



# Evaluation of Six Years of Statewide Screening and Testing for Acute HIV Infection in North Carolina

## Abstract

**Background:** Since 2002, North Carolina (NC) has identified acute HIV infections (AHI) using nucleic acid amplification testing (NAAT) through a statewide program.

**Methods:** All HIV antibody negative serum samples from publicly-funded voluntary testing and counseling (VCT) sites are tested for HIV RNA using specimen pooling. We calculated AHI and chronic HIV prevalence by calendar year and used linear regression to test for trends over time. We compared characteristics of people with acute and chronic HIV infection using the chi-squared test.

**Results:** Between 1/1/2003 and 12/31/2008, 125 clients with AHI and 3,766 with chronic HIV were identified from 891,210 tests for an overall prevalence of 0.014% and 0.42%, respectively. Prevalence in the VCT testing population declined from 2002-2008 in AHI (p=0.06) and chronic cases (p=0.002), likely due to an increase in testing among low-risk groups. NAAT testing increased case identification by 3.2% over standard antibody testing alone. Switching to a 3rd generation EIA in 2008 increased the number of AHI with EIA(-) results at diagnosis (vs. EIA(-), p=0.001). Acute cases were younger (28% ≤21 years vs. 14%, p<0.0001), more likely to be men (79% vs. 70%, p=0.05), more likely to be men who have sex with men (MSM; 58% vs. 34%, p<0.0001) and white (27% vs. 18%, p=0.01) than chronically infected clients.

Among the 28% of adolescent acutes ≤21 years of age, 51% (N=18) were identified from 2007-2008 (vs. 2002-2006, p=0.03). Most adolescents were MSM of color (74%), compared to only 23% of adult acutes (p<0.0001). Among female AHI cases (N=26), the median age was 30 years (range 16-48), the majority were African-American (73%) and 3 were pregnant. HIV risk factors for women with AHI included self/partner incarceration (37%), crack use (33%) and sex work (22%). The sex partners of six women (22%) were found to have been previously diagnosed HIV cases. Women were more likely to have an STI within 8 weeks of their AHI diagnosis (50% vs. 23% of men, p=0.01).

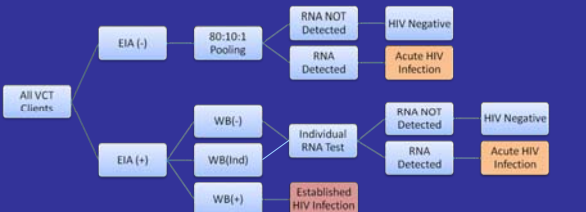
**Conclusions:** AHI and chronic HIV prevalence declined in the VCT population from 2003-2008; further analysis is needed to look at the composition of the tested group and to examine how it changed over time. AHI screening improves HIV cases missed by standard serological tests. Adolescents, especially young MSM of color, were more likely diagnosed with AHI. Women were less commonly diagnosed during AHI, potentially due to decreased risk perception but further research is needed. Characterizing populations with AHI may provide insight into improving early detection of HIV infection.

## Background

- The North Carolina (NC) Screening and Tracing Active Transmission (STAT) Program is a unique statewide collaboration to detect acute HIV infection (AHI) in publicly funded testing sites.
- North Carolina Department of Health and Human Services (NC DHHS) introduced HIV-1 RNA pooling into the routine HIV testing algorithm in November 2002. EIA testing and pooling assays have changed during this 6 year period; the most dramatic being a change from a 2nd to a 3rd generation EIA.

