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Three Years of Shared Service HIV Nucleic Acid Testing for Public Health Laboratories: Worthwhile for HIV-1 but Not for HIV-2

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Abstract

Background: In 2016, HIV-2 nucleic acid testing (NAT) was added to a shared service program that conducts HIV-1 NAT for public health laboratories performing the recommended algorithm for diagnosing HIV. Here, we evaluate the usefulness of HIV-2 NAT in this program as compared with HIV-1 NAT.

Methods: Specimens eligible for HIV-1 NATwere reactive on an HIV-1/2 antibody or antigen/antibody initial test and nonreactive or indeterminate on a supplemental antibody test or were reactive for HIV-1 antigen-only on an HIV-1/2 antigen/antibody initial test. Specimens eligible for HIV-2 NAT were reactive on an initial test, HIV-2 indeterminate or HIV indeterminate on a supplemental antibody test and had no detectable HIV-1 RNA or were reactive for HIV-2 antibody on an HIV-1/2 antigen/antibody test, and this reactivity was not confirmed with a supplemental antibody assay. All specimens were tested in a reference laboratory using APTIMA HIV-1 qualitative RNA and/or a validated qualitative HIV-2 RNA real-time PCR assay.

Results: During 2016 to 2019, HIV-1 RNA was detected in 234 (14%) of 1731 specimens tested. HIV-2 RNA was not detected in 52 specimens tested. Median time from specimen collection to reporting of HIV-1 and HIV-2 NAT results by year ranged from 9 to 10 days and from 22 to 27 days, respectively. Two specimens with HIV-2 indeterminate results on a supplemental antibody test had detectable HIV-1 RNA.

Conclusions: A shared service model for HIV-1 NAT is both feasible and beneficial for public health laboratories. However, because no HIV-2 infections were detected, our data suggest that this program should reconsider the usefulness of HIV-2 NAT testing.

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In 2014, the recommended laboratory algorithm for the diagnosis of HIV was updated to a 3-step algorithm consisting of (1) a sensitive HIV-1/2 antigen/antibody (Ag/Ab) initial immunoassay that detects HIV-1 p24 antigen as well as antibodies to HIV-1 and HIV-2, (2) a supplemental immunoassay that can differentiate HIV-1 and HIV-2 antibodies, and (3) an HIV-1 nucleic acid test (NAT) performed on specimens with negative or indeterminate results on the supplemental antibody differentiation immunoassay to distinguish between early HIV-1 infections and false reactivity on the initial immunoassay.[1] At the time of the algorithm recommendation, the only US Food and Drug Administration (FDA)-approved HIV-1/HIV-2 antibody differentiation immunoassay was the Multispot HIV-1/HIV-2 Rapid Test (Bio-Rad Laboratories, Redmond, WA).

Within a few years of the publication of the recommended algorithm, new HIV tests were approved and the original HIV-1/HIV-2 antibody differentiation test was discontinued. In 2014, FDA approved a new HIV-1/HIV-2 antibody differentiation immunoassay (Geenius HIV 1/2 Supplemental Assay; Bio-Rad Laboratories) that detects 2 different HIV-2 antigens (gp140 and gp36), and thus, its final interpretation allows for partial HIV-2 reactivity, leading to results of HIV indeterminate and HIV-2 indeterminate.[2] Additionally, in 2015, the FDA approved a new HIV-1/2 Ag/Ab immunoassay, intended for use as an initial test, which detects and provides separate results for HIV-1 antigen, HIV-1 antibody, and HIV-2 antibody (BioPlex 2200 HIV Ag-Ab assay; Bio-Rad Laboratories).[3] Lastly, in 2017, Multispot was discontinued and Geenius became the only FDA-approved supplemental antibody differentiation immunoassay. A technical update to the laboratory algorithm was issued by the US Centers for Disease Control and Prevention (CDC) to address the additional results produced by Geenius that were not produced by Multispot.[4] That document addressed the potential for specimens to produce indeterminate HIV-2 reactivity and the increased need for HIV-2 NAT to rule out HIV-2 infection in specimens with partial, unconfirmed HIV-2 reactivity. Additionally, due to the ability of the BioPlex 2200 HIV Ag/Ab assay to discriminate reactivity, a specimen could have HIV-1 antigen only reactivity that cannot be confirmed with a supplemental antibody differentiation immunoassay or HIV-2 antibody reactivity that does not confirm with the supplemental antibody differentiation immunoassay; these results necessitate additional NAT to distinguish false-reactive screening test results from those indicating true infection.

