Table 13: **gp160**

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(32–44)	gp120(39–51)	EQLWVTVYYGVPV	peptide	murine(H-2^{bxk})	[Sastry & Arlinghaus(1991)]
• Peptides induced T-cell proliferative response to immunizing peptide and to gp160					
gp160(38–48)	gp120(45–55)	VYYGVPVWKEA	peptide	murine(H-$2^{bxk,sxd}$)	[Sastry & Arlinghaus(1991)]
• Peptides induced T-cell proliferative response to immunizing peptide and to gp160					
gp160(38–48)	Env(45–55)	VYYGVPVWKEA	Peptide immunization	rhesus monkey( )	[Nehete (1993)]
• Synthetic peptide derived from conserved region of the HIV-1 envelope that stimulates a proliferative response in mice • Proliferative response to this peptide was observed in 3/3 immunized rhesus monkeys					
gp160(38–48)	Env(45–55)	VYYGVPVWKEA	HIV-1 infection	human, chimpanzee( )	[Nehete (1998)]
• Seven out of nine HIV-infected chimpanzees and eight out of seventeen HIV-positive humans exhibited positive proliferative responses to this conserved peptide (peptide 104) – no HIV negative individuals showed a response. • This peptide, along with 4 other peptides from conserved regions of envelope, can induce proliferative responses to HIV and may be useful for vaccines • Peptide 104 elicited proliferative responses in inbred mouse strains and outbred Rhesus monkeys in previous study by same group					
gp160(41–54)	gp120(48–61)	GVPVWKEATTLFC	peptide	murine(H-2^{sxd})	[Sastry & Arlinghaus(1991)]
• Peptides induced T-cell proliferative response to immunizing peptide and to gp160					
gp160(41–54)	Env(48–60)	GVPVWKEATTLFC	Peptide immunization	rhesus monkey( )	[Nehete (1993)]
• Synthetic peptide derived from conserved region of the HIV-1 envelope that stimulates a proliferative response in mice • Despite the proliferative response to this peptide in mice, no response was observed in 3 rhesus monkeys					
gp160(65–75)	gp120(72–82)	AHKVWATHACV	peptide	murine(H-$2^{bxk,sxd}$)	[Sastry & Arlinghaus(1991)]
• Peptides induced T-cell proliferative response to immunizing peptide and to gp160					
gp160(74–85)	gp120(74–85 LAI)	CVPTDPNPQEVV	HIV infection	human( )	[Schrier (1989)]
• Stimulates T-cell proliferation in HIV-infected donors					
gp160(74–85)	gp120(81–92)	CVPTNPVPQEVV	peptide	murine(H-$2^{bxk,sxd}$)	[Sastry & Arlinghaus(1991)]
• Peptides induced T-cell proliferative response to immunizing peptide and to gp160					

HIV Helper-T Cell Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(80–99)	gp120(51–70 HXB2)	NPQEVVLVNTENFNMWKND	*in vitro* stimulation	human( )	[Li Pira (1998)]
• Clonal heterogeneity was broad for a recall response to tetanus toxoid or PPD, but oligoclonal to primary HIV antigens, dominated in this case by TCR Vβ 13 usage • Donor of PBMC that recognized this epitope had HLA-DR alleles 2 and 7					
gp160(91–101)	gp120(90–100 W61D)	YFNMWKNNMV	rgp120	human( )	[Jones (1999)]
• An HIV seronegative volunteer was vaccinated with rgp120 and a QS21/MPL adjuvant; HIV-1 specific T-cell lines were isolated • One T-cell clone reacts with two overlapping peptides, and the region of overlap is: YFNMWKNNMV • The first 20-mer peptide that this clone reacts with is PQEVVLGNVTEYFNMWKNNMV, and the IIIB version of this peptide does not induce proliferation in the T-cell line that responds to the W61D version: IIIB: `------V----N-D----D--`					
gp160(92–111)	gp120(92–111 W61D)	YFNMWKNNMVDQMHEDIISL	rgp120	human( )	[Jones (1999)]
• An HIV seronegative volunteer was vaccinated with rgp120 and a QS21/MPL adjuvant; HIV-1 specific T-cell lines were isolated • The IIIB version of this peptide does not induce proliferation in the T-cell line that responds to the W61D version of the peptide `N-D----D--E---------` • Six T-cell lines react with this peptide, but some of these can also be stimulated by other gp120 peptides located in different regions of gp120					
gp160(101–126)	gp120(101–126)	VEQMHEDIISLWDQSLK-PCVKLTPLC	glycosylated gp160	murine(H-2^{k})	[Sjolander (1996)]
• Study showing that T-cell determinants from glycoproteins can be dependent on the glycosylation of the protein					
gp160(102–114)	gp120(109–121)	EQMHEDIISLWDQ	peptide	murine(H-2^{bxk})	[Sastry & Arlinghaus(1991)]
• Peptides induced T-cell proliferative response to immunizing peptide and to gp160					
gp160(102–116)	gp120(109–123 IIIB)	EQMHEDIISLWDQSL	IIIB gp160	murine(H-2^{d,i5})	[Hale (1989)]
• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types					
gp160(105–117)	gp120(112–124 IIIB)	HEDIISLWDQSLK	HIV infection	human( )	[Clerici (1997)]
• Epitope T2: used in a study of pentoxifyllines influence on HIV specific T-cells					
gp160(105–117)	gp120(112–124 IIIB)	HEDIISLWDQSLK	IIIB gp160	murine(H-2^{k})	[Hale (1989)]
• Epitope T2: Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types					
gp160(105–117)	gp120(112–124 BH10)	HEDIISLWDQSLK	env fragment	murine(H-2^{k,s})	[Cease (1987)]
• Epitope T2: 1 of 2 functional epitopes identified using an amphipathic helix epitope prediction algorithm					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(105–117)	gp120(112–124 BH10)	HEDIISLWDQSLK	gp160 (IIIB) vaccinia	human( )	[Berzofsky (1988)]
• Epitope T2: Proliferative response to T1 and T2 peptides in 14 immunized, uninfected humans					
gp160(105–117)	gp120(112–124 IIIB)	HEDIISLWDQSLK	HIV infection	human( )	[Clerici (1989)]
• Epitope T2: IL-2 production detection of T-helper lymphocytes from asymptomatic HIV-positive individuals					
gp160(105–117)	gp120(112–124 IIIB)	HEDIISLWDQSLK	HIV infection	human( )	[Clerici (1991a)]
• Epitope T2: Peptides stimulate Th cell function and CTL activity in similar patient populations					
gp160(105–117)	gp120(112–124)	HEDIISLWDQSLK	rgp160	human( )	[Clerici (1991b)]
• Epitope T2: Immunizing uninfected individuals with rgp160 results in stronger Th response than does natural infection					
gp160(105–117)	gp120(112–124 IIIB)	HEDIISLWDQSLK	HIV exposure	human( )	[Clerici (1992)]
• Epitope T2: Cell-mediated immune response to HIV-1 peptides in HIV-1 exposed seronegative men					
gp160(105–117)	gp120(112–124 IIIB)	HEDIISLWDQSLK	peptide priming gp160 boost	rhesus monkey( )	[Hosmalin (1991)]
• Epitope T2: Peptide priming to induce T-cell help enhances antibody response to gp160 immunization					
gp160(105–117)	gp120(112–124 IIIB)	HEDIISLWDQSLK	HIV exposure	human( )	[Pinto (1995)]
• Epitope T2: CTL activity analyzed in parallel with T helper reactivity in exposed but uninfected health care workers					
gp160(105–117)	gp120(112–124 IIIB)	HEDIISLWDQSLK	HIV infection	human( )	[Kaul (1999)]
• Kenyan sex workers that remained seronegative were found to frequently have HIV-env peptide specific T-helper responses detected by an IL-2 assay (11/20 cases) and mucosal genital tract anti-HIV IgA (16/21cases) • The helper epitopes peptides used in this study were noted to be previously described [Clerici (1989)], and were not explicitly described in Kaul99					
