METHODS OF TREATING HIV INFECTION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. provisional application USSN 60/555,767, filed March 24, 2004.

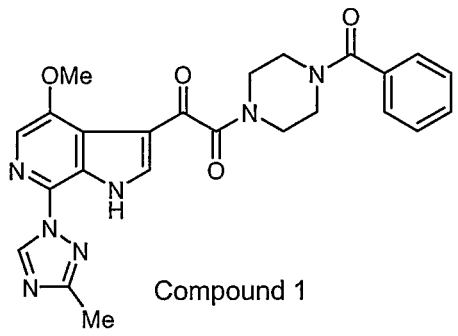
BACKGROUND OF THE INVENTION

HIV-1 (human immunodeficiency virus -1) infection remains a major medical problem, with an estimated 42 million people infected worldwide at the end of 2002. The number of cases of HIV and AIDS (acquired immunodeficiency syndrome) has risen rapidly. In 2002, approximately 5 million new infections were reported and 3.1 million people died from AIDS. Currently available drugs for the treatment of HIV include ten nucleoside reverse transcriptase (RT) inhibitors or approved single pill combinations: zidovudine or AZT (or Retrovir®), didanosine or DDI (or Videx®), stavudine or D4T (or Zerit®), lamivudine or 3TC (or Epivir®), zalcitabine or DDC (or Hivid®), abacavir succinate (or Ziagen®), tenofovir disoproxil fumarate salt (or Viread®), emtricitabine (or Emtriva®), Combivir® (contains 3TC and AZT), Trizivir® (contains abacavir, 3TC and AZT); three non-nucleoside reverse transcriptase inhibitors: nevirapine (or Viramune®), delavirdine (or Rescriptor®) and efavirenz (or Sustiva®), eight peptidomimetic protease inhibitors or approved formulations: saquinavir (or Invirase® or Fortovase®), indinavir (or Crixivan®), ritonavir (or Norvir®), nelfinavir (or Viracept®), amprenavir (or Agenerase®), atazanavir (Reyataz®), fosamprenavir (or Lexiva), Kaletra®(contains lopinavir and ritonavir), and one fusion inhibitor enfuvirtide (or T-20 or Fuzeon®).

Each of these drugs can only transiently restrain viral replication if used alone. However, when used in combination, these drugs have a profound effect on viremia and disease progression. In fact, significant reductions in death rates among AIDS patients have been recently documented as a consequence of the widespread application of combination therapy. Despite these impressive results, 30 to 50% of

patients ultimately fail combination drug therapies. Insufficient drug potency, non-compliance, restricted tissue penetration and drug-specific limitations within certain cell types (e.g. most nucleoside analogs cannot be phosphorylated in resting cells) may account for the incomplete suppression of sensitive viruses. Furthermore, the high replication rate and rapid turnover of HIV-1 combined with the frequent incorporation of mutations, leads to the appearance of drug-resistant variants and treatment failures when sub-optimal drug concentrations are present (Larder and Kemp; Gulick; Kuritzkes; Morris-Jones *et al*; Schinazi *et al*; Vacca and Condra; Flexner; Berkhout and Ren *et al*; (Ref. 6-14)). Thus, there is continuing need for new compounds and methods of treatment for HIV infection.

1-Benzoyl-4-[2-[4-methoxy-7-(3-methyl-1*H*-1,2,4-triazol-1-yl)-1*H*-pyrrolo[2,3-*c*]pyridin-3-yl]-1,2-dioxoethyl]-piperazine (Compound 1) is an HIV-1 attachment inhibitor demonstrating potent antiviral activity against a variety of laboratory and clinical strains of HIV-1 (see U.S. patent application US 2003 0207910, published Nov. 6 2003).



Compound 1

Compound 1 acts by selectively preventing attachment of the exterior viral envelope protein gp120 to its cellular receptor CD4. Binding of gp120 to CD4 is the first step in viral entry and is distinct from the subsequent interaction with a chemokine receptor (CCR5 or CXCR4) or virus-cell fusion event. By inhibiting this interaction, Compound 1 blocks viral entrance into cells.

DESCRIPTION OF THE INVENTION

The invention encompasses pharmaceutical compositions and methods for treating HIV infection and AIDS.

One aspect of the invention is a method for treating HIV infection in a human patient comprising the administration of a therapeutically effective amount of 1-benzoyl-4-[2-[4-methoxy-7-(3-methyl-1*H*-1,2,4-triazol-1-yl)-1*H*-pyrrolo[2,3-*c*]pyridin-3-yl]-1,2-dioxoethyl]-piperazine (Compound 1), or a pharmaceutically acceptable salt or solvate thereof, with a therapeutically effective amount of at least one other agent used for treatment of AIDS or HIV infection selected from the group consisting of nucleoside HIV reverse transcriptase inhibitors, non-nucleoside HIV reverse transcriptase inhibitors, HIV protease inhibitors, HIV fusion inhibitors, HIV attachment inhibitors, CCR5 inhibitors, CXCR4 inhibitors, HIV budding or maturation inhibitors, and HIV integrase inhibitors.

Another aspect of the invention is a method wherein the agent is a nucleoside HIV reverse transcriptase inhibitor.

Another aspect of the invention is a method wherein the nucleoside HIV reverse transcriptase inhibitor is selected from the group consisting of abacavir, didanosine, emtricitabine, lamivudine, stavudine, tenofovir, zalcitabine, and zidovudine, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is a method wherein the agent is a non-nucleoside HIV reverse transcriptase inhibitor.

Another aspect of the invention is a method wherein the non-nucleoside HIV reverse transcriptase inhibitor is selected from the group consisting of delavirdine, efavirenz, and nevirapine, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is a method wherein the agent is an HIV protease inhibitor.

Another aspect of the invention is a method wherein the HIV protease inhibitor is selected from the group consisting of amprenavir, atazanavir, indinavir, lopinavir, nelfinavir, ritonavir, saquinavir and fosamprenavir, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is a method wherein the agent is an HIV fusion inhibitor.

Another aspect of the invention is a method wherein the HIV fusion inhibitor is enfuvirtide or T-1249, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is a method wherein the agent is an HIV attachment inhibitor.

Another aspect of the invention is a method wherein the agent is a CCR5 inhibitor.

Another aspect of the invention is a method wherein the CCR5 inhibitor is selected from the group consisting of Sch-C, Sch-D, TAK-220, PRO-140, and UK-427,857, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is a method wherein the agent is a CXCR4 inhibitor.

Another aspect of the invention is a method wherein the CXCR4 inhibitor is AMD-3100, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is a method wherein the agent is an HIV budding or maturation inhibitor.

Another aspect of the invention is a method wherein the budding or maturation inhibitor is PA-457, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is a method wherein the agent is an HIV integrase inhibitor.

Another aspect of the invention is a method wherein the HIV integrase inhibitor is 3-[(4-fluorobenzyl)methoxycarbamoyl]-2-hydroxyacrylic acid or 2-(2,2)-dimethyl-5-oxo-[1,3]-dioxolan-4-ylidene)-N-(4-fluorobenzyl)-N-methoxyacetamide, or a salt or solvate thereof.

