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Cost-effectiveness of three different Pre-Exposure Prophylaxis (PrEP) regimens for HIV prevention in Mexico

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Background

Pre-exposure prophylaxis (PrEP) can be cost-effective in populations at high risk of HIV. While PrEP is the standard of care in Mexico, evidence of its cost-effectiveness is lacking. Therefore, we analysed the cost-effectiveness of PrEP among men who have sex with men (MSM) and transgender women (TGW).

Methods

We developed a Markov model (Figure 1) to examine the impact of scaling up PrEP through government and community clinics in MSM and TGW at high risk of HIV. The model simulated a hypothetical cohort of people without HIV entering at 25 years. Primary analysis evaluated generic emtricitabine-tenofovir disoproxil fumarate (F/TDF), branded emtricitabine-tenofovir alafenamide (F/TAF), and long-acting cabotegravir (CAB-LA) versus no-PrEP.

	No-PrEP	F/TDF	F/TAF	CAB-LA
Total new infections, n	547,533	490,383	492,504	492,290
Cases prevented, n(%)*	-	57,150(10.4)	55,029(10.1)	55,243(10.1)
Total deaths	45,454	45,419	45,420	45,420
Deaths prevented, n(%)*	-	35(0.1)	34(0.1)	34(0.1)
Total life-years†	8,589,282	8,589,434	8,589,429	8,589,428
Total QALYs†	7,455,581	7,594,473	7,589,599	7,589,532
Total costs, billion†	$12.2	$12.8	$13.8	$13.4
Incremental life-years vs no-PrEP vs F/TDF	 - -	 152 -	 147 -5	 147 -6
Incremental cost, billion† vs no-PrEP vs F/TDF	 - -	 $0.6 -	 $1.6 $1.0	 $1.2 $0.6
Incremental QALYs† vs no-PrEP vs F/TDF	 - -	 138,892 -	 134,018 -4,875	 133,951 -4,941
ICER, $/QALY vs no-PrEP vs F/TDF	 - -	 $4,427ᵅ -	 $12,216 -$209,692	 $8,955ᵅ -$118,314
ICER, $/Life-year vs no-PrEP vs F/TDF	 - -	 $4,033,246 -	 $11,118,290 -$195,712,654	 $8,175,276 -$101,9500,683

Table 1: Benefits and costs of strategies over a 15-year time horizon in MSM and TGW at high-risk of HIV
ICER= incremental cost-effectiveness ratio; PrEP= Pre-exposure prophylaxis; QALY= Quality-adjusted life-year.
* HIV cases and deaths prevented are relative to No-PrEP.
† Life-years, QALYs and costs are discounted at a 3% annual rate over 15 years.
ᵅ Below the cost-effectiveness threshold of $10,165 per QALY gained.

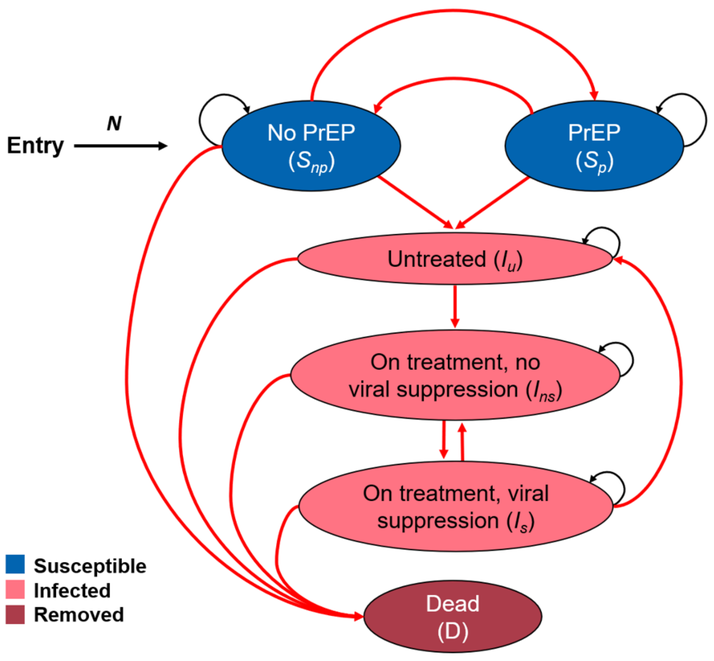

Figure 1: Markov Model for PrEP in Mexico
This figure represents the model structure of men who have sex with men (MSM) and transgender women (TGW) in Mexico who enter (or not) a pre-exposure prophylaxis (PrEP) programme. The circles represent the health states (susceptible, infected or dead). The black arrows denote that individuals can remain in the same health state at the end of each cycle, and the red arrows represent transitions between health states. Individuals enter at the susceptible health state and may die or transition to the infected states.