gp160(105–123)	gp120(112–130 IIIB)	HEDIISLWDQSLKPCVKLT	HIV-1 exposure	human( )	[Furci (1997)]
• 9/11 exposed uninfected individuals in this study had a proliferative response to a C5 peptide, but none reacted with this previously defined epitope					
gp160(108–119)	gp120(108–119 LAI)	IISLWDQSLKPC	HIV infection	human( )	[Schrier (1989)]
• Stimulates T-cell proliferation in HIV-infected donors					

HIV Helper-T Cell Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(110–125)	gp120(110–125)	SLWDQSLKPCVKLTPL	HIV-1 infection	human( )	[Caruso (1997)]
• T-cells from HIV-1 infected individuals as they progress to disease show reduced ability to proliferate in response to HIV antigen, but retain the ability to express the activation antigens CD25 and CD71 • The ability to express activation markers in response to HIV is retained, but not in response to tetanus toxoid recall antigen • This study investigated CD25 and CD71 expression in PBMC from patients in various stages of progression, measuring the response to *in vitro* stimulation by peptide cocktail containing four antigenic Env peptides, or p17 and p24					
gp160(111–123)	gp120(118–130)	LWDQSLKPCVKLT	Peptide immunization	rhesus monkey( )	[Nehete (1993)]
• Synthetic peptide derived from conserved region of the HIV-1 envelope that stimulates a proliferative response in mice • Proliferative response to this peptide was observed in 3/3 immunized rhesus monkeys					
gp160(112–141)	gp120(112–141 NL43)	WDQSLKPCVKLTPLCVS-LKCTDLGNATNTN	rgp120 or rgp160	human( )	[Sitz (1999)]
• There was a great breadth of proliferative response to env peptides in 19 HIV-1 infected rgp160 and 17 HIV-1 infected rgp120 vaccine recipients • Over 35% of vaccinees had a stimulation index of greater than 5 to this peptide					
gp160(115–126)	gp120(115–126 LAI)	SLKPCVKLTPLC	HIV infection	human( )	[Schrier (1989)]
• Stimulates T-cell proliferation in HIV-infected donors					
gp160(115–129)	gp120(115–129 LAI)	SLKPCVKLTPLCVSL	none	human(HLA-DR)	[Gaudebout (1997)]
• Peptide bound to both HLA-DR*1101 and HLA-DR*0401 with high affinity • Because of the distinctive binding pockets of HLA-DR*1101 and HLA-DR*0401, peptides that bound both were considered candidates for promiscuous HLA-DR binding					
gp160(138–159)	gp120(141–160 W61D)	TTSNGWTGEIRKGEIKNCSF	rgp120	human( )	[Jones (1999)]
• An HIV seronegative volunteer was vaccinated with rgp120 and a QS21/MPL adjuvant; HIV-1 specific T-cell lines were isolated • The IIIB version of this peptide does not induce proliferation in the T-cell line that responds to the W61D version of the peptide: IIIB: `---SSGRMIME---------`					
gp160(138–159)	gp120(141–160 W61D)	VQKEYALFYNLDVVPIDDDNA	rgp120	human( )	[Jones (1999)]
• An HIV seronegative volunteer was vaccinated with rgp120 and a QS21/MPL adjuvant; HIV-1 specific T-cell lines were isolated • The IIIB version of this peptide does not induce proliferation in the T-cell line that responds to the W61D version of the peptide `------F--K--II---N-TT` • Two T-cell lines react with this specifically with this peptide					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(147–168)	gp120(152–173 NL43)	MMMEKGEIKNCSFNISTSIRGK	rgp120 or rgp160	human( )	[Sitz (1999)]
	• There was a great breadth of proliferative response to env peptides in 19 HIV-1 infected rgp160 and 17 HIV-1 infected rgp120 vaccine recipients • Over 50% of vaccinees had a stimulation index of greater than 5 to this peptide				
gp160(148–159)	gp120(151–160 W61D)	IGGQIRCSSN	rgp120	human( )	[Jones (1999)]
	• An HIV seronegative volunteer was vaccinated with rgp120 and a QS21/MPL adjuvant; HIV-1 specific T-cell lines were isolated • One T-cell line responds to two overlapping peptides, and the region of overlap is IGGQIRCSSN • The IIIB version of the first reactive peptide, EVGKAMYAPPIGGQIRCSSN, has a single substitution and induces proliferation as well as the original W61D peptide : ----------S--------				
gp160(155–169)	gp120(160–174 LAI)	KNCSFNISTSIRGKV	none	human(HLA-DR)	[Gaudebout (1997)]
	• Peptide binds to both HLA-DR*1101 and HLA-DR*0401 with high affinity • Because of the distinctive binding pockets of HLA-DR*1101 and HLA-DR*0401, peptides that bound both were considered candidates for promiscuous HLA-DR binding				
gp160(162–181)	gp120(162–181 IIIB)	STSIRGKVQKEYAFFYKLDI	HIV-1 gp120 DNA vaccine	rhesus monkey( )	[Lekutis (1997)]
	• HIV-1 env DNA vaccine induced Th cell response to this epitope in a rhesus monkeys				
gp160(172–191)	gp120(172–191 IIIB)	EYAFFYKLDIIPIDNDTTSY	HIV-1 gp120 DNA vaccine	rhesus monkey( )	[Lekutis (1997)]
	• HIV-1 env DNA vaccine induced Th cell response to this epitope in a rhesus monkey				
gp160(185–215)	gp120(191–220 NL43)	NDTTSYTLTSCNTSVIT-QACPKVSFEPIPI	rgp120 or rgp160	human( )	[Sitz (1999)]
	• There was a great breadth of proliferative response to env peptides in 19 HIV-1 infected rgp160 and 17 HIV-1 infected rgp120 vaccine recipients • Over 30% of vaccinees had a stimulation index of greater than 5 to this peptide				
gp160(193–218)	gp120(193–218)	LTSCNSVITQACPKVSF-EPIPIHYC	glycosylated gp160	murine(H-$2^{d,b}$)	[Sjolander (1996)]
	• Study showing that T-cell determinants from glycoproteins can be dependent on the glycosylation of the protein				
gp160(199–211)	gp120(204–216)	SVITQACSKVSFE	peptide	murine(H-$2^{bxk,sxd}$)	[Sastry & Arlinghaus(1991)]
	• Peptides induced T-cell proliferative response in mice representing four haplotypes				

HIV Helper-T Cell Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(199–211)	Env(204–216)	SVITQACSKVSFE	Peptide immunization	rhesus monkey( )	[Nehete (1993)]
• Synthetic peptide derived from conserved region of the HIV-1 envelope that stimulates a proliferative response in mice • A weak or transient proliferative response to this peptide was observed in 3/3 immunized rhesus monkeys					
gp160(199–211)	Env(204–216)	SVITQACSKVSFE	HIV-1 infection	human, chimpanzee( )	[Nehete (1998)]
• HIV-infected chimpanzees and HIV-positive patients show positive proliferative responses to multiple peptides from five conserved regions of the HIV-1 Env					
gp160(200–214)	gp120(205–219 LAI)	VITQACPKVSFEPIP	none	human(HLA-DR)	[Gaudebout (1997)]
• Peptide binds to both HLA-DR*1101 and HLA-DR*0401 with high affinity • Because of the distinctive binding pockets of HLA-DR*1101 and HLA-DR*0401, peptides that bound both were considered candidates for promiscuous HLA-DR binding					
gp160(206–230)	gp120(206–230)	PKVSFEPIPIHYCAPAG-FAILKCNN	glycosylated gp160	murine(H-$2^{d,b}$)	[Sjolander (1996)]
• Study showing that T-cell determinants from glycoproteins can be dependent on the glycosylation of the protein					
gp160(210–223)	gp120(215–228)	FEPIPIHYCAFPGF	peptide	murine(H-2^{bxk})	[Sastry & Arlinghaus(1991)]
• Peptides induced T-cell proliferative response to immunizing peptide and to gp160					
gp160(212–231)	gp120(221–240 W61D)	PIPIHYCAPAGFAILKCNNK	rgp120	human( )	[Jones (1999)]