HIV NAT can be difficult to maintain in many public health laboratories for several reasons. First, only 1 HIV-1 NAT is FDA-approved for diagnosing HIV-1 infection, APTIMA HIV-1 qualitative RNA (Aptima; Hologic GEN-PROBE, San Diego, CA) and no HIV-2 NATs are FDA-approved for diagnostic purposes. Most NATs are moderate- to high-complexity tests and require skilled staff to perform the test and interpret results. Finally, only a small percentage of specimens tested with the laboratory HIV testing algorithm require HIV NAT; low testing volume leads to wasted reagents, higher testing costs, and difficulty maintaining adequate turnaround times and staff expertise.

Because of these difficulties with HIV NAT, in 2012, the Association of Public Health Laboratories (APHL) and the CDC initiated an HIV-1 NAT referral project to provide US public health laboratories with access to HIV-1 NAT in a shared service model.[5] All U.S. public health laboratories were eligible to enroll and 2 public health laboratories,

New York State Department of Health's Wadsworth Center, and the Florida Department of Health, Bureau of Public Health Laboratories, were selected through a competitive process to serve as reference laboratories to perform HIV-1 NAT. In 2016, HIV-2 NAT was added to this project to help obtain additional data and to resolve indeterminate results. Here we summarize data from 3 years of providing HIV-1 and HIV-2 NAT using a shared service model. Although this testing service provides needed access to HIV-1 NAT results,[5] its usefulness for HIV-2 NAT has not been demonstrated.

MATERIALS AND METHODS

This analysis covers data from the APHL/CDC HIV NAT Referral Project, encompassing specimens tested by the 2 HIV NAT reference laboratories from July 1, 2016, to June 30, 2019.

Data Set 1: Denominator Data, July 1, 2016, to June 30, 2018 (2 Years)

All enrolled and submitting laboratories are required to submit yearly denominator data from their own laboratories reporting on the total number of specimens tested by an initial HIV-1/2 antibody immunoassay or HIV-1/2 Ag/Ab immunoassay, the number of specimens tested with a supplemental antibody assay and the number of specimens with each type of supplemental antibody test result to determine the number of specimens that are eligible for testing and finally the total number of specimens sent for HIV NAT. Only 2 years of denominator data were available for this analysis; data from the third year (July 1, 2018 to June 30, 2019) had not been submitted by the enrolled public health laboratories when this analysis was performed.

Data Set 2: Reference Center Testing Data, July 1, 2016, to June 30, 2019 (3 Years)

Line listed data on every specimen submitted to the 2 reference centers for testing over the full 3-year period were reported, including the results of the initial and supplemental antibody differentiation immunoassays, and the results of HIV-1 and/or HIV-2 NAT. Additionally, these data included dates for specimen collection, receipt in the submitting laboratory, shipment to the reference laboratory, receipt in the reference laboratory, performance of HIV-1 or HIV-2 NAT and reporting to submitting laboratory.

Specimen Eligibility

Specimens eligible for HIV-1 NAT include those that are repeatedly reactive by an initial HIV-1/2 antibody or HIV-1/2 Ag/Ab immunoassay and nonreactive or indeterminate on a supplemental HIV-1/HIV-2 antibody differentiation immunoassay. Additionally, specimens reactive for HIV-1 antigen only on the Bioplex 2200 HIV Ag/Ab were eligible for HIV-1 NAT; supplemental antibody testing was not required for these specimens. Specimens eligible for HIV-2 NAT include the following: (1) repeatedly reactive by an initial HIV-1/2 antibody or HIV-1/2 Ag/Ab immunoassay, HIV indeterminate or HIV-2 indeterminate by Geenius and HIV-1 NAT negative, or (2) HIV-2 reactivity on BioPlex 2200 HIV Ag/Ab, unconfirmed HIV-2 antibody on a supplemental HIV-1/HIV-2 antibody differentiation immunoassay and HIV-1 NAT negative.