Parameter combinations				
		CAB-LA price		
CAB-LA vs F/TDF		1x F/TDF ($1,384)	0.5x F/TDF ($692)	0.25x F/TDF ($346)
F/TDF HIV incidence	0.3	-$33,283	$2,724	$20,728
	4.5	$3,336	-$9,455	-$15,851
CAB-LA HIV incidence	0.2	-$462,042	$144,403	$447,626
	0.6	-$72,839	$15,891	$60,256
Discount rate in utilities	0%	-$90,987	$23,769	$81,147
	5%	-$139,382	$36,412	$124,308
Discount rate in costs	0%	-$143,441	$36,040	$125,780
	5%	-$105,207	$28,161	$94,845
CAB-LA retention	76.2%	$88,933	-$11,755	-$62,099
	96.2%	-$29,863	$12,545	$33,750
CAB-LA WTU	76%	-$24,435	$10,803	$28,421
	96%	$83,718	-$12,291	-$60,295

Table 2. Multiway sensitivity analysis of incremental cost-effectiveness ratio for different CAB-LA prices
CAB-LA= long-acting injectable cabotegravir; F/TAF= emtricitabine-tenofovir alafenamide fumarate; F/TDF= emtricitabine-tenofovir disoproxil fumarate; PrEP= Pre-exposure prophylaxis; QALY= Quality-adjusted life-year. HIV incidence is per 100 PY. Colour coding: grey= dominated; blue= cost saving; green= ICER between $0 and $7,217 per QALY gained; yellow= ICER between $7,218 and $10,165 per QALY gained; red= ICER over $10,165 per QALY gained.