Another aspect of the invention is a pharmaceutical composition comprising a therapeutically effective amount of 1-benzoyl-4-[2-[4-methoxy-7-(3-methyl-1*H*-1,2,4-triazol-1-yl)-1*H*-pyrrolo[2,3-*c*]pyridin-3-yl]-1,2-dioxoethyl]-piperazine, or a pharmaceutically acceptable salt or solvate thereof, with at least one other agent used for treatment of AIDS or HIV infection selected from the group consisting of nucleoside HIV reverse transcriptase inhibitors, non-nucleoside HIV reverse transcriptase inhibitors, HIV protease inhibitors, HIV fusion inhibitors, HIV attachment inhibitors, CCR5 inhibitors, CXCR4 inhibitors, HIV budding or maturation inhibitors, and HIV integrase inhibitors, and a pharmaceutically acceptable carrier.

Another aspect of the invention is the composition wherein the agent is a nucleoside HIV reverse transcriptase inhibitor.

Another aspect of the invention is the composition wherein the nucleoside HIV transcriptase inhibitor is selected from the group consisting of abacavir, didanosine, emtricitabine, lamivudine, stavudine, tenofovir, zalcitabine, and zidovudine, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is the composition wherein the agent is a non-nucleoside HIV reverse transcriptase inhibitor.

Another aspect of the invention is the composition wherein the non-nucleoside HIV reverse transcriptase inhibitor is selected from the group consisting

of delavirdine, efavirenz, and nevirapine, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is the composition wherein the agent is an HIV protease inhibitor.

Another aspect of the invention is the composition wherein the HIV protease inhibitor is selected from the group consisting of amprenavir, atazanavir, indinavir, lopinavir, nelfinavir, ritonavir, saquinavir and fosamprenavir, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is the composition wherein the agent is an HIV fusion inhibitor.

Another aspect of the invention is the composition method wherein the HIV fusion inhibitor is enfuvirtide or T-1249, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is the composition wherein the agent is an HIV attachment inhibitor.

Another aspect of the invention is the composition wherein the agent is a CCR5 inhibitor.

Another aspect of the invention is the composition wherein the CCR5 inhibitor is selected from the group consisting of Sch-C, Sch-D, TAK-220, PRO-140, and UK-427,857, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is a method wherein the agent is a CXCR4 inhibitor.

Another aspect of the invention is a method wherein the CXCR4 inhibitor is AMD-3100, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is the composition wherein the agent is an HIV budding or maturation inhibitor.

Another aspect of the invention is the composition wherein the budding or maturation inhibitor is PA-457, or a pharmaceutically acceptable salt or solvate thereof.

Another aspect of the invention is the composition wherein the agent is an HIV integrase inhibitor.

Another aspect of the invention is the composition wherein the HIV integrase inhibitor is 3-[(4-fluorobenzyl)methoxycarbamoyl]-2-hydroxyacrylic acid or 2-(2,2)-dimethyl-5-oxo-[1,3]-dioxolan-4-ylidene)-N-(4-fluorobenzyl)-N-methoxyacetamide, or a pharmaceutically acceptable salt or solvate thereof.

"Combination," "coadministration," "concurrent," and similar terms referring to the administration of Compound 1 with at least one anti-HIV agent mean that the components are part of a combination antiretroviral therapy or highly active antiretroviral therapy (HAART) as understood by practitioners in the field of AIDS and HIV infection.

"Therapeutically effective" means the amount of agent required to provide a meaningful patient benefit as understood by practitioners in the field of AIDS and HIV infection. In general, the goals of treatment are suppression of viral load, restoration and preservation of immunologic function, improved quality of life, and reduction of HIV-related morbidity and mortality.

"Patient" means a person infected with the HIV virus and suitable for therapy as understood by practitioners in the field of AIDS and HIV infection.

"Treatment," "therapy," "regimen," "HIV infection," "ARC," "AIDS" and related terms are used as understood by practitioners in the field of AIDS and HIV infection.

The invention includes all pharmaceutically acceptable salt forms of Compound 1. Pharmaceutically acceptable salts are those in which the counter ions do not contribute significantly to the physiological activity or toxicity of the compounds and as such function as pharmacological equivalents. In many instances, salts have physical properties that make them desirable for formulation, such as solubility or crystallinity. The salts can be made according to common organic techniques employing commercially available reagents. Suitable anionic salt forms include acetate, acistrate, besylate, bromide, chloride, citrate, fumarate, glucouronate, hydrobromide, hydrochloride, hydroiodide, iodide, lactate, maleate, mesylate, nitrate, pamoate, phosphate, succinate, sulfate, tartrate, tosylate, and xinofoate.

The invention also includes all solvated forms of Compound 1, particularly hydrates. Solvates do not contribute significantly to the physiological activity or toxicity of the compounds and as such function as pharmacological equivalents. Solvates may form in stoichiometric amounts or may form from adventitious solvent or a combination of both. One type of solvate is hydrate. Some hydrated forms include monohydrate, hemihydrate, and dihydrate.

Biological Methods

Compound 1 demonstrated synergistic or additive-synergistic HIV antiviral activity when used in conjunction with a variety of other antiviral agents, as described below.

Virus and cell lines. The T-cell lines, MT-2 and PM-1 were obtained through the AIDS Research and Reference Reagent Program, NIAID, and were contributed by Dr. D. Richman and Dr. R. Gallo, respectively. Both cell lines were cultured in RPMI 1640 medium supplemented with 10 % fetal bovine serum, 2 mM L-glutamine and sub-cultured twice a week. The LAI strain of HIV-1 was obtained from the Fred Hutchinson Cancer Research Center, and the Bal strain was from NIH. Both virus stocks were amplified and titered in MT-2 cells (LAI) and PM-1 cells (Bal) using a virus infectivity assay.

Chemicals. Compound 1, atazanavir, didanosine, stavudine, efavirenz, enfuvirtide (T-20), T-1249, AMD-3100, Sch-C, Sch-D and UK-427,857 were synthesized using published or known reactions. Amprenavir, indinavir, nelfinavir, nevirapine, lopinavir, lamivudine, ritonavir, tenofovir, saquinavir, delavirdine and abacavir were extracted from commercial formulations of the prescribed drugs and purified using published or common techniques. Tenofovir was tested as tenovir disopoxil fumerate. Zalcitabine was obtained from the National Institutes of Health. Zidovudine was purchased from Sigma and emtricitabine from Moravek Biochemicals. 3-[(4-Fluorobenzyl)methoxycarbamoyl]-2-hydroxyacrylic acid (Compound 2) and 2-(2,2)-dimethyl-5-oxo-[1,3]-dioxolan-4-ylidene)-N-(4-fluorobenzyl)-N-methoxyacetamide (Compound 3) are described in US patent 6,777,440. Purities of the anti-HIV agents were greater than 95% except for AMD-3100 (>90%), Sch-D (80%), and UK-427,857 (>90%).

