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# Validation of the Elecsys® HIV combi PT assay for screening and reliable early detection of HIV-1 infection in Asia

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ABSTRACT

*Background:* The Elecsys® HIV combi PT assay was developed to allow earlier detection of HIV infection with increased sensitivity and specificity.
*Objectives:* To validate the assay for screening and reliable early detection of HIV-1 infection in Asia.
*Study design:* Samples tested reflected those routinely screened in Asia and comprised: HIV-1 antigen lysate (25 samples) and antibody (20 samples) dilutions; seven HIV-1 seroconversion panels (46 samples); 39 patient samples from early infection; 183 known-positive sera; HIV-1 p24 antigen sensitivity panel (seven samples); >500 routine clinical samples per center. The Elecsys® HIV combi PT assay was compared with fourth- (ADVIA Centaur® HIV combo, ARCHITECT® HIV combo, Elecsys® HIV combi) and third-generation (VIRONOSTIKA® HIV Uni-Form II Plus O, Zhuhai Livzon Anti-HIV EIA, Serodia® Particle Agglutination) assays commonly used in the region.
*Results:* Overall, the Elecsys® HIV combi PT showed superior or similar sensitivity to the comparators for detecting all subtypes. The assay correctly identified all positive samples, including those taken soon after infection, and detected seroconversion at a similar or shorter time interval than the comparators. The analytical sensitivity of Elecsys® HIV combi PT for HIV-1 p24 antigen was 0.90 IU/mL, which was lower than reported previously. The assay showed good specificity (99.86%) that was superior or equivalent to the other fourth-generation assays tested.
*Conclusions:* These robust data demonstrate the good subtype inclusivity of the Elecsys® HIV combi PT assay and its suitability for screening and reliable early detection of HIV infection in Asia.


## 1. Background

The prevalence of HIV in Asia ranges from <0.1 to 1.3%, with estimated prevalences of <0.1%, 0.1%, and 0.5% in Korea, China, and Malaysia, respectively.[1] An estimated five million people in Asia are currently living with HIV, including 380,000 who were newly infected in 2007[2] and ~140,000 children.[3] Given the trend for recent increases in HIV infections in Asia (for example, the number of people living with HIV in China rose from ~470,000 in 2001 to ~780,000 in 2011[4]), adequate surveillance and prevention of transmission are an essential part of managing the epidemic.

The transmission risk for HIV is highest during the acute or very early stages of infection[5–7] with transmission rates in the first 6 months estimated to be 5.5–26 times higher than later in the disease course.[7–9] Acute HIV infection (AHI; detection of HIV RNA or p24 antigen in blood before antibodies have formed)[10] is a critical driver and accounts for 10–50% of all new infections.

*Abbreviations:* Ab, antibody; Ag, antigen; AHI, acute HIV infection; HBs, hepatitis B surface; HIV, human immunodeficiency virus; IR, initially reactive; NA, not available; N/A, not applicable; NAT, nucleic acid test; NIBSC, National Institute for Biological Standards and Control; PCR, polymerase chain reaction; RNA, ribonucleic acid; s/co, signal to cut-off ratio; WHO, World Health Organization.

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Identifying acutely infected individuals has been limited by testing methods requiring substantial investments in infrastructure and time.[10] It relies on detecting viral nucleic acid or HIV-specific antigens (p24) in the patient's blood before antibodies are present. The sensitivity of third-generation HIV enzyme immunoassays is limited by the fact that they only detect antibodies to HIV-1/-2 which restricts their ability to identify early HIV infection. European legislation requires that commercially available assays now need to detect both antigen and antibodies, with a sensitivity for detection of p24 antigen of <2 IU/mL.[11] Hence, several fourth-generation combination immunoassays were developed.[12–14] However, false-negative results have been attributed to an inability of HIV serologic assays, including fourth-generation combination assays, to detect the diverse range of HIV strains. A recent paper by Ly et al.[15] demonstrated that the sensitivity of currently available commercial assays varied according to HIV genotype and cautioned that this could compromise diagnosis of early infection. A limitation of their study was the use of cell culture isolates to assess sensitivity and the authors highlighted the need to establish test performance using native serum samples from infected individuals.

