Cost-Effectiveness of Expanded HIV Screening Among Adult Population in Italy

Andrea Marcellusi (1, 2), Maria Assunta Rotundo (1), Chiara Bini (1), Francesco Saverio Mennini (1, 2)

(1) Faculty of Economics, Economic Evaluation and HTA (EEHTA), CEIS, University of Rome "Tor Vergata", Rome, Italy.
(2) Institute for Leadership and Management in Health - Kingston University London, London, UK.

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BACKGROUND

In 2012, over 35 million people lived with human immunodeficiency virus (HIV) infection worldwide, and of these, approximately 2.2 million lived in high-income countries [1]. Moreover, a large percentage of the infected population are unaware of their status; in Italy, the undiagnosed HIV population was around 11–13% for an overall prevalence of about 125 000–130 000 cases [2].

The global targets set out by the Joint United Nations Programme on HIV/AIDS (UNAIDS) for 2020 are to diagnose 90% of all HIV-positive people, provide antiretroviral therapy for 90% of those diagnosed, and achieve viral suppression for 90% of those treated (known as 90-90-90 targets). Italy is close to the target, but still has rates below the target (Table 1).

Table 1. Current state of rates by country

Country	Diagnosed All PLWH	On ART Diagnosed	Virally Suppressed On ART
UNAIDS Goals [3]	*90%*	*90%*	*90%*
United States	85% [4] (2014)	73% [4] (2014)	79% [4] (2014)
Canada	80% [5] (2014)	76% [5] (2014)	89% [5] (2014)
France	84% [6] (2016)	89% [6] (2016)	91% [6] (2016)
Germany	85% [6] (2016)	91% [6] (2016)	87% [6] (2016)
Italy	**88% [6] (2016)**	**89% [6] (2016)**	**86% [6] (2016)**
Spain	82% [6] (2016)	91% [5] (2016)	88% [6] (2016)
United Kingdom	87% [6] (2016)	95% [6] (2016)	94% [6] (2016)
Japan	86% [7] (2015)	83% [7] (2015)	99% [7] (2015)
Australia	92% [8] (2016)	98% [8] (2016)	79% [8] (2016)
Russia	49% [9] (2013)	24% [9] (2013)	75% [9] (2013)
China	75% [10] (2016)	74% [10] (2016)	n/a
Brazil	n/a	60% [8] (2016)	90% [8] (2016)

OBJECTIVE

In order to support the 90% goal on prevention and 90% on the quality of life of patients, a cost-effectiveness model of expanded HIV screening among adult population in Italy was developed.

