Effectiveness of potential improvements in the cascade of HIV treatment and care in South Africa

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Background

- The new WHO 2013 ART guidelines set ambitious goals of initiating all patients on ART at CD4<500 cells/mm^3. However, several programmes in South Africa (SA) have highlighted that leakages in the cascade of care represent a major barrier to maximizing population health benefits from ART.
- Implementation studies demonstrated that it is possible to substantially reduce the leakages at different steps of the cascade of care.
- Programme managers face a difficult decisions over levels of resources and effort to commit to initiating patients earlier on ART compared to improving implementation of ART delivery.

The aim of this study is to evaluate the value of potential improvements in each step of the cascade of care and of changing in the eligibility criteria to initiate ART, over 20 years in South Africa.

Methods

HIV Synthesis Transmission Model

The 'HIV Synthesis transmission model', an individual-based stochastic model of heterosexual HIV transmission, progression and treatment of HIV infection (Phillips et al., AIDS 2011, 25(6): 43–850), calibrated to South Africa was used.

Table 1 illustrates the situation regarding the cascade of care at the end of 2013, and the intervention considered (assumed implemented over 2014 and 2015). The maintenance of this status is referred to as option R.

One key assumption relating to people who are lost is that if a WHO stage 4 condition is experienced then it is assumed there is an 80% chance of coming back into care.

Table 1. Assumptions regarding the cascade of care in South Africa and the potential

	Model		Observed data
	End of 2013	Change considered (label)	
CD4 eligibility criteria (EC) to be initiated on ART (in cells/μl)	CD4<350	CD4< 500 (F) At diagnosis (D)	CD4 <350 (2013 South African Guidelines)
Population ever tested for HIV	62% (29% in the last year)	85% (T)	51% in 2008 SA National HIV Prevalence, Incidence, Behaviour and Communication Survey
Linked to care by 1 year since diagnosis	71%	85% (L)	35% (Larson 2010 WHO Bull) to 78% (Govindasamy 2011 JAIDS)
Retention in pre-ART care at 1 year since ART eligibility asssessment in those not eligible for ART	42%	71% (P)	31% (Larson 2010 Trop Med Int Health) to 46% (Luseno 2008 XVII Conference)
Retention on ART care at 1 year since ART initiation	84%	92% (A)	80% (Cornell 2010 AIDS) to 93.% (Boulle 2008 Bull WHO)
Median time to switch to 2nd line since virological failure	12 months	5 months (S)	Assumption

In addition combination of the above are considered.

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Methods

Economic Analysis

The 19 scenarios are compared on the basis of their costs and health outcomes, which are both discounted to present value at 3% per annum, over 20 years. Costs are estimated based upon resource use (e.g. number of tests, number of clinic visits) and associated unit costs:

- ART cost (1st line: TDF+3TC+NVP): $97 per year (Source: MSF report 2013)
- WHO stage 4: US$200; WHO stage 3: $20; TB: $50; Cotrimoxazole (CTX) per year $5
- Clinic Visit: $40; CD4 measurement $15; VL cost $45; HIV test (all costs fully loaded) $10;

The benefits of improving implementation are investigated; firstly without any additional costs for implementation initiatives (figure 3a) and then with the following indicative fixed implementation delivery costs (figure 3b):

- $0.5 per person not diagnosed with HIV (either HIV negative or positive and not diagnosed) if an intervention to increase testing was included,
- $50 per person linked to care, per person-year retained in pre-ART care, per person-year retained on ART and per switch to 2nd line was applied if respectively an intervention to increase linkage to care, retention in pre-ART care, on ART and reducing the time to switch to 2nd line was introduced.

Health outcomes are summarised in the form of quality-adjusted life years (QALYs). Expected costs and health outcomes under both scenarios can be compared using incremental cost-effectiveness ratio (ICER) to establish whether each intervention is likely to represent good value from available health sector resources.

Costs and health outcomes are rescaled to provide figures relevant to the entire adult population (15-65 years old) of South Africa.