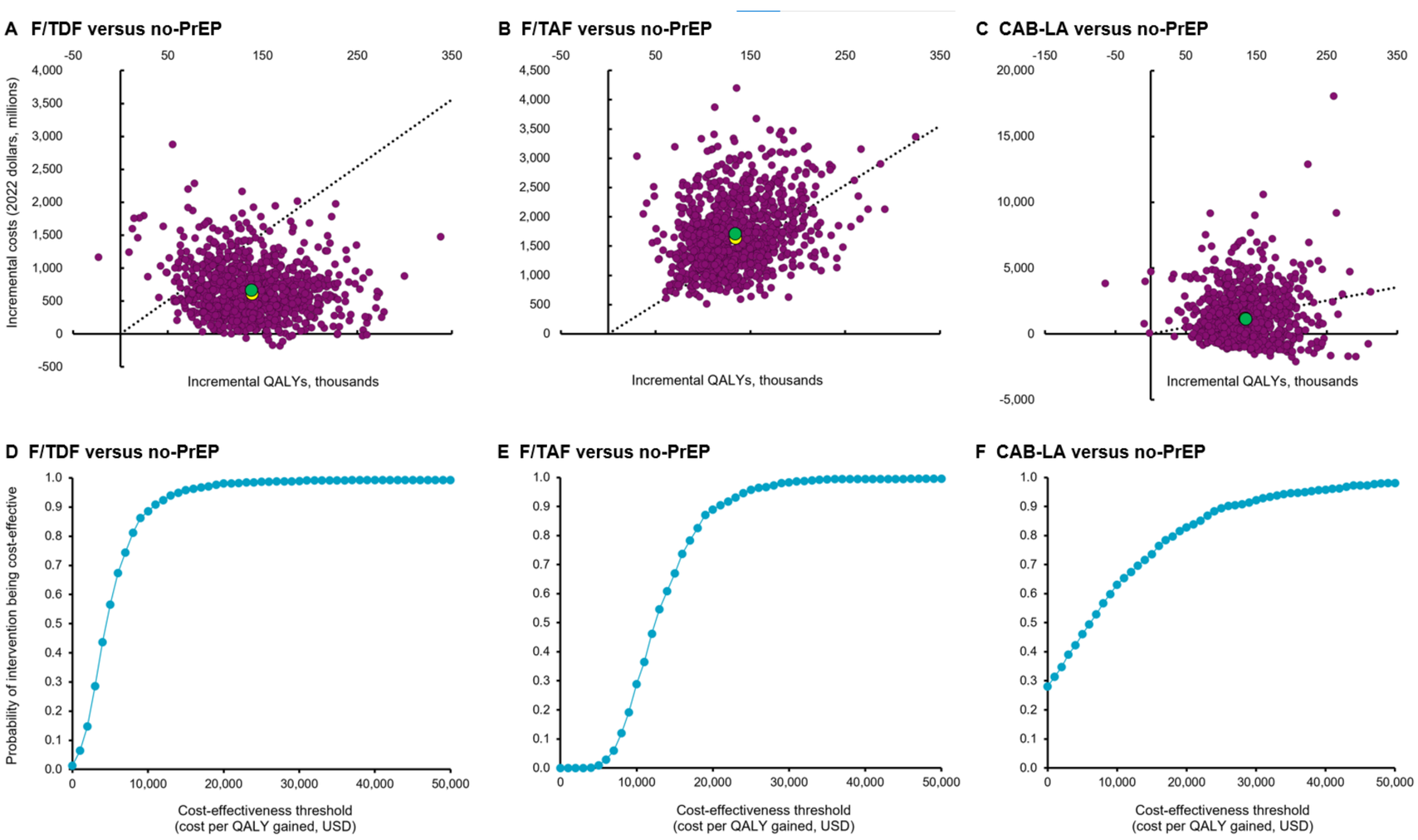

Figure 2: Cost-effectiveness planes and cost-effectiveness acceptability curve (CEAC).
The costs and quality-adjusted life-years (QALY) shown in A), B), and C) are incremental to no-PrEP, which is shown at [0,0]. The purple dots show the individual 1,000 simulations. The green dot displays the mean incremental cost and mean incremental QALYs from the PSA. The yellow dot depicts the mean incremental cost and mean incremental QALYs from the DSA. The CEAC shows the probability of D) F/TDF, E) F/TAF, and F) CAB-LA being cost-effective versus no-PrEP at different cost-effectiveness thresholds. CAB-LA= Long-acting cabotegravir; F/TAF= emtricitabine-tenofovir alafenamide fumarate; F/TDF= emtricitabine-tenofovir disoproxil fumarate; No-PrEP= No pre-exposure prophylaxis (PrEP); PSA= Probabilistic sensitivity analysis; DSA= Deterministic sensitivity analysis.

The secondary analysis assessed F/TAF and CAB-LA versus F/TDF.

The model was analysed from the healthcare perspective in a 15-year horizon (2022-2036). Incremental cost per quality-adjusted life-year (QALY) was compared against the national cost-effectiveness threshold (CET) of $10,165 per QALY gained. As CAB-LA is not approved in Mexico, its cost is unknown. We assumed the CAB-LA price to be equivalent to the price of generic F/TDF in the ImPrEP study. We varied key parameters in sensitivity analyses.

Results

Annual costs of generic F/TDF, branded F/TAF, and CAB-LA were $1,384, $2,220, and $1,384, respectively. The annual costs of no-PrEP, F/TDF, F/TAF and CAB-LA programs were $374, $1,817, $2,650, and $2,506, respectively.

If PrEP was scaled-up at 30% coverage and 80% uptake, F/TDF would avert 57,150 HIV transmissions (10.4% reduction) and yield 138,892 incremental QALYs with an additional cost of $60 million compared with no-PrEP (Table 1). F/TAF and CAB-LA would avert 55,000 HIV transmissions (10.1% reduction), achieving 134,018 and 133,951 incremental QALYs with additional $1.6 and $1.2 billion costs, respectively.

Compared with no-PrEP, the incremental cost-effectiveness ratio (ICER) of F/TDF, F/TAF and CAB-LA were $4,427, $12,216, and $8,955 per QALY gained, with an 89%, 30% and 63% probability of cost-effectiveness (Figure 2), respectively. F/TAF and CAB-LA cost more and yield fewer health benefits than F/TDF. Thus, F/TAF and CAB-LA are dominated by F/TDF in the base-case scenario.

In sensitivity analyses, HIV incidence and drug cost had the greatest effect on the incremental cost per QALYs gained by F/TDF, F/TAF and CAB-LA compared to no-PrEP. Results were robust to sensitivity analyses. Compared with F/TDF, CAB-LA was cost-effective at a maximum price of $788 in populations with higher HIV incidence (Table 2).

Conclusions

- Under base-case assumptions, F/TDF and CAB-LA are cost-effective compared to no-PrEP.
- To be cost-effective over F/TDF, CAB-LA should be half the F/TDF price.
- PrEP scale-up can substantially impact Mexico's public health over the following 15 years.

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