3.0) or from Sept—Feb 2007 (NGI/LabCorp (PCR)) followed by Abbott RT PCR
- Semi-quantitative RNA results:
  - No RNA detected
  - ≤ 10,000 RNA copies detected
  - > 10,000 RNA copies detected
- RNA positives assigned to investigator for immediate disclosure, confirmatory testing and case management
RNA Screening
SF City Clinic, 2003-2007

- 15,483 persons tested
  - 432 (2.8%) HIV Ab positive
  - 15,051 HIV Ab negative
- 49 (0.33%) RNA positive
- 11% increase in HIV case detection
- All (48) with repeat testing confirmed
Crude Cost Analysis
RNA Screening, SF City Clinic

• @ $10 additional cost per RNA test, $3072 per new case identified
• @ $30 per additional costs per RNA test, $9215 per new case identified
Acute HIV cases by month, 2003-2007

N = 40
HIV RNA Screening
Demographics/Sexual Networks

• All gay men/ men who have sex with men
  – 47% white, 30% Hispanic, 17% black
  – 54% age ≥ 30 years
  – 23% had an STD
  – 39% methamphetamine use
  – 40% Internet sex partners
    • 1 new sex venue
  – 27% HIV test in past 6 months; 73% past yr
Expanded HIV RNA screening

- Fall 2006 extended HIV RNA screening to MAGNET and AIDS Health Project
- Client/counselor determine need for test
  - 4 cases out of 245 “clients” who were offered/accepted RNA screening
NIMH Acute HIV Infection Study

Substantial behavior change among San Francisco participants in the 8 weeks following diagnosis with acute HIV

![Graph showing behavior change]

Before Diagnosis  After Diagnosis

Number of Sexual Risk Acts Prior 8 Weeks

- HIV-unknown partners
- HIV-negative partners
- HIV-positive partners

Courtesy of Wayne Steward, UCSF CAPS
RNA testing

• Benefits
  – Identifies those that standard HIV Ab testing misses
  – Finds highly infectious cases
  – Enables tracking and interventions at the leading edge of epidemic

• Costs/risks
  – Added expense
  – Complicated
  – Delays “definitive” test result
RNA screening

• Every HIV test should include HIV RNA testing in those HIV Ab negative
  – Reflex testing
  – Routine
  – Pooled, more cost-effective

• Combined Ab/Ag will detect cases earlier but may not allow staging

Distribution of reported patient viral loads, NYC, 2005-2007

N = 75,576

Viral Load Category

- No viral load values reported
- <=100K
- 100-500K
- 500K - 1 million
- > 1 million

n = 2681

Courtesy of Colin Shepard, NYC DOH
HIV Case Finding

• Screening
  – Sensitivity of current tests
  – RNA pooled screening
  – Routine HIV testing

• Partner notification and contact tracing

• Social network interventions
Routine HIV testing at County Medical Center

• May 2006 county medical center updated policy to allow for non-written patient consent for HIV testing
  – Opt-in testing, informational counseling, and disclosure standard medical practice
• Physician documentation of consent in chart
• Evaluated impact of that administrative change on HIV testing and HIV case identification with time-series analysis
Association Between Rates of HIV Testing and Elimination of Written Consents in San Francisco

Follow-up thru June 2007
County Hospital Medical Center

Mean time to disclosure, CD4 T cell count and clinic visit, county medical center, 2007-2008

N = 55 cases

Mean value = 326 cells/ul
Routine testing

• Benefits
  – Identifies more persons with HIV infection
  – Streamlines and may ‘normalize’ HIV testing process
  – Medical settings offer streamlined access to care

• Costs/ risks
  – Requires more provider time, $$, laboratory resources
  – Increased burden of care
  – May result in discrimination, psychological stress, false positive results
120990. (a) Prior to ordering a test that identifies infection with HIV, a medical care provider shall:

– inform the patient that the test is planned,
– provide information about the test, treatment options and need for future tests, if negative, and;
– advise the patient of his/her right to decline the test and document that refusal.
New California HIV Testing Law
October 12, 2007

120990. (b) Subdivision (a) shall not apply when a person independently requests an HIV test from the provider.
Routine HIV testing implementation