This study evaluated the updated Elecsys® HIV combi PT assay using samples that included those collected from routine practice at several sites within Asia. The Elecsys® HIV combi PT assay was developed as an update to the Elecsys® HIV combi assay and incorporates the following improvements: a pre-treatment step to increase the sensitivity for HIV-1 p24 antigen and specificity; a set of anti-p24 antibodies to provide high sensitivity for p24 antigen and allow detection of early infection, late-phase infection, and p24 antigen derived from HIV-1 group O and HIV-2; and a set of antigens to provide high sensitivity for anti-HIV-1 and anti-HIV-2 antibodies and increase detection of antibodies against all subtypes.[16]

## 2. Objectives

To evaluate the Elecsys® HIV combi PT assay (Roche Diagnostics GmbH, Penzberg, Germany) as a routine screening assay in Asia, an important population for HIV testing with a unique set of HIV subtypes. The study aimed to provide robust data on the Elecsys® HIV combi PT assay by assessing it in routine laboratory settings using a large number of samples reflecting those screened in the Asian region. In addition to determining assay subtype inclusivity, the objectives of this multicenter study included validating the capability of the Elecsys® HIV combi PT assay for the early detection of HIV infection and comparison with other assays commonly used in Asia for HIV testing.

## 3. Study design

### 3.1. Centers and assays compared

Six centers in Asia were involved in the study (Table 1). Each center tested the Elecsys® HIV combi PT assay[17] using the cobas® e 411 or MODULAR® *ANALYTICS* E170 immunoassay analyzer, and at least one of the following comparators in routine use at their center, as shown in Table 1: ADVIA Centaur® HIV Ag/Ab combo (Siemens Healthcare Diagnostics Inc., Deerfield, USA),[18] ARCHITECT® HIV Ag/Ab combo (Abbott Laboratories, Wiesbaden, Germany),[19] Elecsys® HIV combi (Roche Diagnostics GmbH, Penzberg, Germany),[20] VIRONOSTIKA® HIV Uni-Form II Plus O (bioMérieux, Shanghai, China),[21] Serodia® HIV1/2 Particle Agglutination (Fujirebio, Tokyo, Japan),[22] and Zhuhai Livzon Anti-HIV EIA (Zhuhai Livzon Diagnostics Inc., Zhuhai, China).[23] The Elecsys® HIV combi PT, Elecsys® HIV combi, ADVIA Centaur® HIV combo, and ARCHITECT® HIV combo assays are fourth-generation assays, whereas the VIRONOSTIKA® HIV Uni-Form II Plus O, Serodia® Particle Agglutination, and Zhuhai Livzon Anti-HIV EIA assays are third-generation tests.

### 3.2. Samples, methods, and analyses

A total of 4785 different samples were available for testing in this study. Details of the individual samples tested by each center are given in Table 1.

To determine the sensitivity for detecting different HIV-1 subtypes, 25 virus lysate samples representing HIV-1 subtypes A, B, C, CRF01_AE, and F were prepared by Roche Diagnostics GmbH by diluting virus lysate supernatants with HIV-negative serum (dilution factors of 1:3000 to 1:128,000). Samples were stored as frozen aliquots at −20 °C. Detection of subtype antigen relies on the ability of the assay to detect p24 antigen and therefore the lysate dilutions were only assessed using the fourth-generation assays (Elecsys® HIV combi PT, ADVIA Centaur® HIV combo, and ARCHITECT® HIV combo assays). Twenty antibody dilutions were similarly prepared from highly anti-HIV-1-positive samples from patients infected with HIV-1 subtypes A, B, C, D, and CRF01_AE (dilution factors 1:150 to 1:850,000) and provided by Roche Diagnostics GmbH. These samples were used to assess the ability of the fourth- and third-generation assays to detect antibodies to the various subtypes. Samples were stored as frozen aliquots at −20 °C. In addition, 183 samples from HIV-positive patients were provided and tested by two of the centers (30 samples from China and 153 from Malaysia; Table 1) to investigate the sensitivity of the assays for detecting known-positive samples.

