Cost-effectiveness Analysis of Abacavir-based and Tenofovir-based regimens in Singapore

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Introduction

- Human immunodeficiency virus (HIV) infection has evolved into a chronic disease with the use of highly active antiretroviral therapy (HAART). As life expectancy of HIV-positive individuals improves, the duration of treatment increases. Cost of treatment will be a major factor affecting the choice of HAART.
- In addition to cost of medications, the cost of monitoring of short- and long-term side effects will also contribute to the total treatment cost of this disease.
- For management of HIV, the need for long-term treatment, good adherence and a low rate of antiviral resistance should also be evaluated in terms of lifetime costs.

Objectives

- To assess the cost-effectiveness of abacavir (ABC)-based and tenofovir (TDF)-based regimens for treatment of HIV in Singapore, taking into account:
  1. Cost of drugs alone
  2. Cost of drugs and monitoring

Methods

- Study design: This was a single-centre, retrospective study, conducted at the Communicable Disease Centre (CDC), Tan Tock Seng Hospital (TSSH). This study was approved by National Health Group Institutional Review Board.
- Inclusion criteria: (1) Have a positive western blot test and diagnosed with HIV by a medical doctor, (2) above 21 years of age, (3) currently on follow up at CDC, and (4) prescribed with either ABC-based or TDF-based regimens for at least 48 weeks.
- Exclusion criteria: (1) Patients who have less than two viral load (VL) readings, (2) diagnosed with HIV before the year 2006, (3) incomplete or missing case notes.
- Matching criteria: Patients from the ABC group were matched with patients from TDF group according to: (1) age group, (2) gender, (3) remaining two HAART agents prescribed, (4) body mass index (BMI), and (5) race.
- Data analysis: Effectiveness is defined as percentage of patients who achieved undetectable VL at the period between week 24 and week 48. An incremental cost-effectiveness ratio (ICER) analysis was performed to evaluate the cost-effectiveness between ABC-based and TDF-based regimens between the two evaluation periods. Costs were reported in Singapore dollars ($S).

ICER: \( \frac{(C_A - C_T)}{(E_A - E_T)} \)
- \( C_A \): total cost in the ABC group
- \( C_T \): total cost in the TDF group
- \( E_A \): effectiveness in the ABC group
- \( E_T \): effectiveness in the TDF group

NOTE: 1st ICER: drug cost alone, 2nd ICER: drug cost and monitoring costs

Results

- 230 patients were analyzed (82.2% Chinese, 91.3% male; age: 46.0 ± 13.0 years old), 115 patients in each group [Table 1].
- The most commonly used combinations were ABC, lamivudine (3TC) and efavirenz (EFV) (76.5%), and TDF, 3TC and EFV (76.2%); followed by ABC, 3TC, ritonavir boosted-atazanavir (ATV/r) (13.0%) and TDF, 3TC and ATV/r (11.3%) [Table 1].
- Majority of the patients were at least 95% adherent to their medication regimen (93.0% and 91.3% for ABC and TDF group respectively) [Table 1]. For both evaluation periods, more patients in the ABC group obtained undetectable VL (77.4% vs 59.1% and 61.7% vs 76.5%) [Figure 1].
- The ICER value was $S13348.72 for the period of week 24 (week 12 to 36) and $S19085.37 for the period of week 48 (week 37 to week 60) [Table 2].

Discussion

- ABC-based regimen was found to be more cost effective than TDF-based regimen in HIV patients in Singapore for both evaluation periods (week 24 and week 48), regardless whether only cost of medications or cost of medications and monitoring were considered.
- Exclusion of some monitoring costs such as genotyping for HLAB*5701 for ABC could make it even more cost-effective, especially for our Asian population (excluding Indians)[3].
- One of the limitations we faced included the presence of external buyers’ club where patients were able to obtain medications at cheaper prices or fixed-dose combinations that are not available at TSSH. Additional costs such as physician office visits and hospitalization costs for opportunistic infections were not included in the calculation of ICERs.

Conclusion

- As public healthcare expenditure increase, this knowledge may be useful to physicians, policy makers, and tax payers in their efforts at making clinically appropriate yet cost-conscious decisions.

References


Table 1. Patient characteristics (N=230)

<table>
<thead>
<tr>
<th>Demographics Information</th>
<th>ABC-based regimen N (%)</th>
<th>TDF-based regimen N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Male (n=105)</td>
<td>Female (n=105)</td>
</tr>
<tr>
<td>Mean age (years) ± S.D.</td>
<td>46 ± 14.0</td>
<td>49 ± 14.0</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>95 (82.6)</td>
<td>94 (81.7)</td>
</tr>
<tr>
<td>Malay</td>
<td>14 (12.2)</td>
<td>13 (11.3)</td>
</tr>
<tr>
<td>Indian</td>
<td>3 (2.6)</td>
<td>6 (5.2)</td>
</tr>
<tr>
<td>Others</td>
<td>3 (2.6)</td>
<td>2 (1.7)</td>
</tr>
<tr>
<td>Pharmacological</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NNRTI/NRTI²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRTR/P²</td>
<td>15 (13.1)</td>
<td>20 (17.4)</td>
</tr>
<tr>
<td>NRTR/INSTH³</td>
<td>3 (2.6)</td>
<td>3 (2.6)</td>
</tr>
<tr>
<td>Adherence (&gt;95%)</td>
<td>107 (93)</td>
<td>105 (91.3)</td>
</tr>
</tbody>
</table>

Table 2: Incremental cost-effectiveness results

<table>
<thead>
<tr>
<th>Costs of medications only</th>
<th>Undetectable viral load (week 12 to week 36)</th>
<th>Undetectable viral load (week 37 to week 60)</th>
<th>Difference in costs</th>
<th>Difference in effectiveness</th>
<th>Costs of medications only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undetectable viral load (week 12 to week 36)</td>
<td>-2309.33</td>
<td>0.173</td>
<td>-13348.72</td>
<td>Dominant</td>
<td></td>
</tr>
<tr>
<td>Undetectable viral load (week 37 to week 60)</td>
<td>-2309.33</td>
<td>0.173</td>
<td>-19085.37</td>
<td>Dominant</td>
<td></td>
</tr>
<tr>
<td>Undetectable viral load (week 12 to week 36)</td>
<td>-2361.46</td>
<td>0.173</td>
<td>-13650.05</td>
<td>Dominant</td>
<td></td>
</tr>
<tr>
<td>Undetectable viral load (week 37 to week 60)</td>
<td>-2361.46</td>
<td>0.121</td>
<td>-19516.20</td>
<td>Dominant</td>
<td></td>
</tr>
</tbody>
</table>

1. NNRTI (Non-nucleoside reverse transcriptase inhibitors): lamivudine, nevirapine
2. NRTR (Non-reverse transcriptase inhibitors): efaviren, nevirapine
3. INSTH (Integrase inhibitors): etravir, raltegravir

Figure 1. Effectiveness of regimen at Week 24 and Week 48

1. ICER (Incremental cost-effectiveness ratio) = ((Cost A - Cost T) / (Effectiveness A - Effectiveness T))
2. Difference in effectiveness (E_A - E_T)
3. Difference in costs (C_A - C_T)
4. Costs of medications only