Adherence, Pharmacy Data & Survival in HIV-Infected Adults

Jean Nachega, MD, MPH, DTM&H
Johns Hopkins University
Baltimore, Maryland, USA

jnachega@jhsph.edu
Financial Disclosure

- U.S. Federal Research Grant Support
  - NIH/NIAID, DAIDS
    - RO1
    - K23
  - USAID Cooperative Agreement
- UN Global Fund for TB/HIV/Malaria, Geneva
- European Union Developing Countries Clinical Trial Partnership, The Hague, Netherlands
- Industry Research, Honoraria, Travel Grant Support
  - Glaxo Smith Kline
  - Bristol Myers Squibb
  - Aspen Pharmaceuticals
Adherence-Intersection of Biology and Behavior

- Medical care: complex synthesis of biologic and behavioral expertise + social context and compassion.

- Medication adherence exemplifies this interaction and the central role that each plays in therapeutic outcome.

- For HIV disease, adherence to HIV medications is a major determinate of biologic, clinical and public health outcomes.
HIV Therapeutics
Determinants of Drug Efficacy

- Potent drug(s) (Properly prescribed)
  - Adherence
    - Pharmacology
      - Absorption
      - Metabolism
      - Excretion
  - Systemic concentration
  - Intracellular concentration
    - Inhibition of viral replication
      - Viral resistance
      - Viral virulence
  - Host factors
    - Delay disease progression
The degree of adherence was significantly associated with risk for virologic failure (P<0.001). Adherence of 95% or greater was associated with the lowest incidence of virologic failure.
Proportion HIV VL <400 copies/ml by electronic medication monitor adherence
n=65

Bangsberg et al 12th CROI 2005 # 616
Proportion HIV VL <400 copies/ml by electronic medication monitor adherence
n=65

Bangsberg et al 12th CROI 2005 # 616
How Much Adherence is Needed for Viral Suppression?

- 109 indigent patients in San Francisco
  - 56 unboosted PI, 53 NNRTI regimen

- VL < 400 reliably seen with NNRTI if adherence > 54%, but with unboosted PI, only with very high adherence

Bangsberg DR et al. CROI 2005
Adherence and resistance

• The relationship between adherence and resistance is evolving

• High levels adherence associated with more viral suppression

• For individuals with remaining detectable VL, resistance increases with increasing levels of adherence

• Different drugs (and drug combinations) may have different adherence/resistance dynamics

• High levels of adherence reduce progression of HIV but may contribute to increase in population based rates of resistance.
Adherence and risk of viral rebound with new drug resistance

Resistance Risk by Adherence and Regimen Class

Adherence and virological failure at month 6

Adherence: Patient report of % daily doses taken at the right time

Classes of Antiretroviral Agents

<table>
<thead>
<tr>
<th>Entry Inhibitors</th>
<th>NRTIs</th>
<th>Integrase Inhibitors</th>
<th>NNRTIs</th>
<th>PIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-20</td>
<td>Zidovudine</td>
<td>MK058</td>
<td>Nevirapine</td>
<td>Indinavir</td>
</tr>
<tr>
<td>CCR5</td>
<td>Didanosine</td>
<td></td>
<td>Efavirenz</td>
<td>Saquinavir</td>
</tr>
<tr>
<td></td>
<td>Zalcitabine</td>
<td></td>
<td>Delavirdine</td>
<td>Ritonavir</td>
</tr>
<tr>
<td></td>
<td>Lamivudine</td>
<td></td>
<td></td>
<td>Nelfinavir</td>
</tr>
<tr>
<td></td>
<td>Stavudine</td>
<td></td>
<td></td>
<td>Amprenavir</td>
</tr>
<tr>
<td></td>
<td>Abacavir</td>
<td></td>
<td></td>
<td>Fosamprenavir</td>
</tr>
<tr>
<td></td>
<td>Tenofovir</td>
<td></td>
<td></td>
<td>Lopinavir/rtv</td>
</tr>
<tr>
<td></td>
<td>Emtricitabine</td>
<td></td>
<td></td>
<td>Atazanavir</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tipranavir</td>
</tr>
</tbody>
</table>
The Move Toward Simpler Regimens
3-drug regimens: 1996 and 2004