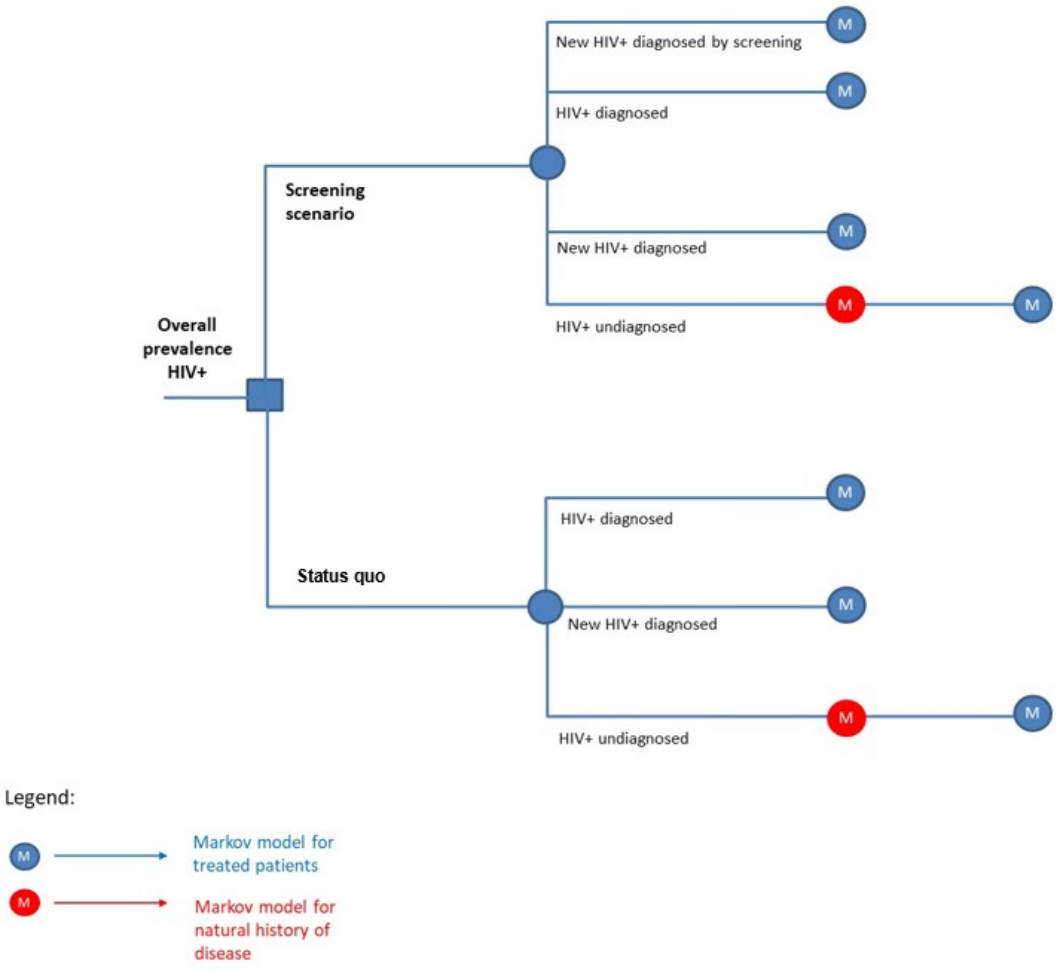
METHODS

A decision tree was combined with two Markov model previously published in the literature to simulate the path of HIV-infected diagnosed and undiagnosed patients in Italy considering the presence or the absence of expanded HIV screening among adult population. The model was informed by epidemiological and cost estimates taken from different sources. A team of infectious disease experts was involved in order to validate the model structure and the parameters included in the analysis. The analysis was conducted from the National Health Service perspective. Both costs and QALYs were discounted at an annual rate of 3% for a lifetime follow-up.

Model structure

Figure 1 shows the model structure. We simulated the cohort of overall HIV-infected patients (Overall prevalence HIV+) in Italy for a 30-year time horizon evaluating 2 different scenarios: 1) status quo, with the current number of HIV-infected diagnosed and undiagnosed patients in Italy; 2) scenario with an increase of the number of HIV-infected diagnosed patients due to the presence of an expanded HIV screening in the overall adult population. In the status quo scenario, patients were divided in 3 groups: new HIV-infected diagnosed patients (incidence), HIV-infected diagnosed patients and HIV-infected undiagnosed patients. In the scenario with the presence of expanded HIV screening we assumed that a share of HIV-infected undiagnosed patients will be diagnosed through screening. Two Markov models were used in the analysis: 1) a Markov model to simulate the diagnostic therapeutic process of HIV-infected diagnosed patients currently treated in Italy [11]; 2) a Markov model to simulate the natural history of disease of HIV-infected undiagnosed patients [12]. The model assumed that HIV-infected undiagnosed patients will be diagnosed after a few years, according to the CD4 levels, and then they will be entering in the Markov model related to treated patients.

Figure 1. Model structure



Epidemiological parameters

Table 2 shows the epidemiological parameters included in the model. The overall prevalence of HIV-infections and the share of HIV-infected undiagnosed patients were obtained from an Italian study previously published in the literature [2], which estimated that the undiagnosed HIV population in Italy was around 11–13% for an overall prevalence of about 125 000–130 000 cases in 2012. The number of new HIV-infected diagnosed patients was obtained from the surveillance system of the Italian Institute for Health [13], which reported 2,847 new HIV diagnoses in 2018 in Italy, equalling an incidence of 4.7 per 100,000 residents.

The stratification of HIV-infected diagnosed patients by CD4 level was obtained from the national surveillance system of the Italian Institute for Health [13]. The stratification of HIV-infected undiagnosed patients by CD4 level was obtained from a previous study conducted in France (Supervie 2013, AIDS).

Table 2. Epidemiological parameters

Parameter	**Estimate**	**Source**
Overall prevalence HIV+	125,951	Mammone et al. 2016 [2]
HIV+ undiagnosed	13,729	Mammone et al. 2016 [2]
New HIV+ diagnosed	2,847	National surveillance system of the Italian Institute for Health [13]
Distribution of CD4 levels for HIV+ undiagnosed patients		
CD4 level	**Estimate**	**Source**
CD4≥500	40.00%	Supervie 2013, AIDS
350<CD4<499	20.00%	
200<CD4<349	21.00%	
CD4<200	19.00%	
Distribution of CD4 levels for HIV+ diagnosed patients		
CD4 level	**Estimate**	**Source**
CD4≥500	24.90%	National surveillance system of the Italian Institute for Health [13]
350<CD4<499	18.00%	
200<CD4<349	19.30%	
CD4<200	37.80%	

Cost parameters

Costs were obtained from the literature (Table 3). The Number need to test (NNT) to identify 1 HIV infection was estimated considering the number of new HIV infected diagnosed and prevalent undiagnosed divided by resident adult population in Italy in 2012 (NNT = 3,713 for general population). Screening test cost was assumed equal to € 5.00.

