BioMEMS Devices for HIV Diagnosis in Global Health

Xuanhong Cheng
(xuc207@lehigh.edu)

September 28, 2009
What is HIV?
Cell

Bacteria (TB, Typhoid)

Virus (HIV, hepatitis, SARS, influenza)

HIV emerging from a cell
HIV Statistics
AIDS
Acquired Immune Deficiency Syndrome

Changes in Life Expectancy, 1950 - 2000

Why is AIDS a pandemic?

Political influence
Gender inequality
Religion
Social acceptance
Scientific challenges
Economical situations
Delivery
Education
Infrastructure

Availability of treatment       When?
Availability of diagnostics    Which?

Source: Prevention Campaign, UNODC
HIV treatment
Impact of Treatment

Before
Impact of Treatment

After 9 months
Diagnostics through BioMEMS
HIV infection

- **Viral load**: 
  - 10^8 to 10^7
  - 10^6 to 10^5
  - 10^4 to 10^2
  - 10^0 to 1

- **HIV RNA level**: 
  - 10^8 to 10^7
  - 10^6 to 10^5
  - 10^4 to 10^2
  - 10^0 to 1

- **CD4 cell count**: 
  - 900 to 0
  - 800 to 100

- **Weeks**: 1 to 8
- **Years**: 0 to 8

- **Units**: (cells/μL blood) for both viral load and CD4 cell count.
Microchip for CD4 Counts
Clinical Validation of Microchip

\[ N = 49 \]
\[ R^2 = 0.86 \]

\[ y = x \]

\[ y = 1.1x \]
Accessories and Time for Microchip Assay
Viral Load Counter by Nanofiltration

Purification

Concentration

Staining

Log (Number Density 1/mL)

Log (N/N_0)