**Online Appendix**

**Maheswaran H, Petrou S et al. Economic costs and health-related quality of life outcomes of HIV treatment following self- and facility-based HIV testing in a cluster randomized trial.**

Appendix A: Direct health provider costing methods

Appendix B: Direct health provider unit costs

Appendix C: Findings from cost analysis presented in 2014 International dollars

Appendix D: Multivariable regression model diagnostics

**Appendix A: Direct health provider costing methods**

The UNAIDS costing guidelines were used to undertake the primary costing studies to estimate the costs for all healthcare resources used.1 The healthcare resources costed were: (1) cost of visit to HIV clinic; (2) cost of seeing medical personnel; (3) cost of medications given; (4) cost of all investigations performed. For each resource input, we included the cost of: staff salaries; training of staff; consumables and equipment; monitoring and evaluation; and overheads (e.g. utilities, capital costs).

We estimated the *cost of visiting each of the three HIV clinics* (Queen Elizabeth Central Hospital; Ndirande Health Centre; and Chilomoni Health Centre) in the study. This excluded the cost of the medical personnel seen on the visits. To estimate this cost, we interviewed senior medical personnel to determine resources used in each of the HIV clinics. We recorded all the staff that worked at the facility and the proportion of their working time they spent not in direct contact with patients. We recorded the consumables and their respective quantities used annually. We also made list of all equipment at each clinic. We interviewed central administrative staff at the Blantyre District Health Office that manage the two health facilities (Ndirande and Chilomoni), and central administrative staff at the Queen Elizabeth Central Hospital (QECH) to estimate costs for monitoring and evaluation, central support and overheads. The cost of monitoring and evaluation was based on the cost of personnel involved, taking into account the proportion of their working time they spent on visits. Central support and overhead costs included the costs for utilities, security and building maintenance. The costs of consumables and equipment’s were obtained from the Malawi Ministry of Health price catalogue, which includes the cost of shipping for imported goods. For items not supplied by the Malawi Ministry of Health, we used the on-land costs obtained from local suppliers. For items bought internationally, we included the cost of shipping and insurance provided in the quote. We assumed the useful life of equipment to be 3 years, and annuitized costs at an annual discount rate of 3%.2 After estimating the total cost of each clinic, excluding the cost of direct patient contact, we obtained the outputs of the clinic. The clinics record and report to the Blantyre District health office, and Malawi Ministry of Health, the total numbers of individuals attending the clinic for HIV care. We divided the total cost by these attendance data to estimate the average health provider cost of a health facility visit.

We estimated the *cost of medical personnel* seen by first asking each cadre of staff the average time they spend on their consultations. We then multiplied their annual salary by the proportion of their total annual working time. Staff salaries were obtained from the employer, and included employer contributions and fringe benefits.

For the *cost of medications* given we used the international market price for the cost of medications, including anti-retroviral medications.3 For the *cost of investigations* performed we used previously estimated costs from a study undertaken in Queen Elizabeth Central Hospital (QECH) by us (REF-paper submitted). Patients in the study who have investigations will have them performed at QECH.

**Appendix B: Direct health provider unit costs**

The tables below provide the estimates for the unit costs for healthcare resources obtained from the primary costing study.

Table B1: Mean health provider unit cost - Consultations with medical personnel

Table D2: Mean health provider unit cost - visit to HIV clinic (excluding direct patient contact)

**Table B1: Mean health provider unit cost - Consultations with medical personnel**

|  |  |  |
| --- | --- | --- |
| Health Professional  | Average time(Minutes) | Health provider cost |
| 2014 US Dollars  | 2014 INT Dollars  |
| Consultation with HIV Counsellor | 10  | 0.18 | 0.49 |
| Consultation with Nurse | 20  | 0.59 | 1.64 |
| Consultation with Clinical Officer | 30 | 0.89 | 2.46 |
| Consultation with Doctor\* | 30 | 5.51 | 15.31 |

\*Consultation with Doctors only at HIV clinic at Queens Elizabeth Central Hospital.