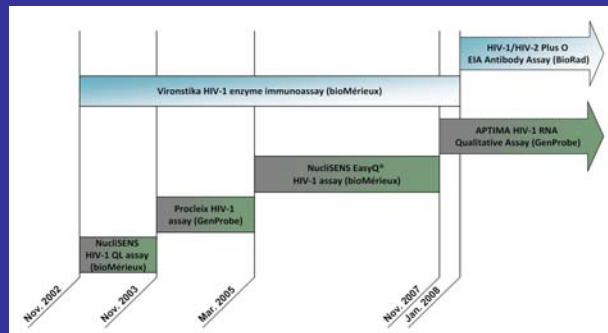
## Methods

**Figure 1.** Description of the HIV testing procedures for detection of acute HIV in North Carolina. [1]



- All clients presenting for VCT at approximately 135 publicly funded testing sites in NC are included in a testing algorithm to detect HIV-1 RNA positive, antibody negative acute HIV. [1]
- Samples with HIV-1 RNA detected and either EIA negative or EIA positive/Western Blot indeterminate are considered to represent unconfirmed acute infections.
- Potential AHI cases are assigned to a team of trained disease-intervention specialists (DIS) located throughout the state. DIS perform the initial interviews with AHI patients, confirmatory testing, and referrals to care within 72 hours of notification. DIS also perform partner notification and testing services prioritized by the date of exposure.
- EIA and HIV RNA tests used over the course of the program are depicted in **Figure 2**. In January of 2008, 3rd generation EIA tests (BioRad) replaced 2nd generation tests (bioMérieux).

**Figure 2. Timeline of HIV ELISA and RNA Tests**



## Conclusion

- In total, 3.2% of infections identified by the STAT Program for antibody-plus-RNA HIV testing were AHI, which would have been either not identified or not confirmed using standard antibody based testing procedures. The program's success at identifying new HIV infections has led to significant policy changes in the state, including universal reflex RNA testing for EIA-negative specimens and mandatory re-testing of pregnant women in the 3rd trimester. (2)
- The yield of AHI cases varied by site type and type of antibody tests performed. Improved sensitivity of current EIAs has resulted in a decreased number of cases presenting as EIA (-) and HIV-1 RNA (+).
- Decreased proportion of infected individuals in NC testing population may be due to increased testing among low risk populations following the adoption of the CDC's opt-out testing in 2007.
- Testing for AHI is especially important in high risk populations such as young MSM of color, for whom these infections would have been missed. The recent increase in AHI detection may be due to increased testing from targeted outreach programs (3); to increased AHI/HIV education; or to increased high risk behaviors such as internet partner meeting.
- Although nearly 2/3 of HIV testers were women, a smaller percentage of women are detected during AHI than men. Plausible explanations include lower perceived risk among clients and providers, and greater barriers to care and prevention services among high-risk women.

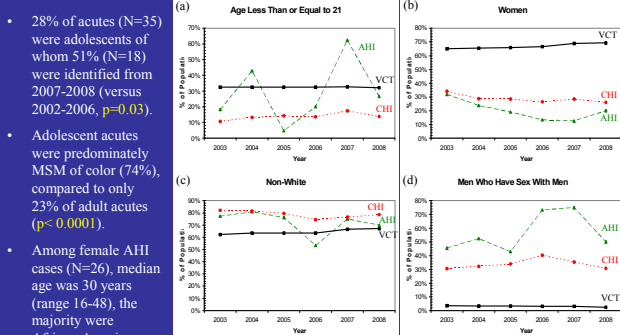
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## Results

**Table 1.** North Carolina Voluntary Testing and Counseling Testing Population 2003-2008

	No. HIV Tests <sup>‡</sup>		Chronic		Acute <sup>‡</sup>	
	N	%	N	%	N	%
<b>Total</b>	891,210	--	3,766	0.42%	125	0.014%
<b>Sex</b>						
Male	279,914	31%	2,631	70%	99	79%
Female	600,399	67%	1,076	29%	26	21%
<b>Median Age (Range)</b>	25	(0-99)	33	(0-94)	26	(16-56)
Age						
≤21	288,998	32%	524	14%	35	28%
>21	597,395	67%	3,226	86%	90	72%
<b>Race</b>						
Black	395,825	44%	2,578	68%	79	63%
White, Non-Hispanic	284,931	32%	663	18%	34	27%
Hispanic	162,901	18%	327	9%	10	8%
American Indian	9,536	1%	24	1%	1	1%
Missing	9,667	1%	34	1%	1	1%
<b>Sexual Risk Group</b>						
Female	600,399	67%	1,076	29%	26	21%
Heterosexual Male	9,944	1%	61	2%	22	18%
MSM	26,870	3%	1,277	34%	73	58%
Unknown Male	21,469	2%	270	7%	4	3%
<b>Site Type</b>						
CHC/PHC	17,189	2%	109	3%	3	2%
Drug Treatment	1,556,981	18%	61	2%	0	0%
Family Planning	12,819	1%	316	8%	8	6%
Field Visit	62,056	7%	872	23%	23	18%
HIV CTS	138	0%	3	0%	0	0%
Hosp/PMO	43,996	5%	380	10%	15	12%
Other	24,043	3%	153	4%	1	1%
Outreach	148,996	17%	96	3%	2	2%
Prenatal/OB	28,836	3%	231	6%	5	4%
Prison/Jail	348,896	39%	1,386	37%	54	43%
STD	6,872	1%	14	0%	0	0%
Missing	30,439	3%	114	3%	14	11%

