*Open Forum Infectious Diseases*

BRIEF REPORT

# Analytical Performance of the Exacto Test HIV Self-Test: A Cross-Sectional Field Study in the Democratic Republic of the Congo

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The Democratic Republic of the Congo (DRC) has begun implementing HIV self-testing to boost the first "95" of the UNAIDS 95-95-95 targets by 2025. This study aims to assess the performance and usability of the Exacto Test HIV (Biosynex, Strasbourg, France) self-test in the lab and in the field. The Exacto Test HIV self-test demonstrated high virological performance (sensitivity, 99.6%; specificity, 100%) in the lab and in the field in the hand of untrained users (sensitivity, 100%; specificity, 98.9%). Taken together, the excellent performance and usability characteristics of the Exacto Test HIV (Biosynex) self-test make the kit a viable option for HIV self-testing in the DRC.

**Keywords.** analytical performance; Democratic Republic of the Congo; Exacto Test HIV; HIV; self-testing.

With an estimated total population of 90 million people, the Democratic Republic of the Congo (DRC), the largest country in Central Africa, has a relatively low HIV prevalence (0.8%), with an estimated 520 000 people with HIV [1]. Despite achievements in scaling up HIV testing during the last decade in this country, 46% of people with HIV remain unaware of their seropositivity [1]. HIV testing remains underutilized among men, adolescents, and key populations due to stigma, discrimination, and lack of confidentiality [1–3].

According to the World Health Organization (WHO), HIV self-testing (HIVST) is an innovation that has the potential to increase uptake of HIV testing and frequency because it offers a discreet, practical, and empowering approach to HIV testing [4–6]. Although there are formal regulatory authorities for marketing approval of HIV testing devices such as WHO prequalification [7], growing guidelines, including those of the DRC [8], suggest that only self-testing that is validated locally by country should be used. Indeed, validation of HIV self-test kits must take into account the local sociocultural context, the biodiversity of circulating HIV strains in the country, and the ease of use of the test by untrained users [5].

We report herein the performance and usability characteristics of the Exacto Test HIV (Biosynex, Strasbourg, France) self-test in the lab (in the hands of professional users) and in the field (in the hand of untrained users) as part of HIVST program implementation in the DRC and country-wide validation of HIV self-test kits.

## METHODS

Exacto Test HIV (Biosynex) self-test is a third-generation immunochromatographic test, using a specific antibody-binding protein that is conjugated to colloidal gold dye particles and synthetic antigens (gp41, gp36) able to detect antibodies against HIV-1 or HIV-2 in whole blood, serum, or plasma, which are bound to the solid phase membrane [9, 10]. The test requires a volume of 2.5 µL of capillary blood with 2 drops of buffer or 5 µL of plasma or serum without buffer. The Exacto Test HIV (Biosynex) self-test kits consisted of a test cassette, diluent vial, pipette, alcohol wipe, compress, lancet, dressing, and A3 printed instruction for use with explanatory pictures in French, Lingala, and Swahili languages, as previously described [9, 11].

In December 2019, lab assessments were carried out at the National AIDS and STIs Reference Laboratory (LNRS) and field assessments were performed at 8 sites (Marechal, Bomoi, Elonga, Kimia, Matonge, and Saint Joseph Health Centers; Kalembelembe Hospital, and Kimbondo Pediatric Hospitals) in Kinshasa, the capital city of the DRC lying in the West of the country and 6 sites (Lumbulumbu, Kasuku-2, Sokolo, and Mikonde Health Centers; and Kindu and Alunguli General Referral Hospitals) in Kindu, the capital city of the province of Maniema lying in the East of the country. The minimum sample size for the study was determined to be ~200 HIV-positive and 200 HIV-negative specimens according to Centers for Disease Control and Prevention and WHO recommendations [12].

In the lab, samples that previously tested positive or negative using the INNO-Lia HIV I/II Score (Fujirebio Europe NV, Ghent, Belgium) and real-time reverse transcription polymerase chain reaction (RT-PCR; Roche Molecular Systems,

Received 14 July 2020; editorial decision 2 November 2020; accepted 5 November 2020.

