Cost-effectiveness analysis of initial HIV treatment under Italian guidelines

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Introduction: Since the mid-1990s, highly active antiretroviral therapy (HAART) has modified the clinical course of human immunodeficiency virus (HIV) infection, reducing the rate of disease progression, the incidence of opportunistic infections, and mortality. The authors of this paper performed an economic analysis to estimate the cost-effectiveness of the HAART regimens in Italy for managing HIV-infected patients according to national guidelines.

Patients and methods: The incremental cost-effectiveness analysis was carried out by means of a Markov model, which through a decision-analytic approach, made it possible to compare the studied antiretroviral regimens. The population considered in the model consisted of adult subjects with HIV who received antiretroviral HAART treatment for the first time. The population considered in the analysis reflects the patients’ characteristics according to one of the regional surveillance systems HIV/AIDS infection report currently operating in Italy. The analysis was carried out from the point of view of the Italian health care system. The considered outcome measures were quality-adjusted life years (QALYs) and direct health costs calculated for the year 2010. Both the outcomes (QALYs) and the costs were discounted by 3.5%. The time horizon adopted in the model was 10 years.

Results: The model shows, in terms of cost per gained QALY, single tablet regimen (STR) appeared to be the most cost-effective therapeutic choice (€22,017), followed by tenofovir (TDF) + lamivudine + efavirenz (EFV) (€24,526), and TDF/emtricitabine (FTC) + nevirapine (€26,416), and TDF + FTC + EFV (€26,558); the remaining strategies have an incremental cost-effectiveness ratio (ICER) value varying from €28,000 to €41,000 per QALY. The sensitivity analysis on the main variables confirmed the validity of the base case scenario.

Conclusion: STR is the most cost-effective treatment strategy, compared with the other therapeutic regimens recommended by the Italian guidelines. All the ICER values of the various regimens considered by the Italian guidelines were lower than the threshold value of €50,000 commonly accepted at the international level. The model developed represents a tool for policy makers and health care professionals to make short- and long-term cost projections and thus evaluate their impact on the available budgets for HIV patients.

Keywords: antiretroviral therapy regimens, single tablet regimens, STR, Markov model, quality-adjusted life years, QALYs, HAART

Introduction

According to UNAIDS, at the end of 2009, 33.3 million people worldwide were estimated to be living with human immunodeficiency virus (HIV) or acquired immunodeficiency syndrome (AIDS).1 In Italy, the surveillance of HIV/AIDS in the period 1985–2008 reported a total of 42,747 new HIV diagnoses. In 2007, there were 2012 new HIV diagnoses, equivalent to an incidence of 6.7 per 100,000 residents.2
The economic burden of HIV infection is well recognized all around the world.\textsuperscript{3,4} Its management involves the use of health care service for HIV treatment, the treatment of AIDS-associated symptoms and opportunistic infections, and other costs associated with morbidity/premature mortality of adult working patients. Since the mid-1990s, highly active antiretroviral therapy (HAART) has modified the clinical course of the HIV infection, reducing the rate of disease progression, the incidence of opportunistic infections, and mortality.\textsuperscript{5,6} This prolonged survival has changed HIV infection into a chronic disease.\textsuperscript{7} As a consequence, combination antiretroviral therapy has resulted in longer survival and a better quality of life for many HIV-infected patients.\textsuperscript{8} The current therapeutic options available in Italy and Europe include more than 20 approved antiretroviral drugs divided into five classes: nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), protease inhibitors, fusion or entry inhibitors, and integrase inhibitors (InI). Each of these groups attacks HIV in a different way. The most common drug regimen (as HAART) given to people beginning treatment usually consists of two NRTIs combined with either an NNRTI, or a “boosted” protease inhibitor, or an InI.\textsuperscript{9} Each drug varies greatly in terms of efficacy, resistance, pill burden, safety, and price. Considering the complexity of the disease, the Italian recommendations are invaluable in assisting physicians in electing the most favorable therapies. However, because HIV is a prolonged disease, the treatment of which may continue for many years, the need for regimens with potent antiviral activity, proven long-term safety, good adherence, and a low rate of antiviral resistance should also be evaluated in terms of lifetime costs. In a context of limited health care resources, pharmacoeconomic considerations are crucial to help policy makers make the most appropriate decisions on resource allocation. The authors of this paper therefore performed an economic analysis to estimate the cost-effectiveness of the HAART regimens in Italy for managing HIV-infected patients according to national guidelines.\textsuperscript{9} They also estimated the impact of the disease on the quality of life of patients.

