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HIV Vaccines and Passive Immunization

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Treatment Action Group

HIV Vaccines and Passive Immunization Pipeline 2022

By Richard Jefferys

The near-term prospects for an effective, licensable HIV vaccine received a blow on August 31, 2021, with the announcement of disappointing results from the Imbokodo trial.

Sponsored by the HIV Vaccine Trials Network (HVTN), Imbokodo was a phase IIb efficacy evaluation of a prime-boost HIV vaccine candidate manufactured by Janssen Vaccines & Prevention B.V., part of the Janssen Pharmaceutical Companies of Johnson & Johnson. The study enrolled 2,637 cisgender women at high risk of exposure to HIV in Malawi, Mozambique, South Africa, Zambia, and Zimbabwe, and the results showed that receipt of the vaccine was associated with a slight—approximately 25%—reduction in the risk of HIV acquisition, which did not achieve statistical significance (meaning the outcome could have occurred just due to chance).

Another ongoing efficacy trial, Mosaico, is evaluating a very similar prime-boost regimen from the same manufacturer in cisgender men and transgender people who have sex with cisgender men and/or transgender people at sites in Argentina, Brazil, Italy, Mexico, Peru, Poland, Spain, and the United States. The study is larger, recruiting 3,800 participants, and there may be some reasons to hope that the results will be superior (the booster vaccine is slightly altered, the primary route of HIV exposure in the population is different, and the larger sample size could allow a low level of efficacy to achieve statistical significance). However, the likelihood of achieving a level of protective efficacy sufficient for licensure appears low.

The Imbokodo trial should not be considered a failure, however. The volunteers have provided data that researchers can mine for clues to help shape future vaccine research. Glenda Gray, the coprincipal investigator for Imbokodo, has noted that the vaccine may have shown superior protection in participants aged 31–35—there were three cases of HIV acquisition in the vaccine arm versus eight among placebo recipients in this subgroup—but the numbers are too small to draw firm conclusions.

The results do potentially represent a watershed moment for the HIV vaccine field. Absent a very surprising outcome in the Mosaico trial, the end of the road for the Johnson & Johnson prime-boost candidate would mean that there are no longer any HIV vaccines in the pipeline that are on the traditional pathway toward licensure.

The Imbokodo and Mosaico efficacy trials were widely viewed as the best hope for an HIV vaccine in the near term because of seemingly promising results in the SIV/macaque animal model. The vaccines were also seen as having the best chance of obtaining protection from HIV acquisition by inducing a mix of T cell and non-neutralizing antibody responses against the virus.

If it turns out to be impossible to achieve greater efficacy with vaccines that induce non-neutralizing responses, the leading option that remains is solving the extremely difficult challenge of inducing broadly neutralizing antibodies (bNAbs) with HIV vaccines.

Unlike many other viruses (SARS-CoV-2, for example), HIV has evolved several highly effective mechanisms for resisting antibody-mediated neutralization. The virus's outer envelope protein is cloaked in a shroud of glycan (sugar) molecules that are difficult for antibodies to penetrate or attach to. The mutation rate of the envelope protein is extremely high, with very few parts of the protein offering stable, conserved targets for antibodies. Additionally, envelope protein spikes are sparsely distributed on the virus's surface, making them more difficult for antibodies to target.

Researchers are working intensively to surmount these challenges, with several new vaccines that are designed to increase the capacity of the immune system to generate bNAbs entering clinical trials. Specifically, these constructs are using messenger RNA (mRNA) technology to deliver specially engineered proteins intended to boost the number of B cells with the correct genetic profile to eventually produce bNAbs (an approach called germline targeting).

These studies represent early steps in the process and can be likened to creating a pool of B cell trainees that can be further educated with additional engineered proteins that are yet to be designed. To distinguish these phase I trials from traditional vaccine development, they're being referred to as experimental medicine vaccine trials (EMVTs).

Researchers are excited about the use of the mRNA platform in this work, not because it can immediately lead to efficacy akin to the results obtained with COVID-19 vaccines, but because it allows for much more rapid delivery and evaluation of the different engineered proteins that are likely to be necessary to coax B cells along the pathway toward bNAb production.

In parallel, extensive research is being conducted into passive immunization: the direct delivery of bNAbs that have been isolated from people with HIV and manufactured at scale, in some cases with modifications that facilitate longer persistence of the antibodies in the body (long-acting bNAbs).