• An HIV seronegative volunteer was vaccinated with rgp120 and a QS21/MPL adjuvant; HIV-1 specific T-cell lines were isolated • Two T-cell lines react with this specifically with this peptide					
gp160(220–234)	gp120(225–240 SF2)	PAGFAILKCNNKTFN	Peptide, *in vitro*	( )	[Manca (1993)]
• T-cell line derived from un-primed, uninfected individual • Responds to APC pulsed with either synthetic peptide or gp120 • Human MAbs 448-D and 450-D enhance APC gp120 uptake and presentation					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(220–235)	gp120( )	PAGFAILKCNNKTFNY	Peptide priming, *in vitro*	human(DR2)	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein • gp120 priming induced T-cells that recognize this peptide				
gp160(220–235)	gp120(220–235 HXB2)	PAGFAILKCNNKTFNY	gp120 protein priming *in vitro*	human(DR2)	[Guzman (1998)]
	• Listeria monocytogenes, an intracellular pathogen which is ingested by macrophages and can escape from the phagosome to replicate in the cytoplasm, was used successfully as carrier to deliver this gp120 epitope to CD4+ T-cells				
gp160(220–235)	gp120(191–205 HXB2)	PAGFAILKCNNKTFNY	*in vitro* stimulation	human(DR2)	[Fenoglio (1999)]
	• gp120 pep24 epitope exhibited antagonistic activity against proliferation of gp120-specific T-cells when flanked by unrelated amino acid sequence • The glutathione S-transferase (GST)-peptide system can be used to display peptides; antigenicity was maintained when this peptide was expressed at the C-term end, but antagonism resulted when this peptide was expressed at the N-term end				
gp160(223–231)	gp120(194–202 HXB2)	FAILKCNNK	gp120-APC protein priming *in vitro*	human(DR2,6)	[Manca (1996)]
	• This epitope was the minimal stimulatory sequence defined for two Th lines stimulated *in vitro* • One Th line was stimulated by gp120, one by a Glutathione-S-transferase (GST)-peptide fusion • Alanine substitutions at position 914, 196, and 202 abrogated activity for the GST-peptide stimulated line, but not for a gp120 stimulated line • Constructs combining GST and the PAGFAILKCNNKTFNY gp120 peptide at the C-term end of GST stimulated Th cells but not at the N-term end				
gp160(223–231)	gp120(238–246 HXB2)	FAILKCNNK	*in vitro* stimulation	human( )	[Li Pira (1998)]
	• Clonal heterogeneity was broad for a recall response to tetanus toxoid or PPD, but oligoclonal to primary HIV antigens, dominated in this case by TCR Vβ 22 usage • Donor of PBMC that recognized this epitope had HLA-DR alleles 2 and 6 • The only (detected) immunogenic variant of this epitope was derived from strain NOF (YAILKCNNK)				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(223–231)	gp120(194–202 HXB2)	FAILKCNNK	gp120-APC protein priming *in vitro*	human(DR2,6)	[Manca (1996)]
	• This epitope was the minimal stimulatory sequence defined for two Th lines stimulated *in vitro* • One Th line was stimulated by p66, one by a Glutathione-S-transferase (GST)-peptide fusion protein • Alanine substitutions at position 914, 196, and 202 abrogated activity for the GST-peptide stimulated line, but not for a gp120 stimulated line • Constructs linking GST to the PAGFAILKCNNKTFNY gp120 peptide at the C-term end of GST stimulated Th cells, constructs linking at the N-term end did not • The C and N termini of GST are not intrinsically permissive or non-permissive, presentation is epitope specific (see SSTVNDIQKLV for contrast)				
gp160(230–245)	gp120( )	NKTFNGKGPCTNVSTY	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(235–247)	gp120(240–252)	GTGPCTNVSTVQC	Peptide immunization	rhesus monkey( )	[Nehete (1993)]
	• Synthetic peptide derived from conserved region of the HIV-1 envelope that stimulates a proliferative response in mice • Proliferative response to this peptide was observed in 1/3 immunized rhesus monkeys, with a weak transient response in the other two				
gp160(240–255)	gp120( )	TNVSTVQCTHGRPIY	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro*				
gp160(242–261)	gp120(242–261 IIIB)	VSTVQCTHGIRPVVSTQLLL	SHIV-89.6 infection	Macaca mulatta(DRB1*0406)	[Lekutis & Letvin(1997)]
	• C2 region epitope that has not been previously described				
gp160(250–265)	gp120( )	GIRPIVSTQLLLNGSC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(264–287)	gp120(269–292 NL43)	SLAEEEVVIRSANFTDN-AKTIIVQ	rgp120 or rgp160	human( )	[Sitz (1999)]
	• There was a great breadth of proliferative response to env peptides in 19 HIV-1 infected rgp160 and 17 HIV-1 infected rgp120 vaccine recipients • 50% of vaccinees had a stimulation index of greater than 5 to this peptide				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(269–283)	gp120(269–283 IIIB B10)	EVVIRSANFTDNAKT		human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(270–285)	gp120( )	VVIRSDNFTNNAKTIC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(274–288)	gp120(274–288 IIIB B10)	SANFTDNAKTIIVQL	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(280–296)	gp120( )	NAKTIIVQLNESVAIC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(289–297)	gp120(292–300 SF2)	NESVAINCT	env 2-3, SF2 gp120	human( )	[Botarelli (1991)]
	• A non-glycosylated form of gp120 was used as an immunogen – 20% of T-cell clones do not recognize the glycosylated form				
gp160(290–295)	gp120( )	ESVQIN	immunization	murine( )	[Veronese (1994)]
	• In a filamentous bacteriophage coat protein background, stimulated Ab production to the V3 loop tip				
gp160(290–306)	gp120(296–312 LAI)	SVVEINCTRPNNNTRKS	HIV infection	human( )	[Schrier (1989)]
	• Stimulates T-cell proliferation in HIV-infected donors				
gp160(296–314)	gp120(303–321 IIIB)	CTRPNNNTRKSIRIQRGPG(Y)	polyvalent peptide	goat( )	[Palker (1989)]
	• Goats were immunized with peptides containing V3 type-specific neutralizing determinants coupled to T1				
gp160(297–321)	gp120(302–324 MN)	TRPNYNKRKRIHIGPGR-AFYTTK	subcutaneous peptide immunization	murine BALB/c(H-2^d)	[Oscherwitz (1999)]
	• Epitope presented as a tandem repeat (eight copies) elicits stronger B-cell and T-cell responses than the epitope presented as a single copy. • This study indicates that the increased response was not due to neodeterminants created at the junction of the peptides, but rather due to an epitope density effect, increased immunogenicity through a high ratio of epitope to protein.				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(301–325)	gp120( )	NNTRKSIRIQRGPGRAF-VTIGKIGN	DNA vaccine IIIB env + rev	murine( )	[Sasaki (1998)]
	• The env response is what is being sought, but co-expression of rev is required – intramuscular versus nasal vaccination with DNA vaccine with a QS-21 adjuvant was studied – QS-21 enhanced the IgG2a response mediated via Th1 cytokines IFNγ and IL-2 – delayed type hypersensitivity (DTH) in response to the V3 peptide was measured by a foot pad swelling test [Sasaki (1998)]				
gp160(302–315)	gp120(307–322 IIIB)	NTRKSIRIQRGPGR	peptide	murine( )	[Goodman-Snitkoff (1990)]