Patients and methods

The purpose of this study was to determine the incremental cost-effectiveness ratio (ICER) per (quality-adjusted) year of life gained for therapeutic combinations (regimens) based on drugs recommended by the Italian guidelines for the first-line treatment of patients with HIV.\textsuperscript{9} The incremental cost-effectiveness analysis was carried out by means of a Markov model, which through a decision-analytic approach, made it possible to compare the studied antiretroviral regimens.\textsuperscript{10} The analysis was carried out from the point of view of the Italian health care service (Servizio Sanitario Nazionale [SSN]). The considered outcome measures were quality-adjusted life years (QALYs) and direct health costs calculated for the year 2011. Both the outcomes (QALYs) and the costs were discounted by 3.5%.\textsuperscript{11} The time horizon adopted in the model was 10 years. The antiretroviral regimens considered follow the latest Italian guidelines and represent the drug options that are more frequently used in the first-line treatment of patients with HIV.\textsuperscript{9} The population considered in the model consisted of adult subjects with HIV who received antiretroviral HAART treatment for the first time; this hypothetical cohort reflects the patient characteristics according to one of the regional surveillance systems HIV/AIDS infection report currently operating in Italy.\textsuperscript{12}

Structure of the model

The Markov model simulates the quality of life and the costs for an HIV patient for 10 years, starting from the administration of the initial treatment, through 1-year cycles, based on the administered antiretroviral therapy.\textsuperscript{13} After entering the model and receiving one of the antiretroviral regimens, the patient can “move” through eight health states, defined by the CD4-cell count combined with the viremia levels (VL), one AIDS state and one death state (Figure 1).

![Markov model structure](https://www.dovepress.com/)

**Figure 1** Structure of the Markov model.

**Abbreviations:** AIDS, acquired immunodeficiency syndrome; VL, viremia levels.
The model assigned patients responding to the antiretroviral therapy a viremia value lower than 50 copies, and allowed responders to move within the CD4 classification. In case of failure of the first-line treatment, the model presumed a viremia value $>50$ copies for the patients and CD4 values following the trend of the untreated population. Nonresponders with a CD4 value $<200$ were changed to the AIDS state; patients were changed to the death state depending on their CD4 class, as shown in Table 1, and also $25\%$ of patients with full-blown AIDS. Finally, the model was completed with appropriate occurrence values to define probabilistic knots, and with precise cost estimates, in order to finalize the comparison, as described below. Modeling was undertaken using Microsoft Excel 2010 (Microsoft Corporation, Redmond, WA).

### Transition probabilities and outcomes

Tables 1 and 2 report the percentage distribution of patients considered in the model with respect to the CD4-cell count. The distribution draws on the observations on the HIV-AIDS infection situation in the Emilia Romagna region (epidemic update as of December 31, 2009). Table 3 shows the immunologic responses for each of the therapeutic regimens studied, as indicated in the Italian guidelines, and reports the bibliographical references. When data were not available, it was assumed that the response remained constant at the last observed value by applying the last value carried forward technique.

To evaluate cost-effectiveness, the ICER was used. When the value of a new therapeutic option needs to be assessed, the ICER provides the additional resources that have to be used to achieve the additional benefit: ICER is the difference in cost divided by the difference in effect between two alternatives. In this analysis, the direct costs and effectiveness of each regimen were compared with the direct costs and effectiveness of the disease natural history (absence of treatment).

The effectiveness indicators considered in this economic evaluation are the QALYs. Table 4 shows the utility values associated with the eight health states identified by the CD4-cell count. These values, published in the study by Simpson et al., were calculated by means of the EuroQol-5 Dimensions (EQ-5D) questionnaire. The permanence in the disease state (CD4 and viremia) was adjusted for the corresponding utility and then combined for the average expected lifetime, with the purpose to evaluate the years of survival adjusted for the quality of life.

### Resource consumption and costs

The resource consumption associated with the patients considered in the model is linked with the administration of the antiretroviral regimens and with other direct health costs, such as hospitalizations, medical examinations, laboratory tests, and so on. Table 5 shows the average annual costs for each first-line regimen. Dosages were calculated based on the Italian and British guidelines, whereas the purchase costs of the pharmaceutical specialties were calculated based on the reimbursement price paid by the SSN, which takes into account the price updates effective from January 1, 2011.