Table 3. Cost parameters

Other direct health costs	**Cost**	**Source**
Test	€ 5.00	Assumption
Health-care services		
CD4≥500	€ 2,502	Rizzardini et al. [14, 15] (Health-care services + other drugs + hospital admission)
350≤CD4<500	€ 3,409	
200≤CD4<350	€ 3,816	
CD4<200	€ 6,343	
Opportunistic infection	€ 2,111	Foglia et al 2013 [16]

RESULTS

Our analysis showed that an increase of new HIV-infected diagnosed patients due to expanded HIV screening strategy resulted in an increment of about 1.909 QALYs and around € 55.4 million incremental costs if compared to the status quo; the resultant ICER was € 29,024/QALY (Table 4). Probabilistic sensitivity analysis confirmed that the expanded HIV screening would be cost-effective for 58% of simulations at a minimum willingness-to-pay threshold of € 30,000 per QALY gained (Figures 2 and 3).

Table 4. Cost-effectiveness results

	Total costs	Total QALYs	Incremental Cost	Incremental QALY	ICER per QALY
Status quo	€ 14,735,247,830	1,659,893			
Screening	€ 14,790,646,237	1,661,801	€ 55,398,406	1,909	€ 29,024

Figure 2. Cost-effectiveness plan

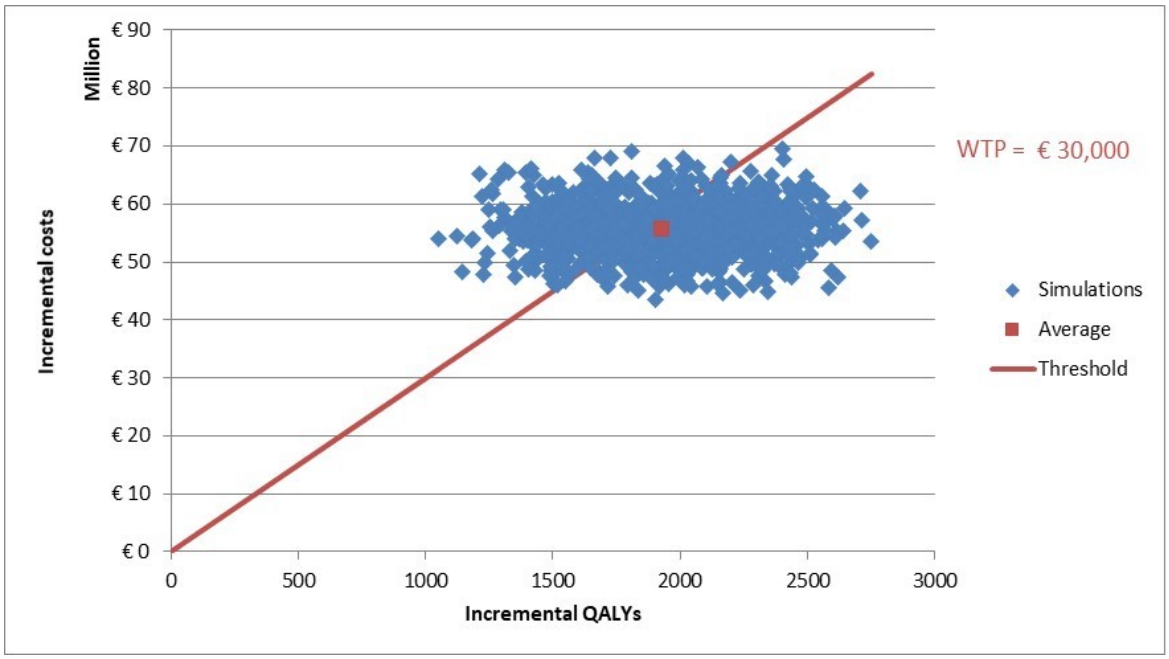
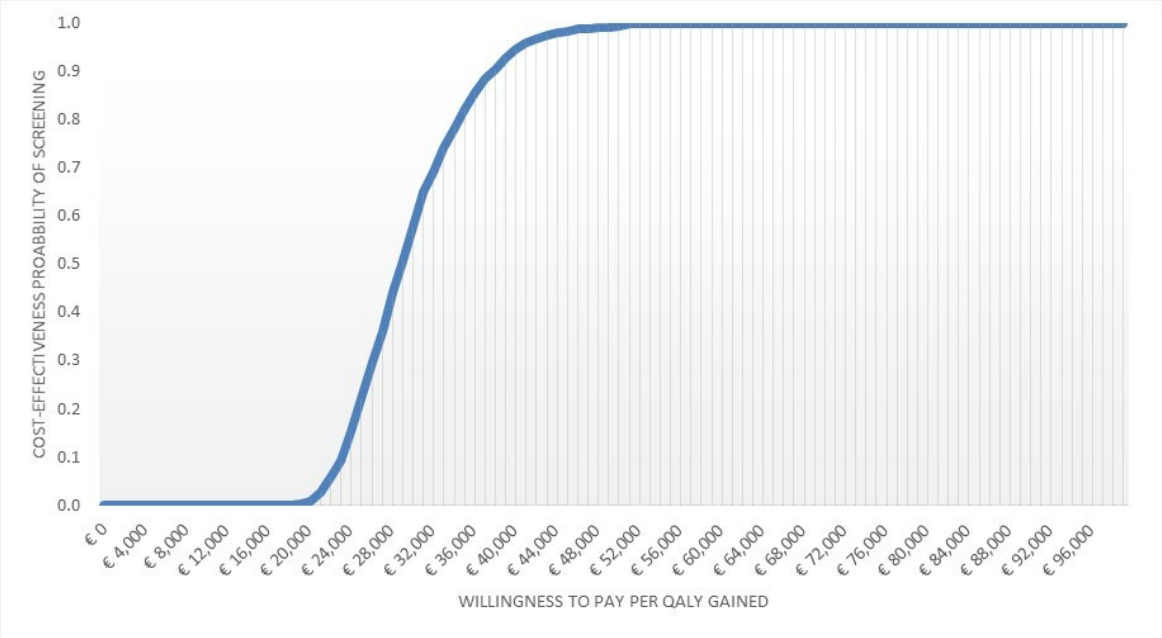