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**Open Forum Infectious Diseases®2020**



DOI: 10.1093/ofid/ofaa554

Inc., Branchburg, NJ, USA) were tested with the Exacto Test HIV (Biosynex) self-test. In the field, assessment of the usability of the self-test consisted of a face-to-face, tablet-based, structured questionnaire. In brief, untrained participants were asked to conduct the HIV self-test by themselves and to interpret their self-test result in a private setting supervised by an observer (physician or nurse), using instructions for use in their preferred language. The observer was responsible for recording observations concerning the performance of the test, the interpretation of results, and the participants' impressions, as previously reported [11]. For method comparison in the field, serological HIV testing was carried out according to the parallel national algorithm of the DRC using Alere Determine HIV-1/2 (Alere Medical Co. Ltd.) and Uni-Gold HIV (Trinity Biotech Manufacturing Ltd.; PNLS 2016). However, all indeterminate samples in the field were further tested with plasma using the INNO-Lia HIV I/II Score.

### Patient Consent

Participation in this survey was voluntary. Written informed consent was obtained from all participants before the beginning of the study. No personal information from the participants was registered to ensure anonymity. Ethical approval for this study was obtained from the Ethics Committee of the School of Public Health of the University of Kinshasa. Note that this survey did not require additional consent beyond that originally obtained for the reuse of the sera stored in the lab because the ethics committee authorized it.

## RESULTS

The analytical results of the virological performance of the Exacto Test HIV (Biosynex) self-test in the lab and in the field are shown in Table 1. In the lab, a total of 441 (including 229 positive and 212 negative) plasma samples were analyzed with the Exacto Test HIV (Biosynex) self-test. Based on the standard test used (INNO-Lia HIV I/II Score and real-time RT-PCR), the sensitivity of the Exacto Test HIV (Biosynex) was 99.6% (95% CI, 98.4%–99.9%) and the specificity was 100% (95% CI, 99.1%–100%). Cohen's kappa (κ) coefficient, used to estimate the reliability of the test, and Youden's index (J), used to estimate the accuracy of the test, were calculated at 99.5% (95% CI, 98.3%–99.9%) and 99.6% (95% CI, 98.4%–99.9%), respectively.

In the field, a total of 528 participants (including 266 newly tested positives and 262 negatives randomly selected from nonreactive persons with reference tests) were included in the study after HIV testing in 9649 individuals. Among these, 525 (99.43%) found the instructions for use easy to follow, 467 (88.4%) found the identification of the different components of the HIV self-test kits easy, 383 (72.5%) found the lancet easy to use, 462 (87.5%) were confident while performing the test, 526 (99.6%) succeeded in performing the self-test, and 482 (91.3%) correctly interpreted their self-test results without help. In the

**Table 1. Analytical Results of the Virological Performance of the Exacto Test HIV Self-Test (Biosynex, Strasbourg, France) in the Lab and in the Field**

| | Results of Reference Tests (Gold Standard)[a] | | | | | |
|---|---|---|---|---|---|---|
| | Diagnostic Assessment in Lab | | | Diagnostic Assessment in Field | | |
| | Positive (n = 229) | Negative (n = 212) | Total (n = 441) | Positive (n = 266) | Negative (n = 262) | Total (n = 528) |
| Exacto Test HIV self-test results, No. (%) | | | | | | |
| Positive | 228 (99.6) | 0 (0) | 228 (51.7) | 265 (99.6) | 3 (1.1) | 268 (50.8) |
| Negative | 1 (0.4) | 212 (100) | 213 (48.3) | 0 (0) | 258 (98.5) | 258 (48.9) |
| Invalid | 0 (0) | 0 (0) | 0 (0) | 1 (0.4) | 1 (0.4) | 2 (0.4)[b] |
| Performance, % (95% CI)[c] | | | | | | |
| Sensitivity | | 99.6 (98.4–99.9) | | | 100 (99.2–100) | |
| Specificity | | 100 (99.1–100) | | | 98.9 (97.6–99.5) | |
| Reliability[d] | | 99.5 (98.3–99.9) | | | 98.9 (97.5–99.5) | |
| Accuracy[e] | | 99.6 (98.4–99.9) | | | 98.9 (97.6–99.5) | |
| PPV[f] | | 100 (99.1–99.9) | | | 71.6 (67.6–75.3) | |
| NPV[f] | | 99.99 (99.1–100) | | | 100 (99.2–100) | |

Abbreviations: NPV, negative predictive value; PPV, positive predictive value; Pr, prevalence; RT-PCR, reverse transcription polymerase chain reaction; Se, sensitivity; Sp, specificity.

