



Rationale for Trials of Pre-Exposure Prophylaxis for HIV Prevention

Researchers believe that an antiretroviral drug taken as a daily oral preventative is one of the most important new prevention approaches being investigated today. An effective daily preventative treatment could help address the urgent need for female-controlled prevention methods and, when combined with existing prevention measures, could help reduce new HIV infections among men and women at high risk.

The concept of providing a preventative treatment before exposure to an infectious agent is not new. For example, when individuals travel to an area where malaria is common, they are advised to take medication to fight malaria before and during travel to that region. The medicine to prevent illness will then be in their bloodstream if they are exposed to the infectious agent that causes malaria.

Several sources of data suggest that the use of antiretroviral drugs in this manner may be effective in reducing the risk of HIV infection. Theoretically, if HIV replication can be inhibited from the very first moment the virus enters the body, it may not be able to establish a permanent infection. Providing antiretrovirals (ARVs) to HIV-infected women during labor and delivery and to their newborns immediately following birth has been shown to reduce the risk of mother-to-child transmission by about 50 percent. Additionally, in observational studies, ARV regimens have been associated with an 80 percent reduction in the risk of HIV infection among health care workers following needle sticks and other accidental exposures, when treatment is initiated promptly and continued for several weeks. Finally, animal studies have shown that tenofovir can reduce the transmission of a virus similar to HIV in monkeys when given before and immediately after a single retroviral exposure. Animal studies have also demonstrated that pre-exposure administration of tenofovir plus emtricitabine provided significant protection to monkeys exposed repeatedly to an HIV-like virus. These data, combined with the drugs' favorable resistance and safety profiles as HIV treatments, make tenofovir and tenofovir plus emtricitabine ideal candidates for HIV prevention trials.

Tenofovir was approved by the U.S. Food and Drug Administration in 2001 as a treatment for HIV infection, and the tenofovir plus emtricitabine combination pill was approved for use as an HIV treatment in 2004. More than 200,000 HIV-infected people around the world have now used these drugs. As treatments for HIV-infected individuals, tenofovir and tenofovir plus emtricitabine have been shown to be both safe and effective. They have relatively low levels of side effects and slow development of associated drug resistance, compared with other available HIV treatments. Because the therapies are taken orally only once a day, with or without food, they are also among the most convenient-to-use HIV drugs available today. These trials are designed to evaluate the drugs' safety and efficacy among uninfected individuals. Side effects may differ in HIV-negative populations, and it is not yet known if tenofovir or tenofovir plus emtricitabine can prevent HIV infection in humans.

Characteristics of Current PrEP Candidates

- Established safety as HIV treatments
- Potent antiretrovirals
- Long duration of action
- Once-daily dosing
- Low levels of resistance



The United States

The U.S. trial is designed to assess the clinical and behavioral safety of once-daily tenofovir among HIV-negative MSM. This trial will not be large enough to evaluate the drug's efficacy in reducing HIV transmission. Data from the CDC trial will provide critical information to guide the development of guidelines for use, should efficacy be demonstrated in other trials.

■ **United States** — The U.S. study is being conducted at three sites in collaboration with the San Francisco Department of Public Health, the AIDS Research consortium of Atlanta, and Fenway Community Health in Boston. The study has enrolled 400 HIV-negative MSM who reported having had anal intercourse in the prior 12 months. Participants are randomly assigned to one of four study arms. Two arms receive either tenofovir or placebo immediately upon enrollment, while the other two arms receive either tenofovir or placebo after nine months of enrollment. This design will allow researchers to compare risk behaviors among those taking a daily pill and those not taking pills.



Education and Enrollment of Trial Participants

Understanding the potential impact of a daily preventative drug regimen on HIV risk behaviors will be critical, should pre-exposure prophylaxis prove effective in reducing HIV transmission. One of the greatest risks, as efforts progress to identify new biomedical prevention approaches, is that individuals at risk will reduce their use of existing HIV prevention strategies. It will therefore be crucial to reinforce proven behavioral prevention strategies, both within and beyond these trials. All three trials are taking multiple steps to address this issue during the education and enrollment of trial participants and through ongoing participant counseling.

First, it is critical to ensure that participants understand that trial participation may not protect them from HIV infection—either because they may receive a placebo or because they may receive a study drug, the efficacy of which remains unproven. This and other key aspects of the trial, including the potential risks and benefits of participation, are explained to potential volunteers in the language of their choice, prior to their enrollment. To ensure participants fully understand all aspects of their participation, all volunteers are required to pass a comprehension test prior to providing written informed consent. Study participants are also free to withdraw from the trial at any time and for any reason.

Risk-Reduction Counseling and Other Prevention and Treatment Services

To assist participants in eliminating or reducing HIV risk behaviors, extensive counseling is provided at each study visit, and more often if needed. This interactive counseling has proven effective in reducing the risk of HIV and other STDs in multiple populations, including past participants of similar HIV prevention trials. Participants are also offered free condoms and STD testing and treatment to reduce their risk for HIV infection. Additionally, in Thailand, participating IDUs are offered follow-up in a methadone drug treatment program and receive bleach and instructions on how to use it to clean needles. Consistent with Thai government policy, sterile syringes are not provided, but are widely available in Thailand without a prescription and at low cost (one sterile syringe and one needle cost about 5 baht, or about \$0.15).