	• Identification of putative Th epitopes that can stimulate an antibody response in peptide-immunized mice				
gp160(305–321)	gp120(312–329)	(CG)KSIRIQRGPGRAFVTIG	HIV-1 infection	human( )	[Adams (1997)]
	• Used as positive control in study examining T-cell response to four p24 Gag peptides				
gp160(308–319)	gp120( )	(CKR)KIHIGPGQAFYT	HIV-1 infection	murine(H-2^{b,d,k,s})	[Ahluwalia (1997)]
	• A V3 loop peptide modified to resemble an Indian form (GPGQ) was incorporated into ISCOMS (immune stimulating complexes) or liposomes, and used to immunize mice – the IgG2aIgG2b antibody response was enhanced by the presentation in the ISCOM suggestive of a Th1 response				
gp160(308–321)	gp120( )	RIHIGPGRAFYTTK	peptide	murine(H-2^{d})	[Klinman (1995)]
	• Epitope SP10: Hybrid T1-V3 peptide activates IL-4 and IL-6 in a dose dependent manner • 10-mer from V3 contributes to this response				
gp160(308–322)	gp120(308–322 IIIB)	RIHIGPGRAFYTTKN	HIV-1 exposure	human( )	[Furci (1997)]
	• 9/11 exposed uninfected individuals in this study had a proliferative response to a C5 peptide, but only 1/11 exposed uninfected individuals recognized this peptide • 1/18 unexposed uninfected controls could recognize this peptide • Erroneously documented as IIIB sequence - most likely MN peptide				
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	vaccinia IIIB gp160	murine(H-2 A^{d})	[Takahashi (1990)]
	• Epitope P18: Induces both class II restricted CD4+ Th cells, and class I restricted CD8+ CTL				
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	Peptide immunization	rhesus monkey( )	[Nehete (1993)]
	• Synthetic peptide derived from conserved region of the HIV-1 envelope that stimulates a proliferative response in mice • Despite the proliferative response to this peptide in mice and humans, no response was observed in 3 rhesus monkeys				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV-1 infection	human( )	[Wasik (1997)]
• The breadth and intensity of the CTL response and the type of Th response was studied in seven rapidly progressing HIV-1+ infants • IL-2 and γ IFN production from Th1 cells correlated with the CTLp frequency against HIV-1 Gag, Env, Nef and Pol • IL-4 production from Th2 cells was inversely correlated with the CTLp frequency • The HIV-1+ children with strong CTL responses had levels of anti-CD3 MAb induction of Th1 cells comparable to uninfected children • The children that did not mount a good CTL response had dramatically decreased numbers of Th1 relative to Th2 cells					
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK		murine(H-2 I-A^d)	[Takeshita (1995)]
• Epitope P18: Binds Class II H-2 I-A^d requiring riqrgPgRaFvti, and Class I H-2 D^d, requiring iGPgRaFvtI					
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV infection	human(DR)	[Baier (1995)]
• Epitope P18: Linked HIV-1 T1 and P18 peptides to anti-HLA-DR and IgD Fab fragments to enhance uptake by antigen presenting cells thus increase immunogenicity					
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV exposure	human( )	[Pinto (1995)]
• Epitope P18: CTL activity analyzed in parallel with T helper reactivity in exposed but uninfected health care workers					
gp160(308–322)	gp120(315–329 MN)	RIHIGPGRAFYTTKN	HIV exposure	human( )	[Pinto (1995)]
• Epitope P18: CTL activity analyzed in parallel with T helper reactivity in exposed but uninfected health care workers					
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV infection	human( )	[Clerici (1989)]
• Epitope P18: IL-2 production detection of T-helper lymphocytes from asymptomatic HIV-positive individuals					
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV infection	human( )	[Clerici (1991a)]
• Epitope P18: Peptides stimulate Th cell function and CTL activity in similar patient populations					
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	rgp160	human( )	[Clerici (1991b)]
• Epitope P18: Immunizing uninfected individuals with rgp160 results in stronger Th response than does natural infection					
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV exposure	human( )	[Clerici (1992)]
• Epitope P18: Cell-mediated immune response to HIV-1 peptides in HIV-1 exposed seronegative men					

HIV Helper-T Cell Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV infection	human( )	[Clerici (1997)]
• Epitope P18: used in a study of the influence of Pentoxifyllines on HIV specific T-cells					
gp160(308–322)	gp120( )	RIHIGPGRAFYTTKN	HIV exposure	human( )	[Clerici (1992)]
• Epitope P18 MN: Cell-mediated immune response to HIV-1 peptides in HIV-1 exposed seronegative men					
gp160(308–322)	Env( )	RIQRGPRAFVTIGK	intramuscular/intra-nasal DNA immunization	murine(H-2^d)	[Lu (1999)]
• MIP-1α expression plasmid co-inoculated with a DNA vaccine consisting of HIV-1 pCMV160IIIB and pcREV enhanced the HIV-specific T-cell immune response as measured by a CTL test against using V3 peptide pulsed targets, and a DTH test to V3 peptide. • The IgG1/IgG2a response was lowered with co-inoculation of MIP-1α, suggesting it preferentially elicits a Th1 response					
gp160(308–322)	gp160(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV-1 infection/exposure	human( )	[Wasik (1999)]
• Epitope T1: IL-2 responses associated with beta-chemokine expression were detectable at birth in the majority of uninfected infants born to HIV+ mothers, declining by age 6 months • In both uninfected and infected infants of HIV-positive mothers, responses to the T1 peptide (KQIINMWQEVGKAMYA) were more frequent than responses to P18 • T1 is a highly conserved epitope, whereas P18 has a higher mutation rate due to its location in the immunodominant V3 loop region					
gp160(308–322)	gp120(315–329 IIIB)	RIQRGPGRAFVTIGK	HIV infection	human( )	[Kaul (1999)]
• Epitope T1: Kenyan sex workers that remained seronegative were found to frequently have HIV-env peptide specific T-helper responses detected by an IL-2 assay (11/20 cases) and mucosal genital tract anti-HIV IgA (16/21 cases) • The helper epitopes peptides used in this study were noted to be previously described [Clerici (1989)], and were not explicitly described in Kaul99					
gp160(308–327)	gp120(306–325 MN)	RIHIGPGRAFYTTKNIIGIT	HIV-1 infection	human(DRB1*0101)	[Hayball (1997)]
• Tandem repeated presentation of epitope enhances binding to class II molecule and therefore induction of T-cell proliferation • Tandem peptides are thought to enhance proliferation through improved recruiting of CD4 to the activation complex, which can counter-balance gp120's sequestering of CD4 and consequential inhibition of a proliferative response					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(309–323)	gp120(309–323 IIIB B10)	EQRGPGRAFVTIGKI	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(309–325)	gp120(314–330)	IQRGPGRAFVTIGKIGN	HIV-1 infection	human( )	[Caruso (1997)]
