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) (1,2). 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 (TTSH). 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: $(C_a – C_t)/(E_a – E_t)$

- 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 (78.2%); 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 81.7% vs 76.5%) [Figure 1].

- The ICER value was –S$13348.72 for the period of week 24 (week 12 to 36) and –S$19085.37 for the period of week 48 (week 37 to week 60) [Table 2].

Table 1. Patient characteristics (N=230)

Demographics Information		ABC-based regimen N (%)		TDF-based regimen N (%)	
		Male (n=105)	Female (n=10)	Male (n=105)	Female (n=10)
Age	Mean age (years) ± S.D.	46 ± 14.0			
Race	Chinese	95 (82.6)		94 (81.7)	
	Malay	14 (12.2)		13 (11.3)	
	Indian	3 (2.6)		6 (5.2)	
	Others	3 (2.6)		2 (1.7)	
Pharmacological	NRTI[1]/NNRTI[2]	97 (84.3)		92 (80.0)	
	NRTI/PI[3]	15 (13.1)		20 (17.4)	
	NRTI/INSTI[4]	3 (2.6)		3 (2.6)	
	Adherence (>95%)	107 (93)		105 (91.3)	

[1]NRTI (Nucleot(s)ide reverse transcriptase inhibitors): Lamivudine, emtricitabine
[2]NNRTI (Non-nucleotide reverse transcriptase inhibitors): Efavirenz, nevirapine
[3]PI (Protease inhibitors): Ritonavir-boosted atazanavir, ritonavir-boosted lopinavir
[4]INSTI (Integrase inhibitors): Raltegravir

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

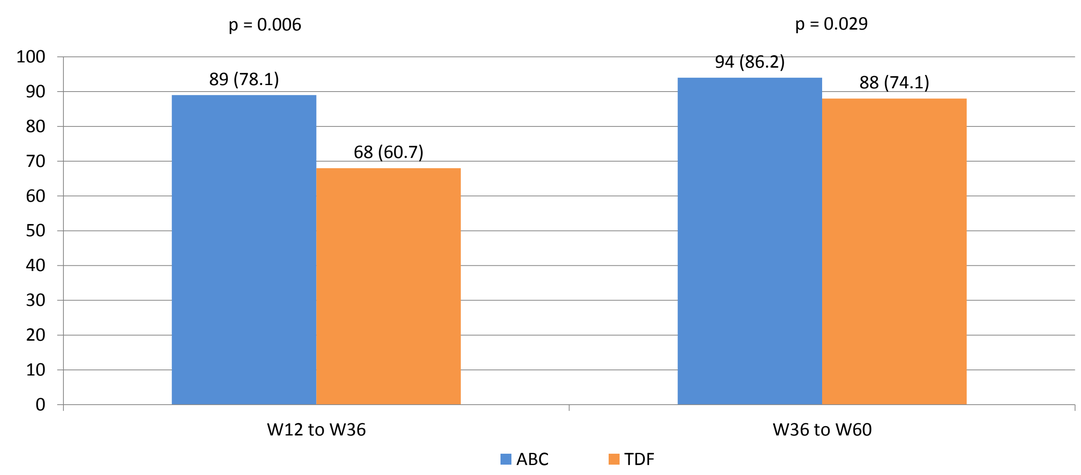

Table 2: Incremental cost-effectiveness results

	Effectiveness measure	Difference in costs ($C_a – C_t$)[a]	Difference in effectiveness ($E_a – E_t$)[b]	Costs of medications only
Costs of medications only	Undetectable viral load (week 12 to week 36) [c]	-2309.33	0.173	-13348.72 Dominant
	Undetectable viral load (week 37 to week 60) [d]	-2309.33	0.121	-19085.37 Dominant
Undetectable viral load (3 to 9 months) [c]	Undetectable viral load (week 12 to week 36) [c]	-2361.46	0.173	-13650.05 Dominant
	Undetectable viral load (week 37 to week 60) [d]	-2361.46	0.121	-19516.20 Dominant

[a] Difference in the total annualized drug cost between treatment groups [i.e. the cost in the ABC group (C_a) minus the cost in the TDF group (C_t)]. This is the numerator of the ICER.
[b] Difference in the effectiveness endpoint between treatment groups [i.e. the proportion of patients achieving the endpoint in the ABC group (E_a) minus the proportion of patients achieving the endpoint in the TDF group (E_t)]. This is the denominator of the ICER.
[c] Proportion of subjects achieving a undetectable viral during the evaluation period (weeks 12 to 36).
[d] Proportion of subjects achieving a undetectable viral during the evaluation period (weeks 37 to 60).

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 TTSH. 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

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