For every health state defined by the CD4-cell count, an additional health cost associated with patients was assumed, including a further consumption of health resources due to hospitalization, day hospital, general practitioner and specialist examinations, laboratory tests, and diagnostic procedures. Costs were estimated based on the results of the research by Garattini et al. (Table 6). The cost data stratified by CD4 were then actualized to 2010.

### Table 2 Patient distribution based on CD4-cell count and viremia

<table>
<thead>
<tr>
<th>CD4-cell count</th>
<th>Viremia (VL)</th>
<th>% distribution of patients (base case)</th>
<th>% distribution of patients (sensitivity analysis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&gt;500$ cells/$\mu$L</td>
<td>$&lt;50$</td>
<td>12.98%</td>
<td>3.25%</td>
</tr>
<tr>
<td>$&gt;500$ cells/$\mu$L</td>
<td>$\geq 50$</td>
<td>12.98%</td>
<td>3.25%</td>
</tr>
<tr>
<td>351–500 cells/$\mu$L</td>
<td>$&lt;50$</td>
<td>12.98%</td>
<td>7.00%</td>
</tr>
<tr>
<td>351–500 cells/$\mu$L</td>
<td>$\geq 50$</td>
<td>12.98%</td>
<td>7.00%</td>
</tr>
<tr>
<td>201–350 cells/$\mu$L</td>
<td>$&lt;50$</td>
<td>16.36%</td>
<td>18.75%</td>
</tr>
<tr>
<td>201–350 cells/$\mu$L</td>
<td>$\geq 50$</td>
<td>16.36%</td>
<td>18.75%</td>
</tr>
<tr>
<td>$&lt;200$ cells/$\mu$L</td>
<td>$&lt;50$</td>
<td>7.70%</td>
<td>21.00%</td>
</tr>
<tr>
<td>$&lt;200$ cells/$\mu$L</td>
<td>$\geq 50$</td>
<td>7.70%</td>
<td>21.00%</td>
</tr>
</tbody>
</table>

**Notes:** 1Adapted from HIV-AIDS infection situation in the Emilia Romagna region (epidemic update as of December 31, 2009); 2adapted from Gallant et al.

### Table 1 Patient distribution based on CD4-cell count and viremia and mortality per health state

<table>
<thead>
<tr>
<th>CD4-cell count</th>
<th>Viremia (VL)</th>
<th>HIV-linked mortality rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&gt;500$ cells/$\mu$L</td>
<td>$&lt;50$</td>
<td>0.40%</td>
</tr>
<tr>
<td>$&gt;500$ cells/$\mu$L</td>
<td>$\geq 50$</td>
<td>0.40%</td>
</tr>
<tr>
<td>351–500 cells/$\mu$L</td>
<td>$&lt;50$</td>
<td>0.40%</td>
</tr>
<tr>
<td>351–500 cells/$\mu$L</td>
<td>$\geq 50$</td>
<td>0.40%</td>
</tr>
<tr>
<td>201–350 cells/$\mu$L</td>
<td>$&lt;50$</td>
<td>0.80%</td>
</tr>
<tr>
<td>201–350 cells/$\mu$L</td>
<td>$\geq 50$</td>
<td>0.80%</td>
</tr>
<tr>
<td>$&lt;200$ cells/$\mu$L</td>
<td>$&lt;50$</td>
<td>8.44%</td>
</tr>
<tr>
<td>$&lt;200$ cells/$\mu$L</td>
<td>$\geq 50$</td>
<td>8.44%</td>
</tr>
</tbody>
</table>

**Abbreviation:** HIV, human immunodeficiency virus.
Sensitivity analysis

The sensitivity analysis verified the impact of a series of variations of the base case with a large influence on the obtained results. A series of univariate analyses were carried out on some parameters of the simulation model, such as: virological response, HIV-associated mortality rate, and the initial distribution of patients based on the CD4-cell count. In particular, the allotment of patients per CD4-cell count was varied based on the evidence of the study by Gallant et al and simulated for hypothetical seriousness scenarios. Each parameter was varied with respect to its 95% confidence interval.

