Human Immunodeficiency Virus (HIV)

Human Immunodeficiency Virus (HIV) belongs to the genus Lentivirus within the Retroviridae family. It primarily targets CD4+ T lymphocytes and, if left untreated, it can lead to Acquired Immunodeficiency Syndrome (AIDS).

The structure of the HIV particle is similar in both types of HIV: HIV-1 and HIV-2. Taking the mature HIV-1 virion as an example, as shown in Figure 1, the virion is roughly spherical, with a diameter of approximately 120 nm, and it is surrounded by a lipoprotein-rich membrane. In a similar way to other retroviruses, the *gag* gene encodes the structural proteins of the capsid (p24), nucleocapsid (p7), budding protein (p6), and matrix (p17). The *env* gene encodes the viral envelope glycoproteins gp120 and gp41, which recognize cell surface receptors and mediate the virus's binding to host CD4+ T cells. Furthermore, the *pol* gene encodes enzymes that are crucial for viral replication.

While HIV-1 is further divided into four groups—M, N, O, and P, Group M is the most prevalent and it includes multiple genetic subtypes (A, B, C, D, F, G, H, J, and K) as well as circulating recombinant forms (CRFs). Group O (Outlier) accounts for approximately 1% of HIV-1 infections and it is mainly distributed in Cameroon and neighboring countries. Groups N and P are extremely rare. Meanwhile, HIV-2 comprises eight known groups, which are designated from A through H, with groups A and B being the primary groups that are associated with widespread transmission, while groups C through H are considered rare. Both HIV-1 and HIV-2 have homologous core structural proteins that are known as capsid proteins. HIV-1 expresses the p24 antigen, while HIV-2 expresses a homologous protein that is commonly referred to as the p24 antigen, although it is also known in scientific literature as the HIV-2 p26 antigen. The HIV1/2 p24 capsid protein (monomer) consists of 230 amino acids and has a mass of approximately 25.6 kDa. The level of p24 antigen correlates positively with viral load, reaching peak concentrations in the blood during the early stages of infection and prior to the appearance of antibodies.

CLINICAL UTILITY

- **Screening and monitoring HIV infections in targeted populations to help curb the HIV epidemic**
- **Early detection and treatment to improve quality of life**

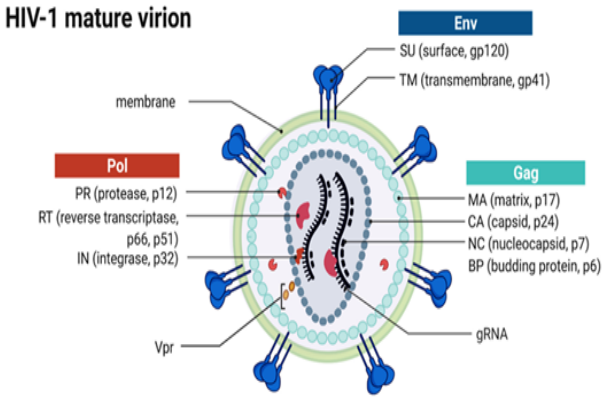

Figure 1.
HIV virion structure
Source: doi.org/10.3390/toxins14020138

HIV RNA can be detected 7–10 days after infection, while the p24 antigen can be detected 10–15 days post-infection, and HIV antibodies are typically detectable within 2 to 8 weeks after infection. The combined HIV p24 antigen and antibody testing can shorten the diagnostic window period to approximately 14 days (as shown in Figure 2). According to the EU IVDR Class D regulatory requirements, the lower limit of detection (LoD) for the WHO HIV-1 p24 international standard (NIBSC code: 90/636) must be ≤ 2 IU/mL, and the assay specificity must be ≥ 99.5%. Therefore, the sensitivity and specificity of HIV p24 antigen detection are of critical importance.

Hytest offers several monoclonal antibodies (MAbs) against HIV p24, which can be used for the development of next-generation HIV p24 antigen immunoassays. Sensitivity analysis on the CLIA platform using the WHO HIV-1 p24 international standard (NIBSC code: 90/636) indicates that the recommended pairs are able to achieve an analytical sensitivity of 0.5–0.64 IU/mL, which exceeds the requirements set by the EU IVDR Class D regulations. Details of the recommended antibody pairs and their corresponding LoD data are summarized in Table 1. In addition, external clinical sample testing shows that the specificity of the recommended pairs exceeds 99.95%, which meets clinical standards.

All of the recommended HIV p24 antibody pairs are capable of recognizing the WHO HIV-1 p24 international standard material (NIBSC code: 90/636), as well as the following HIV-1 subtypes: A1, B, C, D, F1/CRF12_BF/BFrec, G, CRF20_BG, CRF01_AE, CRF02_AG, H, and Group O (NIBSC code: 16/210). They also recognize the WHO International Reference reagent for HIV-2 p26 Antigen (NIBSC code: 16/236). These data indicate that the presented antibodies recognize shared epitopes (or conservative fragments) of non-identical p24 proteins (HIV-1 p24 group M, group O, p26 from HIV-2). Representative calibration curves for the pairs GA17 (capture) -GA12 (detection) and GA17 (capture) -GA54 (detection) are shown in Figure 3.