Drug Susceptibility and Cytotoxicity Assays. For drug susceptibility assays, MT-2 cells were infected with HIV-1 LAI (or PM-1 cells with HIV-1 Bal) at an MOI of 0.005, and seeded into 96-well microtiter plates (0.1×10^6 cells/ml) containing serial dilutions of test compounds. The drug combinations were set up using ratios of the two drugs of 1:1, 1:2.5 and 2.5:1 times the EC_{50} value determined for each drug in prior multiple experiments. Each drug ratio consisted of an array of 3-fold serial dilutions, and was performed in quadruplicate. The plates were incubated at $37^{\circ}C/5\%$ CO_2. The MT-2 cells infected with HIV-1 LAI were incubated for 5 days. On day-five post-infection, 20 µl from each well was harvested and quantitated by a reverse transcriptase (RT) assay, or in samples involving non-nucleoside RT inhibitors, an MTS assay. The PM-1 cells infected with HIV-1 Bal and used for studying the combinations with CCR5 inhibitors were incubated for six days. On day-six post-infection, 20 µl from each well was harvested, 20- and 50-fold diluted and quantitated by p24 assay. Cytotoxicity assays were performed using uninfected cells, exposed to the same drug combinations, and incubated for six days. Cell viability was determined by an MTS assay. The CC_{50} values were calculated by using the exponential form of the median effect equation as mentioned below for calculation of EC_{50}.

Analysis of Drug Combination Effects. For determination of CI values, drugs were diluted in a fixed ratio and multiple ratios were analyzed. The drug serial dilutions spanned a range of concentrations near the EC_{50} value of each compound, so that equivalent antiviral activities could be compared. Concentration-response curves were estimated for each individual drug and every combination using the median-effect equation. The equation was fit using a nonlinear regression routine (Proc Nlin) in PC SAS version 8.01 (SAS Institute Inc., SAS Version 8.01, Cary, NC: SAS Institute Inc., 1990).

EC_{50} values for each drug were determined from the single drug experiments, using the median effect equation, $Fa = 1/[1+ (ED_{50}/\text{drug concentration})^m]$. In this equation, Fa stands for "fraction affected," and represents the fraction of the viral load that has been inactivated. For example, Fa of 0.75 indicates that viral replication had been inhibited by 75%, relative to the no-drug controls. ED_{50} is drug concentration that is expected to reduce the amount of virus by 50%, and m is a parameter that reflects the slope of the concentration-response curve.

To assess antiviral effects of different drug combination treatments, combination indices (CIs) were calculated according to Chou and Rideout. The combination index was computed as

$$CI = [D]_1 /[Dm]1 + [D]_2 /[Dm]2$$

In this equation [Dm]1 and [Dm]2 are the concentrations of drugs that would individually produce a specific level of effect, while [D]1 and [D]2 are the concentrations of drugs in combination that would produce the same level of effect.

Theoretically, additivity is implied if the CI is equal to one, synergy if the CI is less than one, and antagonism if the CI is greater than one. However, extensive experience with combination studies indicates that there are inherent laboratory variables that must be taken into account in interpreting the CIs. At best, we can

construct a range that contains the likely values for the CI, given the noise in the data. In this report, these ranges are reported in parentheses next to each point estimate of the CI. For example, when we report a CI of "0.53 (0.46, 0.60)" this means that our best estimate of the CI is 0.53, but due to noise in the data, values from 0.46 to 0.60 are also reasonable values for the CI. This range, 0.46 to 0.60 falls entirely below the value of 1.0, and hence all likely values for the CI are less than 1.0. Therefore, we can infer synergistic behavior for this case. If the range fell entirely above 1.0, we would infer antagonistic behavior. If the range were to include 1.0, we would infer additivity.

In carrying out the combination experiments below, the EC_{50} for Compound 1 and each comparator compound was determined during the course of each study, and used in the subsequent data analysis. The determined values are consistent with our previously published data and are shown in Table 1.

Table 1. Anti-HIV Activity of the Compounds Used in Two-Drug Combination Studies.

Compound	EC_{50} (μM)	Highest Concentration Used (μM)
Compound 1	0.0001-0.0003	0.15
Abacavir	0.326	90
Tenofovir	0.008	6.0
Zalcitabine	0.034	15
Didanosine	0.652	300
Stavudine	0.072	90
Zidovudine	0.001	0.9
Lamivudine	0.030	12
Emtricitabine	0.025	30
Efavirenz	0.001	0.15
Nevirapine	0.107	9.0
Delavirdine	0.025	0.5
Indinavir	0.003	3.0

Table 1. Anti-HIV Activity of the Compounds Used in Two-Drug Combination Studies.

Compound	EC_{50} (μM)	Highest Concentration Used (μM)
Atazanavir	0.0007	0.15
Lopinavir	0.004	3.0
Nelfinavir	0.003	0.9
Amprenavir	0.011	3.0
Saquinavir	0.005	3.0
Ritonavir	0.007	3.0
Enfuvirtide	0.001	0.9
T-1249		
AMD-3100	0.005	0.8
SchC	0.0009	0.9
SchD		
UK-427,857		
Compound 2	0.079	4.0

Two-Drug Combinations of Compound 1 with Nucleoside Reverse Transcriptase Inhibitors. Nucleoside RT inhibitors were combined with Compound 1 at a range of concentrations near the EC_{50} value of each compound, so that equivalent antiviral activities could be compared. All estimates were computed using SAS Proc NLIN, and a two-parameter logistic. Data is presented in Table 2 as the combination indices and the asymptotic confidence intervals for RT inhibitors at different molar ratios (see Materials and Methods). Nucleoside RT inhibitors show synergistic to additive-synergistic antiviral effects in combination with Compound 1. No significant antagonism of anti-HIV activity is observed. No enhanced cytotoxicity was encountered at the highest concentrations tested with any of the drug combinations, as measured by MTS reduction assay.

Table 2. Two-Drug Combinations using Compound 1 and Nucleoside Reverse Transcriptase Inhibitors.