Results

Table 7 shows the average annual cost and the QALYs for a patient with HIV treated with each of the first-line antiretroviral regimens mentioned in the Italian guidelines. The simulation model shows that patients treated with a single tablet regimen (STR) (0.755 QALY/year) have a better quality of life, with a higher number of QALYs than with other therapeutic regimens, followed by tenofovir/
Table 5 Average annual costs for each first-line therapeutic regimen

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Annual costs HAART treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDF/FTC + EFV (single tablet regimen)</td>
<td>€7226</td>
</tr>
<tr>
<td>TDF/FTC + EFV</td>
<td>€7226</td>
</tr>
<tr>
<td>TDF/FTC + ATV/r</td>
<td>€9016</td>
</tr>
<tr>
<td>TDF/FTC + NVP</td>
<td>€6936</td>
</tr>
<tr>
<td>TDF/FTC + DRV/r</td>
<td>€10,167</td>
</tr>
<tr>
<td>TDF/FTC + LPV/r</td>
<td>€9294</td>
</tr>
<tr>
<td>TDF/FTC + RAL</td>
<td>€13156</td>
</tr>
<tr>
<td>TDF + 3TC + EFV</td>
<td>€6711</td>
</tr>
<tr>
<td>ABC/3TC + EFV</td>
<td>€6776</td>
</tr>
<tr>
<td>ABC/3TC + ATV/r</td>
<td>€8566</td>
</tr>
<tr>
<td>ABC/3TC + LPV/r</td>
<td>€8844</td>
</tr>
</tbody>
</table>

Abbreviations: 3TC, lamivudine; ABC, abacavir; ATV/r, ritonavir-boosted atazanavir; DRV/r, ritonavir-boosted darunavir; EFV, efavirenz; FTC, emtricitabine; LPV/r, ritonavir-boosted lopinavir; NVP, nevirapine; RAL, raltegravir; TDF, tenofovir.

...comparing the above mentioned costs and outcomes in incremental terms (ICER) with the no-treatment strategy, the STR appeared to be the most cost-effective therapeutic choice (€22,017), followed by TDF + 3TC + EFV (€24,526), TDF/FTC + nevirapine (€26,416), and TDF + FTC + EFV (€26,558); the remaining strategies have an ICER value varying from €28,000 to €41,000 per QALY.

The sensitivity analysis carried out on the main variables does not highlight significant variations with respect to the base case. For instance, including the discount rate (0%–5%) on costs and QALYs determines an increase of the ICER for all therapeutic regimens. On the other hand, it is worth noting that the cost per QALY decreases with the increase of the seriousness of the treated patient’s disease (CD4), showing that severe-illness patients can benefit the most (Table 8).

Discussion

The therapeutic success against HIV is mainly due to the results obtained by scientific research, which allow finding drugs with a powerful antiviral activity. Since 1996, with the discovery of new classes of drugs and molecules which can thwart viral replication on various fronts, and especially with the introduction of combined therapies, the life expectancy and quality of life of people with HIV have enormously improved. Adding new antiretroviral STRs to conventional therapies can help physicians in the choice of the optimal treatment to administer HIV patients. Since STR is not the only available therapeutic alternative, it was deemed necessary to carry out a comparison with other antiretroviral regimens; therefore the analysis considered the regimens recommended, to a varying extent, by the Italian guidelines. The comparison was not limited to considering clinical effectiveness, but it also evaluated treatment costs. In particular, an incremental cost-effectiveness analysis was performed for each regimen, with respect to the no-treatment option, from the point of view of the Italian national health care system (SSN) and taking into account the national guidelines. Such comparisons were carried out with the help of a Markov decision model over a 10-year time horizon. The model estimated QALYs as outcomes and direct health costs (drugs, medical examinations, hospitalizations, tests, and so on) as costs; these costs were attributed a value based on prices and rates as of 2010.

Table 6 Average annual cost per patient and health state expressed in CD4 (excluding HAART cost)