	• T-cells from HIV-1 infected individuals as they progress to disease show reduced ability to proliferate in response to HIV antigen, but retain the ability to express the activation antigens CD25 and CD71 • The ability to express activation markers in response to HIV is retained, but not in response to tetanus toxoid recall antigen • This study investigated CD25 and CD71 expression in PBMC from patients in various stages of progression, measuring the response to *in vitro* stimulation by peptide cocktail containing four antigenic Env, peptides, or p17 and p24				
gp160(311–320)	gp120( )	RGPGPAFVTI	intranasal immunization	murine(H-2^d)	[Xin (1998)]
	• Intranasal immunization with IL-2 expression plasmid in addition to DNA vaccine amplifies cellular response to antigen, probably via activation of the T helper type 1 cells				
gp160(314–328)	gp120(314–328 IIIB B10)	GRAFVTIGKIGNMRQ	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(314–341)	gp120(319–346 NL43)	GRAFVTIGKIGNMRQAH-CNISRAKWNAT	rgp120 or rgp160	human( )	[Sitz (1999)]
	• There was a great breadth of proliferative response to env peptides in 19 HIV-1 infected rgp160 and 17 HIV-1 infected rgp120 vaccine recipients • More than 25% of vaccinees had a stimulation index of greater than 5 to this peptide				
gp160(317–331)	gp120(324–338 IIIB)	FVTIGKIGNMRQAHC	IIIB gp160	murine(H-$2^{k,d}$)	[Hale (1989)]
	• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types				
gp160(321–336)	gp120( )	RIIGDIRKAHCNISRY	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(327–341)	gp120(327–341 HXB2)	RQAHCNISRAKWNNT	rec HXB2 gp120	murine(I-A^d)	[Warren & Thomas(1992)]
	• Murine T-cell clone – MHC restriction determined, minimum epitope defined, N terminal flank of the V3 loop				

HIV Helper-T Cell Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(331–345)	gp120( )	CNISRAQWNNTLEQI	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(332–354)	gp120(337–359 NL43)	NISRAKWNATLKQIASK-LREQFG	rgp120 or rgp160	human( )	[Sitz (1999)]
	• There was a great breadth of proliferative response to env peptides in 19 HIV-1 infected rgp160 and 17 HIV-1 infected rgp120 vaccine recipients • More than 30% of vaccinees had a stimulation index of greater than 5 to this peptide				
gp160(335–349)	gp120(342–356 IIIB)	RAKWNNTLKQICSKL	IIIB gp160	murine(H-$2^{k,t4,i5}$)	[Hale (1989)]
	• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types				
gp160(341–356)	gp120( )	TLEQIVKKLREQFGNC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(344–357)	gp120(346–359)	QIVKKLREQFGNNK	HIV infection	human( )	[Krowka (1990)]
	• Conjugation of HIV peptides to liposomes and rIL-2 stimulation may enhance cell-mediated responses				
gp160(353–360)	gp120(355–362 IIIB)	FGNNKTII	SHIV-HXBc2 infection	Macaca mulatta( )	[Lekutis & Letvin(1997)]
	• C3 region minimal epitope determined through fine epitope mapping • Cell line was lost prior to confirmation of MHC requirements				
gp160(363–372)	gp120(368–377 LAI)	QSSGGDPEIV	HIV infection	human( )	[Schrier (1989)]
	• Stimulates T-cell proliferation in HIV-infected donors				
gp160(364–378)	gp120(364–378 IIIB B10)	SSGGKPEIVTHSFNC	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(369–383)	gp120(369–383 IIIB B10)	PEIVTHSFNCGGEFF	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(381–395)	gp120( )	EFFYCNTTQLFNNTW	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(394–408)	gp120(394–408 IIIB B10)	TWFNSTWSTKGSNNT	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(396–411)	gp120( )	FNNTWRLNHTEGTKGC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(399–413)	gp120(399–413 IIIB B10)	TWSTKGSNNTEGSDT	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(410–429)	gp120(410–429 PV22)	GSDTITLPCRIKQFINMWQE	HIV infection	human(DR4)	[Callahan (1990)]
	• Synthetic peptides representing natural variants were used to test for recognition in the context DR4				
gp160(410–429)	gp120(410–429 PV22)	GSDTITLPCRIKQFINMWQE	HIV infection	human(DR4(Dw10))	[Polydefkis (1990)]
	• Human CD4+ T-cell clones lyse recombinant vaccinia virus-infected cells that synthesize envelope gp160				
gp160(416–431)	gp120( )	LPCRIKQIINMWQEVY	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(418–436)	Env(417–435)	CRIKQIINMWQGVGKAMYA	HIV-1 infection	human, chimpanzee( )	[Nehete (1998)]
	• HIV-infected chimpanzees and HIV-positive patients show positive proliferative responses to multiple peptides from five conserved regions of the HIV-1 Env				
gp160(421–436)	gp120(426–441 IIIB)	KQFINMWQEWGKAMYA	HIV-1 exposure	human( )	[Furci (1997)]
	• 9/11 exposed uninfected individuals in this study had a proliferative response to a C5 peptide, but none reacted with this previously defined epitope • IIIB position 435 listed as “W” in this epitope as opposed to “V” in the sequence				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(421–436)	gp120(428–443 IIIB B10)	KQIINMWQEVGKAMYA	env fragment	murine(H-$2^{k,d,s}$)	[Cease (1987)]
• Epitope T1: 1 of 2 functional epitopes identified using an amphipathic helix epitope prediction algorithm					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	peptide	murine(H-$2E\alpha E\beta^k$)	[Boehncke (1993)]
• Epitope T1: C3H H2^k mice were used for immunization in the study because H-2^k mice are particularly good T1 responders – T1 can be presented by $E\alpha E\beta^k$ but not $E\alpha E\beta^b$ – the nature of the T1 class II molecular interaction was thoroughly explored					
• Alanine substitutions across peptide did not negatively affect MHC binding or effective presentation of epitope, except at three critical residues (432N, 435Q, 439K), however substitutions with larger side chains often diminished activity – only a few amino acids were found to be critical for class II interaction and for maintaining T-cell receptor specificity					
• A gain in potency was observed when 436E was replaced with A – this suggests that substitutions in positions that interfere with binding might allow the design of a more potent vaccine					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	subcutaneous peptide immunization	murine(H-2^k)	[Ahlers (1997)]
• Epitope T1: first identified helper epitope in HIV					
• Alanine at position 436 (instead of E in wild-type) enhances MHC binding and antigenicity of peptide by several orders of magnitude					
• Vaccines with a CTL epitope linked to a more potent helper epitope yielded greatly enhanced CTL response relative to the wildtype helper epitope					
• T1 peptide linked to CTL epitope in four vaccine constructs were used to immunize mice: KQIINMWQEVGKAMYAPPISGQIRRIQRGPGRAFVTIGK, KQIINMWQEVGKAMYAPPISGQIRRIQRGPGRAFVTI, K QIINMWQAVGKAMYAPPISGQIRRIQRGPGRAFVTIGK, KQIINMWQAVGKAMYAPPISGQIRRIQRGPGRAFVTI					
gp160(421–436)	gp120(428–433 IIIB)	KQIINMWQEVGKAMYA	HIV-1 infection	human( )	[Wasik (1997)]
• Epitope T1: The breadth and intensity of the CTL response and the type of Th response was studied in seven rapidly progressing HIV-1+ infants					
