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Relationship between a Centers for Disease Control and Prevention expanded HIV testing initiative and past-year testing by race/ethnicity: a multilevel analysis of the Behavioral Risk Factor Surveillance System

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Abstract

The Centers for Disease Control and Prevention's (CDC) expanded testing initiative (ETI) aims to bolster HIV testing among populations disproportionately affected by the HIV epidemic by providing additional funding to health departments serving these communities. ETI prioritizes testing in clinical settings; therefore, we examined the relationship between state-level ETI participation and past-year HIV testing among a racially/ethnically diverse sample of adult respondents to the 2012 Behavioral Risk Factor Surveillance System who accessed health services within the 12 months prior to being interviewed. Controlling for individual- and state-level characteristics in a multilevel logistic regression model, ETI participation was independently and positively associated with past-year testing, but this association varied by race/ethnicity. Hispanics had higher odds (adjusted odds ratio [AOR]: 1.49; 95% CI: 1.11–2.02) and American Indian/Alaska Natives had lower odds (AOR: 0.66; 95% CI: 0.43–0.99) of testing if they resided in states with (vs. without) ETI participation. State-level ETI participation did not significantly alter past-year testing among other racial/ethnic groups. Prioritizing public health resources in states most affected by HIV can improve testing patterns, but other mechanisms likely influence which racial/ethnic groups undergo testing.

Keywords

HIV/AIDS; screening; race/ethnic differences; testing initiative; multilevel

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Introduction

More than one million people are living with HIV in the United States (US) (CDC, 2014) and the epidemic disproportionately affects certain demographic groups and regions of the country. In 2010, African-Americans and Hispanics accounted for 29% of the population but 65% of incident infections (CDC, 2012a). Geographically, the highest rates of HIV and AIDS diagnoses have been in California and states in the south and northeast (CDC, 2012b).

To increase individuals' awareness of their HIV infection status, the CDC updated its testing guidelines by recommending that adolescents and adults receiving routine medical services be screened for HIV regardless of risk (Branson et al., 2008). However, in 2008, less than half of the US adult population had ever been tested (Johnson et al., 2011) with an estimated 14% of people living with an undiagnosed infection in 2012 (CDC, 2014).

Recognizing that African-Americans and Hispanics are disproportionately affected by the epidemic, the CDC sought to increase testing opportunities for these groups through the expanded HIV testing initiative (ETI) (CDC, 2011a). ETI supplements existing CDC-funded HIV testing programs (Valdiserri, 1997) by prioritizing testing, linkage to care, and prevention services in jurisdictions where the proportion of AIDS cases is high. Under ETI, a selected number of state and local health departments received two rounds of funding between October 2007 and December 2011 with the mandate to initiate new testing programs among high-risk populations, including African-Americans and Hispanics (funding opportunity numbers CDC-PS07–768 and CDC-PS10–10138) and to conduct most of their activities in clinical settings such as emergency departments, urgent care clinics, STD clinics, and community health centers. Health departments receiving ETI funding reported that 76% of the approximately 2.8 million tests conducted and 81% of the 18,432 new HIV diagnoses from 2007 to 2010 were among African-Americans and Hispanics with 90% of these tests being performed in clinical settings (CDC, 2011b).

Although earlier analyses indicated that CDC funding to expand HIV testing was associated with more individuals being tested (Hayek et al., 2015) and that HIV testing occurred more often in ETI-funded states (CDC, 2013), it is unclear whether this benefit persists when adjusting for factors that could explain state variation in HIV testing patterns (e.g., availability of healthcare resources and disease burden) or whether ETI funding has a differential association with HIV testing when considering race/ethnicity. Therefore, the purpose of this study was to examine the relationship between ETI funding and past-year HIV testing, controlling for state-level factors and race/ethnicity, among adults who reported accessing medical services in the year prior to being surveyed. The information gained will allow us to examine HIV testing patterns among persons anticipated to undergo screening based on the current CDC recommendation and determine whether additional funding increases testing across all racial/ethnic groups, even among those who were not the primary focus of the ETI program.