Seven different commercially available HIV-1 seroconversion panels representing a maximum of 46 samples were used. Panels were purchased from SeraCare Life Sciences Inc. (Milford, USA; panels PRB958 and PRB930) and North American Biologicals Inc. (Boca Raton, USA; panels 4099, 25165, 9003, 1436, and 0759) and comprised samples taken from patients before and after they tested positive for HIV infection and throughout the immune response. The panels were evaluated to assess how early each assay could detect infection and data calculated using the Paul Ehrlich Institute model, as described previously.[16] Sensitivity for early detection was also assessed using 39 single samples taken from patients 9 to >800 days after HIV infection. These samples were stored at −20 °C as frozen aliquots and tested after thawing once.

A defined HIV-1 p24 antigen sensitivity panel was used to measure the lower limit of detection of the fourth-generation assays. The NIBSC/WHO HIV-1 p24 Antigen International Reference Standard was purchased from NIBSC (London, UK) and dilutions of 0.0, 0.32, 0.62, 1.13, 2.34, 4.54, and 8.92 IU/mL were tested. Analytical sensitivity was determined using Graphpad Prism 5.0 to generate a linear regression.

The specificity of the screening assays was determined using samples collected at each center as part of routine clinical testing (daily routine samples). A minimum of 500 fresh (where possible) samples were provided and tested by each center, and specificity (including 95% confidence intervals) calculated using statistical software package SPSS 11.0.

Results for the Elecsys® HIV combi PT are expressed as a signal to cut-off ratio (s/co) and considered to be negative if the s/co <0.9 and positive if the s/co ≥1.0. An s/co between 0.9 and <1.0 is considered borderline[17]; as a safety measure, within this study borderline results were taken to be positive. Each assay was used in accordance with the manufacturer's instructions and results interpreted accordingly. Initially reactive samples were confirmed by Western blot, Elecsys® HIV Ag test, Elecsys® HIV Ag confirmatory test, or HIV RNA testing and the confirmatory test(s) used by each center are shown in Table 1.

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**Table 1**
Centers involved in the study, methods used, and samples tested.

