Who Pays and Why? Costs, Effectiveness, and Feasibility of HIV Treatment as Prevention

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Treatment as prevention (TasP) has been added to the toolbox of human immunodeficiency virus (HIV) prevention technologies, and countries are at different stages of TasP deployment. In this article we review some of the cost implications and summarize effectiveness data from different settings. Also, we reflect on the affordability and feasibility of programmatic deployment as well as the multiple challenges of maintaining service quality while HIV treatment programs grow in size and complexity. We conclude that in low-resource settings, TasP progress will be very incremental with progressively earlier treatment initiation while working within the capacity and resource constraints of the respective healthcare systems. In the long-term, feasibility will rely on complementary interventions to reduce new HIV infections, such as male circumcision, and on demand creation for early treatment uptake as well as adherence. TasP holds potential for moving us closer to the global goal of ending AIDS.

Keywords. treatment as prevention; implementation; cost; effectiveness.

According to the Burden of Disease Study, AIDS was, by far, the fastest-growing cause of disease burden globally between 1990 and 2010, and, jointly with malaria, AIDS is the greatest cause of disease burden in sub-Saharan Africa [1]. Signs of stagnating progress toward global targets and elimination commitments cast a light on the achievements in human immunodeficiency virus (HIV) prevention and the limitations of interventions expected to reduce HIV transmission [2]. The observation that antiretrovirals (ARVs) reduce the infectiousness of HIV-positive individuals have firmly positioned ARVs as both treatment and prevention technologies. Because the national and global HIV responses face critical resource limitations, the obvious question is whether treatment as prevention (TasP) will provide “value for the money” and whether governments should invest in treating a much larger proportion of HIV-positive people as part of their efforts to meet their HIV incidence targets.

In 2012, HIV care and treatment services consumed more than half (55%) of the $18.9 billion available for HIV programs in low- and middle-income countries (LMICs) [2]. Antiretroviral therapy (ART) dominates HIV budgets in concentrated epidemics and increasingly in generalized epidemics [3]. The financing of ART programs in many LMICs heavily depends on external funding despite growing domestic HIV spending. Forty-three LMICs finance more than 75% of HIV treatment costs from international sources, and another 59 LMICs finance more than half of their treatment costs externally. Malawi’s treatment costs are almost completely covered by international sources and nearly equal the total health budget. In contrast, ART programs in Brazil, Russia, India, and China are almost entirely funded by the public sector, and South Africa’s HIV budget grew by 500% in a decade to $1.9 billion, the second largest globally [4].

It is estimated that there are 35.3 million people living with HIV (PLHIV) [2]. Approximately 9.7 million PLHIV are on ART, a number close to the pre-2010 global treatment target (11 million) but far away from the target based on the 2010 guidelines (17 million, or 21 million if serodiscordant couples and pregnant women were to be treated regardless of CD4 count) and just over a third of the way to the current...
recommendation of treatment initiation at a CD4 count of ≤500 cells/μL (26 million) [5].

A brief review of the population-level effectiveness of TasP in preventing new HIV infections provides a mixed picture. Despite ART coverage of about 85%, Swaziland has a measured HIV incidence of 2.4% [6]. A nearby KwaZulu Natal research site reports 34% lower HIV infection level in areas with ART coverage of 30%–40% compared with HIV infection levels in areas with ART coverage below 10% [7]. A cohort study in Uganda found no difference in HIV incidence in discordant couples in a rural program [8]. However, an observational study in discordant couples in China found 26% lower HIV incidence linked to indexes with HIV transmission via transfusion or sex but not via injecting drug use [9]. In resource-sufficient countries, HIV infections are rising in highly ARV-treated men who have sex with men (MSM) communities [10]. However, in British Columbia, where ARV treatment and laboratory and medical monitoring of HIV-infected individuals are universally covered and fully subsidized and where the cascade of care has been carefully analyzed and strengthened, there was a steady decline in the number of new HIV diagnoses from 702 to 238 cases (−66%; P = .0004) between 1996 and 2012 [11, 12]. This extended to the MSM population, where the rate of new HIV diagnoses declined from 4.43 per 1000 in 1996 to 1.81 per 1000 in 2012. In response to the inconclusive evidence of TasP effectiveness for HIV prevention in low-income settings where the HIV prevalence is high, several cluster randomized controlled trials, powered to detect significant HIV incidence effects, have been initiated in generalized epidemic settings.