• Private providers not routinely offering
• Medical centers and hospitals requiring written consent
• Confusion about counseling requirements
• Hospital administrators and associations are risk averse
HIV Case Finding

• Screening
  – Sensitivity of current tests
  – RNA pooled screening
  – Routine HIV testing

• Partner notification and contact tracing
Implementation of HIV Safety Net and Partner Services

• January 2005
  – Assured STD clinic cases learned test results
  – Interviewed HIV cases (acute, new, syphilis/HIV) to identify risk behaviors, venues and elicit contacts for partner notification

• July 2006
  – Hospital laboratory reported cases to STD program
  – Expanded safety net and partner notification services throughout county medical center
  – County hospital HIV clinic nurse team
Partner notification cases by year and site of diagnosis

N = 285

*through February 2007
Partner notification cases by gender and year

N = 285

*Through February 2007
Partner notification cases by race/ethnicity

- White: 48%
- Hispanic: 23%
- Black: 22%
- Asian/PI: 7%

N = 285
Select risk behaviors among interviewed HIV cases, 2007
N=158

- Any drug use: 100%
- IDU: 0%
- Paid for sex: 20%
- Received money for sex: 0%
Substance use
N=158
Meeting places
N=158
Partner notification interview outcomes by duration of infection, 2004-2006

<table>
<thead>
<tr>
<th></th>
<th>Acute HIV</th>
<th>Nonacute HIV</th>
<th>Long-Standing HIV</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>(%)</td>
<td>N</td>
<td>(%)</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>(100.0)</td>
<td>398</td>
<td>(100.0)</td>
</tr>
<tr>
<td>Offered Partner Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interviewed</td>
<td>25</td>
<td>(83.3)</td>
<td>308</td>
<td>(77.4)</td>
</tr>
<tr>
<td>Refused</td>
<td>3</td>
<td>(10.0)</td>
<td>37</td>
<td>(9.3)</td>
</tr>
<tr>
<td>Unable to locate</td>
<td>2</td>
<td>(6.7)</td>
<td>53</td>
<td>(13.3)</td>
</tr>
</tbody>
</table>

Ahrens K et al, JAIDS, 2007
Contact elicitation and partner notification outcomes 2003-2008

3366 cases assigned

54 acute
- 46 (85%) interviewed
- 19 (41%) named partners
- 98 partners (partner index 2.1)
  - 6 new HIV cases (6%)

635 non-acute
- 414 (65%) interviewed
- 192 (46%) named partners
- 450 partners (partner index 1.1)
  - 42 new HIV cases (9%)

2677 syphilis/HIV long standing
- 2039 (76%) interviewed
- 1166 (57%) named partners
- 3080 partners (partner index 1.5)
  - 30 new HIV cases (1%)

NNTI = 16.3
NNTI = 9.9
NNTI = 68
Cost analysis of contact elicitation and partner notification

• Number Needed to Interview (NNTI) = Interviews/ new cases
  ~ 8-10 interviews to find 1 new case of HIV infection among newly detected HIV cases

• Cost
  – Time per interview with average partner follow-up
    ~ 8 hours of staff time
  – $2240 / new case of HIV infection detected
  – If NNTI = 20, cost = $4480

*At $28/hr of staff time
$30,000 estimated “cost-effective” amount to identify new HIV case, Coco Am Fam Med 2005
Summary

• RNA screening combined with rapid testing offers optimized testing protocol
• HIV control—screening, disclosure, partner services— is feasible and identifies high prevalence population
• Costs comparable to traditional counseling & testing and “cost-effective”
CD4 T cell count as impact measure

- Monitoring the impact of HIV testing is critical to evaluate public health activities
- Linkage to care is key component of CDC Advancing HIV Prevention
  - Assures timely medical care and risk reduction counseling

Klausner et al, CDC HIV Prevention 2007
Johns Hopkins Clinic Study
Baltimore 1990-2006

- In 1990-1994, average CD4 T cell count upon clinic entry was 371 cells/mm³
- In 2003-2006, average CD4 T cell count upon clinic entry declined to 276 cells/mm³

Plot of CD4+ cell count in antiretroviral-naive persons at presentation for HIV care, by calendar year.