<table>
<thead>
<tr>
<th></th>
<th>AIDS</th>
<th>CD4+ &lt; 200</th>
<th>201 &lt; CD4+ &lt; 500</th>
<th>CD4+ &gt; 501</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalization and therapy</td>
<td>€2457</td>
<td>€771</td>
<td>€233</td>
<td>€43</td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>€2121</td>
<td>€674</td>
<td>€196</td>
<td>€39</td>
</tr>
<tr>
<td>Laboratory tests</td>
<td>€149</td>
<td>€64</td>
<td>€19</td>
<td>€3</td>
</tr>
<tr>
<td>Diagnostic procedures</td>
<td>€187</td>
<td>€33</td>
<td>€19</td>
<td>€0</td>
</tr>
<tr>
<td>Day hospital</td>
<td>€6336</td>
<td>€2583</td>
<td>€2316</td>
<td>€1886</td>
</tr>
<tr>
<td>Accesses</td>
<td>€6279</td>
<td>€2557</td>
<td>€2300</td>
<td>€1877</td>
</tr>
<tr>
<td>Medical visits</td>
<td>€57</td>
<td>€25</td>
<td>€15</td>
<td>€9</td>
</tr>
<tr>
<td>Specialist examinations</td>
<td>€314</td>
<td>€348</td>
<td>€319</td>
<td>€299</td>
</tr>
<tr>
<td>Laboratory tests (outpatients)</td>
<td>€980</td>
<td>€950</td>
<td>€937</td>
<td>€859</td>
</tr>
<tr>
<td>Diagnostic procedures (outpatients)</td>
<td>€137</td>
<td>€80</td>
<td>€21</td>
<td>€28</td>
</tr>
<tr>
<td>Total cost</td>
<td>€10,225</td>
<td>€4732</td>
<td>€3827</td>
<td>€3115</td>
</tr>
</tbody>
</table>

Abbreviation: HAART, highly active antiretroviral therapy.
The results of the simulation model show that in terms of cost per gained QALY, STR is the most cost-effective treatment strategy, compared with the other therapeutic regimens recommended by the guidelines. All the ICER values of the various regimens considered by the Italian guidelines were lower than the threshold value of €50,000, commonly accepted at the international level. This value has the purpose of expressing the willingness of the decision makers to pay in order to obtain additional health units, or the purpose of making new therapies available to citizens. Though no officially established threshold is available for Italy, it is worth noting that recent guidelines by the Italian Health Economics Association recommend that a threshold of €25,000–40,000 be adopted. Other acceptable references of cost-effectiveness for the Italian context are €36,500 and €36,000 and have been calculated by two different authors.

The favorable result of the STR is probably due to literature evidence showing a better adherence of the patients to STR, which determines an increase of the quality of life of patients with HIV. However, it is now recognized that low adherence to antiretroviral drugs is strictly linked to the indicators of the HIV-disease progression, such as virological failure, insufficient immunologic reconstitution, the clinical progression of the disease, and lastly, death. Adherence to therapy is not only necessary to obtain a therapeutic result in patients starting a treatment, but also to maintain an effective viral suppression in the course of time.

The sensitivity analysis on the main variables confirmed the validity of the base case. It is worth noting, in particular, that the increasing seriousness of the patients’ conditions (CD4-cell decrease) improves the incremental cost-effectiveness ratio with respect to the no-treatment strategy for all therapeutic regimens. This result is consistent with the indications of the Italian and international guidelines, suggesting the maximum evidence of outcomes in the treatment of patients with CD4-cell levels lower than 500. Furthermore, the results of this present study are in line with other pharmacoeconomic analyses, in particular with the study of Ravasio and with the more recent cost-utility analysis. Also, the sensitivity analysis includes any reduction in price of drugs due to patent expiry. For example, with the assumption of a 3TC price reduction of 50% included into the TDF + 3TC + EFV regimen, the most cost-effective strategy remains the STR.

This study has a few limitations, the most important of which concerns the quality of data entered into the model; parameters such as efficacy, for example, are based on studies with a limited time-frame and hence may be inadequate for modeling the treatment of a chronic disease for a longer time. Other important limitations regard the transition probabilities, which were lacking in some cases and thus assumed to remain constant over time, and the utilities, which were derived from different literature sources and considered to be acceptable for an Italian population. These assumptions were necessary to simplify the model or to take account of incomplete data into literature sources.