**Table B2: Mean health provider unit cost - visit to HIV clinic (excluding direct patient contact)**

|  |  |  |  |
| --- | --- | --- | --- |
| Costs | Ndirande HIV clinic | Chilomoni HIV Clinic | QECH HIV Clinic |
| US Dollars (2014) | INT Dollars (2014) | % of Total\* | US Dollars (2014) | INT Dollars (2014) | % of Total\* | US Dollars (2014) | INT Dollars (2014) | % of Total\* |
| Personnel cost\* | 12,524 | 34,789 | 22.4% | 11,494 | 31,928 | 24.1% | 58,632 | 162,865 | 29.9% |
| Consumables | 29,543 | 82,004 | 52.9% | 19,140 | 53,105 | 40.1% | 60,621 | 159,689 | 29.3% |
| Rental space | 1,504 | 4,179 | 2.7% | 1,504 | 4,179 | 3.2% | 5,732 | 15,921 | 2.9% |
| Equipment | 7,233 | 20,092 | 13.0% | 7,621 | 21,169 | 16.0% | 21,140 | 57,440 | 10.5% |
| Central support and overheads | 5,069 | 14,081 | 9.1% | 7,947 | 22,075 | 16.7% | 53,559 | 148,775 | 27.3% |
|  |  |  |  |  |  |  |  |  |  |
| Total cost (excluding direct patient contact) | 55,874 | 155,146 |  | 47,706 | 132,456 |  | 199,683 | 544,690 |  |
|  |  |  |  |  |  |  |  |  |  |
| Average cost per clinic visitation (excluding direct patient contact) | 2.42 | 6.71 |  | 3.25 | 9.03 |  | 3.57 | 9.75 |  |

\*Personnel cost excludes the proportion of time clinical personnel spent in direct contact with patients

**Appendix C: Findings from cost analysis presented in 2014 International dollars**

The tables below provide the estimates from the cost analysis in 2014 International Dollars.

Table C1: ART assessment costs by mode of HIV testing (2014 INT Dollars)

Table C1: First year ART costs by mode of HIV testing (2014 INT Dollars)

Table C2: Multivariable analysis exploring relationship between CD4 count and mode of HIV testing, and ART assessment and first year ART costs (2014 INT Dollars)

**Table C1: ART assessment costs by mode of HIV testing (2014 INT Dollars)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | Mean differences(95% CI)\* |
|  |  |  | **N** | **Mean (SE)** | **HIVST v****Facility HTC** |
| Direct health provider cost (2014 INT$) | Clinic visits1 | Facility HTC | 265 | 17.42 (0.78) | -6.18(-9.32, -3.05) |
| HIVST | 60 | 11.23 (1.36) |
| Investigations2 | Facility HTC | 265 | 41.74 (1.12) | -0.65(-3.74, 2.44) |
| HIVST | 60 | 41.09 (1.25) |
| Treatments3 | Facility HTC | 265 | 2.89 (0.27)  | -1.48(-2.28, -0.68)  |
| HIVST | 60 |  1.41 (0.31) |
| **Total** | Facility HTC | 265 | 61.17 (1.50) | -7.40(-12.25, -2.55) |
| HIVST | 60 | 53.77 (2.01) |
| Total direct non-medical and indirect cost (2014 INT$) | Facility HTC | 265 | 9.21 (1.13) | -0.67(-2.65, 1.31) |
| HIVST | 60 | 7.35 (2.58) |
| Total societal cost (2014 INT$) | Facility HTC | 265 | 70.38 (2.05) | -9.26(-17.80, -0.72) |
| HIVST | 60 | 61.11 (3.88) |

