Cost-Effectiveness of PrEP

Bruce R. Schackman, PhD
Department of Public Health
Weill Cornell Medical College

TasP and PrEP Evidence Summit 2012
London
June 12, 2012
Disclosures

• Member of the HPTN 069 NEXT-PrEP (Novel Exploration of Therapeutics for PrEP) clinical trial team

• No financial disclosures
Agenda

• Cost-effectiveness overview
• PrEP cost-effectiveness model considerations
• Cost-effectiveness of PrEP in United States and South Africa: current findings
• Issues and future research needs
Cost-effective ≠ Cost saving
Cost-effectiveness is about value for money

- Cost-effectiveness analysis is about comparative assessment of worth
- Very, very few health interventions are cost-saving
- Cost-effectiveness is evaluated from the societal perspective
- Cost-effectiveness analysis does not directly address the cost impact on specific budgets
Only one of many measures of the appropriateness of health interventions

- Clinical duty
- Ethical duty
- Equity / justice
- Patient preference
- Economic efficiency
Choosing a cost-effectiveness threshold

• $100,000/QALY now frequently used in the US
• 1-3x GDP/capita frequently used in middle and low-income countries
  – $8,100/DALY-$24,300/DALY for South Africa
  – Although benchmark is $/DALY, also has been applied to $/LY
Discounting: valuing appropriately over time

• We prefer receiving benefits (money, health) now versus later
• Discounting reduces future streams of costs and effects to a common present value
• Spending on prevention now may not bear fruit for many years
• Treatments that save lives now can result in additional costs in the future
• Impact depends on when costs and benefits occur and the time horizon of the study
All models are wrong, some models are useful
Individual-level Model

Primary HIV Infection → Chronic HIV Infection

Chronic HIV Infection → Acute Clinical Event

Death → Chronic HIV Infection

Transmission Model

Susceptible → Infected

Infected → ART

Infected → Infected on PrEP

PrEP → Susceptible

PrEP → Infected on PrEP

Infected on PrEP → Infected

Infected → Death

ART → Susceptible
Individual-level model inputs

- Target population demographics
- HIV incidence (varies by age/risk group)
- Effectiveness of PrEP (efficacy, adherence)
- Disinhibition (reduces effectiveness of PrEP)
- Duration of PrEP (e.g. lifetime, 20-30 years)
- Risk of resistance
- HIV testing frequency with and without PrEP
- ART initiation with and without PrEP
Transmission model inputs

• Initial HIV prevalence
• Initial ART coverage and changes over time
• Initial coverage of other prevention programs (condom use) and changes over time
• Timing of PrEP roll-out into the population
Modeling the impact of HIV chemoprophylaxis strategies among men who have sex with men in the United States: HIV infections prevented and cost-effectiveness

Kamal Desai\textsuperscript{a}, Stephanie L. Sansom\textsuperscript{b}, Marta L. Ackers\textsuperscript{b}, Scott R. Stewart\textsuperscript{c}, H. Irene Hall\textsuperscript{d}, Dale J. Hu\textsuperscript{b}, Rachel Sanders\textsuperscript{d}, Carol R. Scotton\textsuperscript{b}, Sada Soorapathan\textsuperscript{b}, Marie-Claude Boily\textsuperscript{a}, Geoffrey P. Garnett\textsuperscript{a} and Peter D. McElroy\textsuperscript{b}


A. David Paltiel, Kenneth A. Freedberg, Callie A. Scott, Bruce R. Schackman, Elena Losina, Bingxia Wang, George R. Seage III, Caroline E. Sloan, Paul E. Sax, and Rochelle P. Walensky

\textit{Clinical Infectious Diseases} 2009; 48:806–15

The Cost-Effectiveness of Preexposure Prophylaxis for HIV Prevention in the United States in Men Who Have Sex With Men

Jessie L. Juusola, MS; Margaret L. Brandeau, PhD; Douglas K. Owens, MD, MS; and Eran Bendavid, MD, MS

### Study model characteristics

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Transmission</td>
<td>Individual-level</td>
<td>Transmission</td>
</tr>
<tr>
<td><strong>Time horizon</strong></td>
<td>5 years</td>
<td>lifetime</td>
<td>20 years</td>
</tr>
<tr>
<td><strong>PrEP</strong></td>
<td>tenofovir/emtricitabine</td>
<td>tenofovir/emtricitabine</td>
<td>tenofovir/emtricitabine</td>
</tr>
<tr>
<td><strong>No PrEP</strong></td>
<td>unclear</td>
<td>Annual HIV testing and ART initiation at CD4 &lt;350</td>
<td>67% annual testing and ART initiation at CD4&lt;350 or CD4&lt;500</td>
</tr>
<tr>
<td><strong>Base case HIV incidence</strong></td>
<td>0.75%-1.85% (varies by age)</td>
<td>1.6%</td>
<td>0.8%, 2.3% high risk</td>
</tr>
</tbody>
</table>
## Study model inputs for PrEP