| Center | Comparison method(s) | Confirmation HIV antibody or antigen assay or HIV RNA NAT | Sample type or source (no. of samples) |
|---|---|---|---|
| The Catholic University of Korea, Seoul St. Mary's Hospital, Seoul, Korea | ADVIA Centaur® HIV Ag/Ab combo | Elecsys® HIV Ag test<br>Elecsys® HIV Ag confirmatory test<br>HIV RNA NAT | HIV-1 subtyped lysate dilutions (25)<br>HIV-1 subtyped antibody dilutions (20)<br>Seroconversion panels NABI 0759, 4009, 25165, and SeraCare PRB 930 (25)<br>NIBSC WHO p24 antigen standard material (7)<br>Routine samples (1039) |
| Department of Laboratory Medicine, Korea University Hospital, Seoul, Korea | ARCHITECT® HIV Ag/Ab combo | HIV immunoblot<br>Elecsys® HIV Ag test<br>Elecsys® HIV Ag confirmatory test | HIV-1 subtyped lysate dilutions (25)<br>HIV-1 subtyped antibody dilutions (20)<br>Seroconversion panels NABI 0759, 4009, 25165, and SeraCare PRB 958 (27)<br>NIBSC WHO p24 antigen standard material (7)<br>Routine samples, including high-risk patients, check-up patients, hepatitis B/C, and dialysis patients (1000) |
| The First Hospital of China Medical University, Clinical Laboratory Department, Shenyang, China | ARCHITECT® HIV Ag/Ab combo<br>VIRONOSTIKA® HIV Uni-Form II Plus O | HIV immunoblot<br>Elecsys® HIV Ag test<br>Elecsys® HIV Ag confirmatory test | HIV-1 subtyped lysate dilutions (25)<br>HIV-1 subtyped antibody dilutions (20)<br>Seroconversion panels NABI 9003, 4009, 1436, and SeraCare PRB 930 (22)<br>Early HIV infections sample; time since infections 9–837 days (39)<br>NIBSC WHO p24 antigen standard material (7)<br>Routine samples (703) |
| West China Hospital, Sichuan University, Chengdu, China | Elecsys® HIV combi<br>Zhuhai Livzon Anti-HIV EIA | HIV immunoblot<br>Elecsys® HIV Ag test<br>Elecsys® HIV Ag confirmatory test<br>HIV RNA NAT | HIV-1 subtyped lysate dilutions (25)<br>HIV-1 subtyped antibody dilutions (20)<br>Known HIV-1 antibody-positive samples (30)<br>Seroconversion panels NABI 0759, 25165, 1436, 9003, and SeraCare PRB 930 (35)<br>Unselected routine samples (543)<br>Potentially interfering samples, including end-stage renal disease, autoimmune diseases, HBsAg positive, anti-HBs positive, icterus, hemolysis, lipemia (132) |
| Virology Unit, Institute for Medical Research, Kuala Lumpur, Malaysia | Elecsys® HIV combi<br>Serodia® HIV1/2 Particle Agglutination | HIV immunoblot<br>Elecsys® HIV Ag test<br>Elecsys® HIV Ag confirmatory test | HIV-1 subtyped lysate dilutions (25)<br>HIV-1 subtyped antibody dilutions (20)<br>Known HIV-1 antibody-positive samples (153)<br>Seroconversion panels NABI 0759, 25165, 1436, 9003, and SeraCare PRB 930 (35) |
| Department of Medical Microbiology, University Malaya Medical Centre, Kuala Lumpur, Malaysia | ARCHITECT® HIV Ag/Ab combo | HIV immunoblot<br>Elecsys® HIV Ag test<br>Elecsys® HIV Ag confirmatory test<br>PA assay | HIV-1 subtyped lysate dilutions (25)<br>HIV-1 subtyped antibody dilutions (20)<br>Seroconversion panels NABI 4009, 25165, 1436, 9003, and SeraCare PRB 958 (30)<br>NIBSC WHO p24 antigen standard material (7)<br>Routine samples; ante-natal care testing, blood donors, clinical routine (1048) |

Ab = antibody; Ag = antigen; HBs = hepatitis B surface; HIV = human immunodeficiency virus; NAT = nucleic acid test; NIBSC = National Institute for Biological Standards and Control; RNA = ribonucleic acid; WHO = World Health Organization.

## 4. Results

The Elecsys® HIV combi PT assay was more sensitive at detecting all virus lysate subtypes than the ADVIA Centaur® HIV combo and Elecsys® HIV combi assays (Table 2). Sensitivity between the Elecsys® HIV combi PT and ARCHITECT® HIV combo assays was similar for subtypes B, C, and F, but the Elecsys® HIV combi PT assay detected subtypes A and CRF01_AE one dilution step lower than the ARCHITECT® assay. The Elecsys® HIV combi PT assay was more sensitive at detecting antibodies to all subtypes than the majority of comparators, with similar sensitivity to the Elecsys® HIV combi assay (Table 2). Furthermore, two centers tested a total of 183 samples from the region known to be HIV positive. The Elecsys® HIV combi PT and Elecsys® HIV combi assays correctly diagnosed 183/183 samples, while the Zhuhai Livzon Anti-HIV EIA and Serodia® Particle Agglutination assays correctly diagnosed the 30/30 and 153/153 samples tested, respectively.