Methods

The study focused on past-year HIV testing among non-institutionalized adults aged 18–64 who participated in the 2012 Behavioral Risk Factor Surveillance System (BRFSS). BRFSS captures information on health-related behaviors through a random-digit dial survey conducted annually by states over landline and cellular telephone interviews using a disproportionate stratified sample design (BRFSS, 2013a). Response rates were 49.1% for landline and 35.3% for cell phone. Nonresponse and noncoverage bias was minimized by adjusting sample weights such that the sum of weights over a set of specified demographic and telephone source categories matched population distributions (BRFSS, 2013b). State of residence was used to link BRFSS respondents with state-level data obtained from four external sources: (1) US Census, (2) Area Health Resource File (AHRF) – a database on health resources (AHRF, 2010), (3) HIV surveillance report (CDC, 2012a), and (4) CDC-funded testing services report (CDC, 2012c).

We limited our sample to individuals with a past-year doctor's visit, as ETI was structured to support the CDC revised guidelines of routine HIV testing in clinical settings, and excluded individuals residing in US territories or missing an HIV testing response. The resulting sample size was n = 194,326 or 60% of the original sample aged 18–64 years. Compared to the original sample, the unweighted analytic sample had a slightly higher percentage of non-Hispanic African-American respondents (11.3% vs. 9.6%) and similar percentage of Hispanic respondents (7.2% vs. 8.0%).

Measures

Past-year HIV test—The outcome was assessed through 2012 BRFSS items asking participants whether they ever received an HIV test, excluding tests as part of a blood donation, and if so, the month and year of their last test. We constructed a binary variable defined as past-year HIV test (yes vs. no) occurring within 12 months before the interview date.

State-level variables—Our primary explanatory variable was state-level ETI participation reflecting whether a state health department (or the District of Columbia health department) received funding through ETI (yes vs. no), where no ETI participation was the reference condition. We did not consider ETI participation at the county level because these health departments were already located in ETI participating states. Other state-level variables included: (1) number of CDC-funded HIV testing events in 2010 reported by state health departments and the District of Columbia since we anticipated ETI participating states would have higher testing levels, (2) 2010 Census population, (3) proportion of population between the ages of 25 and 34 in 2010 since this age group had the highest HIV incidence rate, (4) 2010 disease burden measured by the number of HIV diagnoses per 100,000 residents, and (5) availability of healthcare resources approximated by the number of physicians per 100,000 residents in 2010.

Individual-level variables—Demographics and healthcare indicators were assessed at the individual level. Characteristics associated with HIV testing (Chandra, Billioux, Copen, Balaji, & DiNenno, 2012) were obtained from the 2012 BRFSS and included age (in years),

gender (male, female), race/ethnicity (non-Hispanic white, non-Hispanic African-American, non-Hispanic Asian/Native Hawaiian or other Pacific Islander – Asian/NHOPI, non-Hispanic American Indian/Alaskan Native – AIAN, non-Hispanic other, and Hispanic), marital status (not married, living together, married), education (college graduate, some college, high school graduate or GED, less than high school), and income (<$50,000 vs. ≥ $50,000). We included binary measures (yes vs. no) for current health insurance, inability to see doctor at least once in the past year because of costs, and engaging in any of the following HIV risk behaviors in the past year: intravenous drug use, sexually transmitted disease, exchanging sex for drugs or money, or unprotected anal sex.

Analysis

Bivariate analyses were conducted to describe the analytic sample. We compared state-level characteristics by ETI participation, as most of the ETI funding was provided to state health departments. A two-level random intercept logistic regression model analyzed the influence of state-level ETI participation on an individual's likelihood to report a past-year test, with individuals (level 1) nested within states (level 2). Three sequential multilevel models were constructed. Model 1 included state-level ETI participation only. Model 2 accounted for differences between states by controlling for all state-level variables. Model 3 tested for an interaction between state-level ETI participation and race/ethnicity after controlling for all of the individual- and state-level variables. Models were fit using a multilevel pseudo maximum likelihood estimation method (Asparouhov & Muthen, 2006) in MPLUS 7 (Muthén & Muthén, 2012). State-level variables, except ETI participation, were standardized to help with convergence of the model parameters. The median odds ratio (MOR) was calculated to quantify the variation in past-year HIV testing between states, as this is a better measure for quantifying cluster heterogeneity in a multilevel logistic regression (Larsen & Merlo, 2005). The BRFSS sampling weights capturing the unequal probability of selection were used in all analyses. The sampling weights were rescaled and incorporated into the likelihood function of the multilevel models to produce unbiased regression coefficients and variance estimates applying a rescaling method suggested by Asparouhov (2008) and Rabe-Hesketh and Skrondal (2006).