To be acceptable for HIV-1 or HIV-2 NAT, whole blood, plasma and serum may be stored up to 72 hours at 2°C to 25°C. Plasma or serum may be stored for an additional 5 days at 2°C to 8°C and no more than 8 days total before being frozen at −20°C. Minimum specimen volumes are 550 μL for HIV-1 NAT and 150 μL for HIV-2 NAT; a volume of at least 1.1 mL is preferred for each test to provide adequate volume for retesting (HIV-1 NAT) and for increased assay sensitivity (HIV-2 NAT). Eligible serum or plasma specimens were shipped frozen overnight to 1 of 2 reference laboratories, Wadsworth Center, New York State Department of Health or Bureau of Public Health Laboratories, Florida Department of Health, along with a requisition form listing the initial and supplemental antibody tests performed in the submitting laboratory, results of these tests, specimen storage conditions at the submitting laboratory, and dates of specimen collection, receipt at submitting laboratory and shipping.

Testing

Upon receipt, the reference laboratory tested specimens for HIV-1 RNA with APTIMA following package insert instructions; both reference laboratories performed APTIMA twice a week.

HIV-2 NAT was performed at the Wadsworth Center once or twice a month using a clinically-validated qualitative HIV-2 RNA RT-rtPCR assay[6]; specimens were stored at −70°C until they were tested. Specimens submitted to Florida Department of Health for HIV-1 NAT that were eligible for HIV-2 NATwere shipped frozen overnight to the Wadsworth Center for testing. The qualitative HIV-2 RNA assay was conducted as previously described,[6] with the following changes: magnetic silica was diluted in molecular grade water, and reverse transcription was performed using qScript cDNA Supermix (QuantaBio, Beverly, MA). Each run included an HIV-2 high positive control (300,000 International Units [IU]/0.2 mL), HIV-2 low positive control (90 IU/0.2 mL), and negative control; a whole virus RNA internal control was added to each sample during the lysis step and amplified in a duplex assay with the HIV-2 target to verify assay performance. Because this is a qualitative assay, we omitted the HIV-2 calibrators and additional controls for detecting HIV-2 DNA that are included in the quantitative assay, as previously described.[6]

Data Analysis

Testing data from the reference laboratories (data set 2) were combined; data from ineligible specimens and duplicate records were removed. To determine if there was any difference in the percent of HIV-1 RNA reactive specimens across the 3 years, a χ^2 test was performed.

RESULTS

From 2016 to 2018, based on the denominator data (data set 1), a total of 657,078 initial tests were performed in the submitting laboratories with 8759 (1.3%) reactive results requiring supplemental testing. Among specimens with initially reactive results, 161 (1.8%) acute HIV-1 infections were identified. The percent of total specimens screened in the submitting laboratories that were eligible for HIV-1 NAT was low (0.2%) throughout this

period but considerably higher than the percentage of specimens eligible for HIV-2 NAT (0.005–0.014%) (Table 1).