[a]The gold standard was INNO-Lia HIV I/II Score (Fujirebio Europe NV, Ghent, Belgium) and real-time RT-PCR (Roche Molecular Systems, Inc., Branchburg, NJ, USA) in lab assessment, whereas it was Determine HIV-1/2 (Alere Medical Co. Ltd) and Uni-Gold HIV (Trinity Biotech Manufacturing Ltd, Bray, Co. Wicklow, Ireland) in parallel followed by INNO-Lia HIV I/II Score in case of discordance of Determine HIV-1/2 and Uni-Gold HIV in field assessment.

[b]Two participants failed in performing the self-test. As a result, they had an invalid result (ie, no visible control strip at the end of the migration) and were excluded from the final performance analyses.

[c]95% confidence intervals were calculated using the Wilson score bounds.

[d]Reliability was estimated using the Cohen's kappa (κ) coefficient, calculated as the following: $\kappa = (Po—Pe)/(1 – Pe)$, where *Po* is the relative observed agreement between the Exacto Test HIV self-test and the gold standard and *Pe* is the hypothetical probability of chance agreement.

[e]Accuracy was estimated using Youden's index (J), calculated as the following: J = sensitivity + specificity – 1.

[f]The PPV and NPV of the self-tests were calculated using Bayes' formula (PPV = SePr/[SePr + (1 – Sp)(1 – Pr)]; NPV = Sp(1 – Pr)/[Sp(1 – Pr) + (1 – Se)(Pr)]), taking the national HIV prevalence (1.2%) into account in the lab assessment; the Pr of HIV in our series was estimated at 2.76% (266 confirmed positive among 9649 screened persons) in field assessment.

field, based on the standard test used (Alere Determine HIV-1/2 and Uni-Gold HIV in parallel followed by INNO-Lia HIV I/II Score in cases of discordance between the Alere Determine HIV-1/2 and Uni-Gold HIV), the sensibility of the Exacto Test HIV (Biosynex) self-test was estimated at 100% (95% CI, 99.2%–100%), its specificity at 98.9% (95% CI, 97.6%–99.5%), its PPV according to the HIV prevalence in our series (2.7%) at 71.6% (95% CI, 67.6%–75.3%), and its NPV at 100% (95% CI, 99.2%–100%) (Table 1). Finally, the reliability of the self-test in the hands of untrained users was 98.9% (95% CI, 97.5%–99.5%).

## DISCUSSION AND CONCLUSIONS

Based on the standard tests used, our findings show that the Exacto Test HIV (Biosynex) self-test demonstrated high virological performance in the lab and in the field. Taken together, the excellent performance and usability characteristics of Exacto Test HIV (Biosynex) self-test make the kit a viable option for HIV self-testing in the DRC. The accuracy of the Exacto Test HIV can be compromised by misinterpreted results, regardless of the quality of the test itself [11, 13]. This is likely due to visual disturbances, especially for positive results with a low-intensity test band or practical difficulties incorrectly reading self-test results among some individuals, such as those with little education or visual impairments [9, 11, 14]. However, the use of video instruction using local languages will be needed to improve the usability of the self-test and the interpretation of self-test results. Finally, to facilitate the use of the lancet, the manufacturer should indicate on the instructions for use that the use of the lateral surface of the fingers decreases the pain.


### Acknowledgments

The authors are grateful to the provincial AIDS and STI control coordination and various actors in the field who facilitated this work. The authors also thank Dr. Etienne Mpoyi (WHO Contact Person), Dr. Willy Mvita (Manager of the HIV Project at the *Cellule d'Appui et de Gestion Financière* [*CAGF*]), Dr. If Malaba (Health Laboratories Chief Manager at the DRC Ministry of Public Health), and Ms. Bintou Touré-Fadiga (Disease Fund Manager [HIV/TB] at the Global Fund to Fight AIDS, Tuberculosis, and Malaria).

***Financial support.*** This work was supported by the Global Fund to Fight AIDS, Tuberculosis, and Malaria and the Joint United Nations Program on HIV/AIDS. The funders played a role in data collection and analysis. The funders were not involved in the decision to publish or preparation of the manuscript.

***Potential conflicts of interest.*** The authors report no conflicts of interest. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

***Author contributions.*** S.T.W., J.M.M., L.F.K.L., and L.B. conceived and designed the research; S.T.W. and A.S. were involved in volunteer recruitment and follow-up; S.T.W. and J.M.M. performed the experiments; S.T.W. and G.N.D. performed statistical analyses; S.T.W. and L.B. analyzed the results and drafted the manuscript.


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