Results

Across the US, the weighted proportion of past-year HIV testing among adults who recently saw a doctor was 13.3%, with considerable state variation ranging from 6.1% in Utah to 18.8% in Georgia (Figure 1). Southern and northeastern states, most of which were ETI participating states, had the highest proportion of past-year testers (ranging from 15.1% to 18.8%).

Table 1 displays the distribution of individual and state-level characteristics by past-year HIV test. A large proportion of African-Americans (14.5%) and Hispanics (14.6%) were represented in the weighted BRFSS sample and they made up approximately 50% of past-year HIV testers. Furthermore, only 11% of past-year testers reported at least one HIV risk behavior. Although the majority of participants had current health insurance, past-year testers were less likely to have a usual source of care and more likely to have not seen a

doctor in the past year because of costs relative to those without a past-year HIV test. In addition, past-year testers were more likely to reside in states that received ETI funding, had higher HIV prevalence, more CDC HIV testing events, and a greater density of physicians.

Twenty-two state health departments and the District of Columbia received ETI funds. At the state level, ETI funding was associated with a higher HIV prevalence rate (318.6 vs. 115.3; $p < .001$), as expected since ETI funding selection was based on disease burden; more CDC-funded HIV testing events (median of 99,494 vs. 7,799; $p < .001$); more physicians per 100,000 residents (271.0 vs. 236.5; $p = .0231$); and larger populations (8.0 vs. 1.95 million; $p < .001$).

In the unadjusted model (Table 2, model 1), the odds of a past-year test was 67% greater among individuals residing in an ETI compared to non-ETI participating state (OR = 1.67; 95% CI = 1.39, 2.02). With the exception of American Indians and Alaskan Natives (AIAN), every racial/ethnic group had a higher percentage of past-year testing if they resided in an ETI rather than non-ETI participating state (Figure 2).

After controlling for the state-level variables (Table 2, model 2), ETI participation remained a significant predictor of past-year testing, but its association was slightly attenuated (adjusted odds ratio [AOR] = 1.25; 95% CI = 1.09, 1.43). Variation in past-year testing between states also decreased with the inclusion of other state-level variables; MOR decreased from 1.49 to 1.18.

After adjusting for individual- and state-level characteristics, AIAN and Hispanics experienced significant differences in testing by ETI participation (Table 3). The adjusted odds of a past-year test was 44% lower for AIAN in states with vs. without ETI funding (AOR = 0.66; 95% CI: 0.43, 0.99), whereas the adjusted odds of a past-year test was 49% higher among Hispanics residing in a state with vs. without ETI funding (AOR = 1.49; 95% CI = 1.11, 2.02).

Discussion

In 2007, the CDC launched ETI, a large-scale HIV testing program, to increase awareness of HIV status within geographic regions and among racial/ethnic minority populations experiencing a disproportionate burden of HIV/AIDS. Using a nationally representative sample, our study found that individuals residing in states whose health departments received ETI funding had significantly better odds of a past-year HIV test independent of other factors that might explain state- and individual-level variation in HIV testing. Past-year testing was highest in the southern and northeastern states where state health departments received ETI funding to support large-scale testing and states with the highest rate of persons living with an AIDS diagnosis (CDC, 2012a).

Furthermore, by limiting our sample to adults who accessed medical services in the past year, we ensured that it reflected people most likely to undergo routine HIV testing in clinical settings, regardless of risk per CDC's testing guidelines. Nevertheless, we still observed racial/ethnic differences in past-year testing with past-year testers having poorer healthcare access compared to non-testers. Therefore, other mechanisms such healthcare

utilization, residing in high-risk areas, and an individual's perception of risk may affect which racial/ethnic groups are most likely to be tested.