Results from the seroconversion panel analyses are given in Table 3. The Elecsys® HIV combi PT assay detected HIV infection at a similar time to the ARCHITECT® HIV combo assay, but 0.8 days earlier than the Elecsys® HIV combi, 1.0 days earlier than the ADVIA Centaur® HIV combo, 5.0 days earlier than Zhuhai Livzon Anti-HIV EIA, 6.0 days earlier than VIRONOSTIKA® HIV Uni-Form II Plus O, and 6.6 days earlier than the Serodia® Particle Agglutination assay. In addition, using the 39 samples taken from patients at different time points between 9 and >800 days after infection, the Elecsys® HIV combi PT and ARCHITECT® HIV combo assays detected all samples as positive. However, the VIRONOSTIKA® HIV Uni-Form II Plus O assay, a third-generation test, reported one sample as borderline and six false-negative results.

The lower detection limit of the fourth-generation assays was similar and conforms to that for obtaining CE approval (<2 IU/mL).[11] Combining the data generated by the sites for each assay resulted in an analytical sensitivity of 0.90 IU/mL for the Elecsys® HIV combi PT

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**Table 2**
Assay sensitivity for detecting HIV-1 subtype antigen or antibody. Dilutions of viral lysates and antibody-positive samples were prepared for various HIV-1 subtypes and tested for p24 antigen or HIV-1-specific antibody.

| HIV subtype | Elecsys® HIV combi PT | Elecsys® HIV combi | ADVIA Centaur® HIV combo | ARCHITECT® HIV combo | VIRONOSTIKA® HIV Uni-Form II Plus O | Zhuhai Livzon Anti-HIV EIA | Serodia® Particle Agglutination |
|---|---|---|---|---|---|---|---|
| HIV antigen | | | | | | | |
| A | 1:64,000 | 1:16,000 | 1:32,000 | 1:128,000 | N/A | N/A | N/A |
| B | 1:37,280 | 1:9320 | 1:18,640 | 1:37,280 | N/A | N/A | N/A |
| C | 1:53,440 | 1:6680 | 1:26,720 | 1:53,440 | N/A | N/A | N/A |
| CRF01_AE | 1:31,968 | 1:7992 | 1:3996 | 1:63,936 | N/A | N/A | N/A |
| F | 1:15,936 | 1:1992 | 1:7968 | 1:15,936 | N/A | N/A | N/A |
| HIV antibody | | | | | | | |
| A | 1:170,000 | 1:170,000 | 1:17,000 | 1:17,000 | 1:17,000 | 1:17,000 | 1:17,000 |
| B | 1:15,000 | 1:15,000 | 1:1500 | 1:1500 | 1:1500 | 1:1500 | 1:1500 |
| C | 1:100,000 | 1:100,000 | 1:10,000 | 1:10,000 | 1:10,000 | 1:1000 | 1:100,000 |
| D | 1:142,500 | 1:28,500 | 1:28,500 | 1:2850 | 1:28,500 | 1:2850 | 1:285 |
| CRF01_AE | 1:50,000 | 1:50,000 | 1:5000 | 1:500 | 1:5000 | 1:500 | 1:500 |

HIV = human immunodeficiency virus; N/A = not applicable for third-generation assays.

**Table 3**
Seroconversion sensitivity data using the Paul Ehrlich Institute calculation method.

| Seroconversion panel | Elecsys® HIV combi PT | Elecsys® HIV combi | ADVIA Centaur® HIV combo | ARCHITECT® HIV combo | VIRONOSTIKA® HIV Uni-Form II Plus O | Zhuhai Livzon Anti-HIV EIA | Serodia® Particle Agglutination |
|---|---|---|---|---|---|---|---|
| PRB 930 | 0 | 4 | 4 | 0 | 8 | 8 | 8 |
| PRB 958 | 8 | NA | NA | 8 | NA | NA | NA |
| NABI 0759 | 0 | 0 | 0 | 0 | NA | 4 | 8 |
| NABI 1436 | 0 | 0 | NA | 0 | 9 | 9 | 9 |
| NABI 4009 | 0 | NA | 0 | 0 | 3 | NA | NA |
| NABI 9003 | 6 | 6 | NA | 6 | 10 | 6 | 10 |
| NABI 25165 | 0 | 0 | 0 | 0 | NA | 4 | 4 |
| Mean number of days to a positive result across:[a] | | | | | | | |
| 7 panels | 2.0 | – | – | 2.0 | – | – | – |
| 5 panels | 1.2 | 2.0 | – | – | – | 6.2 | 7.8 |
| 4 panels | 0.0 | – | 1.0 | – | – | – | – |
| 4 panels | 1.5 | – | – | – | 7.5 | – | – |

