MAX ART

For Better Health and Zero New HIV Infections

The economies of scale of test and treat:

Poster 1143

A longitudinal costing study in Swaziland

Background

Swaziland has one of the highest adult HIV prevalence rates worldwide (27% of people aged 15-49). An estimated 220,000 people 15 years and over are currently living with HIV, of which currently 78% are on antiretroviral therapy (ART) as of 2016. Following the release of the 2015 World Health Organization guidelines, Swaziland and many other countries in sub-Saharan Africa - have adopted universal test and treat (UTT) strategy. As Swaziland works to meet UNAIDS' 90-90-90 targets, it is critical to understand the cost of UTT scale-up and its implications for the health system. This is the first empirical longitudinal costing study of annual ART patient costs of a UTT strategy with routine viral load monitoring within a public sector health system.

Methods

We collected comprehensive monthly facility-level data on ART patient costs from 14 facilities implementing UTT by the MaxART consortium, a randomized stepped-wedge health systems trial (September 2014-August 2017). In addition to time-and-motion observations, we extracted cost data from facility budgets, expenditure reports, and patient records. This "bottom-up costing" included direct personnel, medications, laboratory services (with viral load), and treatment for opportunistic infections (OI), tuberculosis. We express all costs per patient per year (PPPY). Costs were converted from local currency to U.S. Dollars using annualized exchange rates. Multilevel regression models controlling for time fixed effects and facility random effects was used to determine the existence of economies of scale.

Results

Total ART costs per person per year (PPPY) were $209 (95% CI: 183-236). ARVs costs accounted for the largest proportion at $96 (95% CI: 94-97), followed by personnel $73 (95% CI:48-97), laboratory services $35 (95% CI: 31-40) and tuberculosis costs $5 (95% CI: 3-8) after adjusting for time (Table 1).

TABLE 1 - ART COST COMPOSITION UNDER UNIVERSAL TEST AND TREAT

	Cost per patient-year Mean (95% CI)
TOTAL	**$209 (183-236)**
ARVs	$96 (94-97)
Personnel	$73 (48-97)
TB	$5 (3-8)
Labs	$35 (31-40)

