Biomedical HIV Prevention Research: The Basics
Basic Overview

We will introduce the range of biomedical HIV prevention options currently being studied and/or implemented:

- AIDS vaccines
- Microbicides
- Pre-exposure prophylaxis (PrEP)
- Treatment as prevention
- Medical male circumcision

For each option we will review:

- What is it?
- How might it work?
- Snapshot: What do we know?
HIV/AIDS Toolkit

Prior to exposure
- Education and behavior change
- Needle exchange
- Adult medical male circumcision
- Pre-exposure prophylaxis (PrEP)
- Preventive vaccines
- Treat other STDs (e.g., HSV-2)

Point of transmission
- Male and female condoms
- Use of clean needles
- Antiretroviral therapy (prevent vertical transmission)
- Post exposure prophylaxis (PEP)
- Microbicides (vaginal / rectal)

After infection
- Antiretroviral therapy
- Care
- Education and behavioral change
- Therapeutic HIV/AIDS vaccines
- Treat other STDs (e.g., HSV-2)
What is a vaccine?

- A substance that teaches the immune system how to **protect** itself against a **virus** or **bacteria**
- No effective AIDS vaccine available today
- AIDS vaccines **cannot cause** HIV
- No vaccine is 100% effective. Most licensed vaccines are 70%-95% effective.
How does a vaccine work?

- By teaching the body to recognize and fight invaders – vaccine presents a small amount of virus or copy of virus
  - AIDS vaccines **do not contain HIV**, only manufactured copies of one or more pieces of the virus
- Body reacts by creating antibodies or killer cells
- If someone who is vaccinated later “sees” the virus via sexual or needle exposure, the body calls on the vaccine-induced antibodies and killer cells to stave off infection or lessen disease progression if infection is established

Graphics courtesy of Gail Broder, HVTN
### Types of experimental AIDS vaccines

- **Preventive Vaccines**
  - Designed for people who are not infected with HIV
  - Reduces risk of infection or viral load set point after infection

- **Therapeutic Vaccines**
  - Designed for people who are living with HIV
  - Uses the body’s immune system to control HIV in the body

**Humoral Immunity**

**Cellular Immunity**
What do we know?

- Proof of concept! The RV144 prime-boost AIDS vaccine trial showed a modest prevention effect (31% reduction in risk)--announced November 2009

- Researchers are trying to understand why the vaccine regimen in RV144 worked so that they might be able to create more effective vaccines
What is a microbicide?

- An effective microbicide could be used in the vagina or rectum to reduce the risk of HIV transmission during sex.
- Microbicides are being tested in various forms--creams, foams, gels, slow release vaginal rings, films, enemas and suppositories.
How might a microbicide work?

- Microbicicides might provide protection through an active ingredient such as an ARV, which might block HIV activity directly or another approach may provide a physical barrier at the site of exposure (vagina and/or rectum).
What do we know?

- Proof of concept! CAPRISA 004 tested 1% tenofovir gel (an antiretroviral-based microbicide) in heterosexual women and showed that it reduced risk of HIV by approximately 39%.

- 1% tenofovir gel is the only microbicide that has shown a protective effect in a large-scale trial; non-ARV-based candidates tested in earlier trials were safe but not effective (e.g., PRO 2000, Carraguard).

- Most data to-date is on vaginal microbicides; rectal microbicide research not as far along but making important advances.
What is PrEP?

- Pre-exposure prophylaxis is a concept where people take medicine to *prevent* rather than to treat a disease or condition.
- PrEP for HIV prevention involves HIV-negative individuals taking ARVs (drugs currently used to treat people with HIV/AIDS) to reduce risk of HIV infection.
How might PrEP work?

- ARVs block HIV as it infects cells or copies itself once inside a cell; TDF and TDF/FTC are reverse-transcriptase inhibitors, drugs that are absorbed into cells and help block a critical step in viral replication.
- In HIV-negative people, TDF and TDF/FTC appear to provide protection by stopping HIV from successfully copying itself.
- Video available at http://vimeo.com/24036739
What do we know?

- Proof of concept! Three large-scale PrEP safety and effectiveness trials (in gay men and transgender women; serodiscordant couples; heterosexual men and women) have shown evidence of HIV risk reduction.
- One large-scale trial in heterosexual women showed no effect.
- Adherence matters—those who were able to follow the PrEP regimen as prescribed had lower risk.
What is treatment as prevention?

- Use of antiretroviral treatment in HIV-positive people to reduce the risk passing HIV to others
- The strategy is a secondary benefit of ARV treatment of which the primary benefit is the individual’s health
- The rationale is that ARVs reduce viral load, which has been shown to decrease infectiousness
What do we know?

- Treatment as prevention works! HPTN 052, a multinational trial in serodiscordant couples, showed that treatment initiation reduced risk of infection by 96% in the HIV-negative partner and reduced risk of extrapulmonary TB in HIV-positive partner.
- Observational studies show a relationship between low viral loads and reduced risk of transmitting HIV to sexual partners.
- Studies are ongoing to look at further benefit for HIV-positive individual and impact on HIV incidence.
Medical Male Circumcision

- 4 ecological studies
- 35 cross-sectional studies
- 14 prospective studies
- 3 randomized controlled trials

Recent data from South Africa show that MC has a direct effect on HIV prevalence with incidence rates 76% lower in circumcised men.

Confirm that medical male circumcision reduces risk of HIV infection in heterosexual men by approximately 60%
Global Recommendations

- Countries with high prevalence (>15%), generalized heterosexual HIV epidemics and low rates of MC should consider urgently scaling up access to MC services
- 13 countries identified: Botswana, Kenya, Lesotho, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe
- Consider ethics, communication, culture, health systems, funding, gender, comprehensive prevention strategies
- No conclusive evidence that MMC protects MSM
- For more on scale-up and other MMC resources, visit [www.malecircumcision.org](http://www.malecircumcision.org)

Source data: DHS and other data