Consistent with other studies (Kaiser Family Foundation, 2009; Murray & Oraka, 2014), our findings suggest that African-Americans are more likely to have a past-year test as compared to other racial/ethnic groups. As expected, the unadjusted analysis showed that African-Americans were more likely to undergo a past-year test if they resided in an ETI participating state. However, even though ETI was launched in communities with high HIV prevalence rates or large concentrations of African-American and Hispanics (CDC, 2011a), after accounting for individual- and state-level determinants of testing, ETI funding did not significantly increase the proportion of African-Americans receiving a past-year test. These findings may be explained by greater attention, at the national level, to the disproportionate burden of the HIV/AIDS epidemic within the African-American community and the multitude of social marketing campaigns targeted towards African-Americans – such as “Take Charge. Take the Test” and “Testing Makes Us Stronger” – which coincided with the ETI implementation period.

By contrast, lack of awareness about HIV/AIDS or perception of risk could explain why whites and Asian/NHOPI were the least likely to have a past-year test in both participating and non-participating ETI states, although the reason for being tested was never asked of BRFSS participants. Our results parallel that of Murray and Oraka (2014) who found that, primarily because of a lack of perceived risk, a higher proportion of Whites and Asians, than members of other groups, never received an HIV test nor did they report future intentions of receiving an HIV test.

Our findings among Hispanics demonstrate that ETI was independently associated with increased testing. This gain may reflect testing in locations frequented by Hispanics who tend to lack a usual source of care (Mayberry, Mili, & Ofili, 2000). In a previous study, Hispanics were more likely than whites and African-Americans to undergo testing in a clinic or hospital rather than a private doctor's office (Rountree, Chen, Brown, & Pomeroy, 2009). Hispanics were also more likely to test if they saw a health professional (Lopez-Quintero, Shtarkshall, & Neumark, 2005). As with members of other racial/ethnic groups, the lack of HIV testing among Hispanics is influenced by the perception of risk (Lopez-Quintero et al., 2005) and some may fail to test because of low HIV knowledge (Chen, Meyer, Bollinger, & Page, 2012), which is more common among foreign-born Hispanics with a shorter duration of US residence (London & Driscoll, 1999) or low levels of US acculturation (Kinsler et al., 2009). By shifting away from risk-based testing and focusing on areas with large Hispanic populations, ETI may have reached Hispanics who otherwise would not have undergone an HIV test. This could be attributed to more testing within the southern states, where the burden of HIV/AIDS is highest and growth of the Hispanic population is substantial (Painter, 2008).

Additional research is needed to understand factors influencing HIV testing among AIAN (Ford, Godette, Mulatu, & Gaines, 2015). Both the unadjusted and adjusted findings indicated that AIAN were significantly less likely to report a past-year test if they resided in an ETI participating state. This was not surprising since AIAN are geographically

concentrated in the southwest and northern plain states with generally low rates of HIV/AIDS and correspondingly low levels of ETI participation. However, the need to expand testing in this population is important given that more than one-third of AIAN receive a late-stage diagnoses (Shouse, Kajese, Hall, & Vallero, 2009) and from 2007 to 2010, the rate of HIV diagnoses increased among AIAN despite it is decreasing or remaining stable for other racial/ethnic groups (CDC, 2012b). Furthermore, other sexually transmitted infections (STIs) exceed that of the overall US population, exacerbating HIV risk among AIAN (Kaufman et al., 2007).

Finally, while our study was intended to understand testing behaviors of people within the healthcare setting, some groups are less likely to access care. Prior research has found that men are less likely than women to access health services (Bertakis, Azari, Helms, Callahan, & Robbins, 2000) with African-American and Hispanic men more likely to delay care for STI symptoms (Kalmuss & Austrian, 2010). Young adults who are at increased risk of HIV also tend to underutilize healthcare services (Fortenberry, 1997).

There are some limitations to this study that warrant consideration. First, the BRFSS relied on self-reports and this may have overestimated the prevalence of past-year testing if people incorrectly believed that screening was automatically performed during medical visits (Kaiser Family Foundation, 2009). We also excluded individuals missing an HIV testing response, representing 7% of the sample, who were more likely to be male, Asian/NHOPI or Hispanic, less educated and lower income. To minimize potential bias, we used sampling weights in our estimation of past-year testing by race/ethnicity and ETI participation. Furthermore, although the BRFSS response rate is low, weighted BRFSS estimates have been comparable to other national surveys with higher response rates (Nelson, Powell-Griner, Town, & Kovar, 2003). The weighted prevalence we observed, 13.3%, was slightly higher than a 2010 national survey estimate of 10.1% of adults with a past-year test in the general population (CDC, 2013). However, our estimate reflects adults accessing health care and included a higher proportion of individuals affected by the HIV epidemic (e.g., African-Americans and Hispanics) and thus more likely to test.