Of similar importance to the effectiveness of TasP is the feasibility of large-scale TasP implementation in real-life programmatic conditions. What proportion of ART patients are virally suppressed? Are there ART patients with such high viral loads that they remain as infectious as nontreated PLHIV? In South Africa, 30% of ART patients have >1500 viral copies/mL and should be considered infectious, and 10% have >50,000 viral copies/mL [13]. In Kenya, 22% of PLHIV reporting ART use have >1000 viral copies/mL [14], and in Swaziland, 15% of ART patients are found with >1000 viral copies/mL in routine viral load monitoring [15]. Looking at the entire treatment cascade, only 28% of all PLHIV in the United States are virally suppressed [16]. In British Columbia’s well-developed ART program, the proportion of people adherent to treatment but not virologically suppressed decreased from 95% in 1996 to 22% in 2011 (viral suppression threshold in 2011 was <50 copies/mL) [11]. These figures illustrate that in most settings, there is an enormous gap between the aspiration to provide ARVs to the PLHIV population and the actual numbers of HIV cases attaining viral suppression through the consistent, daily consumption of effective ARVs. Underlying successful viral suppression are complex systems of supply chain management, case identification, adherence support activities, virological and clinical monitoring, and similar systems. The closer ART is brought to the target population through program decentralization, the more intricate and expensive the supply chain for multiple first- and second-line ARV drug regimens becomes. Several recent reports from sub-Saharan African countries flag the fragility of ARV supplies, with stock outs, rationing, and failure to switch to better ARV formulations being reported [17]. Case identification remains a key challenge despite resource-intensive “know-your-status” campaigns and continuous investments in the promotion of HIV testing. Keeping ART patients on the program is another priority where significant resources and expertise need to be allocated; 60-month retention is below 50% in Indonesia and below 60% in Malawi [18]. As ART is increasingly extended to individuals who have never experienced the AIDS disease stage and feel healthy, it is feared that relatively more ART funding will need to be allocated to enrollment, counseling, and retention and adherence activities. Special HIV screening and ART promotion efforts are clearly required to reach those who are marginalized, such as injecting drug users who have an estimated ART coverage of <5% in LMICs [19]. Finally, acquired ARV drug resistance challenges the large-scale implementability of ART programs, with rising resistance levels associated with the age of the ART program as well as the individual treatment duration (acquired resistance affecting >10% of patients after 1 year of ART and >20% after 3 years of ART) [20].

Despite the manifold challenges to TasP implementability and scale-up, the results from various program settings point to important positive externalities of HIV treatment. In South Africa, the country with the largest ART program, treatment was linked to a gain of 11 years of life expectancy [21] and a 20% decline in adult mortality [22]. Other reports link ART to decreases in workers’ absenteeism to preinfection levels in Botswana [23] and reductions in child labor, improved child nutrition, and better school attendance in Kenya [24]. Formal cost-effectiveness assessments of TasP are scarce, but a South African modeling study estimates that TasP costs $8400 per HIV infection and is therefore considered cost effective per the World Health Organization threshold of 3 times the country’s per capita gross domestic product [25]. Importantly, male circumcision was rated as a much more cost-effective intervention at $1100 per infection averted, and high coverage of male circumcision and ART (among PLHIV with CD4 counts <350 cells/μL) was estimated to be $5 billion less expensive than prioritizing TasP from 2009 to 2020.

A key to the scale-up of ARV-based HIV interventions has been the massive decline in ARV drug costs. Global price reporting mechanisms closely track the costs of the various treatment regimens; even in the last 5 years, several first- and second-line regimens have seen significant drops in unit costs.
Through task shifting, delivery models have moved from physician-intensive models to models based on trained lower-level healthcare staff. In Uganda, ART administered by nurses has helped reduce personnel costs, and through use of an innovative pharmacy worker-intensive model, personnel costs were reduced by two-thirds [27]. Analyses on the variation of ART delivery costs in Kenya help in the design of measures to drive costs down while maintaining service quality [28]. The evidence on cost determinants such as site maturity and client volume informs program planning and budgeting as well as an agenda to increase program efficiency [29]. Innovations such as longer-acting ARVs, lower-dose formulations, cheaper and better diagnostics, and technology innovations such as dispensing robots hold the promise for further cost reductions in treatment. Nevertheless, application of current costs to estimates suggests that initiating treatment at a CD4 count of 500 cells/μL could equal South Africa’s entire health budget [30], and TasP could equal 10% of Nigeria’s health budget [31]. Treating all 26 million PLHIV at the CD4 count threshold of 500 cells/μL could cost $16 billion annually, and extending TasP to all PLHIV could cost $20 billion annually. While these prospects are daunting, we cannot deny that HIV programs have invigorated actions toward better implementation efficiency. Take Thembisa Lethu in South Africa, the world’s largest ART center with approximately 30,000 clients enrolled and about 1000 seen daily. Its integrated information and communications technology (ICT) system uses an automated pharmacy robot, which reduces dispensing from 4 hours to 30 minutes. The robot connects to the ICT system and verifies and validates patients’ electronic prescriptions [32]. Such systems were first trialed for ARVs and then for other essential drugs. The ICT system is to be expanded to an integrated district health management system in Tswana, while ART clients are successfully decentralized to primary care facilities.

Our brief summary of the economic success of TasP shows that its economic focus must be on feasibility, affordability, probability and the cost effectiveness of eliminating HIV as a public health threat. The positive externalities of ART on households, communities, and society have been established, and the economic case for investment in HIV treatment has been made. TasP is feasible in high-income countries with limited HIV epidemics and early treatment initiation. In lower-income countries with large epidemics, TasP will be approached with progressively earlier initiation of those with more advanced infections. Importantly, male circumcision scale-up can help several high-burden countries obtain universal access to ART and ultimately move toward TasP by reducing new HIV infections. TasP progress will be painstaking, incremental, and patient by patient, relying on demand generation while trying to sustain quality in a growing treatment program. The signs are that TasP will never be a public good with all the different capacity and resource constraints that healthcare systems face. However, the elimination of AIDS is a public good, and TasP in combination with other HIV interventions will take us closer to this global goal.

Notes

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