FIGURE 1 - ACTUAL TOTAL COST VS VISITS PER MONTH
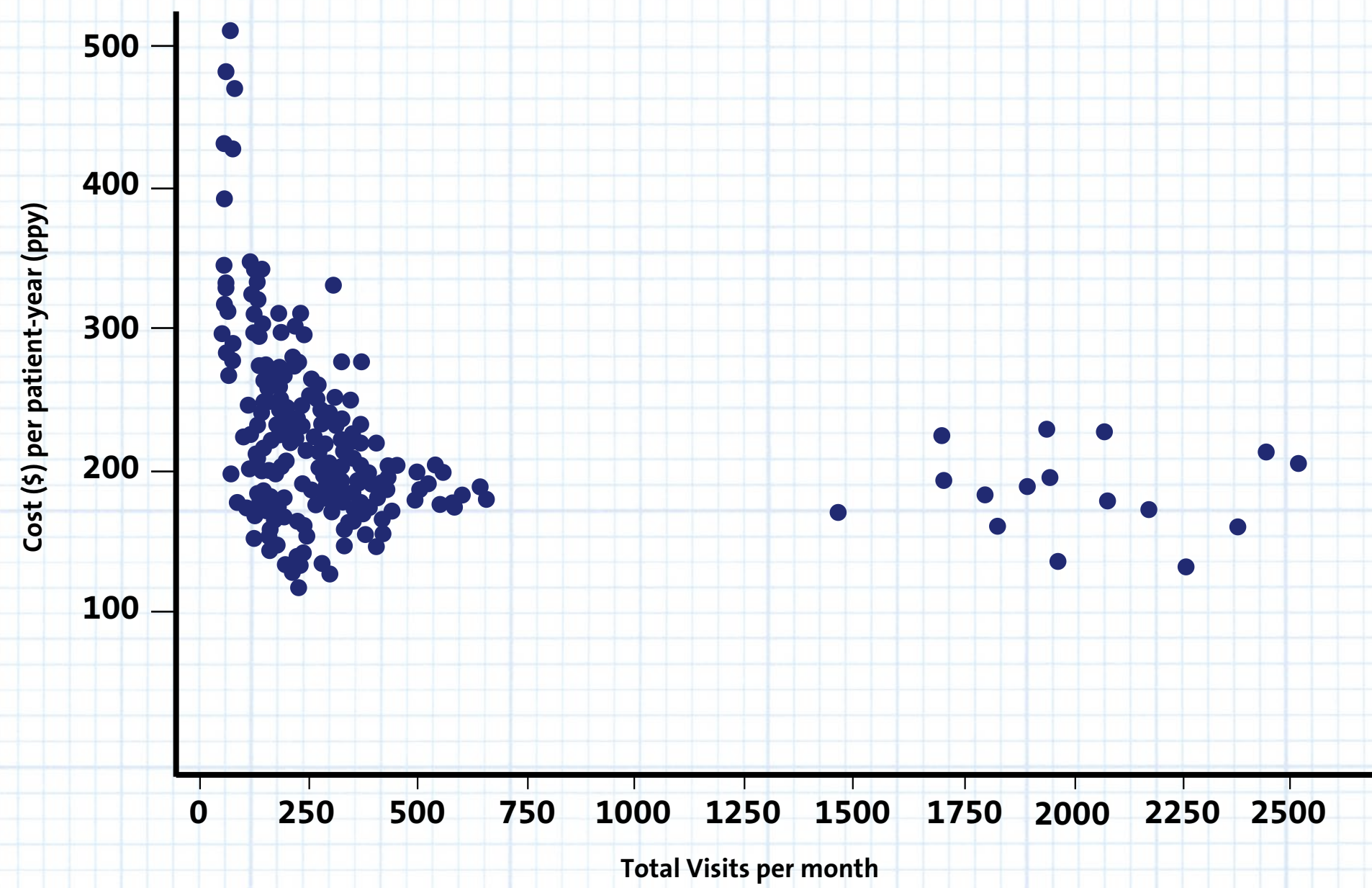
We identified strong evidence for economies of scale in the relationship between costs PPPY and total visits. As number of total visits increase, costs initially decrease rapidly (from about $500) and then plateau (below $200 PPPY) approximately at 250 patient visits (*Figure 1*).

The empirical results using the cubic functional form are presented in the *Table 2* with cost per patient-year as an independent variable and total visits as dependent variable while adjusting for fixed effect of time and random effect of facility. In the generalized linear model, there was a decrease in total cost per patient-year of $-0.41 (95% CI: -0.62 - -20) for each additional visit.

TABLE 2 - REGRESSION RESULTS OF A MIXED-EFFECT GENERALIZED LINEAR MODEL

Dependent variable per facility month*	N	coefficient (95% CI)	p-value
Total visits		-0.41 (-0.62 - -20)	<0.001
(Total visits)^2		2 e-04 (7 e-05 − 4 e-04)	0.006
(Total visits)^3	258	-5 e-08 (-9 e-08 - -4e-09)	0.032
Intercept		277 (232-322)	<0.001

Conclusion

Swaziland's national ART program displays strong economies of scale under UTT with far less efficiency achieved in clinics reaching fewer than 250 patient visits per month. In the context of scaling up UTT, increases in patient volumes are efficient trajectories. Where this approach is not feasible, such as in rural and remote areas, alternative delivery models should be explored to maximize efficiency gains as countries roll out UTT strategy and increase the number of patients on ART. Toward that end, Swaziland has already taken a step toward exploring alternative delivery models by piloting a community ART programs.

Authors

Shaukat Khan[1], Cebele Wong[1], Pascal Geldsetzer[2], Gerda Asmus[3], Thomas How[1], Charlotte Lejeune[1], Velephi Okello[4], Till Bärnighausen[2,3]

[1] Clinton Health Access Initiative
[2] Harvard T.H. Chan School of Public Health
[3] Institute of Public Health, University of Heidelberg
[4] Swaziland Ministry of Health