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>50%</td>
<td>50%</td>
<td>44%</td>
</tr>
<tr>
<td>Monthly medication cost</td>
<td>$943</td>
<td>$724</td>
<td>$776</td>
</tr>
<tr>
<td>Full use of meds?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Monitoring</td>
<td>quarterly</td>
<td>lab quarterly, MD semi-annually</td>
<td>every 2-3 months</td>
</tr>
<tr>
<td>Labs</td>
<td>“medical monitoring”</td>
<td>HIV, CBC, metabolic, chemistry, lipids</td>
<td>HIV, STI, creatinine, urea nitrogen</td>
</tr>
<tr>
<td>Resistance evaluated?</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Cost-effectiveness of PrEP in US MSM: study findings

• Cost-effectiveness ratio is more attractive when PrEP is targeted to high-risk MSM:
  – < $100,000/QALY with high incidence (2-3%) vs. > $200,000/QALY with lower incidence (0.8%)
  – Mixed results for intermediate incidence (1-2%)
  – Ways to target: younger age, 5+ annual partners, not being tested for HIV annually

• Cost-effectiveness improves dramatically when effectiveness improves or cost of PrEP is lower

• Results less sensitive to resistance, toxicity
Cost of PrEP in US MSM

• High-risk MSM, average annual cost for a 20-year program (based on Juusola, 2012)
  – 100% coverage: $4,250 million cost, $500 million health care savings, $3,750 million net cost
  – 20% coverage: $850 million cost, $150 million health care savings, $700 million net cost
The Cost-effectiveness of Pre-Exposure Prophylaxis for HIV Infection in South African Women

Rochelle P. Walensky,1,2,3,5 Ji-Eun Park,2 Robin Wood,5,7 Kenneth A. Freedberg,1,2,5,8,11 Callie A. Scott,2 Linda-Gail Bekker,6,7 Elena Losina,4,5,12 Kenneth H. Mayer,13,14,16 George R. Seage III,9,16 and A. David Paltiel16

Clinical Infectious Diseases 2012;54(10):1504–13

Evaluating the Cost-Effectiveness of Pre-Exposure Prophylaxis (PrEP) and Its Impact on HIV-1 Transmission in South Africa

Carel Pretorius1*, John Stover1, Lori Bollinger1, Nicolas Bacaër2, Brian Williams3

November 2010 | Volume 5 | Issue 11 | e13646
Cost-effectiveness of PrEP in young South African women

• Walensky (2012) modeled individual-level impact of 39% efficacy vaginal gel based on CAPRISA results, annual PrEP cost $188, lifetime perspective
• Cost-effectiveness is <1 x South Africa GDP at 2.2% annual incidence age 25 and younger
• May be cost saving if targeted to higher risk women and higher efficacy or lower cost
• Results less sensitive to resistance, toxicity
Cumulative cost in young South African women (US$ per 1,000 women enrolled)
Impact of ART expansion in South Africa on cost-effectiveness of PrEP in young women

- Pretorius (2010) extended a previous model of transmission impact of expanded ART coverage in South Africa to examine PrEP
- Results point to interaction between PrEP and ART coverage
  - At current ART coverage, synergies occur with PrEP
  - PrEP becomes less cost-effective with expanded ART coverage, but impact occurs only when coverage is 3x level in 2010
  - PrEP retains impact longer when targeted to higher risk women
Issues identified across studies

• Implementation impact on efficacy and cost
  – Adherence: medication adherence and wastage, monitoring adherence, duration of PrEP
  – Coverage of target group vs. those at low risk
• Interaction between PrEP and TasP
  – Individual-level: testing and entry into care
  – Transmission: impact of TasP on probability of transmission without PrEP
Priorities for future studies

• Evaluating new PrEP modalities, integrating cost-effectiveness studies into clinical trials

• Evaluating “real world” implementation
  – Uptake in high risk groups
  – Adherence and duration on PrEP
  – Access barriers and insurance coverage
  – Budget impact

• Modeling cost-effectiveness of combination interventions, including PrEP and TasP
Acknowledgements

• Ashley Eggman, MS, Weill Cornell
• Roy M. Gulick, MD, MPH, Weill Cornell
• A. David Palitiel, PhD, Yale
• Rochelle Walensky, MD, MPH, Harvard