ART: Anti-retroviral treatment

\*Bootstrapped 95%CI

1: includes costs for consultations with health professional

2: includes cost of CD4 count and TB diagnostics

3: includes cost for cotrimoxazole, condoms and other medications

**Table C2: First year ART costs by mode of HIV testing (2014 INT Dollars)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | Mean differences(95% CI)\* |
|  |  |  | **N** | **Mean (SE)** | **HIVST v****Facility HTC** |
| Direct health provider cost (2014 US$) | Clinic visits1 | Facility HTC | 165 | 65.54 (3.20) | -11.43(-23.18, 0.33) |
| HIVST | 36 | 54.12 (5.65) |
| Investigations2 + Treatments3 | Facility HTC | 165 | 164.30 (3.35) | -1.38(-13.60, 10.84) |
| HIVST | 36 | 162.92 (5.26) |
| **Total** | Facility HTC | 165 | 229.85 (5.95) | -12.80(-35.74, 9.77) |
| HIVST | 36 | 217.04 (9.53) |
| Total direct non-medical and indirect cost (2014 US$) | Facility HTC | 165 | 38.61 (6.36) | 4.22(-23.37, 31.80) |
| HIVST | 36 | 42.82 (12.94) |
| Total societal cost (2014 US$) | Facility HTC | 165 | 268.45 (11.07) | -8.59(-50.99, 33.82) |
| HIVST | 36 | 259.86 (19.11) |

ART: Anti-retroviral treatment

\*Bootstrapped 95%CI

1: includes costs for consultations with health professional

2: costs of investigations combined with costs for treatments, as Malawi HIV guidelines at time of study were for clinical monitoring and hence few participants had investigations performed during study period.

3: includes cost for anti-retroviral drugs, cotrimoxazole, condoms and other medications

**Table C2: Multivariable analysis exploring relationship between CD4 count and mode of HIV testing, and ART assessment and first year ART costs (2014 INT Dollars)\***

|  |  |  |
| --- | --- | --- |
|  | Total health provider cost (2014 INT Dollars) | Total societal cost (2014 INT Dollars) |
| ART assessment (n=325) | Frist year on ART(n=201) | ART assessment (n=325) | Frist year on ART(n=201) |
| Coef (95% CI) | Coef (95% CI)\*\* | Coef (95% CI) | Coef (95% CI)\*\* |
| Modality of HIV testing | Facility HTC | Ref | Ref | Ref | Ref |
| HIVST | -8.13 (-11.63, -4.63) | -14.47 (-29.84, 0.91) | -9.91 (-15.78, -4.05) | -14.21 (-40.46, 12.05) |
| Baseline CD4 count | CD4 count >350 cells/μl | Ref | Ref | Ref | Ref |
| CD4 count 200-350 cells/μl | 3.96 (-3.02, 10.95) | -4.98 (-28.14, 18.19) | 7.79 (-2.20, 17.77) | 7.07 (-33.13, 47.27) |
| CD4 count 50-200 cells/μl | 2.28 (-1.72, 6.29) | -7.56 (-32.24, 17.11) | 5.23 (-1.30, 11.76) | 5.34 (-33.86, 44.55) |
| CD4 count <50 cells/μl | -0.34 (-7.63, 6.94) | -16.76 (-49.66, 16.13) | 3.61 (-8.66, 15.89) | -28.73 (-87.05, 29.59) |
| Not done or missing | -44.67 (-48.96, -40.38) | -12.31 (-40.61, 15.99) | -45.68 (-51.99, -39.38) | -14.73 (-46.67, 17.22) |
| Constant | 60.33 (51.36, 69.30) | 251.38 (222.83, 279.93) | 59.82 (47.93, 71.71) | 285.24 (238.04, 332.45) |

Model adjusted for modality of HTC, CD4 count, age, sex, martial status, educational attainment, income and wealth quintile

Total cost = constant + β(Modality of HIV testing) + β(Baseline CD4 count) + β(age) + β(sex) + β(marital status) + β(educational attainment) + β(income) + β(wealth quintile) + ε

\*Findings from Generalized Linear Model with Poisson distribution and Identity link function. Distributional family (Poisson) describes the distribution of the data, whilst the link function describes the relationship between the linear predictor and the [mean](https://en.wikipedia.org/wiki/Expected_value) of the response (cost).