Molar Ratio (EC_{50} Ratio)[a]	Combination Indices at % HIV Inhibition[b] (Confidence Interval)			Overall Result
	50%	75%	90%	
Zalcitabine				
1:100 (1:1)	0.58 (0.46, 0.69)	0.61 (0.43, 0.78)	0.69 (0.39, 1.00)	Synergistic
1:250 (1:2.5)	0.55 (0.47, 0.63)	0.56 (0.44, 0.68)	0.65 (0.43, 0.86)	
1:40 (2.5:1)	0.24 (0.22, 0.26)	0.18 (0.16, 0.20)	0.14 (0.12, 0.17)	
Emtricitabine				
1:200 (1:1)	0.42 (0.35, 0.50)	0.49 (0.37, 0.61)	0.60 (0.38, 0.83)	Synergistic
1:500 (1:2.5)	0.19 (0.15, 0.22)	0.35 (0.26, 0.44)	0.67 (0.36, 0.99)	
1:80 (2.5:1)	0.11 (0.09, 0.12)	0.26 (0.21, 0.31)	0.67 (0.44, 0.89)	
Didanosine				
1:2000 (1:1)	0.31 (0.29, 0.32)	0.16 (0.15, 0.17)	0.08 (0.08, 0.09)	Synergistic
1:5000 (1:2.5)	0.27 (0.23, 0.31)	0.31 (0.24, 0.38)	0.35 (0.23, 0.48)	
1:800 (2.5:1)	0.15 (0.11, 0.19)	0.31 (0.22, 0.40)	0.65 (0.31, 0.98)	
Tenofovir				
1:40 (1:1)	0.09 (0.07, 0.11)	0.17 (0.12, 0.22)	0.34 (0.18, 0.49)	Moderate-Synergistic
1:100 (1:2.5)	0.18 (0.13, 0.22)	0.37 (0.23, 0.50)	0.79 (0.30, 1.28)	
1:16 (2.5:1)	0.37 (0.31, 0.44)	0.60 (0.46, 0.73)	0.97 (0.62, 1.33)	
Stavudine				
1:600 (1:1)	0.52 (0.40, 0.64)	0.60 (0.41, 0.80)	0.75 (0.36, 1.14)	Moderate-Synergistic
1:1500 (1:2.5)	0.38 (0.31, 0.45)	0.37 (0.28, 0.46)	0.40 (0.23, 0.56)	
1:240 (2.5:1)	0.69 (0.51, 0.88)	0.78 (0.49, 1.07)	0.92 (0.36, 1.48)	
Zidovudine				
1:6 (1:1)	0.25 (0.17, 0.34)	0.53 (0.29, 0.78)	1.13 (0.24, 2.02)	Additive-Synergistic
1:15 (1:2.5)	0.46 (0.36, 0.56)	0.52 (0.36, 0.68)	0.59 (0.29, 0.89)	
1:2.4 (2.5:1)	0.37 (0.28, 0.47)	0.49 (0.32, 0.67)	0.66 (0.28, 1.05)	
Lamivudine				
1:80 (1:1)	0.75 (0.45, 1.05)	0.79 (0.35, 1.23)	0.90 (0.11, 1.69)	Additive-Synergistic
1:200 (1:2.5)	0.13 (0.10, 0.16)	0.21 (0.16, 0.27)	0.39 (0.21, 0.58)	
1:32 (2.5:1)	0.14 (0.10, 0.17)	0.26 (0.18, 0.33)	0.49 (0.22, 0.75)	
Abacavir				
1:1000 (1:1)	0.69 (0.49, 0.89)	0.77 (0.46, 1.09)	0.87 (0.30, 1.44)	Additive-Synergistic
1:2500 (1:2.5)	0.56 (0.45, 0.67)	0.51 (0.37, 0.65)	0.48 (0.27, 0.68)	
1:400 (2.5:1)	0.10 (0.05, 0.14)	0.27 (0.16, 0.39)	0.76 (0.14, 1.37)	

a Ratio of Compound 1 to comparator compound.

b A lower bound of the asymptotic confidence interval greater than 1 indicates antagonisms, an upper bound of less than 1 indicates synergism, and a value of 1 being contained in the interval indicates additivity. The 95% confidence intervals are shown in parenthesis, and represent a measure of variability in the data.

Two-Drug Combinations of Compound 1 with Non-Nucleoside Reverse Transcriptase Inhibitors. The results presented in Table 3 show that the combined effect of Compound 1 with efavirenz and delavirdine is synergistic while the effect with nevapiradine is additive-synergystic. No enhanced cytotoxicity was observed at the highest concentrations tested with any of the drug combinations.

Table 3. Two-Drug Combinations using Compound 1 and Non-Nucleoside Reverse Transcriptase Inhibitors.

Molar Ratio (EC_{50} Ratio)[a]	Combination Indices at % HIV Inhibition[b] (Confidence Interval)			Overall Result
	50%	75%	90%	
Efavirenz				
1:2.5 (1:1)	0.70 (0.50, 0.89)	0.47 (0.30, 0.64)	0.32 (0.13, 0.50)	
1:6.25 (1:2.5)	0.47 (0.28, 0.65)	0.46 (0.21, 0.70)	0.45 (0.06, 0.83)	Synergistic
1:1 (2.5:1)	0.52 (0.36, 0.69)	0.39 (0.21, 0.57)	0.30 (0.08, 0.51)	
Delavirdine				
1:8.33 (1:1)	0.90 (0.75, 1.06)	0.49 (0.38, 0.61)	0.28 (0.18, 0.39)	
1:20.8 (1:2.5)	0.57 (0.42, 0.71)	0.55 (0.36, 0.75)	0.57 (0.26, 0.89)	Synergistic
1:3.33 (2.5:1)	0.64 (0.49, 0.78)	0.46 (0.31, 0.60)	0.34 (0.17, 0.50)	
Nevirapine				
1:150 (1:1)	0.19 (0.15, 0.23)	0.22 (0.16, 0.28)	0.26 (0.15, 0.38)	Additive-Synergistic
1:375 (1:2.5)	0.48 (0.35, 0.62)	0.66 (0.40, 0.92)	0.92 (0.35, 1.49)	
1:60 (2.5:1)	0.58 (0.48, 0.67)	0.99 (0.76, 1.22)	1.71 (1.09, 2.33)	

a Ratio of Compound 1 to comparator compound.

b A lower bound of the asymptotic confidence interval greater than 1 indicates antagonisms, an upper bound of less than 1 indicates synergism, and a value of 1 being contained in the interval indicates additivity. The 95% confidence intervals are shown in parenthesis, and represent a measure of variability in the data.

Two-Drug Combinations Involving Compound 1 and HIV Protease Inhibitors. In general, protease combinations with Compound 1 are synergistic to additive-synergistic. No cytotoxicity was observed at the highest concentrations used in any of these combination antiviral assays. Results from this two-drug combination study are summarized in Table 4.

Table 4. Two-Drug Combination using Compound 1 and Protease Inhibitors.

Molar Ratio (EC_{50} Ratio)[a]	Combination Indices at % HIV Inhibition[b] (Confidence Interval)			Overall Result
	50%	75%	90%	
Ritonavir				
1:33.3 (1:1)	0.60 (0.49, 0.72)	0.61 (0.45, 0.77)	0.70 (0.41, 0.99)	
1:83.3 (1:2.5)	0.54 (0.45, 0.63)	0.58 (0.44, 0.71)	0.73 (0.46, 1.00)	Synergistic
1:13.3 (2.5:1)	0.23 (0.20, 0.26)	0.20 (0.17, 0.24)	0.19 (0.14, 0.24)	
Saquinavir				
1:33.3 (1:1)	0.31 (0.28, 0.33)	0.31 (0.28, 0.35)	0.32 (0.26, 0.38)	
1:83.3 (1:2.5)	0.60 (0.52, 0.67)	0.67 (0.56, 0.79)	0.77 (0.56, 0.97)	Synergistic
1:13.3 (2.5:1)	0.39 (0.33, 0.45)	0.59 (0.46, 0.72)	0.90 (0.58, 1.22)	
Atazanavir				
1:1 (1:1)	0.53 (0.46, 0.60)	0.67 (0.54, 0.79)	0.90 (0.64, 1.17)	Additive-Synergistic
1:2.5 (1:2.5)	0.23 (0.16, 0.30)	0.49 (0.29, 0.69)	1.17 (0.38, 1.95)	
1:0.4 (2.5:1)	0.34 (0.26, 0.42)	0.56 (0.38, 0.74)	0.97 (0.46, 1.48)	

Table 4. Two-Drug Combination using Compound 1 and Protease Inhibitors.