<sup>‡</sup>From NC CTS -- number of HIV Tests performed; previous positives removed.  
 Note: Table excludes 2 Acute cases identified from 11/1/2002-12/31/2002 as the number of HIV tests and chronic case were not available for this 2 month period



**Figure 3a-d.** Proportion of acute, chronic, and overall testing population who were (a) ≤21 years old (b) women (c) non-white and (d) men who have sex with men by calendar year 2003-2008. AHI, Acute HIV Infection; CHH, Chronic HIV Infection; VCT, Voluntary Counseling and Testing Population, previous positives removed.

- 28% of acutes (N=35) were adolescents of whom 51% (N=18) were identified from 2007-2008 (versus 2002-2006, p=0.03).
- Adolescent acutes were predominantly MSM of color (74%), compared to only 23% of adult acutes (p<0.0001).
- Among female AHI cases (N=26), median age was 30 years (range 16-48), the majority were African-American (73%) and 3 were pregnant.

- Risk factors for women with AHI included self/partner incarceration (37%), crack use (33%) and sex work (22%). Sex partners of six women (22%) were previously diagnosed with HIV.
- Women were more likely to have an STI within 8 weeks of AHI diagnosis (50% vs. 23% of men, p=0.01).

**Table 2.** HIV Prevalence in North Carolina Voluntary Testing and Counseling Testing Population Stratified by Calendar Year

Calendar Year	No. HIV Tests <sup>‡</sup>	N	Chronic %	N	Acute %
2003	106,994	581	0.54%	22	0.21%
2004	118,885	552	0.46%	21	0.18%
2005	130,440	590	0.45%	21	0.16%
2006	145,398	645	0.44%	15	0.010%
2007	175,341	670	0.38%	16	0.009%
2008	214,154	728	0.34%	30	0.014%

<sup>‡</sup>From NC CTS -- number of HIV Tests performed; previous positives removed.

- Switching to the 3rd generation EIA in 2008 increased the number of AHI cases with EIA(+) results at diagnosis (p=.001) (**Table 3**)

**Table 3.** Initial HIV Testing Patterns of Acute Patients Stratified by EIA Generation Type

EIA(-); NAAT(+)	2nd Generation <sup>‡</sup> (2003-2007)		3rd Generation <sup>‡</sup> (2008)		χ <sup>2</sup> p-value <sup>§</sup>
	N	(%)	N	(%)	
EIA(+); WB(Ind)	12	13%	10	33%	p=0.001
EIA(+); WB(-)	2	2%	3	10%	
Missing	1	1%			

<sup>‡</sup>2nd Generation Test: Vironstika HIV-1 enzyme immunoassay (bioMérieux)  
<sup>‡</sup>3rd Generation Test: HIV-1/HIV-2 Plus O EIA Antibody Assay (BioRad)  
<sup>§</sup>Comparing EIA(-) versus EIA(+)

## References

- Pilcher CD, Fiscus SA, Nguyen TQ, Foust E, Wolf L, Williams D, et al. Detection of acute infections during HIV testing in North Carolina. *N Engl J Med* 2005;352:1873-1883.
- Patterson KB, Leone PA, Fiscus SA, Kuruc J, McCoy SI, Wolf L, et al. Frequent Detection of Acute HIV in Pregnant Women. *AIDS*, 2007; 21 (17): 2303-2308
- Hightow LB, Leone PA, MacDonald PD, et al. Men Who Have Sex With Men and Women: A Unique Risk Group for HIV Transmission on North Carolina College Campuses. *STDs* 2006;99:585-593.