Overall, our study demonstrates a positive gain to investing federal resources in the groups and areas most affected by the HIV epidemic. Since ETI prioritized screening in clinical settings and was launched in states that, on average, had more resources to provide testing service (e.g., greater density of physicians), our findings suggest the need for innovative strategies within healthcare systems to improve clinicians' ability to routinely offer HIV screening regardless of risk. However, despite our instructive findings, the differential association of state-level ETI participation and past-year testing by race/ethnicity highlights the need for alternative strategies to complement screening in healthcare settings to reach groups who underutilize medical services. Public health agencies should consider expanding testing in non-traditional venues, which may increase the screening of adults affected by the epidemic most severely.

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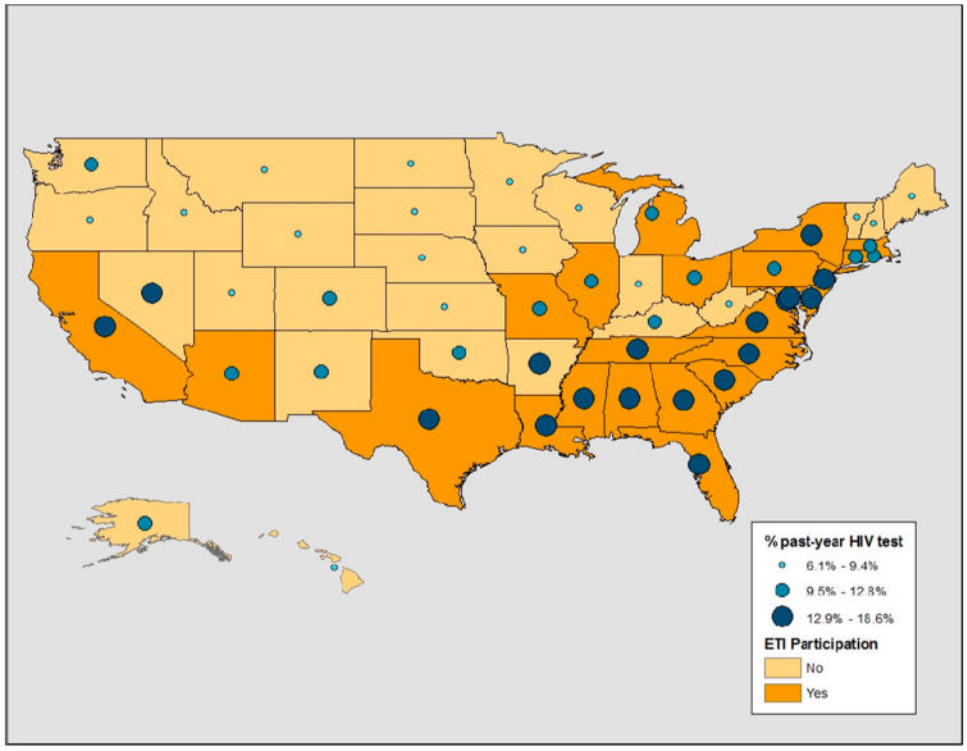

Figure 1.
Weighted proportion of past-year HIV test by state-level ETI participation.

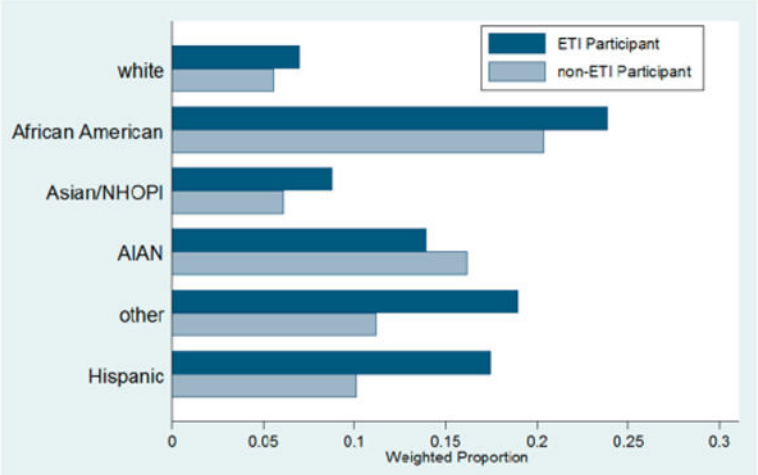

Figure 2.
Unadjusted weighted proportion of past-year HIV test by state-level ETI participation and race/ethnicity.