1996:
ddi + d4T + SQV
- 24 pills per day:
  - SQV: 6 q8h with food
  - ddi: 2 bid ½ hr ac or 2 hrs pc
  - d4T: 1 pill bid
- significant long-term toxicity

2004:
TDF/FTC or ABC/3TC + EFV
- 2 pills qd
  - no food restrictions
  - no long-term toxicity anticipated
Levels of adherence found to be disappointingly low

- San Francisco
  Bangsberg AIDS 2000 67%
- Pittsburgh
  Paterson An Int Med 2000 74%
- Los Angeles
  Liu Annals Int Med 2001 63%
- New York City
  Arnsten CID 2001 57%
- Baltimore
  Lucas JAIDS 2001 73%
- Philadelphia
  Gross AIDS 2001 79%
## Reported HAART Adherence Across Sub-Saharan Sites

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Duration</th>
<th>Method</th>
<th>Adherence Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orrell et al. AIDS 2003</td>
<td>289</td>
<td>12 Mos</td>
<td>Pill count</td>
<td>93.5%</td>
</tr>
<tr>
<td>Weiser et al. JAIDS 2003</td>
<td>109</td>
<td>6 Mos</td>
<td>Self-Report</td>
<td>74%</td>
</tr>
<tr>
<td>Laniece et al. AIDS 2003</td>
<td>158</td>
<td>36 Mos</td>
<td>Self-Report</td>
<td>91%</td>
</tr>
</tbody>
</table>
Reasons for Missing Doses of Antiretroviral Therapy

**US**
- Simply forgot
- Slept through dose
- Away from home
- Change in routine
- Busy with other things
- Too sick
- Depressed

---

**Africa**
- Forgot
- Away from home
- Schedule difficulties
- Ran out of pills
- Cost
- Home language
- Fear of stigmatization by sexual partner
HAART Adherence in sub-Saharan Africa

- Rates of adherence are better-than in developed countries.
  - Africans are better medication adherers
  - Maybe too early to tell
    - Precious resource
    - Highly selected populations
    - Short term studies
    - Starting with better regimens
    - Positive results reported
  - Early good results are encouraging but not a reason for complacency
Measurement Options

- Direct observation
- MEMS Caps (Electronic diaries)
- Pharmacy Refill data
- Pill counts
- Self-reports
- Drug levels
- Provider assessment
DOT: PROS 😊

- Direct observation therapy
  - Definitively externally verify a dose taken
  - Can be performed by variety of individuals
  - Especially easy in care facilities
Pharmacy Data

• Advantages
  – Only choice for retrospective studies
  – Can assess short or long-term behavior

• Disadvantages
  – No intra-interval information
  – Removed from actual drug taking
  – May not capture prescriptions from other sources
  – If automatic refills, data useless
DOT: CONS 😞…

• “Fool’s gold” standard
  – Packaged as an intervention so not useful for observational studies
  – Not generalizable for behavioral studies
  – Need other measure for control group
  – Stigma/confidentiality issues
Electronic Diaries

• Advantages
  – Full variability of pill taking
  – Less sensitive to overestimates
  – Short and long term behavior

• Disadvantages
  – Inconvenience
  – May suffer from underestimation
  – Cost
Pharmacy Data

- **Advantages**
  - Only choice for retrospective studies
  - Can assess short or long-term behavior

- **Disadvantages**
  - No intra-interval information
  - Removed from actual drug taking
  - May not capture prescriptions from other sources
  - If automatic refills, data useless
Self-reported measure
Pharmacy-based measure

Change in Log Viral Load (c/ml) / Fitted values
Percent Adherence

Change in Log Viral Load (c/ml)
Fitted values

Entire cohort, N=110
Pharmacy Refill Adherence and Subsequent Mortality in Patients Starting HAART (N=1280)

![Bar chart showing adherence and mortality rates]

Hogg et al. AIDS 2002, 16: 1051-58
Self-reports

- Advantages
  - Easy to obtain
  - Minimal cost

- Disadvantages
  - Overestimate true adherence
    - Even if non-adherence reported (Wagner GJ, AIDS Care 2000)
  - Only short-term exposure accurate
  - Limited variability over time
Self-Reports Measures

- Haubrich/CCG
  - Classification by centile over 4 weeks
- Chesney/ACTG
  - Missed doses over prior 4 days
- Walsh
  - VAS over prior month
- Variations
Drug levels