\*\*Findings from ten imputed datasets with coefficients calculated using Rubin’s rules4

**Appendix D: Multivariable regression model diagnostics**

Tables D1 and D2 show the findings from the model diagnostics for the multivariable regression analysis of EQ-5D utility scores. Censored least absolute deviations (CLAD) estimator failed to converge as median EQ-5D utility score censored. Table D3 shows the correlation between variables entered into the regression modles.

Table D2: Estimated predicted values compared to actual utility scores

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Model** | **Obs** | **Mean** | **Min** | **Max** | **MSE** | **MAE** |
| Observed | 324 | 0.840 | 0.142 | 1.000 |  |  |
| Model | OLS | 324 | 0.840 | 0.590 | 0.955 | 0.000 | 0.096 |
| TOBIT | 324 | 0.846 | 0.579 | 0.947 | 0.007 | 0.097 |
|  | Flogit | 324 | 0.839 | 0.553 | 0.934 | 0.000 | 0.096 |

OLS: Ordinary Least Squares MSE: Mean Squared Error

Flogit: Fractional logit MAE: Mean Absolute Error

Table D2: MSE and MAE for regression models by utility score range

|  |  |
| --- | --- |
|  | **Observed EQ-5D utility score** |
|  | 0 to <0·2 | 0·2 to <0·4 | 0·4 to <0·6 | 0·6 to <0·8 | 0·8 to <1 | 1 |
| **Obs** | 1 | 2 | 11 | 131 | 80 | 99 |
|  | MSE | MAE | MSE | MAE | MSE | MAE | MSE | MAE | MSE | MAE | MSE | MAE |
| **OLS** | 0.448 | 0.448 | 0.469 | 0.469 | 0.198 | 0.198 | 0.072 | 0.082 | 0.012 | 0.035 | 0.141 | 0.141 |
| **TOBIT** | 0.437 | 0.437 | 0.482 | 0.482 | 0.203 | 0.203 | 0.079 | 0.089 | 0.017 | 0.039 | 0.132 | 0.132 |
| **Flogit** | 0.411 | 0.411 | 0.470 | 0.470 | 0.191 | 0.191 | 0.073 | 0.084 | 0.012 | 0.034 | 0.141 | 0.141 |

OLS: Ordinary Least Squares Flogit: Fractional logit CLAD: Censored least absolute deviations

MSE: Mean Squared Error MAE: Mean Absolute Error

Table D3: Correlation between variables entered into regression models

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Modality of HIV testing | Baseline CD4 count | Age | Sex | Marital status | Educational attainment | Income | Wealth quintile |
| Modality of HIV testing | 1 |  |  |  |  |  |  |  |
| Baseline CD4 count | -0.0196 | 1 |  |  |  |  |  |  |
| Age | -0.0774 | 0.0543 | 1 |  |  |  |  |  |
| Sex | 0.119 | -0.1604 | -0.2313 | 1 |  |  |  |  |
| Marital status | 0.0145 | -0.0392 | 0.186 | 0.2076 | 1 |  |  |  |
| Educational attainment | -0.1183 | 0.0943 | -0.1045 | -0.2159 | -0.2051 | 1 |  |  |
| Income | 0.0197 | 0.1099 | 0.2432 | -0.4262 | 0.0511 | 0.1245 | 1 |  |
| Wealth quintile | 0.0169 | -0.0859 | -0.0938 | 0.1682 | 0.1563 | -0.2864 | -0.2654 | 1 |

**References**

1. UNAIDS. Manual for costing HIV facilities and services. Available at: <http://www.unaids.org/sites/default/files/en/media/unaids/contentassets/documents/document/2011/20110523_manual_costing_HIV_facilities_en.pdf> (Accessed May 2014). 2011.

2. WHO. Making choices in health: WHO guide to cost-effectiveness analysis. Available at: <http://www.who.int/entity/choice/publications/p_2003_generalised_cea.pdf>. 2003.

3. International Drug Price Indicator Guide. Available at: <https://www.msh.org/blog/2014/07/30/2013-international-drug-price-indicator-guide-now-available>. 2013.

4. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. *Stat Med.* 2011;30(4):377-399.