Results

Figure 1. Life years gained over 20 years (in million) in South Africa

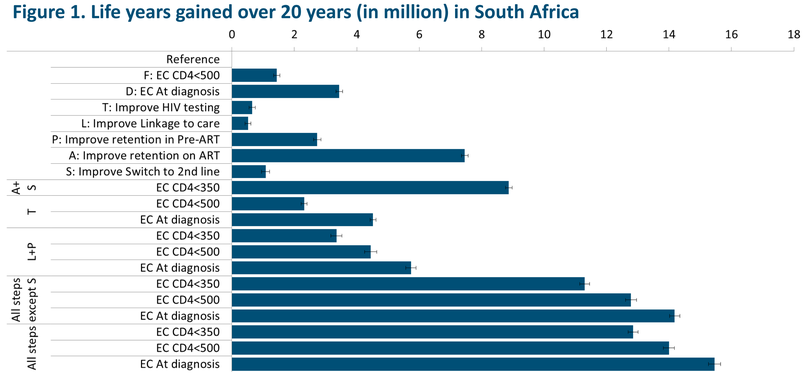
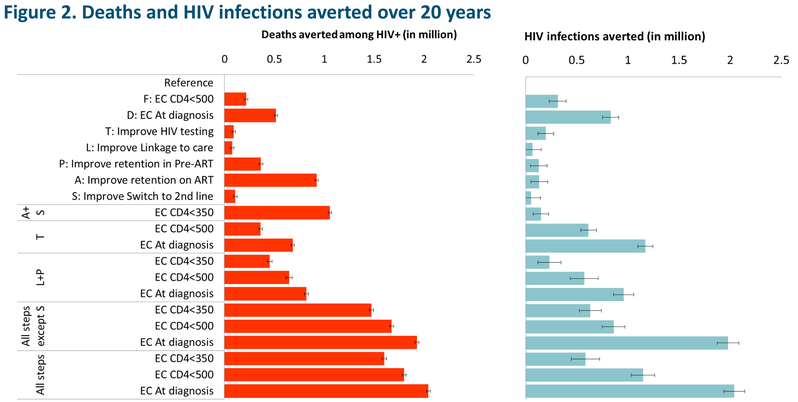


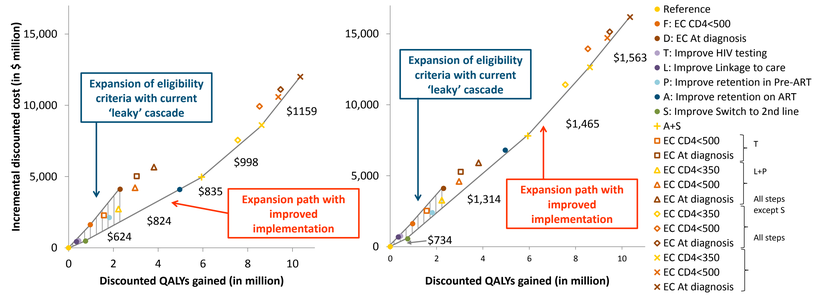
Figure 2. Deaths and HIV infections averted over 20 years



Results

Figure 3. Value of strengthened implementation in South Africa

a. Maximum value (no costs of implementation initiatives included) **b. Indicative value (illustrative costs of implementation initiatives included)**



In Figure 3a and 3b two cost-effectiveness frontiers have been presented, one across the interventions aimed at improving how care is delivered (interventions T, L, P, A, S and their combinations) and one across the intervention where the eligibility criteria to be initiated on ART are modified to either CD4<500 cells/mm^3, as recommended by WHO or to all people diagnosed with HIV. The area between the two frontiers represents the area of potential gain from improving implementation.

Table 2. Maximum cost of the intervention to be cost-effective at the CET indicated (considering only the single interventions applied to improve the current leaky cascade)

Potential intervention	$ cost is per....	Cost –effectiveness threshold (CET)			
		$1,000	$2,000	$5,000	$12,000
T: Improve HIV testing	person not diagnosed with HIV	-	$0.8	$3	$10
L: Improve Linkage to care	person linked to care	-	$54	$261	$743
P: Improve retention in Pre-ART	person-year in pre-ART care	-	$278	$1,279	$3,616
A: Improve retention on ART	person-year on ART	$16	$108	$382	$1,023
S: Improve Switch to 2nd line	person switched to 2nd line	$171	$624	$1,985	$5,159

Note: South Africa GDP in 2012 US$ 11,600

The estimates indicated in table 2 provide the framework to design interventions that could improve the cascade. For example interventions aimed at reducing the delay in switching to 2nd line (from 12 to 5 months) or at improving the retention on ART (from 84% to 92%) can be more expensive per unit considered because they lead to greater health benefit.

Conclusions

- Policymakers need to determine how best to spend available resources on ART to generate health gains in the population. The single improvement which leads to the highest increment in total life years over 20 years is improvement of retention on ART (7.5 million), which leads to the greatest reduction in deaths among HIV+ people (923,000), despite only an assumed relatively modest increase in retention (8%).
- Modifying the ART eligibility criteria to initiate ART at diagnosis averts the highest number of new HIV infections (831,000), but results in a lower increment in life years of 3.4 million. The specified improvements at all steps of the cascade allow a gain of over 15 million life years over 20 years.
- Our analysis indicates that policymakers should seek to strengthen the cascade of HIV testing and treatment (in particular by improving retention on ART and switch to 2nd line) before raising the eligibility criteria. Further research on what initiatives could improve implementation of ART, and how much these are likely to cost, would be very valuable.
- In the longer term, greatest health gains can be achieved by both improving implementation and increasing eligibility for ART, but this requires substantial commitment of resources.