Molar Ratio (EC_{50} Ratio)[a]	Combination Indices at % HIV Inhibition[b] (Confidence Interval)			Overall Result
	50%	75%	90%	
Lopinavir				
1:20 (1:1)	0.47 (0.38, 0.56)	0.66 (0.48, 0.84)	1.02 (0.58, 1.46)	Additive-Synergistic
1:50 (1:2.5)	0.89 (0.73, 1.05)	0.90 (0.67, 1.13)	1.00 (0.60, 1.40)	
1:8 (2.5:1)	0.29 (0.25, 0.33)	0.37 (0.30, 0.44)	0.51 (0.37, 0.65)	
Nelfinavir				
1:6 (1:1)	0.39 (0.34, 0.44)	0.47 (0.39, 0.56)	0.58 (0.41, 0.74)	Additive-Synergistic
1:15 (1:2.5)	0.41 (0.32, 0.50)	0.81 (0.57, 1.05)	1.61 (0.84, 2.37)	
1:2.4 (2.5:1)	0.12 (0.09, 0.15)	0.32 (0.22, 0.42)	0.87 (0.38, 1.35)	
Amprenavir				
1:33.3 (1:1)	0.14 (0.11, 0.17)	0.35 (0.26, 0.45)	0.87 (0.46, 1.28)	Additive-Synergistic
1:83.3 (1:2.5)	0.13 (0.09, 0.17)	0.27 (0.17, 0.38)	0.58 (0.19, 0.97)	
1:13.3 (2.5:1)	0.46 (0.32, 0.60)	0.79 (0.46, 1.11)	1.33 (0.42, 2.25)	
Indinavir				
1:20 (1:1)	0.41 (0.26, 0.56)	0.69 (0.34, 1.04)	1.59 (0.29, 2.90)	Additive-Synergistic
1:50 (1:2.5)	0.30 (0.18, 0.41)	0.62 (0.32, 0.92)	1.96 (0.29, 3.64)	
1:8 (2.5:1)	0.05 (0.03, 0.06)	0.16 (0.13, 0.20)	0.68 (0.39, 0.98)	

a Ratio of Compound 1 to comparator compound.

b A lower bound of the asymptotic confidence interval greater than 1 indicates antagonisms, an upper bound of less than 1 indicates synergism, and a value of 1 being contained in the interval indicates additivity. The 95% confidence intervals are shown in parenthesis, and represent a measure of variability in the data.

Two-Drug Combination of Compound 1 with Entry Inhibitors. The results presented in Table 5 indicate that the combination of Compound 1 with AMD-3100 is strongly synergistic at the 50 and 75% inhibition levels, with tendency to additivity at 90%. Therefore, it is classified as moderate synergistic. No significant cytotoxicity was observed at the highest concentration of the combined drugs.

Table 5. Anti-HIV Activity from a Two-Drug Combination using Compound 1 and Entry Inhibitors

Molar Ratio (EC_{50} Ratio)[a]	Combination Indices at % HIV Inhibition[b] (Confidence Interval) 50%	75%	90%	Overall Result
Enfuvirtide				
1:10 (1:1)	0.47 (0.40, 0.54)	0.53 (0.42, 0.65)	0.60 (0.39, 0.81)	
1:25 (1:2.5)	0.48 (0.37, 0.60)	0.60 (0.40, 0.80)	0.75 (0.35, 1.15)	Synergistic
1:4 (2.5:1)	0.35 (0.29, 0.40)	0.47 (0.37, 0.57)	0.63 (0.40, 0.86)	
T-1249				
AMD-3100				
1:16 (1:1)	0.44 (0.29, 0.60)	0.62 (0.31, 0.92)	0.98 (0.21, 1.76)	
1:40 (1:2.5)	0.56 (0.42, 0.70)	0.54 (0.35, 0.73)	0.66 (0.29, 1.02)	Moderate-Synergistic
1:6.4 (2.5:1)	0.52 (0.36, 0.68)	0.61 (0.35, 0.88)	0.77 (0.24, 1.31)	
SchC				
1:10 (1:1)	0.19 (0.14, 0.25)	0.46 (0.29, 0.63)	1.12 (0.4, 1.83)	
1:25 (1:2.5)	0.50 (0.38, 0.61)	0.92 (0.64, 1.21)	1.74 (0.83, 2.65)	Additive-Synergistic
1: 4 (2.5:1)	0.08 (0.05, 0.11)	0.21 (0.14, 0.28)	0.54 (0.21, 0.88)	
SchD				
UK-427,857				

a Ratio of Compound 1 to comparator compound.

b A lower bound of the asymptotic confidence interval greater than 1 indicates antagonisms, an upper bound of less than 1 indicates synergism, and a value of 1 being contained in the interval indicates additivity. The 95% confidence intervals are shown in parenthesis, and represent a measure of variability in the data.

Two-Drug Combination of Compound 1 with an HIV integrase inhibitor. The results presented in Table 6 indicate that the combination of Compound 1 with Compound 2 is moderate synergistic. No significant cytotoxicity was observed at the highest concentration of the combined drugs.

Table 6. Anti-HIV Activity from a Two-Drug Combination using Compound 1 and Compound 2

Molar Ratio (EC_{50} Ratio)[a]	Combination Indices at % HIV Inhibition[b] (Confidence Interval)			Overall Result
	50%	75%	90%	
BMS-538203				
1:80 (1:1)	0.48 (0.39, 0.58)	0.51 (0.37, 0.65)	0.54 (0.31, 0.76)	Moderate-Synergistic
1:200 (1:2.5)	0.44 (0.36, 0.53)	0.51 (0.37, 0.65)	0.59 (0.34, 0.85)	
1:32 (2.5:1)	0.50 (0.36, 0.63)	0.70 (0.44, 0.97)	1.00 (0.41, 1.59)	

a Ratio of Compound 1 to comparator compound.

b A lower bound of the asymptotic confidence interval greater than 1 indicates antagonisms, an upper bound of less than 1 indicates synergism, and a value of 1 being contained in the interval indicates additivity. The 95% confidence intervals are shown in parenthesis, and represent a measure of variability in the data.

Pharmaceutical Composition and Methods of Use

Compound 1 inhibits HIV attachment, an essential step in HIV replication, and can be useful for the treatment of HIV infection and the consequent pathological conditions such as AIDS or ARC. As shown above, Compound 1 is active in conjunction with a wide variety of other agents and may be particularly beneficial in HAART and other new combination compositions and therapies.