Table 1

Weighted descriptive statistics by past-year HIV testing status.

		HIV test		
	Overall	**No**	**Yes**	***p* value**
Individual-level variables				
Female (%)	54.9	55.0	54.0	.177
Race/ethnicity (%)				
Non-Hispanic white	62.8	66.2	40.7	<.001
Non-Hispanic African-American	14.5	11.9	31.7	
Non-Hispanic Asian/NHOPI	5.0	5.2	3.3	
Non-Hispanic AIAN	1.1	1.0	1.3	
Non-Hispanic other	2.0	1.9	2.9	
Hispanic	14.6	13.7	20.1	
Marital status (%)				
Not married	43.3	40.1	64.2	<.001
Living together	4.7	4.3	7.0	
Married	52.0	55.6	28.8	
Education (%)				
College	28.7	29.2	24.9	<.001
Some college	32.1	31.9	33.5	
High school	27.4	27.4	27.0	
<High school	11.9	11.5	14.6	
Employed (%)	64.1	64.5	61.6	<.001
Income < $50,000 (%)	49.2	46.9	64.1	<.001
Mean age in years (SE)	42.0 (0.1)	43.1 (0.1)	35.0 (0.2)	<.001
Did not see doctor because of costs (%)	13.5	12.7	18.3	<.001
Usual source of care (%)	86.3	87.4	79.0	<.001
Currently insured (%)	86.8	87.5	82.0	<.001
HIV risk behavior (%)	4.1	3.1	10.5	<.001
State-level variables				
Mean no. of CDC HIV testing events	70,095	68,283	87,991	<.001
% aged 25–34 years	13.1	13.1	13.3	<.05
Physician density per 100,000	290.7	281.6	301.3	<.001
HIV prevalence	2.8	2.7	3.7	<.001
Reside in state with ETI program	52.0	76.6	83.8	<.001

Table 2

Odds ratio (95% CI) of past-year HIV testing by state-level characteristics.

	Odds ratio (95% CI)	
State-level variables	**Model 1**	**Model 2**
Expanded HIV testing initiative	1.67 (1.39–2.02) **	1.25 (1.09–1.43) *
No. of CDC HIV testing events		1.04 (0.97–1.11)
% aged 25–34 years		0.98 (0.88–1.09)
Physician density		0.88 (0.81–0.96) **
HIV prevalence		1.34 (1.19–1.51) **
Population size		0.98 (0.93–1.04)
State-level variance (SE)	0.107 (0.04)	0.031 (0.01)
MOR	1.49	1.18

Note: MOR describes the difference in variation of past-year HIV test between two randomly chosen people with same covariates but from different states. MOR of 1 indicates no difference.

** $p < .01$.

* $p < .05$.

Table 3

AOR of past-year testing comparing state-level ETI participation to non-participation (reference group) by race/ethnicity.

Race	OR	95% CI
non-Hispanic white	0.98	(0.84–1.14)
non-Hispanic African-American	0.98	(0.78–1.21)
non-Hispanic Asian/NHOPI	0.83	(0.52–1.32)
non-Hispanic AIAN	0.66 *	(0.43–0.99)
non-Hispanic other	1.02	(0.64–1.61)
Hispanic	1.49 **	(1.11–2.02)

Note: AOR generated from a weighted multilevel model that controlled for number of CDC HIV testing events, % population aged 25–34 years, physician density, HIV prevalence rate, state population, state-level ETI participation, gender, age, race/ethnicity, marital status, education, income, health insurance status, needed to see doctor but could not because costs, HIV risk, and interaction between state-level ETI participation and individual-level race/ethnicity.

** $p < .01$.

* $p < .05$.