**What Is Resistance?**

HIV drugs are designed to keep the amount of HIV virus in your body under control by preventing it from reproducing (or making copies of itself). Sometimes the HIV virus changes, or mutates, as it makes copies of itself. These changes may allow the virus to overcome the effects of a drug and keep reproducing. When this happens, we say that HIV has developed resistance to that drug.

Resistance is a major challenge in HIV treatment. Resistance decreases the ability of HIV drugs to control the virus and reduces your treatment options. The best way to prevent resistance is to stick closely (adhere) to your HIV drug regimen. With good adherence [2], resistance is less likely to develop. This gives your current drugs the best chance of working and will keep more treatment options open to you in the future.
What Causes Resistance?

After infecting a CD4 cell (disease-fighting white blood cell), HIV makes many new copies of itself; these copies then infect other CD4 cells. This process happens very quickly – HIV can make billions of new viruses every day. When making new viruses, HIV must copy its genetic information. Copying happens so fast that mistakes are made. These mistakes are called mutations, and they occur randomly.

Some mutations are harmless. They produce weak viruses that cannot infect other CD4 cells. Other mutations can cause big problems – they allow the virus to reproduce even when it is exposed to certain HIV drugs. If a drug does not work against a mutated virus, that virus will reproduce rapidly. This causes the amount of HIV in your blood (your viral load) to go up, and it may be necessary to change drugs to get HIV back under control.

The main reason to use a combination of HIV drugs instead of just one is to block reproduction at several points in HIV's lifecycle. A combination of drugs aimed at several different targets is much better at preventing HIV reproduction than one drug alone. With less reproduction, viral load is lower, and mutations and resistance are less likely to occur.

Cross-Resistance and Sequencing

Cross-resistance happens when certain mutations cause resistance not just to one drug, but to an entire class (type) of drugs. There are six classes of HIV drugs:

- Nucleoside or nucleotide reverse transcriptase inhibitors (NRTIs) such as Retrovir (zidovudine) and Ziagen (abacavir)
- Non-nucleoside reverse transcriptase inhibitors (NNRTIs) such as Sustiva (efavirenz) and Viramune (nevirapine)
- Protease Inhibitors (PIs) such as Reyataz (atazanavir) and Prezista (darunavir)
- Entry inhibitors such as Selzentry (maraviroc) and Fuzeon (enfuvirtide)
- Integrase inhibitors such as Isentress (raltegravir)
- Boosting agents such as Norvir (ritonavir) and Tybost (cobicistat)

Cross-resistance is more likely to happen in some classes than others. For example, resistance to the NRTI Retrovir also causes resistance to many of the other NRTIs. Resistance to one NNRTI also leads to resistance to most of the other NNRTIs. This may limit your choices when it is time to pick a new combination of HIV drugs.

If you are starting a treatment regimen (combination of HIV medications) for the first time, it is important to ask your health care provider about additional options in case the current regimen does not work for you. Thinking ahead will help to ensure that you have several good drug choices in the future.

How Do I Know if I Have Drug Resistance?

Resistance is common and can be transmitted with the virus. The World Health Organization (WHO) reported in 2012 that an estimated 10 to 17 percent of people who newly acquired HIV and live in the US, Europe, Australia, and Japan were infected with strains of the virus that are resistant to at least one HIV medication. This means that some people who just acquired HIV and have never taken
any HIV medications already have drug-resistant HIV and therefore fewer HIV treatments to choose from. People living with HIV who have already received HIV treatment are even more likely to have resistant virus and fewer drug choices.

The best way to tell if you have drug resistance is to have regular viral load tests. If your HIV drugs are working well to control your virus, your viral load should be "undetectable" – so low that the test cannot detect any virus in your blood. If you are taking HIV drugs and your viral load does not become undetectable or goes up after you have been taking the drugs for a while, your virus may have developed drug resistance.

If this happens, it is important that you have a drug resistance test. These tests can help you and your health care provider determine which HIV drugs will work for you.

**Resistance Testing**

According to guidelines [7] from the US Department of Health and Human Services (DHHS), resistance testing is recommended for:

- People who have just acquired HIV, whether or not they are going to take HIV drugs right away
- People who have never taken HIV drugs and are starting to receive medical care, whether or not they are going to take HIV drugs right away
- People who have never been on HIV drugs and are planning to start
- People who are on HIV drugs and see their viral load go up (usually over 1,000 copies/mL)
- People who have recently started HIV drugs and their viral load is not coming down to undetectable
- Pregnant women living with HIV

Resistance testing is not usually recommended for:

- People who have stopped HIV drugs for four weeks or more
- People with a viral load below 500 copies

Stopping HIV medications for some time allows the resistant virus in the blood to die out and become replaced by the non-resistant virus (wild type). If the resistant virus has died out, the resistance test does not provide useful information. However, the test may still be helpful, if there are mutations (changes in the virus’ genetic sequence or genetic code) of the wild-type virus.

There are several ways to test for resistance:

- **Genotype test**

  This test uses HIV from your blood to check for mutations associated with drug resistance. This is the preferred test for those who are new to HIV treatment, whose HIV drugs fail to bring their viral load down enough, and for pregnant women with detectable virus while on treatment.

- **Phenotype test**

  This test exposes your virus to many HIV drugs in a test tube to determine which ones still work against your HIV. This is the preferred test for people with complex drug-resistance patterns.

- **Virtual phenotype test**

  This is a genotype test that goes one step further – it takes your genotype, finds similar genotypes in a database, and uses their phenotypic test results to predict which drugs will be
Resistance tests are helpful when choosing a drug regimen. The tests are only a guide, however. Other factors, such as past medications, side effects, and adherence should be taken into account as well.

**Preventing Resistance**

The best way to avoid resistance is to take your medications daily as prescribed. It is important not to skip doses. Also, try to take your medications at the same time every day. If you maintain good adherence [2], you give your HIV drugs the best chance to work and yourself the best chance to live in good health.

Although resistance may seem overwhelming, remember that you have the power to help prevent it. If you follow your medication schedule, the virus will not reproduce as quickly. And if it is not reproducing, it cannot make the changes that lead to resistance.

**Tags:**
- women and HIV drug resistance [8]
- women and HIV resistance [9]
- HIV drug resistance [10]
- HIV resistance testing [12]
- resistance testing [13]
- phenotype [14]
- genotype [15]
- drug resistance [16]
- cross resistance [17]

**Additional Resources**

- Drug Resistance and Resistance Testing (CATIE) [18]
- Drug Resistance (aidsmap) [19]
- HIV Drug Resistance (World Health Organization) [20]
- HIV Drug Resistance (POZ) [21]
- HIV Resistance Testing (AIDS InfoNet) [22]
- A Guide to HIV Drug Resistance (The Body.com) (PDF) [23]
- HIV Drug Resistance Database (Stanford University) [24]
- Drug Resistance Testing (AIDSinfo) [25]
- Drug Resistance (AIDSinfo) [26]
- Why Do People With Drug-Resistant HIV Still Have Few Treatment Options? (plus) [27]