- Advantages
  - No assumptions about behavior
  - “Hard” data for skeptics

- Disadvantages
  - If short half-life: data re: last dose only
  - Variability in drug taking not assessed
  - Cost
Validity of Drug Levels

- Untimed measures of serum PIs/NNRTIs levels
  - Poor sensitivity/fair specificity (Liechty CA et al., AIDS 2004)
  - Additive to pharmacy refill data (Harrigan PR et al., JID 2005)

- Indinavir in hair (Bernard L et al. AIM 2002)
  - Routine access not available
Drug levels

• Advantages
  – No assumptions about behavior
  – “Hard” data for skeptics

• Disadvantages
  – If short half-life: data re: last dose only
  – Variability in drug taking not assessed
  – Cost
RECAP

- DOT is gold standard
  - limited utility

- Other methods have strengths and weaknesses depending on setting
  - MEMS most sensitive to non-adherence
  - Self-reports most specific
  - Pharmacy data useful for large populations or retrospective studies

- Challenges still exist
  - lumping of drugs, populations
  - relevant outcome: adherence, suppression, resistance, survival
HAART Adherence Assessed by Pharmacy Claims Predict Survival in HIV-infected South African Adults

Jean B. Nachega*, MD, MPH
Michael Hislop, MSc
David Dowdy, ScM
Melanie Lo, MHS
Saad B. Omer, MBBS, MPH
Leon Regensberg, MBChB, MRCP
Richard E. Chaisson*, MD
Gary Maartens*, MBChB, FCP, DTM&H

Department of Medicine, Division of Clinical Pharmacology
University of Cape Town, Cape Town, South Africa
Aid for AIDS (AfA) (Pty) Ltd., Cape Town, South Africa
&
Johns Hopkins University, Baltimore, MD, USA

Research Support NIH/NIAID
Our hypothesis was that a high rate of consistently filled pharmacy claims would be predictive of better survival rates in HIV-infected South African adults.
Methods I

• Evaluation of records from HIV-infected enrollees in Aid for AIDS (AfA) between Jan 1999 and Mar 2003.
• AfA is a disease management program available to beneficiaries and employees of contracted medical insurance funds and companies in Southern Africa.
• Inclusion criteria: age >18; HAART naïve; minimum HAART duration: 6 months.
• Adherence expressed as % (number of months with claims submitted, divided by number of complete months since submitting the first claim for HAART).
Methods I

- AfA is a disease management program available to beneficiaries and employees of contracted medical insurance funds and companies in Southern Africa.
- Inclusion criteria: age >18; HAART naïve; minimum HAART duration: 6 months.
- Adherence expressed as % (number of months with claims submitted, divided by number of complete months since submitting the first claim for HAART).
Methods III

- Analysis was restricted to patients with at least 6 Months of follow up after their initial pharmacy claim.
- Chi-Square Statistics and Univariate Logistic regression were used to identify predictors of viral suppression.
- Adherence rates were compared against the reference stratum (>95% adherence) using Chi-square statistics for trend.
- Multivariate Logistic Regression was used to model the individual and simultaneous effects of baseline variables and HAART adherence on viral suppression.
Study Profile & Outcomes

7299 pts filled at least one claim from Jan 1999 to March 2001

- 219 (3%) pts excluded due to missing baseline CD4 & VL
- 792 (10%) pts excluded as they did not complete 180 days of ART

N = 6288

- 3291 pts with adherence >80%
  - 2822 Alive
  - 59 Deaths
  - 410 ‘Loss’

- 2999 pts with adherence <80%
  - 2091 Alive
  - 163 Deaths
  - 745 ‘Loss’

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
### Baseline Characteristics by Adherence at HAART Initiation (N=6288)