During the 3-year period, 2016 to 2019 (data set 2), a total of 33 unique public health laboratories submitted specimens, though the number of submitting laboratories varied by year (Table 2). The number of specimens referred for HIV NAT from each enrolled submitting laboratory ranged from 1 to 74 per year. Twenty-nine laboratories used a single initial immunoassay to screen specimens; 11 used the Architect HIV Ag/Ab Combo (Architect, Abbott Diagnostics, Chicago, Illinois), 17 used the GS HIV Combo Ag/Ab EIA (GS, Bio-Rad Laboratories), and 1 used the BioPlex 2200 HIV Ag/Ab (Bio-Rad Laboratories). Four laboratories switched their initial immunoassays during this period; 2 switched to GS HIV Combo Ag/Ab EIA from either ADVIA Centaur HIV 1/O/2 (Ortho-Clinical Diagnostics, Inc., Raritan, NJ) or Architect HIV Ag/Ab Combo and 2 other laboratories switched from the GS HIV Combo Ag/Ab EIA to the BioPlex 2200 HIV Ag/Ab. In 2016, laboratories used both Multispot and Geenius as the supplemental antibody test. By 2017 Geenius was used by all submitting laboratories as Step 2 in the algorithm. During this period, there was also a mandatory upgrade of the Geenius software from APF V1.1 to APF V1.3 that adjusted the cutoff for the HIV-2 gp140 band with the stated goal from the manufacturer of decreasing HIV-2 indeterminate results; however, the exact date when submitting laboratories switched software versions was not recorded.

From 2016 to 2019, reference laboratories received and tested 1731 specimens with HIV-1 NAT and 52 specimens with HIV-2 NAT (data set 2). HIV-1 RNA was detected in 234 (14%) of 1731 total specimens tested (Table 2). The percentage of HIV-1 RNA reactive specimens for each of the 3 years of this study (14%, 16%, 11%) did not differ significantly during this period ($\chi^2 = 4.6$, $P = 0.10$). HIV-2 RNA was not detected in any of the 52 specimens tested. There were an additional 17 specimens that were eligible for HIV-2 NAT but were not tested because the test requisition form did not indicate that HIV-2 reactivity was present and that HIV-2 NAT may be warranted; most of these were specimens with BioPlex undifferentiated results that were Geenius negative (Table 3). The median turnaround time (TAT) from specimen collection to reporting of the HIV-1 NAT result was 9 to 10 days; this period includes shipment of specimen to submitting laboratory where initial HIV testing was performed, shipment of specimen to reference laboratory, and time between receipt in reference laboratory until HIV-1 RNA testing was completed and reported. Median TAT from specimen collection to reporting of the HIV-2 NAT results was 22 to 27 days (Table 2).

The most frequent supplemental antibody test result contributing to the need for HIV-1 NAT was a result of “nonreactive” (Table 3). Within this group, HIV-1 RNA was detected in 11% of specimens. The 3 indeterminate results (HIV-1 indeterminate, HIV-2 indeterminate, and HIV indeterminate) were the next most frequent results leading to the need for HIV-1 NAT. Fifty-four percent (60 of 111) of specimens with some level of HIV-1 antibody reactivity (HIV-1 indeterminate and HIV indeterminate results) had detectable levels of HIV-1 RNA. Of the 45 specimens with an HIV-2 indeterminate result, 2 (4%) had detectable HIV-1 RNA. Eleven specimens required HIV-1 NAT because of BioPlex 2200 HIV Ag/Ab results of HIV-1 antigen only, including 8 with nonreactive supplemental antibody test results; 2 had detectable HIV-1 RNA. Nineteen other specimens had results from the BioPlex 2200

HIV Ag/Ab of Reactive, undifferentiated or HIV-2 reactive that were unconfirmed by a supplemental antibody test; none of these had detectable HIV-1 RNA.

The most frequent result leading to HIV-2 NAT was a supplemental antibody test result of HIV-2 indeterminate (n = 39), followed by HIV indeterminate (n = 7) and BioPlex 2200 HIV Ag/Ab unconfirmed HIV-2 antibody reactivity (n = 6). Six of the specimens with an HIV-2 indeterminate result were collected from the same individual over a 2-year period; all 6 were HIV-1 and HIV-2 NAT-negative.

DISCUSSION

Our results show that the shared service model for HIV-1 NAT is both feasible and beneficial to public health laboratories conducting HIV diagnostic testing. The percentage of specimens screened at submitting laboratories requiring HIV-1 NAT (0.2%) remains the same as previously reported for the earliest years of the program among 22 public health laboratories.[5] It continues to be easier for many public health laboratories to ship specimens for HIV NAT to a reference laboratory than it is to maintain expensive and complex tests in their own laboratories, even though it adds extra time. The median TAT of only 1 day for NAT testing in the reference laboratory is reasonable relative to the total of 9 to 10 days from specimen collection to reporting of results for HIV-1 NAT. Further improvement in TAT will require shortening the time from specimen collection to receipt at the reference laboratory to optimize TAT for public health action, particularly in the case of acute HIV-1 infection.