The results of the AMP trials (described in last year's Pipeline Report) have established that a bNAb can protect against HIV acquisition as long as the recipient is exposed to an HIV variant that is sensitive to that particular bNAb. The caveat is that the extensive variation of circulating HIV almost certainly means that multiple bNAbs, or bNAbs designed to attack multiple targets (bispecific or trispecific bNAbs), will be needed for broad protection in populations at greatest risk of exposure to HIV.

Several studies of bNAb combinations have reported results over the past year. A phase I evaluation of dual or triple combinations involving four bNAbs—VRC07-523LS, PGDM1400, PGT121, and 10-1074—found that infusions were well tolerated in HIV-negative recipients, and the bNAbs didn't appear to interfere with each other in any

way. Laboratory assays demonstrated that the magnitude and breadth of HIV neutralization was superior with triple compared to dual bNAb combinations.

CAPRISA 012A assessed subcutaneous injection of the bNAbs VRC07-523LS and PGT121 in South African women, also finding that administration was safe (results were published in the *Journal of Infectious Diseases* on February 4, 2022). The levels of VRC07-523LS that were documented were considered acceptable, while PGT121 concentrations were lower, but detectable.

The researchers note that they're now initiating a CAPRISA 012B trial, which will evaluate the safety and pharmacokinetics of another long acting bNAb, CAP256V2LS, alone and in combination with VRC07-523LS and/or PGT121. The study will also assess the use of recombinant human hyaluronidase, an agent that allows for subcutaneous administration of larger volumes of bNAb (or other substances) by enhancing dispersal at the site of injection (a video animation of the mechanism can be viewed on YouTube). Several other bNAb studies are also exploring this approach (see Passive Immunization table), including a newly initiated trial of the bNAb VH3810109 (formerly known as GSK3810109 or N6-LS) sponsored by ViiV Healthcare.

Subcutaneous delivery of the bNAbs VRC01LS and VRC07-523LS has demonstrated safety in infants, with results presented in the *Journal of Infectious Diseases* and at CROI 2022, respectively. Researchers are interested in developing the approach for preventing HIV transmission during breastfeeding.

There are outstanding questions regarding whether passive immunization with bNAbs can ever become a practical and affordable approach to HIV prevention, but there are ongoing collaborative efforts to minimize the cost of manufacture (see the 2020 report and call to action from IAVI and Wellcome for background). The ideal goal remains the induction of high levels of bNAbs with vaccines, which is now an even greater focus for the field because of the Imbokodo results. Data from the recently launched mRNA vaccine trials should help shed light on whether the goal is achievable.

Table: HIV Vaccines and Passive Immunization Pipeline 2022 (Active Clinical Trials)

Agent	Class/Type	Trial Registry Identifier(s)	Manufacturer/ Sponsor	Status
HIV VACCINES				
Ad26.Mos4.HIV, clade C Mosaic gp140 HIV/alum	Ad26 vectors encoding four mosaic Env, Gag, and Pol antigens (Ad26.Mos1.Gag-Pol, Ad26.Mos2.Gag-Pol, Ad26.Mos1.Env, Ad26.Mos2S.Env) Clade C and mosaic gp140 protein in alum adjuvant	NCT03964415 (HPX3002/ HVTN 706)	Janssen Vaccines & Prevention B.V.	Phase III
■ Stieh D. HVTN 705-706 Imbokodo & Mosaico updates, plans for correlates and sieve analyses. Paper presented at: HVTN Full Group Meeting; 2021 May 6 (see video starting at 1:00). ■ Baden LR, Stieh DJ, Sarnecki M, et al. Safety and immunogenicity of two heterologous HIV vaccine regimens in healthy, HIV-uninfected adults (TRAVERSE): a randomised, parallel-group, placebo-controlled, double-blind, phase 1/2a study. *Lancet HIV.* 2020 Oct;7(10):e688–98.				
DNA-HIV-PT123 AIDSVAX B/E DNA-HIV-PT123 MVA CMDR CN54gp140/MPLA-L Descovy or Truvada PrEP	DNA vaccines encoding clade C ZM96 Gag, clade C ZM96 Env, and CN54 Pol-Nef Bivalent HIV gp120 glycoprotein including clade B (MN) and clade E (A244) proteins Recombinant CN54gp140 Env protein from the clade C 97/CN/54 isolate in MPLA-L adjuvant MVA encoding envgp160, CM235 clade E and gag and pol CM240 clade A	NCT04066881	MRC/UVRI and LSHTM Uganda Research Unit	Phase IIb
■ Joseph S, Kaleebu P, Ruzagira E, et al. OC 8491 PREPVACC: a phase III, MAMS adaptive prophylactic HIV vaccine trial with a second randomisation to compare F/TAF with TDF/FTC PrEP. *BMJ Global Health.* 2019;4:A10.				