In addition to these limitations, the final result should be interpreted taking into account some others constraints. One constraint could be the adoption of a long-term simulation model (10 years) to compare the three alternative regimens, which was built on the basis of clinical information (now
Table 8: Results of one-way sensitivity analyses

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Base Case Costs</th>
<th>Costs per CD4 (−20%)</th>
<th>Costs per CD4 (+20%)</th>
<th>Annual costs HAART (−20%)</th>
<th>Annual costs HAART (+20%)</th>
<th>Discount rate 5%</th>
<th>Discount assumption (−50% current price)</th>
<th>Discount rate 0%</th>
<th>Discount assumption (−50% current price)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDF/FTC + EFV</td>
<td>€22,017</td>
<td>€17,236</td>
<td>€22,836</td>
<td>€21,198</td>
<td>€16,795</td>
<td>€27,239</td>
<td>€24,696</td>
<td>€20,006</td>
<td>€17,236</td>
</tr>
<tr>
<td>TDF/FTC + ATV/r</td>
<td>€30,412</td>
<td>€23,039</td>
<td>€31,370</td>
<td>€29,455</td>
<td>€23,373</td>
<td>€37,452</td>
<td>€33,462</td>
<td>€28,356</td>
<td>€23,039</td>
</tr>
<tr>
<td>TDF/FTC + DRV/r</td>
<td>€33,061</td>
<td>€25,164</td>
<td>€33,989</td>
<td>€32,133</td>
<td>€25,521</td>
<td>€40,601</td>
<td>€35,295</td>
<td>€31,730</td>
<td>€25,164</td>
</tr>
<tr>
<td>TDF/FTC + RAL</td>
<td>€41,328</td>
<td>€31,525</td>
<td>€41,839</td>
<td>€39,615</td>
<td>€33,196</td>
<td>€50,462</td>
<td>€43,418</td>
<td>€37,753</td>
<td>€31,525</td>
</tr>
<tr>
<td>TDF + 3TC + ATV/r</td>
<td>€26,558</td>
<td>€19,914</td>
<td>€27,546</td>
<td>€25,570</td>
<td>€20,259</td>
<td>€32,857</td>
<td>€30,355</td>
<td>€23,834</td>
<td>€19,914</td>
</tr>
<tr>
<td>ABC + 3TC + ATV/r</td>
<td>€28,182</td>
<td>€21,456</td>
<td>€29,088</td>
<td>€27,277</td>
<td>€21,641</td>
<td>€34,724</td>
<td>€31,094</td>
<td>€26,170</td>
<td>€21,456</td>
</tr>
<tr>
<td>ABC + 3TC + LPV/r</td>
<td>€32,448</td>
<td>€24,179</td>
<td>€33,599</td>
<td>€31,296</td>
<td>€24,807</td>
<td>€40,089</td>
<td>€36,193</td>
<td>€29,916</td>
<td>€24,179</td>
</tr>
<tr>
<td>TDF + 3TC + EFV</td>
<td>€24,526</td>
<td>€18,439</td>
<td>€25,513</td>
<td>€23,540</td>
<td>€18,634</td>
<td>€30,418</td>
<td>€28,395</td>
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<tr>
<td>TDF + 3TC + LPV/r</td>
<td>€27,840</td>
<td>€20,532</td>
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<td>€21,035</td>
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<td>TDF/FTC + ATV/r</td>
<td>€28,182</td>
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<td>€34,724</td>
<td>€31,094</td>
<td>€26,170</td>
<td>€21,456</td>
</tr>
</tbody>
</table>

Notes: Discount rate 3.5%; data from Gallant et al.15

Abbreviations: 3TC, lamivudine; ABC, abacavir; ATV/r, ritonavir-boosted atazanavir; DRV/r, ritonavir-boosted darunavir; EFV, efavirenz; FTC, emtricitabine; LAM, lamivudine; LPV/r, ritonavir-boosted lopinavir; NVP, nevirapine; RAL, raltegravir; TDF, tenofovir.

To conclude, it is worth noting that the model developed is a dynamic instrument that can be adapted to various health care settings (overall in chronic disease, such as hepatitis B virus or HIV) in that it can be run using different input data (ie, efficacy, cost, and epidemiological data).30 By allowing the simulation of different scenarios, it represents an invaluable tool for policy makers and health care professionals to make short- and long-term cost projections and thus evaluate their impact on the available budgets.

**Disclosure**

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**References**


19. Squires K, Young B, DeJesus E, et al. Similar efficacy and tolerability of atazanavir (ATV) compared to ATV/ritonavir (RTV, r), each in combination with abacavir/lamivudine (ABC/3TC), after initial suppression with ABC/3TC + ATV/r in HIV-1 infected patients: 84 week results of the ARIES trial. Program and abstracts of the 5th International AIDS Society Conference on HIV Pathogenesis, Treatment and Prevention; July 19–22, 2009; Cape Town, South Africa. Abstract WELBB103.