Keruly J and Moore R. Clinical Infectious Diseases, Nov 15 2007
Data collection

• In July 2006, standard HIV case management updated to include monitoring access to care
• Disease control investigators (DCI) collected date of first HIV primary care visit, value/date of initial viral load and value/date of initial CD4 T cell count:
  – Patient interview
  – Used confidential electronic medical records
  – Requested information from HIV care providers via telephone or FAX
  – Closed case after 90 days
Matching records with HIV/AIDS Registry

- After DCI investigation, we matched our data to the plasma viral loads and CD4 T cell counts reported to the county’s HIV/AIDS Surveillance Section
  - San Francisco has had names-based HIV-reporting since April 2006
  - Longstanding AIDS Registry
Data Collection Schema

HIV CASE DIAGNOSED

STD CONTROL DCI INVESTIGATION
- HIV VIRAL LOAD
- CD4 T CELL COUNT
- FIRST PRIMARY CARE VISIT DATE

HIV/AIDS REGISTRY ELECTRONIC LAB REPORTS
- VIRAL LOAD AND DATE
- CD4 COUNT AND DATE

MATCHED ON NAME AND DATE OF BIRTH
Analysis

• Used first dates of primary care visit and laboratory tests after HIV diagnosis
• With discrepant laboratory results but same dates, used HIV/AIDS Registry data
• Excluded persons with HIV laboratory tests ordered on same day of diagnosis (n=26)
Data source of viral load and CD4 T cell count (N=160)
Distribution of time to first care visit
N = 218*

72% had a documented or reported primary care visit

*Complete 2007 and updated 2008 data
## Entry into primary care by interview status

<table>
<thead>
<tr>
<th>Case Interviewed?</th>
<th>No (n=39)</th>
<th>Yes (n=121)</th>
<th>PR</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>First visit within 3 months of diagnosis</td>
<td>21 (54%)</td>
<td>89 (74%)</td>
<td>1.4</td>
<td>0.02</td>
</tr>
<tr>
<td>Initial CD4 &lt;200</td>
<td>8 (8%)</td>
<td>18 (17%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial CD4 200-500</td>
<td>7 (7%)</td>
<td>33 (32%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial CD4 500 +</td>
<td>5 (5%)</td>
<td>32 (31%)</td>
<td></td>
<td>0.09</td>
</tr>
</tbody>
</table>

Interviewed cases associated with first primary care visit < 90 days
Distribution of initial CD4 T cell count

15% with CD4 T cell count ≤ 200 cells/ mm³; 25% ≤ 350 cells/ mm³
Summary

• Clinical measures can be collected by public health staff and used to monitor outcomes of case-finding and HIV testing programs
• In first 90 days, DCI collected CD4 T cell count data more often than were available in the HIV/AIDS Surveillance Registry
• Interviewed HIV-cases were more likely to be in primary care than non-interviewed cases
• 15% of HIV-cases were diagnosed with AIDS at first CD4 T cell count
  – 25% met current criteria for HIV therapy (CD4 \( \leq 350 \text{ cells/mm}^3 \))
Policy Implications

• Public health model:
  – Routine HIV testing
  – Disclosure, linkage and documentation of care
  – Partner services

Should be prioritized within existing health departments and emphasized over other less proven prevention strategies
Policy Implications

• Routine HIV testing requires national coalition: medical and hospital associations, insurers, businesses, thought leaders
  – Operational research

• Integrated CDC Guidelines for Partner Services offers timely opportunity to expand effective programs
Policy Implications

• CDC should **require** jurisdictions to use reported HIV case information for case management—disclosure, linkage to care, partner services

• CDC should directly fund local STD control programs to perform HIV case-finding and control activities
  – Evaluate, monitor, disseminate best practices
Policy Implications

• Testing programs should routinely monitor CD4 T cell counts
  – Evaluate impact of testing promotion
  – Documentation of linkage to care
  – Promote testing in groups with lower values
  – Clear goals should be set for what % of newly diagnosed patients have CD4 T cells ≤ 350 mm³
    • For example, < 10% of newly diagnosed patients should have CD4 ≤ 350 cells/ mm³
Future Considerations

• Demonstrate how HIV genotyping data (pol) can identify networks for targeted intervention in recent transmission clusters

• Recommend that sequence data be locally reportable and monitored
  – Routinely measured with resistance assays
  – Support appropriate informatics
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So many crotches, so little time.

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