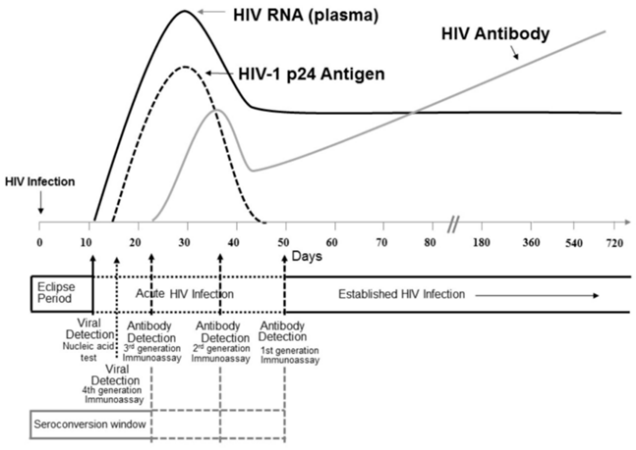

Figure 2.
Serological markers for HIV infection.

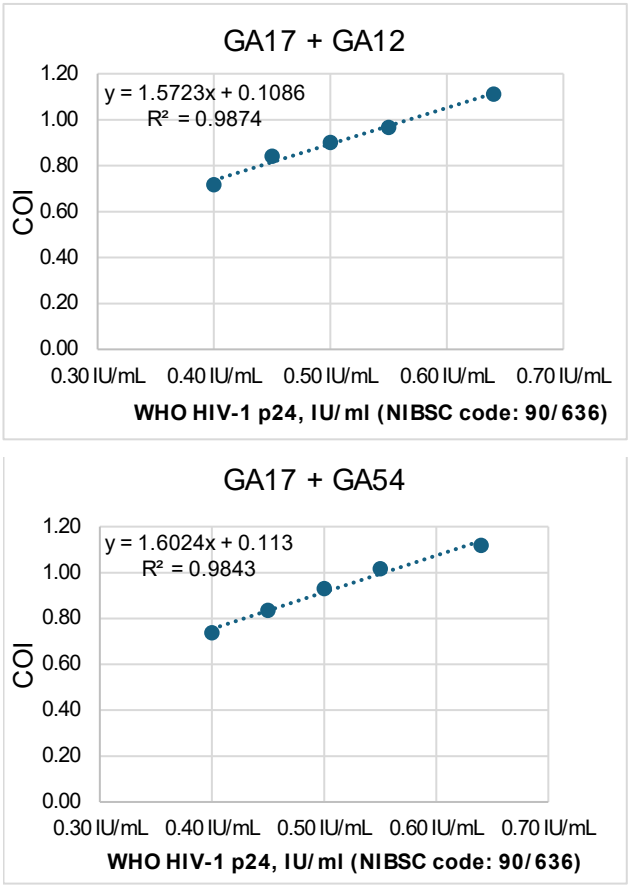

Figure 3.
Representative results for two antibody pairs: GA17 (capture)-GA12 (detection), GA17 (capture)-GA54 (detection) for detecting the WHO HIV-1 p24 International Standard Material (unit: COI). Detection method: sandwich - chemiluminescent assay (alkaline phosphatase labelling).

Table 1.

HIV p24 antibody pairs LoD

Sample preparation: WHO HIV-1 p24 international standard material (NIBSC code: 90/636), HIV-1 p24 (group M) antigen , HIV-1 p24 (group O) antigen and HIV-2 p26 antigen.

Detection method: all of the samples were detected using sandwich-CLIA (alkaline phosphatase labelling).

The recommended pairs exhibited a greater detection capacity for HIV-1 p24 and HIV-2 p26 reagents than antibodies used in Abbott and Roche's assays.

Capture MAb	Detection MAb	LoD of WHO international standard p24, IU/ml	LoD of HIV1 p24_M, pg/ml	LoD of HIV1 p24_O, pg/ml	LoD of HIV-2 p26, pg/ml
GA17	GA12	0.64	4	1.5	15
GA17	GA38	0.55	1.5	1.5	8
GA17	GA54	0.55	4	1.5	15
GA34	GA32	0.55	2	4	8
GA34	GA39	0.55	2	4	5
Abbott Alinity HIV Ag/Ab combo reagent kit		1	5	4	n/d when HIV-2 p26 is 1ng/ml
Roche CombiPT HIV reagent kit		1.3	5	10	20

ORDERING INFORMATION

MONOCLONAL ANTIBODIES

Product name	Cat. #	MAb	Isotype	Remarks
Monoclonal anti-HIV1/2 p24	3H24	GA12	IgG1	*CLIA, FIA, in vitro monoclonal antibody*
		GA17	IgG1	CLIA, FIA, in vivo monoclonal antibody
		GA32	IgG	CLIA, FIA, recombinant monoclonal antibody
		GA34	IgG	CLIA, FIA, recombinant monoclonal antibody
		GA38	IgG	CLIA, FIA, recombinant monoclonal antibody
		GA39	IgG	CLIA, FIA, recombinant monoclonal antibody
		GA54	IgG1	CLIA, FIA, recombinant chimeric antibody

Hytest

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