While participants will likely be at lower risk as a result of these prevention services, some individuals will engage in behavior that places them at risk for HIV infection. To ensure that participants who are infected during the trial are quickly referred to the best available medical and psychosocial services, participants receive free rapid HIV testing at every visit. This regular HIV testing will also help guard against the development of drug-resistant virus, as the study drug will be immediately discontinued when infection is detected.

Participants who become infected receive confirmatory testing for infection, post-test risk-reduction and support counseling, and help enrolling in local HIV care programs. Both Thailand and Botswana have antiretroviral treatment and HIV care programs in place at minimal or no cost to patients. In the United States, participants are referred to local health care providers or public health programs for needed medical and social services.

Additionally, to help guide treatment decisions and to determine if prior exposure to tenofovir or tenofovir plus emtricitabine has any effect on the course of disease, initial testing will be provided for viral load, CD4 count, and HIV resistance mutations. Participants will also be followed for an additional 12 months following infection to examine their immune and virologic response. Although study procedures ensure a very low risk of drug-resistant virus emerging, the initial HIV resistance testing will provide important data on the degree to which any resistance does occur.

Monitoring for Side Effects

The health of participants is closely monitored throughout each trial, and participants are linked to any necessary medical care. In addition to scheduled reviews of safety data by the DSMB, both clinical and behavioral safety are closely monitored on an ongoing basis.

Although the drugs being tested have excellent safety profiles, there are potential medical risks. Tenofovir has been associated with minor side effects such as nausea, vomiting, and loss of appetite, as well as rare but more serious effects, such as impaired kidney function or reductions in bone density. Tenofovir plus emtricitabine has similarly been associated with a relatively low level of side effects, including diarrhea, nausea, fatigue, headache, dizziness, and rash, with infrequent reports of more serious side effects, such as impaired kidney function and lactic acidosis (a build-up of lactic acid in the blood). For both drugs, these effects have largely been reversed after use of the drug was discontinued.

Careful monitoring is provided using laboratory testing for any biological abnormalities (such as elevated creatinine or decreased phosphorus), so that the drug being tested can be promptly discontinued if serious concerns are identified. CDC will work with partners in each community to ensure that care is provided if either drug results in any health problems during the trial.

Community Involvement

CDC has and will continue to work closely with community partners at each research site to ensure active community participation during the planning and implementation of these trials.

■ **Botswana** — In Botswana, community advisory boards have been established at each site, which include representatives from local governments (elected and traditional), as well as community members and representatives from key stakeholder organizations. Participant advisory boards have also been established. These groups provide input to researchers throughout the trial.

■ **Thailand** — In Thailand, a community relations committee, composed of injecting drug users from each of the 17 drug treatment centers, family members, and representatives of local community organizations, meets regularly and provides advice to study staff on all aspects of study design, implementation, and trial conduct.



■ **United States** — In the United States, all three sites have established active community advisory boards that are consulted regularly about study procedures and educational materials for potential participants. Members of these boards provide ongoing advice throughout the trials.

In addition to the regular input received by these established committees, broader outreach and consultations with advocates and community-based organizations representing populations at risk for HIV are held, as needed, to address current and future plans for HIV prevention research and programs.

CDC Participation in Partners PrEP Study

The University of Washington is working with collaborators in Kenya and Uganda to conduct the Partners PrEP Study, which is examining the safety and efficacy of two different PrEP regimens — once-daily tenofovir and once-daily tenofovir plus emtricitabine — among heterosexual couples. CDC co-manages two trial sites in Uganda, in conjunction with The AIDS Support Organization (TASO), the largest indigenous non-governmental organization providing HIV care in Uganda.

This randomized, double-blind, placebo-controlled study operates at eight trial sites in Kenya and Uganda and will include 3,900 serodiscordant couples (couples in which one person is HIV-infected and the other is not). Stable serodiscordant couples are the largest risk group for HIV infection in Africa, and this trial will provide important data on whether PrEP could be used to prevent new HIV infections among this population. HIV-uninfected partners are assigned to one of three groups: tenofovir, tenofovir plus emtricitabine, and placebo. All participants receive ongoing risk reduction counseling and HIV testing, and their safety is monitored by the study's DSMB and local IRBs. HIV-infected members of the discordant couples receive ongoing HIV care.

The trial is the first to test the safety and efficacy of both tenofovir and tenofovir plus emtricitabine in the same population and will allow investigators to simultaneously evaluate the two drugs as candidates for use as PrEP.

Planning for Possible Implementation of PrEP

As we move forward with the search for new HIV prevention strategies, it will be critical to determine how these approaches can best be integrated into existing programs, should they prove effective in reducing risk. Because no strategy is 100 percent effective in preventing HIV infection, the future impact of PrEP will ultimately be determined by how effectively strategies are used in combination to provide the greatest protection to individuals at risk.

CDC has begun to examine potential implementation strategies with a wide range of stakeholders in the U.S. Experts are examining a number of critical issues including possible funding streams, risk assessment tools, and delivery of PrEP as part of a comprehensive prevention program. Additionally, CDC is conducting research to determine effective models for reaching the populations at greatest risk in the U.S.

At the international level, should efficacy be proven, WHO and UNAIDS would develop normative guidance on PrEP implementation, and individual countries would develop their own programs and policies for integrating PrEP into prevention efforts. As these plans are developed, CDC will provide technical assistance to its international partners and to countries where CDC trials are being conducted.