Agent	Class/Type	Trial Registry Identifier(s)	Manufacturer/ Sponsor	Status
ALVAC-HIV vCP1521 AIDSVAX B/E	Canarypox vector encoding HIV-1 CRF01_AE Env, clade B Gag, the protease-encoding portion of the Pol protein, and a synthetic polypeptide encompassing several known CD8+ T-cell epitopes from the Nef and Pol proteins AIDSVAX B/E recombinant protein vaccine containing gp120 from HIV-1 clades B and CRF01_AE	NCT01931358 NCT01435135	U.S. Army Medical Research and Development Command	Phase II
■ Pitisuttithum P, Nitayaphan S, Chariyalertsak S, et al. Late boosting of the RV144 regimen with AIDSVAX B/E and ALVAC-HIV in HIV-uninfected Thai volunteers: a randomised controlled trial. *Lancet HIV.* 2020 Apr;7(4):e238–48. ■ Easterhoff D, Pollara J, Luo K, et al. HIV vaccine delayed boosting increases Env variable region 2-specific antibody effector functions. *JCI Insight.* 2020 Jan 30;5(2):e131437. ■ Easterhoff D, Pollara J, Luo K, et al. Boosting with AIDSVAX B/E enhances Env constant region 1 and 2 antibody-dependent cellular cytotoxicity breadth and potency. *J Virol.* 2020 Jan 31;94(4):e01120-19. ■ Akapirat S, Karnasuta C, Vasan S, et al. Characterization of HIV-1 gp120 antibody specificities induced in anogenital secretions of RV144 vaccine recipients after late boost immunizations. *PLoS One.* 2018 Apr 27;13(4):e0196397. ■ Rerks-Ngarm S, Pitisuttithum P, Excler J-L, et al. Randomized, double-blind evaluation of late boost strategies for HIV-uninfected vaccine recipients in the RV144 HIV vaccine efficacy trial. *J Infect Dis.* 2017 Apr 15;215(8):1255–63. ■ Easterhoff D, Moody MA, Fera D, et al. Boosting of HIV envelope CD4 binding site antibodies with long variable heavy third complementarity determining region in the randomized double blind RV305 HIV-1 vaccine trial. *PLoS Pathog.* 2017 Feb 24;13(2):e1006182				
Tetravalent Ad26.Mos4.HIV Clade C gp140 Mosaic gp140	Ad26 vectors encoding two mosaic HIV-1 Envs and mosaic Gag and Pol + clade C HIV Env protein boost ± mosaic HIV Env protein boost	NCT02935686	Janssen Vaccines & Prevention B.V.	Phase I/IIa
■ Stieh DJ, Tomaka F, Comeaux CA, et al. ASCENT: phase 2a, randomized, double-blind, placebo controlled study evaluating safety and immunogenicity of two HIV-1 prophylactic vaccine regimens comprising Ad26.Mos4.HIV and either clade C gp140 or bivalent gp140 (Abstract TUAC0402LB). Paper presented at: 10th IAS Conference on HIV Science (IAS 2019); 2019 July 21–24; Mexico City, Mexico.				
Ad26.Mos.HIV MVA Mosaic gp140 protein	Ad26 vectors encoding mosaic Env, Gag, and Pol MVA vectors encoding mosaic Env, Gag, and Pol + gp140 protein boost	NCT02315703	Janssen Vaccines & Prevention B.V./ NIAID/MHRP/IAVI/ Beth Israel Deaconess Medical Center	Phase I/IIa
■ Barouch DH, Tomaka FL, Wegmann F, et al. Evaluation of a mosaic HIV-1 vaccine in a multicentre, randomised, double-blind, placebo-controlled, phase 1/2a clinical trial (APPROACH) and in rhesus monkeys (NHP 13-19). *Lancet.* 2018 Jul 21;392(10143):232–43.				
ChAdOx1.HTI MVA.HTI	Chimpanzee adenovirus and MVA vectors encoding HIVACAT T cell immunogen (HTI)	NCT04563377	University of Oxford	Phase I/IIa
VIR-1111	Prototype CMV vector	NCT04725877	Vir Biotechnology, Inc.	Phase Ia
■ Vir Biotechnology (Press Release). Vir Biotechnology announces initiation of phase 1 clinical trial to evaluate a novel vaccine platform. 2021 January 6.				