<table>
<thead>
<tr>
<th></th>
<th>Adherence &lt;80%</th>
<th>Adherence &gt;80%</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median (IQR) Age</td>
<td>35.8 (31.1-41.4)</td>
<td>36.3 (31.6-42.0)</td>
<td>0.01</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>- Male, %</td>
<td>42.0</td>
<td>37.2</td>
<td></td>
</tr>
<tr>
<td>- Female, %</td>
<td>58.0</td>
<td>62.8</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td>- Black, %</td>
<td>97.1</td>
<td>96.8</td>
<td></td>
</tr>
<tr>
<td>- White, %</td>
<td>1.7</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>- Other, %</td>
<td>1.2</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Median (IQR) CD4+ (cell/mm³)</td>
<td>149 (66-228)</td>
<td>148 (64-227)</td>
<td>0.67</td>
</tr>
<tr>
<td>Median (IQR) Log₁₀VL (c/ml)</td>
<td>5.17 (4.6-5.6)</td>
<td>5.15 (4.6-5.6)</td>
<td>0.56</td>
</tr>
</tbody>
</table>
Patient % by Adherence Stratum
N= 6288

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
## Bivariate & Multivariate Analysis of the Baseline Factors Associated with Survival (N=6288)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Crude RH (95% CI)</th>
<th>Adjusted RH (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adherence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;80%</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>&lt;80%</td>
<td>3.01 (2.24-4.06)*</td>
<td>3.23 (2.37-4.39)*</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.50 (1.15-1.95)*</td>
<td>1.22 (0.39-1.59)</td>
</tr>
<tr>
<td>Female</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1.23 (0.39-3.85)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1.34 (0.59-3.03)</td>
<td>1.23 (0.39-3.85)</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;55</td>
<td>2.03 (0.98-4.18)</td>
<td>2.00 (0.96-1.95)</td>
</tr>
<tr>
<td>18-34</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>35-44</td>
<td>1.21 (0.91-1.61)</td>
<td>1.13 (0.84-1.51)</td>
</tr>
<tr>
<td>45-54</td>
<td>1.06 (0.68-1.64)</td>
<td>1.02 (0.66-1.59)</td>
</tr>
<tr>
<td>&lt;50</td>
<td>6.00 (4.03-8.92)*</td>
<td>5.13 (3.42-7.72)*</td>
</tr>
<tr>
<td>51-200</td>
<td>2.15 (1.45-3.22)*</td>
<td>1.86 (1.23-2.80)*</td>
</tr>
<tr>
<td>&gt;200</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>CD4+ (cell/mm³)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;200</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>51-200</td>
<td>2.15 (1.45-3.22)*</td>
<td>1.86 (1.23-2.80)*</td>
</tr>
<tr>
<td>&lt;50</td>
<td>6.00 (4.03-8.92)*</td>
<td>5.13 (3.42-7.72)*</td>
</tr>
<tr>
<td>Log₁₀VL (c/ml)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;5</td>
<td>2.93 (1.44-5.95)*</td>
<td>2.93 (0.98-4.11)</td>
</tr>
<tr>
<td>4-4.99</td>
<td>1.57 (0.74-3.31)</td>
<td>1.37 (0.65-2.90)</td>
</tr>
<tr>
<td>&lt;4</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA*
Cox’s Proportional Hazard Analysis by Level of Adherence

<table>
<thead>
<tr>
<th>Adherence Strata (%)</th>
<th>Hazard Ratio</th>
<th>Deaths (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td></td>
<td></td>
<td>0.53</td>
</tr>
<tr>
<td>80-99</td>
<td></td>
<td></td>
<td>0.03</td>
</tr>
<tr>
<td>60-79</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>40-59</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>20-39</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>0-19</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
Multivariate Analysis of the Baseline Factors Associated with Survival (N=6288)

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
### Cox’s Proportional Hazard Analysis by Level of Adherence II

<table>
<thead>
<tr>
<th>Adherence</th>
<th>Hazard Ratio (95%CI)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;80%</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>&lt;80%</td>
<td>3.01 (2.24-4.06)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
Survival by Adherence Level
CD4 counts < 50

RH=4.54 (95%CI:2.83-7.29)

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
Survival by Adherence Level
CD4 = 50-200

RH=2.39 (95%CI: 1.51-3.78)

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
Survival by Adherence Level
CD4 > 200

RH = 2.08 (95% CI: 1.00-4.31)

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
Adherence to NNRTI-Based HAART & Virologic Outcomes in South Africa

Aim: To Assess whether high level of adherence is consistently required for virologic suppression for patients on NNRTI-based HAART as First Line

3,325 HIV-infected Adults enrolled in a private-sector HIV/AIDS disease management program were studied.