Figure 3. Cost Effectiveness Acceptability Curve (CEAC)


COST-EFFECTIVENESS PROABBILITY OF SCREENING
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
€ 0
€ 4,000
€ 8,000
€ 12,000
€ 16,000
€ 20,000
€ 24,000
€ 28,000
€ 32,000
€ 36,000
€ 40,000
€ 44,000
€ 48,000
€ 52,000
€ 56,000
€ 60,000
€ 64,000
€ 68,000
€ 72,000
€ 76,000
€ 80,000
€ 84,000
€ 88,000
€ 92,000
€ 96,000
WILLINGNESS TO PAY PER QALY GAINED

DISCUSSION

This study is still ongoing. Will be carried out:

- scenario analyses to evaluate screening strategies for populations at risk (MSM, hetero males, hetero females, IDUs);
- analysis to assess the impact of the lockdown due to COVID19 on delay in terms of reduction of screening and early diagnosis and consequences on delayed treatments, complications, disease progression, deaths, costs and quality of life of HIV+ patients.

CONCLUSIONS

In Italy there is an urgent need to apply HIV screening strategies to increase awareness of the risks of the disease. The early identification of HIV-infected undiagnosed patients in Italy through expanded HIV screening in adult population was a cost-effective strategy with a positive impact on the quality of life of patients. The screening strategy is the main driver to achieve the objectives of 90% in terms of prevention and 90% in terms of QoL gained and, our model, demonstrates that it is a cost-effective option if compared to the status quo.

ACKNOWLEDGMENT

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ABSTRACT

OBJECTIVES: The global targets set out by the Joint United Nations Programme on HIV/AIDS (UNAIDS) for 2020 are to diagnose 90% of all HIV-positive people, provide antiretroviral therapy for 90% of those diagnosed, and achieve viral suppression for 90% of those treated (known as 90-90-90 targets). In Italy, there is no uniform HIV screening strategy across the country. Our study aimed to assess the cost-effectiveness of expanded HIV screening among adult population.

METHODS: A decision tree was combined with previously published Markov models for evaluate the management of HIV-infected patients in Italy. The model was informed by epidemiological and cost estimates taken from different sources. The cohort of overall HIV-infected patients in Italy was followed over a 30-year time horizon evaluating different scenarios due to the expanded HIV screening. The analysis was conducted from the National Health Service (NHS) perspective and both costs and QALYs were discounted at an annual rate of 3%. Probabilistic sensitivity analysis was conducted to evaluate parameter uncertainty.

RESULTS: Our preliminary analysis showed that HIV screening strategy and the related timely treatment resulted both in an increment of about 1,909 QALYs and around € 55.4 million incremental costs if compared to the status quo; the resultant ICER was € 29,024/QALY. Probabilistic sensitivity analysis confirmed that the expanded HIV screening would be cost-effective for 58% of simulations at a minimum willingness-to-pay threshold of € 30,000 per QALY gained.

CONCLUSIONS: In Italy there is an urgent need to apply HIV screening strategies to increase awareness of the risks of the disease. Our analysis indicates that the expanded HIV screening in adult population would be cost-effective as it will allow to treat patients at early stages with a positive impact in terms of patients QoL.

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