Agent	Class/Type	Trial Registry Identifier(s)	Manufacturer/ Sponsor	Status
EnvSeq-1 Envs adjuvanted with GLA-SE	Four individual EnvSeq-1 Env proteins (CH505TF, CH505w53, CH505w78, CH505 M5), GLA-SE adjuvant	NCT03220724 (HVTN 115)	NIAID	Phase I
■ Wolfe LS, Smedley JG 3rd, Bubna N, Hussain A, Harper R, Mostafa S. Development of a platform-based approach for the clinical production of HIV gp120 envelope glycoprotein vaccine candidates. *Vaccine*. 2021 Jun 29;39(29):3852–61. ■ Williams W, et al. Repertoire analysis and function of B cell lineages expanded by HIV-1 vaccines HVTN 115-Part A and HVTN 133. Paper presented at: HVTN Full Group Meeting; 2021 May 6 (see video starting at 26:10).				
Env/Gag DNA vaccine gp120 protein vaccine/ GLA-SE adjuvant (PD-PHV-201401)	Polyvalent DNA vaccine encoding Envs from HIV-1 clades A, B, C, and A/E and clade C Gag + polyvalent gp120 protein vaccine + GLA-SE adjuvant	NCT04927585	NIAID	Phase I
■ Lu S, Ferrari G, et al. HVTN 124 – antibody & cellular. Paper presented at: HVTN Full Group Meeting; 2021 May 6 (see video starting at 36:33). ■ Worcester HIV Vaccine (Press Release). HVTN 124 study conclusion supports advancement to WHV 138 clinical trial. 2021 March 3.				
BG505 SOSIP.664 gp140/ ASO1B	Native-like HIV-1 Env trimer + AS01B adjuvant	NCT03699241	IAVI	Phase I
■ Dey AK, Cupo A, Ozorowski G, et al. cGMP production and analysis of BG505 SOSIP.664, an extensively glycosylated, trimeric HIV-1 envelope glycoprotein vaccine candidate. *Biotechnol Bioeng*. 2018 Apr;115(4):885–99. ■ IAVI (Press Release). IAVI announces first-in-human clinical trial of native-like HIV envelope vaccine candidate. 2019 March 27.				
Ad4-Env145NFL Ad4-Env150KN VRC-HIVRGP096-00-VP (Trimer 4571) /alum	Replication-competent Ad4 HIV vaccines encoding Env proteins + native-like HIV-1 Env trimer with alum adjuvant	NCT03878121	NIAID	Phase I
ConM SOSIP.v7 gp140/ MPLA liposomes	Native-like HIV-1 envelope vaccine adjuvanted with MPLA liposomes	NCT03961438	Academisch Medisch Centrum - Universite-it van Amsterdam (AMC-UvA)	Phase I
■ De Bree G, et al. Germline-targeting by native-like envelope trimers. SY07.05. Paper presented at: R4P; 2021 February 3.				
ConM SOSIP EDC ConM SOSIP ConS UFO EDC ConS UFO Mosaic SOSIPs/MPLA	Prime-boost combinations of model immunogens based on HIV-1 envelope proteins with MPLA adjuvant	NCT03816137	Imperial College London	Phase I
■ Day S, Groot E, Cheeseman H et al. Towards a prophylactic HIV vaccine: fine needle aspiration reveals cellular features of human lymph nodes compared with blood in the EAVI2020_01 study (Abstract P027). HIV Medicine. 2022;23(Suppl. 2):23–95. ■ Sliepen K, Han BW, Bontjer I, et al. Structure and immunogenicity of a stabilized HIV-1 envelope trimer based on a group-M consensus sequence. *Nat Commun*. 2019 May 29;10(1):2355. ■ Markus S. EAVI2020 announces start of new HIV vaccine trial. Imperial College London. 2019 April 2.				