Primary end point: proportion of patients in whom VL remained <400 copies/mL in 80% of samples. This is a 28-month median follow-up study
Dose Response Pattern Between NNRTI Adherence & Virologic Suppression (N= 3,325)

- 22% adherence
- 56.5% adherence
- 68.5% adherence
- 76% adherence
- 80% adherence

HIV-1RNA <400/mL

Pearson’s $\chi^2$; $P$ for trend <0.001

Nachega et al 13th CROI 2006, Denver, CO, AbOr# 93
Univariate & Multivariate Analysis of the Baseline Factors Associated with VL Suppression (N=3220)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Univariate OR(95% CI)</th>
<th>Adjusted RH(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (per 10 yrs)</td>
<td>1.13 (1.04-1.23)</td>
<td>1.1 (0.94-1.32)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.23 (1.08-1.40)</td>
<td>1.11 (0.94-1.32)</td>
</tr>
<tr>
<td>Male</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1.38 (0.95-1.99)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1.23 (0.39-3.85)</td>
<td></td>
</tr>
<tr>
<td>Adherence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;70%</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>70-79%</td>
<td>3.73 (2.89-4.80)*</td>
<td>4.58 (3.44-6.10)</td>
</tr>
<tr>
<td>80-89%</td>
<td>6.81 (5.46-8.50)*</td>
<td>7.54 (5.88-9.67)</td>
</tr>
<tr>
<td>90-94%</td>
<td>9.80 (7.60-12.62)*</td>
<td>11.91 (8.91-15.9)</td>
</tr>
<tr>
<td>&gt;95%</td>
<td>12.06 (9.98-14.58)*</td>
<td>15.58 (12.44-19.52)</td>
</tr>
<tr>
<td>CD4+ (cell/mm³)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>51-200</td>
<td>1.19 (1.00-1.41)*</td>
<td>1.09 (0.87-1.36)</td>
</tr>
<tr>
<td>&gt;200</td>
<td>1.49 (1.25-1.79)*</td>
<td>1.36 (1.07-1.74)*</td>
</tr>
<tr>
<td>Log₁₀VL (c/ml)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5</td>
<td>1.37 (1.20-1.55)*</td>
<td>1.27 (1.07-1.50)*</td>
</tr>
<tr>
<td>&gt;5</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Variables Associated with Viral Suppression in Multivariate Logistic Regression Model

<table>
<thead>
<tr>
<th>MLR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High ART adherence (OR: 15.6; 95% CI 12.4-19.5)</td>
<td></td>
</tr>
<tr>
<td>High baseline CD4 count (OR: 1.4; 95% CI 1.1-1.7)</td>
<td></td>
</tr>
<tr>
<td>Baseline viral load $&lt;10^5$ copies/ml (OR: 1.3; 95% CI 1.1-1.5)</td>
<td></td>
</tr>
</tbody>
</table>
Study Limitations

• Filling a pharmacy claim does not necessarily mean that the patient is correctly taking the claimed medication.

• Study population included patients enrolled in a private managed insurance program.

• Therefore, the utility of pharmacy refill as a measure of adherence needs to be evaluated in the public sector.

Nachega J, Hislop M, Dowdy D. et al., CROI 2005, Ab#25, Boston, MA
Summary I

- When used appropriately in the setting of ‘fully suppressive’ triple-drug therapy, NNRTIs are highly effective against HIV-1 with durable viral suppression\(^1-3\)

- High levels of adherence, as assessed by pharmacy claim data, in private-sector management program, strongly predict VL suppression on NNRTI-based ART

- Pharmacy records are a simple and valid program-level adherence monitoring tool
Summary II

- Pharmacy claim records provide a valid tool of evaluating HAART adherence.

- Each 20% decrease in adherence, as measured by pharmacy claims, is associated with decreased survival.

- Pharmacy claims (or refills in public sector) may be a simple and low cost adherence monitoring tool in settings where other labor-intensive or expensive methods are not practicable.
Acknowledgements

- David Bangsberg, MD, MPH, SFGH, UCSF, San Francisco, CA
- Gerald Friedland, MD, Yale University, New Haven, CT
- Richard E Chaisson, MD, Johns Hopkins Univ., Baltimore
- Robert Gross, MD, Univ. of Pennsylvania, PA
- Gary Maartens, MD, FCP, Univ. Cape Town, South Africa