• IL-2 and γ IFN production from Th1 cells correlated with the CTLp frequency against HIV-1 Gag, Env, Nef and Pol					
• IL-4 production from Th2 cells was inversely correlated with the CTLp frequency					
• The HIV-1+ children with strong CTL responses had levels of anti-CD3 MAb induction of Th1 cells comparable to those of uninfected children					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	gp160 (IIIB) vaccinia	human( )	[Berzofsky (1988)]
• Epitope T1: Proliferative response to T1 and T2 peptides in 14 immunized, uninfected humans					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	polyvalent peptide	goat( )	[Palker (1989)]
• Epitope T1: Goats immunized with peptides containing V3 type-specific neutralizing determinants coupled to T1					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	HIV infection	human( )	[Clerici (1989)]
• Epitope T1: IL-2 production detection of T-helper lymphocytes from asymptomatic HIV-positive individuals					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	IIIB gp160	murine(H-$2^{k,d,t4}$)	[Hale (1989)]
• Epitope T1: Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	HIV infection	human( )	[Clerici (1991a)]
• Epitope T1: Peptides stimulate Th cell function and CTL activity in similar patient populations					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	rgp160	human( )	[Clerici (1991b)]
• Epitope T1: Immunizing uninfected individuals with rgp160 results in stronger Th response than does natural infection					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	HIV exposure	human( )	[Clerici (1992)]
• Epitope T1: Cell-mediated immune response to HIV-1 peptides in HIV-1 exposed seronegative men					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	immunization	murine( )	[Veronese (1994)]
• Epitope T1: Engineered into a filamentous bacteriophage coat protein, stimulated for Ab production to the V3 loop					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	peptide	chimpanzee( )	[Haynes (1993)]
• Epitope T1: Hybrid T1-V3 peptide immunogenicity reduced when the fusogenic domain of gp41 was added					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	peptide	murine(H-2^{d})	[Klinman (1995)]
• Epitope T1: Hybrid T1-V3 peptide activates IL-4 and IL-6 in a dose dependent manner					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	HIV infection	human( )	[Clerici (1997)]
• Epitope T1: used in a study of the influence of Pentoxifyllines on HIV specific T-cells					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	HIV exposure	human( )	[Pinto (1995)]
• Epitope T1: CTL activity analyzed in parallel with T helper reactivity in exposed but uninfected health care workers					
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	HIV infection	human(DR)	[Baier (1995)]
• Epitope T1: Linked HIV-1 T1 and P18 peptides to anti-HLA-DR and anti-IgD Fab fragments to enhance uptake by antigen presenting cells and thus increase immunogenicity					

HIV Helper-T Cell Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(421–436)	gp160(428–433 IIIB)	KQIINMWQEVGKAMYA	HIV-1 infection/exposure	human( )	[Wasik (1999)]
	• Epiope T1: IL-2 responses associated with beta-chemokine expression were detectable at birth in the majority of uninfected infants born to HIV+ mothers, declining by age 6 months • T1 peptide: In both uninfected and infected infants of HIV-positive mothers, responses to the T1 peptide were more frequent than responses to P18 (RIQRGPGRAFVTIGK) • T1 is a highly conserved epitope, whereas P18 has a higher mutation rate due to its location in the immunodominant V3 loop region				
gp160(421–436)	gp120(428–443 IIIB)	KQIINMWQEVGKAMYA	HIV infection	human( )	[Kaul (1999)]
	• Epiotpe T1: Kenyan sex workers that remained seronegative were found to frequently have HIV-env peptide specific T-helper responses detected by an IL-2 assay (11/20 cases) and mucosal genital tract anti-HIV IgA (16/21cases) • The helper epitopes peptides used in this study were noted to be previously described [Clerici (1989)], and were not explicitly described in Kaul99				
gp160(421–436)	gp120( )	KQIINMWQEVGKAMYA	HIV-1 infection + polyvalent peptide vaccine	human( )	[Bartlett (1998)]
	• Epitope T1: C4-V3 PV (polyvalent HIV envelope synthetic peptide immunogen) consisted of T1 helper epitope presented in tandem with a V3 loop CTL epitope from one of four different North American strains • This was a pilot phase I study involving vaccination of ten HIV-infected subjects who were HLA-B7-positive • Enhanced lymphoproliferative response to peptide was observed in 5/8 vaccinees, and four patients showed increases in neutralizing antibody responses				
gp160(421–444)	gp120(428–451 IIIB)	KQIIMNWQEVGKAMYAP-PISGQIR	peptide	murine($H2^d$)	[Shirai (1996)]
	• Epitope T1: Linked to a CTL epitope from hepatitis C virus, induced CD4+ helper cells producing IL-2				
gp160(423–440)	gp120(428–445)	FINMWQEVGKAMYAPPIS	HIV-1 infection	human( )	[Caruso (1997)]
	• T-cells from HIV-1 infected individuals as they progress to disease show reduced ability to proliferate in response to HIV antigen, but retain the ability to express the activation antigens CD25 and CD71 • The ability to express activation markers in response to HIV is retained, but not in response to tetanus toxoid recall antigen • This study investigated CD25 and CD71 expression in PBMC from patients in various stages of progression, measuring the response to *in vitro* stimulation by peptide cocktail containing four antigenic Env peptides, or p17 and p24				
gp160(424–438)	gp120(424–438 IIIB B10)	INMWQEVGKAMYAPP	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(425–439)	gp120(432–446 IIIB)	NMWQEVGKAMYAPPI	IIIB gp160	murine(H-2^{t4})	[Hale (1989)]
	• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types				
gp160(426–441)	gp120( )	MWQEVGKAMYAPPIGC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(430–444)	gp120(437–451 IIIB)	VGKAMYAPPISGQIR	IIIB gp160	murine(H-$2^{k,d,i5,t4}$)	[Hale (1989)]
	• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types				
gp160(430–453)	gp120(430–453)	VGKAMYAPPISGQIRCS-SNITGLL	glycosylated gp160	murine(H-2^{b})	[Sjolander (1996)]
	• Study showing that T-cell determinants from glycoproteins can be dependent on the glycosylation of the protein • Peptide stimulation of an *in vitro* proliferative response required *in vivo* priming with glycosylated protein • Local glycosylation sites not thought to be part of the epitope, rather thought to be important for epitope processing				
gp160(436–451)	gp120( )	APPIGGQISCSSNITY	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(438–460)	gp120(443–465 NL43)	PISGQIRCSSNITGLLLTRDGGN	rgp120 or rgp160	human( )	[Sitz (1999)]
	• There was a great breadth of proliferative response to env peptides in 19 HIV-1 infected rgp160 and 17 HIV-1 infected rgp120 vaccine recipients • Close to 40% of vaccinees had a stimulation index of greater than 5 to this peptide				