Agent	Class/Type	Trial Registry Identifier(s)	Manufacturer/ Sponsor	Status
HIV-1 BG505 SOSIP.664 gp140/TLR agonist/alum adjuvants	Native-like HIV-1 Env trimer + TLR 7/8 agonists ± alum adjuvants	NCT04177355 (HVTN 137)	NIAID	Phase I
■ McElrath J, et al. HVTN 137 - antibody & cellular. Paper presented at: HVTN Full Group Meeting; 2021 May 6 (see video starting at 1:14:13).				
BG505 SOSIP.GT1.1 gp140 vaccine	Soluble, cleavage-competent, trimeric HIV-1 Env glycoprotein gp140 + adjuvant	NCT04224701	IAVI	Phase I
■ De Bree G, et al. Germline-targeting by native-like envelope trimers. SY07.05. Paper presented at: R4P; 2021 February 3.				
ChAdOx1.tHIVconsv1 MVA.tHIVconsv3 MVA. tHIVconsv4	Chimpanzee adenovirus and MVA vectors encoding conserved HIV antigens	NCT04553016	University of Oxford	Phase I
ChAdOx1.tHIVconsv1 MVA.tHIVconsv3 MVA. tHIVconsv4	Chimpanzee adenovirus and MVA vectors encoding conserved HIV antigens	NCT04586673	University of Oxford	Phase I
CH505TF gp120 GLA-SE adjuvant	HIV-1 CH505 transmitted/founder gp120 + GLA-SE adjuvant	NCT04607408 (HVTN 135)	HVTN	Phase I
IHV01 A244/AHFG ALFQ adjuvant	IHV01 (FLSC) protein and A244/ AHFG protein ± ALFQ adjuvant	NCT04658667	U.S. Army Medical Research and Development Command	Phase I
■ Chua JV, Davis C, Husson JS, et al. Safety and immunogenicity of an HIV-1 gp120-CD4 chimeric subunit vaccine in a phase 1a randomized controlled trial. *Vaccine*. 2021 Jun 4:S0264-410X(21)00685-X.				
Env-C DNA HIV Env gp145 C.6980 protein Rehydragel/ALF43/ dmLT adjuvants	DNA vaccine encoding clade C Env ± HIV Env gp145 C.6980 protein ± adjuvant (Rehydragel, ALF43 or dmLT)	NCT04826094	NIAID	Phase I
CD40.HIVRI.Env DNA-HIV-PT123	Adjuvanted anti-CD40 mAb fused to Env gp140 HIV clade C ZM-96 ± DNA vaccines encoding clade C ZM96 Gag, clade C ZM96 Env, and CN54 Pol-Nef	NCT04842682	ANRS	Phase I
DREP-HIV-PT1 DNA-HIV-PT123 CN54gp140/ MPLA-L	Clade C DNA-launched replicon (DREP) DNA vaccines encoding clade C ZM96 Gag, clade C ZM96 Env, and CN54 Pol-Nef recombinant CN54gp140 Env protein from the clade C 97/CN/54 isolate in MPLA-L adjuvant	NCT04844775	ANRS	Phase I
AdC6-HIVgp140 AdC7-HIVgp140 CH505TF gp120 GLA-SE adjuvant	Chimpanzee adenovirus vectors encoding clade C gp140 ± CH505TF gp120 protein boost in GLA-SE adjuvant	NCT05182125 (HVTN 139)	HVTN	Phase I