Detectable levels of HIV-1 RNA were found in 14% of the 1731 specimens tested at the reference laboratories from 2016 to 2019, demonstrating the importance of HIV-1 RNA testing to detect acute HIV-1 infections. Specimens with partial HIV-1 reactivity on the supplemental antibody test (ie, those with HIV-1 indeterminate and HIV indeterminate results) had a higher rate of HIV-1 RNA positivity (54%) than those with nonreactive supplemental antibody test results (11%). This result is logical when considering test specificity; it is much less likely for a specimen to show false reactivity on 2 different tests than it is to show false reactivity on a single test. The HIV-1 RNA was also detected in 2 specimens with HIV-2 indeterminate results supporting the recommendation to perform HIV-1 NAT before considering HIV-2 NAT for specimens with HIV-2 indeterminate results.[4]

Although there is a clear need for HIV-1 NAT in the laboratory HIV testing algorithm, our data suggest a re-examination to determine if the effort expended for HIV-2 NAT testing within this study is worthwhile. Over 3 years and with more than 1700 specimens submitted requiring HIV NAT, no true HIV-2 infections were detected. However, the lack of confirmed HIV-2 infections is not surprising for a few reasons. First, low numbers of HIV-2 diagnoses have been reported from U.S. National Surveillance Data and from clinical laboratory data.[7,8] In the United States, most HIV-2 cases are concentrated in New York state and surrounding areas. The population in this region includes many immigrants from West African countries, where worldwide HIV-2 prevalence is highest.[9] From 2011 to 2018, the New York State public health laboratory (Wadsworth Center) performed HIV-2 RNA testing (qualitative and/or quantitative) on 72 HIV-2–infected residents of New York.[10]

However, New York State's public health laboratory (Wadsworth Center) was not eligible to participate as a submitting laboratory in this study because Wadsworth functions as a reference laboratory and does not provide routine HIV screening. Additionally, Wadsworth already has access to HIV-1 and HIV-2 NAT on site to resolve discordant results on referral specimens. Therefore, specimens from New York State with the highest likelihood of HIV-2 infection were not included in this analysis. Second, the Geenius test result leading to most of the HIV-2 RNA testing was HIV-2 indeterminate. This result occurs if there is reactivity in only 1 of the 2 HIV-2 bands (gp36 or gp140). According to unpublished observations from the Wadsworth Center, false reactive HIV-2 indeterminate results are most often associated with reactivity of the gp140 band. In addition, the manufacturer specifically adjusted the cutoff of the gp140 band in the newest Geenius software version to reduce HIV-2 indeterminate results. Unfortunately, data on band reactivity for specimens submitted to the reference centers as part of this study are not available. False HIV-2 indeterminate reactivity is problematic, particularly because it can be maintained over a long period, as evidenced by a person who was tested as part of this referral project with 6 HIV-2 indeterminate results over a 2-year period. Finally, even though the HIV-2 RNA test method is very sensitive and can detect as little as 7 international units (IU)/mL,[6] it may not be the best way to exclude or confirm HIV-2 infection because HIV-2 viral load levels in the plasma of infected, antiretroviral-naïve people can be undetectable or very low. Total nucleic acid testing of whole blood samples which will detect both HIV-2 RNA and DNA may be a more sensitive method for confirming and ruling out infection.

In conclusion, we verified the usefulness of a shared services HIV nucleic acid testing model supporting public health laboratories needing HIV-1 NAT, but the usefulness of HIV-2 NAT might be in question. The lack of HIV-2 infections identified coupled with the effort and expense of conducting HIV-2 NAT highlights the shortcomings of the HIV-1/HIV-2 differentiation assay. Better alternatives are needed to reduce excess false reactivity leading to HIV indeterminate and HIV-2 indeterminate results that might prompt HIV-2 NAT and to confirm true HIV-2 infections in a timely manner.