Compound 1 will generally be given as a pharmaceutical composition, and the active ingredient of the composition may be comprised of Compound 1 alone or Compound 1 and at least one other agent used for treating AIDS or HIV infection. The compositions will generally be made with a pharmaceutically accepted carrier or vehicle, and may contain conventional exipients. The compositions are made using common formulation techniques. The invention encompasses all conventional forms. Solid and liquid compositions are preferred. Some solid forms include powders, tablets, capsules, and lozenges. Tablets include chewable, buffered, and extended release. Capsules include enteric coated and extended release capsules. Powders are for both oral use and reconstitution into solution. Powders include lyophilized and flash-melt powders. In a solid composition, Compound 1 and any antiretroviral agent are present in dosage unit ranges. Generally, Compound 1 will be in a unit dosage range of 1-1000 mg/unit. Some examples of dosages are 1 mg, 10 mg, 100 mg, 250

mg, 500 mg, and 1000 mg. Generally, other antiretroviral agents will be present in a unit range similar to agents of that class used clinically. Typically, this is 0.25-1000 mg/unit.

Liquids include aqueous solutions, syrups, elixers, emusions, and suspensions. In a liquid composition, Compound 1 and any antiretroviral agent are present in dosage unit ranges. Generally, Compound 1 will be in a unit dosage range of 1-100 mg/mL. Some examples of dosages are 1 mg/mL, 10 mg/mL, 25 mg/mL, 50 mg/mL, and 100 mg/mL. Generally, other antiretroviral agents will be present in a unit range similar to agents of that class used clinically. Typically, this is 1-100 mg/mL.

The invention encompasses all conventional modes of administration; oral and parenteral (injected intramuscular, intravenous, subcutanaeous) methods are preferred. Generally, the dosing regimen will be similar to other antiretroviral agents used clinically. Typically, the daily dose will be 1-100 mg/kg body weight daily for Compound 1. Generally, more compound is required orally and less parenterally. The specific dosing regime, however, will be determined by a physician using sound medical judgement.

The invention also encompasses methods where Compound 1 is given in combination therapy. That is, Compound 1 can be used in conjunction with, but separately from, other agents useful in treating AIDS and HIV infection. Some of these agents include HIV attachment inhibitors, CCR5 inhibitors, CXCR4 inhibitors, HIV cell fusion inhibitors, HIV integrase inhibitors, HIV nucleoside reverse transcriptase inhibitors, HIV non-nucleoside reverse transcriptase inhibitors, HIV protease inhibitors, budding and maturation inhibitors, immunomodulators, and anti-infectives. In these combination methods, Compound 1 will generally be given in a daily dose of 1-100 mg/kg body weight daily in conjunction with other agents. The other agents generally will be given in the amounts used therapeutically. The specific dosing regime, however, will be determined by a physician using sound medical judgement.

Table 7 lists some agents useful in treating AIDS and HIV infection, which are suitable for this invention. The invention, however, is not limited to these agents.

Table 7. ANTIVIRALS

DRUG NAME	MANUFACTURER	INDICATION
097 (non-nucleoside reverse transcriptase inhibitor)	Hoechst/Bayer	HIV infection, AIDS, ARC
Amprenavir 141 W94 GW 141 (protease inhibitor)	Glaxo Wellcome	HIV infection, AIDS, ARC
Abacavir (1592U89) GW 1592 (RT inhibitor)	Glaxo Wellcome	HIV infection, AIDS, ARC
Acemannan	Carrington Labs (Irving, TX)	ARC
Acyclovir	Burroughs Wellcome	HIV infection, AIDS, ARC, in combination with AZT
AD-439	Tanox Biosystems	HIV infection, AIDS, ARC
AD-519	Tanox Biosystems	HIV infection, AIDS, ARC
Adefovir dipivoxil AL-721	Gilead Sciences Ethigen (Los Angeles, CA)	HIV infection, ARC, PGL HIV positive, AIDS
Alpha Interferon HIV in combination w/Retrovir	Glaxo Wellcome	Kaposi's sarcoma
Ansamycin LM 427	Adria Laboratories (Dublin, OH) Erbamont (Stamford, CT)	ARC
Antibody which Neutralizes pH Labile alpha aberrant Interferon	Advanced Biotherapy Concepts (Rockville, MD)	AIDS, ARC
AR177	Aronex Pharm	HIV infection, AIDS, ARC
Beta-fluoro-ddA	Nat'l Cancer Institute	AIDS-associated diseases
BMS-232623 (CGP-73547) (protease inhibitor)	Bristol-Myers Squibb/ Novartis	HIV infection, AIDS, ARC

DRUG NAME	MANUFACTURER	INDICATION
BMS-234475 (CGP-61755) (protease inhibitor)	Bristol-Myers Squibb/ Novartis	HIV infection, AIDS, ARC
CI-1012	Warner-Lambert	HIV-1 infection
Cidofovir	Gilead Science	CMV retinitis, herpes, papillomavirus
Curdlan sulfate	AJI Pharma USA	HIV infection
Cytomegalovirus Immune globin	MedImmune	CMV retinitis
Cytovene	Syntex	Sight threatening
Ganciclovir		CMV peripheral, CMV retinitis
Delaviridine (RT inhibitor)	Pharmacia-Upjohn	HIV infection, AIDS, ARC
Dextran Sulfate	Ueno Fine Chem. Ind. Ltd. (Osaka, Japan)	AIDS, ARC, HIV positive asymptomatic
ddC Dideoxycytidine	Hoffman-La Roche	HIV infection, AIDS, ARC
ddI Dideoxyinosine	Bristol-Myers Squibb	HIV infection, AIDS, ARC; combinationwith AZT/d4T
DMP-450 (protease inhibitor)	AVID (Camden, NJ)	HIV infection, AIDS, ARC
Efavirenz (DMP 266) (-)6-Chloro-4-(S)-cyclopropylethynyl-4(S)-trifluoro-methyl-1,4-dihydro-2H-3,1-benzoxazin-2-one, STOCRINE (non-nucleoside RT inhibitor)	DuPont Merck	HIV infection, AIDS, ARC
EL10	Elan Corp, PLC (Gainesville, GA)	HIV infection
Famciclovir	Smith Kline	herpes zoster, herpes simplex
FTC (reverse transcriptase inhibitor)	Emory University	HIV infection, AIDS, ARC
GS 840 (reverse transcriptase inhibitor)	Gilead	HIV infection, AIDS, ARC