Agent	Class/Type	Trial Registry Identifier(s)	Manufacturer/ Sponsor	Status
Stabilized CH505 TF chTrimer 3M-052-AF/alum adjuvants	Stabilized CH505 TF chTrimer protein 3M-052-AF (imidazoquinoline) + alum adjuvants	NCT04915768 (HVTN 300)	NIAID	Phase I
BG505 MD39.3 BG505 MD39.3 gp151 BG505 MD39.3 gp151 CD4KO HIV trimer mRNA vaccines	Messenger RNA (mRNA) vaccines encoding one of three HIV trimer proteins: BG505 MD39.3, BG505 MD39.3 gp151 or BG505 MD39.3 gp151 CD4KO	NCT05217641	NIAID	Phase I
■ National Institutes of Health (Press Release). NIH launches clinical trial of three mRNA HIV vaccines. 2022 March 14. ■ Steichen JM, Kulp DW, Tokatlian T, et al. HIV vaccine design to target germline precursors of glycan-dependent broadly neutralizing antibodies. *Immunity*. 2016 Sep 20;45(3):483–96.				
eOD-GT8 60mer mRNA Vaccine (mRNA-1644) Core-g28v2 60mer mRNA Vaccine (mRNA-1644v2-Core)	Messenger RNA (mRNA) vaccines encoding engineered priming immunogens designed to sequentially activate B-cell precursors as steps toward induction of bNAbs	NCT05001373	IAVI	Phase I
eOD-GT8 60mer mRNA Vaccine (mRNA-1644)	Messenger RNA (mRNA) vaccine encoding an engineered priming immunogen designed to activate B-cell precursors as a step toward induction of bNAbs	NCT05414786	IAVI	Phase I
■ IAVI (Press Release). IAVI and Moderna launch trial of HIV vaccine antigens delivered through mRNA technology. 2022 January 17.				
PASSIVE IMMUNIZATION				
3BNC117-LS-J 10-1074-LS-J	LA monoclonal bNAbs administered subcutaneously or intravenously	NCT04173819	IAVI	Phase I/II
N6LS	LA monoclonal bNAb administered subcutaneously or intravenously ± recombinant human hyaluronidase	NCT03538626	NIAID	Phase I
■ Widge AT, Houser KV, Gaudinski MR, et al. A phase I dose-escalation trial of human monoclonal antibody N6LS in healthy adults (Abstract 508). Paper presented at: CROI; 2020 March 8–11, Boston, MA.				
10E8.4/iMab	Bispecific monoclonal antibody administered subcutaneously or intravenously	NCT03875209	David Ho	Phase I
■ Padte NN, Yu J, Huang Y, Ho DD. Engineering multi-specific antibodies against HIV-1. *Retrovirology*. 2018 Aug 29;15(1):60. ■ Huang Y, Yu J, Lanzi A, et al. Engineered bispecific antibodies with exquisite HIV-1-neutralizing activity. *Cell*. 2016 Jun 16;165(7):1621–31.				
PGT121.414.LS VRC07-523LS	LA monoclonal bNAbs administered subcutaneously or intravenously	NCT04212091 (HVTN 136/ HPTN 092)	NIAID	Phase I
VRC-HIVMAB0102-00-AB (CAP256V2LS)	LA monoclonal bNAb administered subcutaneously or intravenously	NCT04408963	NIAID	Phase I

Agent	Class/Type	Trial Registry Identifier(s)	Manufacturer/ Sponsor	Status
PGDM1400LS VRC07-523LS PGT121.414.LS	LA monoclonal bNAbs administered subcutaneously or intravenously	NCT05184452	NIAID	Phase I
VH3810109 (formerly known as GSK3810109 or N6-LS)	LA monoclonal bNAb administered subcutaneously with recombinant human hyaluronidase PH20 (rHuPH20)	NCT05291520	ViiV Healthcare	Phase I
CAP256V2LS VRC07-523LS PGT121	LA and non-LA bNAbs administered subcutaneously ± recombinant human hyaluronidase PH20 (rHuPH20)	PACTR202003767867253 (CAPRISA 012B)	CAPRISA	Phase I

- Mahomed S, Garrett N, Karim QA, et al. Assessing the safety and pharmacokinetics of the anti-HIV monoclonal antibody CAP256V2LS alone and in combination with VRC07-523LS and PGT121 in South African women: study protocol for the first-in-human CAPRISA 012B phase I clinical trial. BMJ Open. 2020 Nov 26;10(11):e042247.

Shaded entries represent additions since the 2021 Pipeline Report

TABLE ABBREVIATIONS

Ad4: adenovirus serotype 4

Ad26: adenovirus serotype 26

bNAb: broadly neutralizing antibody

CMDR: Chiang Mai double recombinant

CROI: Conference on Retroviruses and Opportunistic Infections

GLA-SE: glucopyranosyl lipid adjuvant formulated in a stable emulsion

HVTN: HIV Vaccine Trials Network

IAVI: International AIDS Vaccine Initiative

LA: long-acting

mAb: monoclonal antibody

MHRP: U.S. Military HIV Research Program

MPLA: monophosphoryl lipid A

MVA: modified vaccinia Ankara strain

NIAID: U.S. National Institute of Allergy and Infectious Diseases

NIH: U.S. National Institutes of Health

PrEP: pre-exposure prophylaxis

R4P: HIV Research for Prevention Conference

STD: sexually transmitted disease

TLR: toll-like receptor

UFO: uncleaved pre-fusion optimized

UVRI: Uganda Virus Research Institute

VRC: The Dale and Betty Bumpers Vaccine Research Center