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Conflict of Interest and Sources of Funding:

None declared.

REFERENCES

1. Centers for Disease Control and Prevention and Association of Public Health Laboratories. Laboratory testing for the diagnosis of HIV infection: Updated recommendations. 2014. Available: http://stacks.cdc.gov/view/cdc/23447. Accessed October 23, 2019.
2. Food and Drug Administration. Geenius HIV 1/2 supplemental assay. Available: https://www.fda.gov/vaccines-blood-biologics/approved-blood-products/geenius-hiv-12-supplemental-assay. Accessed October 23, 2019.
3. Food and Drug Administration. BioPlex 2200 HIVAg-Ab Assay. Available: https://www.fda.gov/vaccines-blood-biologics/approved-blood-products/bioplex-2200-hiv-ag-ab-assay. Accessed October 23, 2019.
4. Centers for Disease Control and Prevention. Technical update on HIV-1/2 differentiation assays. Available: https://stacks.cdc.gov/view/cdc/40790. Accessed October 23, 2019.
5. Wesolowski LG, Wroblewski K, Bennett SB, et al. Nucleic acid testing by public health referral Laboratories for Public Health Laboratories using the US HIV diagnostic testing algorithm. J Clin Virol 2015; 65:6–10. [PubMed: 25766979]
6. Styer LM, Miller TT, Parker MM. Validation and clinical use of a sensitive HIV-2 viral load assay that uses a whole virus internal control. J Clin Virol 2013; (58 Suppl 1):e127–e133. [PubMed: 24342472]
7. Peruski AH, Wesolowski LG, Delaney KP, et al. Trends in HIV-2 diagnoses and use of the HIV-1/HIV-2 differentiation test—United States, 2010–2017. MMWR Morb Mortal Wkly Rep 2020;69:63–66. [PubMed: 31971928]
8. Wesolowski LG, Chavez PR, Cardenas AM, et al. Routine HIV test results in 6 US clinical laboratories using the recommended laboratory HIV testing algorithm with Geenius HIV 1/2 supplemental assay. Sex Transm Dis 2020; 47(Suppl 1):S13–S17. [PubMed: 32343517]
9. Torian LV, Selik RM, Branson B, et al. HIV-2 infection surveillance—United States, 1987–2009. MMWR 2011; 60:985–988.
10. Styer LM, Parker MM. Clinical HIV-2 Viral Load Testing of a Large Population of HIV-2 Infected Individuals. Atlanta GA USA: Presented at: 2019 HIV Diagnostics Conference. Available: http://hivtestingconference.org/wp-content/uploads/2019/04/B4_Styer_Clinical_HIV2-Viral-Load.pdf. Accessed October 23, 2019.

TABLE 1.

Specimens From Public Health Laboratories Participating in the NAT Referral Program, US, 2016–2018

	Year*	
	2016–2017	**2017–2018**
No. submitting laboratories	27	28
No. specimens screened with HIV-1/2 antibody or HIV Ag/Ab tests	347,910	309,168
No. specimens tested with supplemental antibody test (% of specimens screened)	4547 (1.3%)	4212 (1.4%)
No. eligible† specimens for HIV-1 NAT (% of specimens screened)	671 (0.2%)	606 (0.2%)
Percent of acute HIV-1 infections from all specimens screened at submitting laboratories	0.02%	0.03%
Percent of acute HIV-1 infections among specimens tested with supplemental antibody test	1.7%	2.0%
No. eligible‡ specimens for HIV-2 NAT (% of specimens screened)	48 (0.014%)	15 (0.005%)

*Specimens tested in reference laboratories from July 1 to June 30 of indicated years.

†Either (1) HIV-1/2 antibody or HIV Ag/Ab reactive (repeatedly) and supplemental antibody negative or indeterminate or (2) BioPlex HIV-1 Ag reactive (repeatedly) only.