DRUG NAME	MANUFACTURER	INDICATION
HBY097 (non-nucleoside reverse transcriptaseinhibitor)	Hoechst Marion Roussel	HIV infection, AIDS, ARC
Hypericin	VIMRx Pharm.	HIV infection, AIDS, ARC
Recombinant Human Interferon Beta	Triton Biosciences (Almeda, CA)	AIDS, Kaposi's sarcoma, ARC
Interferon alfa-n3	Interferon Sciences	ARC, AIDS
Indinavir	Merck	HIV infection, AIDS, ARC, asymptomatic HIV positive, also in combination with AZT/ddI/ddC
ISIS 2922	ISIS Pharmaceuticals	CMV retinitis
KNI-272	Nat'l Cancer Institute	HIV-associated diseases
Lamivudine, 3TC (reverse transcriptase inhibitor)	Glaxo Wellcome	HIV infection, AIDS, ARC, also with AZT
Lobucavir	Bristol-Myers Squibb	CMV infection
Nelfinavir (protease inhibitor)	Agouron Pharmaceuticals	HIV infection, AIDS, ARC
Nevirapine (RT inhibitor)	Boeheringer Ingleheim	HIV infection, AIDS, ARC
Novapren	Novaferon Labs, Inc. (Akron, OH)	HIV inhibitor
Peptide T Octapeptide Sequence	Peninsula Labs (Belmont, CA)	AIDS
Trisodium Phosphonoformate	Astra Pharm. Products, Inc.	CMV retinitis, HIV infection, other CMV infections
PNU-140690 (protease inhibitor)	Pharmacia Upjohn	HIV infection, AIDS, ARC
Probucol	Vyrex	HIV infection, AIDS
RBC-CD4	Sheffield Med. Tech (Houston, TX)	HIV infection, AIDS, ARC
Ritonavir (protease inhibitor)	Abbott	HIV infection, AIDS, ARC
Saquinavir (protease inhibitor)	Hoffmann-LaRoche	HIV infection, AIDS, ARC
Stavudine; d4T Didehydrodeoxy-thymidine	Bristol-Myers Squibb	HIV infection, AIDS, ARC
Valaciclovir	Glaxo Wellcome	Genital HSV & CMVinfections

DRUG NAME	MANUFACTURER	INDICATION
Virazole Ribavirin	Viratek/ICN (Costa Mesa, CA)	asymptomatic HIV-positive, LAS, ARC
VX-478	Vertex	HIV infection, AIDS, ARC
Zalcitabine	Hoffmann-LaRoche	HIV infection, AIDS, ARC, with AZT
Zidovudine; AZT	Glaxo Wellcome	HIV infection, AIDS, ARC, Kaposi's sarcoma, in combination with other therapies
Tenofovir disoproxil, fumarate salt (Viread®) (reverse transcriptase inhibitor)	Gilead	HIV infection, AIDS
Combivir® (reverse transcriptase inhibitor)	GSK	HIV infection, AIDS
abacavir succinate (or Ziagen®) (reverse transcriptase inhibitor)	GSK	HIV infection, AIDS
Reyataz® (atazanavir)	Bristol-Myers Squibb	HIV infection, AIDS
Fuzeon (Enfuvirtide, T-20)	Roche/Trimeris	HIV infection, AIDS, viral fusion inhibitor
Trizivir®		HIV infection, AIDS
Kaletra®	Abbott	HIV infection, AIDS, ARC

IMMUNOMODULATORS

DRUG NAME	MANUFACTURER	INDICATION
AS-101	Wyeth-Ayerst	AIDS
Bropirimine	Pharmacia Upjohn	Advanced AIDS
Acemannan	Carrington Labs, Inc. (Irving, TX)	AIDS, ARC
CL246,738	American Cyanamid Lederle Labs	AIDS, Kaposi's sarcoma
EL10	Elan Corp, PLC (Gainesville, GA)	HIV infection
FP-21399	Fuki ImmunoPharm	Blocks HIV fusion with CD4+ cells

DRUG NAME	MANUFACTURER	INDICATION
Gamma Interferon	Genentech	ARC, in combination w/TNF (tumor necrosis factor)
Granulocyte Macrophage Colony Stimulating Factor	Genetics Institute Sandoz	AIDS
Granulocyte Macrophage Colony Stimulating Factor	Hoechst-Roussel Immunex	AIDS
Granulocyte Macrophage Colony Stimulating Factor	Schering-Plough	AIDS, combination w/AZT
HIV Core Particle Immunostimulant	Rorer	Seropositive HIV
IL-2 Interleukin-2	Cetus	AIDS, in combination w/AZT
IL-2 Interleukin-2	Hoffman-LaRoche Immunex	AIDS, ARC, HIV, in combination w/AZT
IL-2 Interleukin-2 (aldeslukin)	Chiron	AIDS, increase in CD4 cell counts
Immune Globulin Intravenous (human)	Cutter Biological (Berkeley, CA)	Pediatric AIDS, in combination w/AZT
IMREG-1	Imreg (New Orleans, LA)	AIDS, Kaposi's sarcoma, ARC, PGL
IMREG-2	Imreg (New Orleans, LA)	AIDS, Kaposi's sarcoma, ARC, PGL
Imuthiol Diethyl Dithio Carbamate	Merieux Institute	AIDS, ARC
Alpha-2 Interferon	Schering Plough	Kaposi's sarcoma w/AZT, AIDS
Methionine-Enkephalin	TNI Pharmaceutical (Chicago, IL)	AIDS, ARC
MTP-PE Muramyl-Tripeptide Granulocyte Colony Stimulating Factor	Ciba-Geigy Corp. Amgen	Kaposi's sarcoma AIDS, in combination w/AZT
Remune	Immune Response Corp.	Immunotherapeutic
rCD4 Recombinant Soluble Human CD4	Genentech	AIDS, ARC
rCD4-IgG hybrids		AIDS, ARC

DRUG NAME	MANUFACTURER	INDICATION
Recombinant Soluble Human CD4	Biogen	AIDS, ARC
Interferon Alfa 2a	Hoffman-La Roche in combination w/AZT	Kaposi's sarcoma, AIDS, ARC
SK&F106528 Soluble T4	Smith Kline	HIV infection
Thymopentin	Immunobiology Research Institute (Annandale, NJ)	HIV infection
Tumor Necrosis Factor; TNF	Genentech	ARC, in combination w/gamma Interferon

ANTI-INFECTIVES

DRUG NAME	MANUFACTURER	INDICATION
Clindamycin with Primaquine	Pharmacia Upjohn	PCP
Fluconazole	Pfizer	Cryptococcal meningitis, candidiasis
Pastille Nystatin Pastille	Squibb Corp.	Prevention of oral candidiasis
Ornidyl Eflornithine	Merrell Dow	PCP
Pentamidine Isethionate (IM & IV)	LyphoMed (Rosemont, IL)	PCP treatment
Trimethoprim		Antibacterial
Trimethoprim/sulfa		Antibacterial
Piritrexim	Burroughs Wellcome	PCP treatment
Pentamidine Isethionate for Inhalation	Fisons Corporation	PCP prophylaxis
Spiramycin	Rhone-Poulenc diarrhea	Cryptosporidial
Intraconazole-R51211	Janssen-Pharm.	Histoplasmosis; cryptococcal meningitis
Trimetrexate	Warner-Lambert	PCP
Daunorubicin	NeXstar, Sequus	Kaposi's sarcoma
Recombinant Human Erythropoietin	Ortho Pharm. Corp.	Severe anemia assoc. with AZT therapy
Recombinant Human Growth Hormone	Serono	AIDS-related wasting, cachexia
Megestrol Acetate	Bristol-Myers Squibb	Treatment of anorexia assoc. W/AIDS
Testosterone	Alza, Smith Kline	AIDS-related wasting

DRUG NAME	MANUFACTURER	INDICATION
Total Enteral Nutrition	Norwich Eaton Pharmaceuticals	Diarrhea and malabsorption related to AIDS

CLAIMS

We claim:

1. A method for treating HIV infection in a human patient comprising administering a therapeutically effective amount of 1-benzoyl-4-[2-[4-methoxy-7-(3-methyl-1*H*-1,2,4-triazol-1-yl)-1*H*-pyrrolo[2,3-*c*]pyridin-3-yl]-1,2-dioxoethyl]-piperazine, or a pharmaceutically acceptable salt or solvate thereof, with a therapeutically effective amount of at least one other agent used for treatment of AIDS or HIV infection selected from the group consisting of nucleoside HIV reverse transcriptase inhibitors, non-nucleoside HIV reverse transcriptase inhibitors, HIV protease inhibitors, HIV fusion inhibitors, HIV attachment inhibitors, CCR5 inhibitors, CXCR4 inhibitors, HIV budding or maturation inhibitors, and HIV integrase inhibitors.