Day of bleeding with first positive results (last negative sample plus 1 day) compared with PCR or p24 antigen data provided by the panel suppliers (SeraCare and North American Biologicals). The first positive bleed with the PCR or p24 antigen assay was considered to be day 0. HIV = human immunodeficiency virus; NA = not available; PCR = polymerase chain reaction.

[a] Values were calculated separately for each combination of panels tested.

assay, 0.74 IU/mL for the ARCHITECT® HIV combo, and 1.70 IU/mL for the ADVIA Centaur® HIV combo assay.

The specificity of each assay was calculated by combining data from the different sites. The Elecsys® combi PT assay showed very high specificity (99.86%) that was slightly better than that of the ARCHITECT® HIV combo (99.78%), ADVIA Centaur® HIV combo (99.52%), and Elecsys® HIV combi (99.85%) assays, but lower than the two third-generation assays tested (see Table 4).

## 5. Discussion

This is the first multicenter study in Asia to validate the Elecsys® HIV combi PT assay for HIV screening. By testing a large sample number, robust data have been generated demonstrating that the Elecsys® HIV combi PT assay: had good subtype inclusivity with the ability to detect all HIV-1 subgroups routinely found in Asia; reliably differentiated between HIV-positive and -negative samples; and detected infection early within the disease course. In addition, the performance of the assay was comparable or superior to the other assays tested.

HIV is a highly variable virus and maintains this diversity through 'error-prone' rapid replication and recombination between different HIV subtypes within the same person.[24] While heterogeneity allows the virus to effectively overcome both the host's immune system and therapeutic interventions, it varies geographically and creates a challenge for screening.[15,25,26]

**Table 4**
The overall specificity of each assay calculated by combining the data obtained from testing routine samples and samples with potentially interfering substances at each site.

| | Elecsys® HIV combi PT | Elecsys® HIV combi | ADVIA Centaur® HIV combo | ARCHITECT® HIV combo | VIRONOSTIKA® HIV Uni-Form II Plus O | Zhuhai Livzon Anti-HIV EIA |
|---|---|---|---|---|---|---|
| Total number | 4465 | 675 | 1039 | 2751 | 703 | 675 |
| IR (≥1 s/co) | 51 | 1 | 5 | 50 | 2 | 0 |
| Confirmed positive | 45 | 0 | 0 | 44 | 2 | 0 |
| Number of false positives[a] | 6 | 1 | 5 | 6 | 0 | 0 |
| Specificity (IR, ≥1 s/co) | 99.86% | 99.85% | 99.52% | 99.78% | 100.00% | 100.00% |
| 95% Confidence limit (IR, ≥1 s/co) | 99.71–99.95 | 99.18–100.00 | 98.88–99.84 | 99.52–99.92 | 99.48–100.00 | 99.45–100.00 |

HIV = human immunodeficiency virus; IR = initially reactive; s/co = signal/cut-off.

[a] Identified as negative by HIV-1 Western blot, anti-HIV particle agglutination or HIV antigen assay testing. In these analyses, borderline results were considered to be positive. The specificity of the Serodia® Particle Agglutination test was not included because of pre-selection bias.