‡Either (1) HIV-1/2 antibody or HIV Ag/Ab reactive (repeatedly), supplemental antibody HIV indeterminate or HIV-2 indeterminate, HIV-1 RNA not detected or (2) BioPlex HIV Undifferentiated or HIV-2 antibody reactive and supplemental antibody nonreactive.

TABLE 2.

HIV Test Results Obtained at Reference Laboratories and turnaround time for Results in the NAT Referral Program, US, 2016–2019

	Year*		
	2016–2017	**2017–2018**	**2018–2019**
No. submitting laboratories	27	28	29
HIV-1 NAT			
No. eligible specimens† received and tested at reference laboratories	547	541	643
No. HIV-1 NAT reactive (% of specimens tested)	77 (14%)	84 (16%)	73 (11%)
HIV-2 NAT			
No. eligible specimens‡ received and tested at reference laboratories	17	11	24
No. HIV-2 NAT reactive	0	0	0
TAT: median, d			
Specimen collection to receipt in submitting laboratory	1	1	1
Receipt in submitting laboratory to shipment to reference laboratory	6	5	4
Shipment to reference laboratory to receipt in reference laboratory	1	1	1
Receipt in reference laboratory to HIV-1 NAT performed and reported	1	1	1
Specimen collection to HIV-1 NAT reported	10	9	9
HIV-1 NAT performed to HIV-2 NAT performed and reported	13	19	10.5
Specimen collection to HIV-2 NAT reported	22	27	22
Specimen collection to HIV-1 NAT, % within 1 wk	18%	21%	25%
Specimen collection to HIV-1 NAT, % within 2 wk	73%	84%	87%

*Specimens tested in reference laboratories from July 1 to June 30 of indicated years.

†Either (1) HIV-1/2 antibody or HIV Ag/Ab reactive (repeatedly) and supplemental antibody negative or indeterminate or (2) BioPlex HIV-1 Ag reactive (repeatedly) only.

‡Either (1) HIV-1/2 antibody or HIV Ag/Ab reactive (repeatedly), supplemental antibody HIV indeterminate or HIV-2 indeterminate, HIV-1 RNA not detected or (2) BioPlex HIV Undifferentiated or HIV-2 antibody reactive and supplemental antibody nonreactive.

TABLE 3.

HIV-1 and HIV-2 NAT Results by Supplemental Antibody Results for Specimens Tested at Reference Laboratories for HIV NAT, US, 2016–2019

Supplemental Ab or BioPlex, Supplemental Ab Result*	n (%)	HIV-1 RNA D	HIV-1 RNA ND	HIV-1 NAT Inv/NP	% HIV-1 RNA D	HIV-2 RNA D	HIV-2 RNA ND	HIV-2 NAT NP	% HIV-2 RNA D
Nonreactive (G/M)	1545 (89.3)	170	1357	18	11%	N/A	N/A	N/A	N/A
HIV-1 Indeterminate (G/M)	97 (5.6)	53	44	0	55%	N/A	N/A	N/A	N/A
HIV Indeterminate (G)	14 (0.8)	7	7	0	50%	0	7	0	0%
HIV-2 Indeterminate (G)	45 (2.6)	2	43	0	4%	0	39	4	0%
BioPlex HIV-1 Ag only, G NR or NP†	11 (0.6)	2	9	0	18%	N/A	N/A	N/A	N/A
BioPlex Undifferentiated, G NR	17 (1.0)	0	17	0	0%	0	5	12	0%
BioPlex HIV-2 reactive, G NR	2 (0.1)	0	1	1	0%	0	1	1	0%
Total	1731	234	1478	19	14%	0	52	17	0%

*All specimens were HIV-1/2 antibody or HIV Ag/Ab initial test reactive.

†Geenius testing was not required for specimens with Bioplex HIV-1 Ag only results. However, 8 of 11 were tested with Geenius and were NR (including the 2 for which HIV-1 NAT was Detected); 3 were not tested with Geenius.

D, detected; ND, not detected; N/A, not applicable; G, Geenius; M, Multispot; NR, nonreactive; Inv, invalid; NP, not performed.