2. The method of claim 1 wherein the agent is a nucleoside HIV reverse transcriptase inhibitor.

3. The method of claim 2 wherein the nucleoside HIV reverse transcriptase inhibitor is selected from the group consisting of abacavir, didanosine, emtricitabine, lamivudine, stavudine, tenofovir, zalcitabine, and zidovudine, or a pharmaceutically acceptable salt or solvate thereof.

4. The method of claim 1 wherein the agent is a non-nucleoside HIV reverse transcriptase inhibitor.

5. The method of claim 4 wherein the non-nucleoside HIV reverse transcriptase inhibitor is selected from the group consisting of delavirdine, efavirenz, and nevirapine, or a pharmaceutically acceptable salt or solvate thereof.

6. The method of claim 1 wherein the agent is an HIV protease inhibitor.

7. The method of claim 6 wherein the HIV protease inhibitor is selected from the group consisting of amprenavir, atazanavir, indinavir, lopinavir, nelfinavir, ritonavir, saquinavir and fosamprenavir, or a pharmaceutically acceptable salt or solvate thereof.

8. The method of claim 1 wherein the agent is an HIV fusion inhibitor.

9. The method of claim 8 wherein the HIV fusion inhibitor is enfuvirtide or T-1249, or a pharmaceutically acceptable salt or solvate thereof.

10. The method of claim 1 wherein the agent is an HIV attachment inhibitor.

11. The method of claim 1 wherein the agent is a CCR5 inhibitor.

12. The method of claim 11 wherein the CCR5 inhibitor is selected from the group consisting of Sch-C, Sch-D, TAK-220, PRO-140, and UK-427,857, or a pharmaceutically acceptable salt or solvate thereof.

13. The method of claim 1 wherein the agent is a CXCR4 inhibitor.

14. The method of claim 13 wherein the CXCR4 inhibitor is AMD-3100, or a pharmaceutically acceptable salt or solvate thereof.

15. The method of claim 1 wherein the agent is an HIV budding or maturation inhibitor.

16. The method of claim 15 wherein the budding or maturation inhibitor is PA-457, or a pharmaceutically acceptable salt or solvate thereof.

17. The method of claim 1 wherein the agent is an HIV integrase inhibitor.

18. The method of claim 17 wherein the HIV integrase inhibitor is 3-[(4-fluorobenzyl)methoxycarbamoyl]-2-hydroxyacrylic acid or 2-(2,2)-dimethyl-5-oxo-

[1,3]-dioxolan-4-ylidene)-N-(4-fluorobenzyl)-N-methoxyacetamide, or a pharmaceutically acceptable salt or solvate thereof.

19. A pharmaceutical composition comprising a therapeutically effective amount of 1-benzoyl-4-[2-[4-methoxy-7-(3-methyl-1*H*-1,2,4-triazol-1-yl)-1*H*-pyrrolo[2,3-*c*]pyridin-3-yl]-1,2-dioxoethyl]-piperazine, or a pharmaceutically acceptable salt or solvate thereof, with at least one other agent used for treatment of AIDS or HIV infection selected from the group consisting of nucleoside HIV reverse transcriptase inhibitors, non-nucleoside HIV reverse transcriptase inhibitors, HIV protease inhibitors, HIV fusion inhibitors, HIV attachment inhibitors, CCR5 inhibitors, CXCR4 inhibitors, HIV budding or maturation inhibitors, and HIV integrase inhibitors, and a pharmaceutically acceptable carrier.

20. The composition of claim 19 wherein the agent is a nucleoside HIV reverse transcriptase inhibitor.

21. The composition of claim 20 wherein the nucleoside HIV transcriptase inhibitor is selected from the group consisting of abacavir, didanosine, emtricitabine, lamivudine, stavudine, tenofovir, zalcitabine, and zidovudine, or a pharmaceutically acceptable salt or solvate thereof.

22. The composition of claim 19 wherein the agent is a non-nucleoside HIV reverse transcriptase inhibitor.

23. The composition of claim 22 wherein the non-nucleoside HIV reverse transcriptase inhibitor is selected from the group consisting of delavirdine, efavirenz, and nevirapine, or a pharmaceutically acceptable salt or solvate thereof.

24. The composition of claim 19 wherein the agent is an HIV protease inhibitor.

25. The composition of claim 24 wherein the HIV protease inhibitor is selected from the group consisting of amprenavir, atazanavir, indinavir, lopinavir, nelfinavir,

ritonavir, saquinavir and fosamprenavir, or a pharmaceutically acceptable salt or solvate thereof.

26. The composition of claim 19 wherein the agent is an HIV fusion inhibitor.

27. The composition of claim 26 wherein the HIV fusion inhibitor is enfuvirtide or T-1249, or a pharmaceutically acceptable salt or solvate thereof.

28. The composition of claim 19 wherein the agent is an HIV attachment inhibitor.

29. The composition of claim 19 wherein the agent is a CCR5 inhibitor.

30. The composition of claim 29 wherein the CCR5 inhibitor is selected from the group consisting of Sch-C, Sch-D, TAK-220, PRO-140, and UK-427,857, or a pharmaceutically acceptable salt or solvate thereof.

31. The composition of claim 19 wherein the agent is a CXCR4 inhibitor.

32. The composition of claim 31 wherein the CXCR4 inhibitor is AMD-3100, or a pharmaceutically acceptable salt or solvate thereof.

33. The composition of claim 19 wherein the agent is an HIV budding or maturation inhibitor.

34. The composition of claim 33 wherein the budding or maturation inhibitor is PA-457, or a pharmaceutically acceptable salt or solvate thereof.

35. The composition of claim 19 wherein the agent is an HIV integrase inhibitor.

36. The composition of claim 35 wherein the HIV integrase inhibitor is 3-[(4-fluorobenzyl)methoxycarbamoyl]-2-hydroxyacrylic acid or 2-(2,2)-dimethyl-5-oxo-

[1,3]-dioxolan-4-ylidene)-N-(4-fluorobenzyl)-N-methoxyacetamide, or a pharmaceutically acceptable salt or solvate thereof.