gp160(446–461)	gp120( )	SSNITGLLLTRDGGTC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(456–470)	gp120( )	RDGGTNVTNDTEVFRC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(459–473)	gp120(459–473 IIIB B10)	GNSNNESEIFRPGGG	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(468–483)	gp120(466–481)	FRPGGGDMRDNWRSEL	HIV infection	human( )	[Krowka (1990)]
	• Conjugation of HIV peptides to liposomes and rIL-2 stimulation may enhance cell-mediated responses				
gp160(474–488)	gp120(474–488 IIIB B10)	DMRDNWRSELYKYKV	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(476–490)	gp120(483–497 IIIB)	RDNWRSELYKYKVVK	IIIB gp160	murine(H-$2^{d,t4}$)	[Hale (1989)]
	• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types				
gp160(482–501)	gp120(482–501 IIIB)	ELYKYKVVKIEPLGVAPTKA	HIV-1 gp120 DNA vaccine	rhesus monkey( )	[Lekutis (1997)]
	• HIV-1 env DNA vaccine induced Th cell response to this epitope in a rhesus monkey • This epitope was recognized by both monkeys used in this study				
gp160(484–496)	gp120(484–496 HXB2)	YKYKVVKIEPLGV	HIV-1 env DNA vaccination	Macaca mulatta(DR*W201)	[Lekutis & Letvin(1998)]
	• Variants of this epitope with substitutions at position 490(K) retained ability to bind to MHC class II, but failed to induce proliferation/cytokine secretion in HIV-1 env-specific CD4+ Th cells, the modified peptide antagonized the wildtype peptide-induced proliferative response				
gp160(484–498)	gp120(484–498 IIIB B10)	YKYKVVKIEPLGVAP	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(484–499)	gp120(492–506 IIIB)	CKYKVVKIEPLGVAPT	IIIB gp160	murine(H-$2^{d,k,t4,i5}$)	[Hale (1989)]
	• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types				
gp160(485–500)	gp120( )	KYKVIKIEPLGIAPTC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(486–494)	gp120(486–494 IIIB)	YKVVKIEPL	SHIV-HXBc2 infection	Macaca mulatta(DRB*W201)	[Lekutis & Letvin(1997)]
	• C5 region minimal epitope determined through fine epitope mapping				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(487–512)	gp120(494–518 IIIB)	KVVKIEPLGVAPTKAKR-RVVQREKRC	peptide	murine( )	[Goodman-Snitkoff (1990)]
	• Identification of putative Th epitopes that can stimulate an antibody response in peptide immunized mice				
gp160(499–511)	gp120( )	TKAKRRVVEREKR	*in vitro* stimulation	human(DR)	[Wilson (1997)]
	• Thought to be a mimic of a HLA class II DR β chain variable region • Response to this epitope may cause a breakdown of self-tolerance • Presentation of epitope induced autoreactive T-cell lines in PBMC from uninfected donors • Suppression of proliferation to soluble antigens by the CD8+ fraction of TKAKRRVVEREKR stimulated T-cells was observed				
gp160(519–543)	gp41(519–543)	FLGFLGAAGSTMGAASL-TLTVQARC	peptide	murine(H-2^{bxk,sxd})	[Sastry & Arlinghaus(1991)]
	• Peptides induced T-cell proliferative response to immunizing peptide and to gp160				
gp160(519–543)	Env(519–543)	FLGFLGAAGSTMGAASL-TLTVQARC	Peptide immunization	rhesus monkey( )	[Nehete (1993)]
	• Synthetic peptide derived from conserved region of the HIV-1 envelope that stimulates a proliferative response in mice, and in rhesus monkeys • Proliferative response to this peptide was observed in 3/3 immunized rhesus monkeys				
gp160(519–543)	Env(519–543)	FLGFLGAAGSTMGAASL-TLTVQARQ	HIV-1 infection	human, chimpanzee( )	[Nehete (1998)]
	• HIV-infected chimpanzees and HIV-positive patients show positive proliferative responses to multiple peptides from five conserved regions of the HIV-1 Env				
gp160(547–561)	gp41(547–561 IIIB B10)	GIVQQQNNLLRAIEA	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				
gp160(562–576)	gp41(562–576 IIIB B10)	QQHLLQLTVWGIKQL	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(572–591)	gp41(572–591)	GIKQLQARILAVERYLKDQQ	peptide	murine(H-$2^{d,b}$)	[Brown (1995)]
• This peptide was a good immunogen in BALB/c and CBA mice, producing a good proliferative response • At least one of the four residues GIKQ enhances stimulation, and in CBA mice these residues influence the ability to prime T-cells *in vivo* • QLQARILAVERY stimulated the greatest *in vitro* T-cell response • VERYLKDQQ was the minimal reactive sequence recognized by a T-cell line					
gp160(576–591)	gp41(576–591)	LQARILAVERYLKDQQ	peptide	murine(H-$2^{d,b}$)	[Brown (1995)]
• This peptide was a poor immunogen in BALB/c and CBA mice used in this experiment, producing a weak proliferative response					
gp160(578–608)	gp41(585–615 IIIB)	ARILAVERYLKDQQLLG-IWGCSGKLICTTAV	peptide	murine( )	[Goodman-Snitkoff (1990)]
• Identification of putative Th epitopes that can stimulate an antibody response in peptide immunized mice					
gp160(579–601)	gp41(579–601)	RILAVERYLKDQQLLGG-IWGCSGK	peptide	murine(H-$2^{d,b}$)	[Brown (1995)]
• This peptide was a good immunogen in BALB/c and CBA • This peptide produced a strong Th response in both mice strains which was more responsive towards GIKQLQARILAVERYLKDQQ and LQARILAVERYLKDQQ than to itself					
gp160(579–604)	gp41(584–609 LAI)	RILAVERYLKDQQLLGI-WGCSGKLIC	HIV infection	human( )	[Schrier (1989)]
• Stimulates T-cell proliferation in HIV-infected donors					
gp160(586–597)	Env(586–598)	YLRDQQLLGIWG	HIV-1 infection	human, chimpanzee( )	[Nehete (1998)]
• HIV-infected chimpanzees and HIV-positive patients show positive proliferative responses to multiple peptides from five conserved regions of the HIV-1 Env					
gp160(586–598)	Env(586–598)	YLRDQQLLGIWGC	Peptide immunization	murine, rhesus monkey( )	[Nehete (1993)]
• Synthetic peptide derived from conserved region of the HIV-1 envelope that stimulates a proliferative response in mice • Proliferative response to this peptide was observed in 1/3 immunized rhesus monkeys, with a weak transient response in the other two					
gp160(593–604)	gp41(598–609 LAV-1)	LGLWGCSGKLIC	peptide	murine($H2^{d}$)	[Schrier (1988)]
• Murine T-dependent B-cell response – 7/29 had a proliferative response to this peptide					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(593–604)	gp41(593–604 IIIB)	LGIWGCSGKLIC	HIV infection	human( )	[Bell (1992)]
	• Elicits T-cell proliferation and B cell responses, but only during the asymptomatic phase of HIV infection				
gp160(594–603)	gp41(594–603 IIIB)	GIWGCSGKLI	HIV-1 infection	human( )	[Kelleher (1998b)]
	• Epitope documented as a "previously described" epitope [Bell (1992)], but in Bell *et al*. it was described as gp41(594-603 IIIB), LGIWGCSGKLIC • Immunization with a p24-VLP virus-like particle did not significantly impact CD4+ lymphocyte count, viral load, or p24 antibody titre • Immunization with p24-VLP did not increase the proliferative response to this gp41 epitope, however, there was a modest, short-lived increased proliferative response to p24				
gp160(594–604)	gp41( )	GIWGCSGKLIC	HIV infection	human( )	[Mutch (1994)]
	• Core region of peptides that can stimulate proliferative responses from seronegative and seropositive people				