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Screening tests should ideally detect infection regardless of genotype and recognize infection with the subtypes and recombinants commonly found in the region of use.[15] The HIV-1 subtypes frequently found in Asia are B, C, and CRF01_AE, a recombinant form described in Thailand, Cambodia, Vietnam, Malaysia, China, Taiwan, Korea, and Japan.[24–26] The Elecsys® HIV combi PT assay detected known-positive samples as well as HIV-1 antigen or antibody regardless of subtype and, in general, with a similar or greater sensitivity than the comparator assays. Our findings support those published previously[16,27] and confirm the high antibody sensitivity of the assay; combined with good antigen sensitivity this affirms use of the Elecsys® HIV combi PT assay to reduce the diagnostic window period in clinical practice.[27] Furthermore, previous studies found that the Elecsys® assay successfully detected HIV-2 antigen and antibodies with greater sensitivity than other assays tested.[15,16] Hence the available data show that the Elecsys® HIV combi PT assay detects infection with all subtypes and variants, including those frequently encountered in Asia.

The specificity of the Elecsys® HIV combi PT assay was good (99.86%) and better than that determined previously in European (99.81%; unselected samples) and Korean (99.5%) samples.[16,27] In addition, results for the comparator assays are in agreement with those reported previously, such as 99.8% for the Elecsys® HIV combi assay,[12] >99.5% for the ARCHITECT® HIV combo assay,[13,16,27–30] and 99.3%/99.74% for the ADVIA Centaur® HIV combo assay.[16,31] The specificity of the Serodia® Particle Agglutination assay was reported previously as >99.97%,[14,32] and that of the VIRONOSTIKA® HIV Uni-Form II Plus O assay ranged from 97.9 to 100.0%.[14,33–35] These findings support the validity of the data, affirm the specificity of the Elecsys® HIV combi PT assay using real-world samples from the Asian population, and demonstrate that the assay is suitable for use in routine HIV screening in Asia.

While the specificity of the third-generation assays – VIRONOSTIKA® HIV Uni-Form II Plus O and Zhuhai Livzon Anti-HIV EIA assays – was 100% in this study, these assays lacked sensitivity in the early stages of infection meaning that positive samples can be missed. This was highlighted by the investigation of samples taken 9 to >800 days after infection, and the seroconversion panel data. The Elecsys® HIV combi PT assay detected seroconversion 5.0, 6.0, and 6.6 days earlier than the Zhuhai Livzon Anti-HIV EIA, VIRONOSTIKA® HIV Uni-Form II Plus O, and Serodia® Particle Agglutination assays, respectively (Table 3). These results are consistent with previous studies demonstrating that fourth-generation immunoassays detect infection sooner than third-generation assays[12,13,31,36,37] and that the Elecsys® HIV combi PT assay detects seroconversion at a similar time or sooner than other assays.[16,27] Early detection of HIV infection is vital as it can reduce unknown spread of the virus and allows early initiation of treatment which can, in turn, increase life expectancy.[38,39] Therefore, diagnostic use of a fourth-generation assay is indispensable in this context. While third-generation tests are still frequently used in some regions,[40,41] fourth-generation screening assays are now recommended for HIV testing in European sexually transmitted infection clinics and by the WHO.[42,43]

The performance of the Elecsys® HIV combi PT assay in this study was similar to that published previously,[15,16,27] although the analytical sensitivity was lower (0.90 IU/mL) than in other studies (1.095 IU/mL, 1.05 IU/mL, and 1.13 IU/mL, respectively).[15,16,27] This, and the superior or comparable performance to that of the Elecsys® HIV combi assay, provides reassuring evidence on the performance of the improved assay and demonstrates that it not only meets European requirements, but is also appropriate for use in Asia. Hence, the assay offers automated high-throughput screening with the ability to detect early infection in a variety of geographical settings.

This study validated the Elecsys® HIV combi PT assay for screening and reliable early detection of HIV infection in Asia. The assay was rigorously tested in over 4000 samples and demonstrated excellent sensitivity and specificity and a diagnostic window that was shorter or similar to that of the comparator assays. Therefore, use of the Elecsys® HIV combi PT assay in Asia may improve the number of AHI cases identified compared with other fourth- and third-generation assays currently used in this region.

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## Competing interests

None declared.

## Ethical approval

Not required.

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