gp160(598–609)	gp41(603–614 LAI)	CSGKLICTTAVP	HIV infection	human( )	[Schrier (1989)]
	• Stimulates T-cell proliferation in HIV-infected donors				
gp160(604–615)	gp41(609–620 LAI)	CTTAVPWNASWS	HIV infection	human( )	[Schrier (1989)]
	• Stimulates T-cell proliferation in HIV-infected donors				
gp160(609–616)	gp41( )	PWNASWSN	HIV infection	human( )	[Mutch (1994)]
	• Core region of peptides that can stimulate proliferative responses from seronegative and seropositive people				
gp160(614–629)	gp41( )	WSNKSLEDIWDNMTWC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(634–649)	gp41( )	EIDNYTNTIYTLLEEC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
	• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein				
gp160(647–661)	gp41(647–661 IIIB B10)	EESQNQQEKNEQELL	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(650–662)	gp41(655–667 LAI)	QNQQEKNEQELLE	HIV infection	human( )	[Schrier (1989)]
• Stimulates T-cell proliferation in HIV-infected donors					
gp160(667–681)	gp41(667–681 IIIB B10)	ASLWNWFNITNWLWY	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses					
gp160(682–696)	gp41(682–696 IIIB B10)	IKLFIMIVGGLVGLR	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses					
gp160(724–745)	gp41(731–752)	PRGPDRPEGIEEEGGERDRDRS	chimeric CPMV-gp41 peptide	murine(H-2k)	[McInerney (1999)]
• A gp41 peptide was expressed in a cowpea mosaic virus (CPMV) and mice were vaccinated with a purified chimeric particle and five adjuvants were tested. The only adjuvant that could stimulate anti-gp41 antibodies and an *in vitro* proliferative response was Quil A • The antibodies were predominantly IgG2a, suggesting a Th1 response					
gp160(732–744)	gp41(737–749 LAI)	GIEEEGGERDRDR	HIV infection	human( )	[Schrier (1989)]
• Stimulates T-cell proliferation in HIV-infected donors					
gp160(780–794)	gp41(787–801 IIIB)	RIVELLGRRGWEALK	IIIB gp160	murine(H-$2^{d,k,t4}$)	[Hale (1989)]
• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types					
gp160(794–808)	gp41(801–815 IIIB)	KYWWNLLQYWSQELK	IIIB gp160	murine(H-2^{k})	[Hale (1989)]
• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types					
gp160(799–813)	gp41(806–820 IIIB)	LLQYWSQELKNSAVS	IIIB gp160	murine(H-$2^{k,d,t4}$)	[Hale (1989)]
• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types					
gp160(799–813)	gp41(806–820 IIIB)	LLQYWSQELKNSAVS	IIIB gp160	murine(H-$2^{k,d,t4}$)	[Hale (1989)]
• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types					
gp160(814–829)	gp41( )	WLNATAIAVTEGTDRC	Peptide priming *in vitro*	human( )	[Manca (1995c)]
• Peptide stimulation of PBMC from non-infected individuals *in vitro* • Peptide priming does not always induce T-cells that recognize whole protein					
gp160(821–835)	gp41(828–842 IIIB)	AVAEGTDRVIEVVQG	IIIB gp160	murine(H-2^{k})	[Hale (1989)]
• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types					

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(821–838)	gp41(827–843)	YVAEGTDRVIEVVQGACR	HIV-1 infection	human( )	[Caruso (1997)]
	• T-cells from HIV-1 infected individuals as they progress to disease show reduced ability to proliferate in response to HIV antigen, but retain the ability to express the activation antigens CD25 and CD71 • The ability to express activation markers in response to HIV is retained, but not in response to tetanus toxoid recall antigen • This study investigated CD25 and CD71 expression in PBMC from patients in various stages of progression, measuring the response to *in vitro* stimulation by peptide cocktail containing four antigenic Env peptides, or p17 and p24				
gp160(827–835)	gp41(834–842 IIIB)	DRVIEVVQG	IIIB gp160	murine(H-2^k)	[Hale (1989)]
	• Suggested H-2^k epitope based on region of overlap				
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	IIIB gp160	murine(H-$2^{k,i5}$)	[Hale (1989)]
	• Epitope TH4: Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types • Called Th4.1 and TH4				
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	peptide priming gp160 boost	rhesus monkey( )	[Hosmalin (1991)]
	• Epitope TH4: Peptide priming to induce T-cell help enhances antibody response to gp160 immunization • Called Th4.1 and TH4				
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	HIV infection	human( )	[Clerici (1997)]
	• Epitope TH4: used in a study of the influence of Pentoxifyllines on HIV specific T-cells				
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	HIV exposure	human( )	[Pinto (1995)]
	• Epitope TH4: CTL activity analyzed in parallel with T helper reactivity in exposed but uninfected health care workers • Called Th4.1 and TH4				
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	HIV infection	human( )	[Clerici (1991a)]
	• Epitope TH4: Peptides stimulate Th cell function and CTL activity in similar patient populations • Called Th4.1 and TH4				
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	rgp160	human( )	[Clerici (1991b)]
	• Epitope TH4: Immunizing uninfected individuals with rgp160 results in stronger Th response than does natural infection • Called Th4.1 and TH4				

HIV Helper-T Cell Epitopes

HXB2 Location	Author Location	Sequence	Immunogen	Species(HLA)	References
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	HIV exposure	human( )	[Clerici (1992)]
	• Epitope TH4: Cell-mediated immune response to HIV-1 peptides in HIV-1 exposed seronegative men • Called Th4.1 and TH4				
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	HIV infection	human( )	[Clerici (1989)]
	• Epitope TH4: IL-2 production detection of T-helper lymphocytes from asymptomatic HIV-positive individuals • Called Th4.1 and TH4				
gp160(827–841)	gp41(834–848 IIIB)	DRVIEVVQGAYRAIR	HIV infection	human( )	[Kaul (1999)]
	• Epitope TH4: Kenyan sex workers that remained seronegative were found to frequently have HIV-env peptide specific T-helper responses detected by an IL-2 assay (11/20 cases) and mucosal genital tract anti-HIV IgA (16/21cases) • The helper epitopes peptides used in this study were noted to be previously described [Clerici (1989)], and were not explicitly described in Kaul99				
gp160(834–841)	gp41(841–848 IIIB)	QGAYRAIR	IIIB gp160	murine(H-2^{i5})	[Hale (1989)]
	• Suggested H-2^{k} epitope based on region of overlap				
gp160(834–848)	gp41(841–855 IIIB)	QGAYRAIRHIPRRIR	IIIB gp160	murine(H-$2^{d,t4,i5}$)	[Hale (1989)]
	• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types				
gp160(839–848)	gp41(846–855 IIIB)	AIRHIPRRIR	IIIB gp160	murine(H-$2^{d,t4}$)	[Hale (1989)]
	• Suggested H-$2^{d,t4}$ epitope based on region of overlap				
gp160(839–853)	gp41(846–860 IIIB)	AIRHIPRRIRQGLER	IIIB gp160	murine(H-$2^{d,t4}$)	[Hale (1989)]
	• Six multideterminant helper T-cell regions are recognized by mice of three or four MHC types				
gp160(842–856)	gp41(842–856 IIIB B10)	HIPRRIRQGLERILL	HIV infection	human( )	[Wahren (1989b), Wahren (1989a)]
	• 12 gag and 18 env T-cell sites were identified that could commonly evoke T-cell responses				