

Cost and Cost-Effectiveness of Strategically Decentralized Community Posts Compared with Centralised Facilities for HIV Treatment Delivery in Lusaka, Zambia, 2020

Gibstar Makangila^{1*}, Kelly Chanika², Alex Kambulu²

¹Executive Director, Circle of Hope, Lusaka, Zambia

²Research Directorate, Africa Research University, Lusaka, Zambia

Abstract—Financing for HIV treatment in sub-Saharan Africa is under pressure, and evidence on whether community-based delivery achieves good outcomes at lower cost is limited. Circle of Hope, a faith-based organisation in Zambia, established Community Posts that bring HIV testing, treatment and viral load monitoring to where people live and work. We conducted an economic evaluation from the provider perspective comparing four early Community Posts with four long-established centralised health facilities in Lusaka District over twelve months in 2020. Monthly cost records were linked to routine programme data on testing, case finding, treatment initiation, linkage, retention and viral suppression, and differences were estimated with mixed models that account for clustering within facilities. Community Posts cost a mean of US\$2,054 per month compared with US\$25,543 at centralised facilities, while serving fewer patients (1,720 versus 4,905). Cost per patient on treatment was US\$1.21 versus US\$5.44 per month (difference –US\$4.23, 95% CI –5.21 to –3.24), or about US\$15 versus US\$65 per patient-year. Community Posts achieved higher testing yield (40.3% versus 10.9%), linkage (99.9% versus 89.9%) and retention (98.9% versus 95.1%), with no significant difference in viral suppression (96.9% versus 95.2%). Community Posts therefore dominated centralised facilities, with lower cost and equal or better outcomes. Their cost would need to be about 4.6 times higher than recorded before the advantage disappeared. Findings are exploratory because few sites were studied and some costs were not captured, but they support prospective full-cost evaluation and scale-up of the model.

Index Terms—HIV treatment, cost-effectiveness, community health services, differentiated service delivery, Zambia.

1. Introduction

Sub-Saharan Africa carries the largest share of the global HIV burden, and progress towards the 95-95-95 targets depends on delivering testing, treatment and viral load monitoring at scale and at a cost that health systems can sustain [1]. Zambia is among the countries most affected, with a national HIV prevalence reported at 11.9% in 2022 [2]. Its HIV programme relies substantially on international financing that is now constrained and uncertain. In this setting, service delivery

models that improve access and retention while using fewer resources per patient are of direct policy interest.

Community-based and differentiated service delivery has been promoted to reduce the burden on facilities and on patients. Community-based strategies can strengthen engagement across the HIV care cascade [3], and task-shifting to nurses and community health workers has achieved clinical outcomes comparable to physician-led care in systematic reviews [4], [5]. Evaluations of community-supported models of antiretroviral therapy (ART) in sub-Saharan Africa have generally reported retention that is comparable to, or better than, facility-based care [6], [7]. Evidence on cost is thinner and less consistent. Many studies report costs and outcomes separately, few compare delivery models operating in the same city and period, and most omit costs borne by patients such as transport and lost income [7].

In 2018, Circle of Hope (COH), a Zambian faith-based organisation, established Community Posts (CPs) in Lusaka District. These are small HIV service points located in markets, churches and other community spaces, staffed by multidisciplinary teams of clinicians, outreach workers and trained faith and community champions, and guided by a values-based framework (Responsibility, Empathy, Compassion, Integrity, Passion and Ethics, abbreviated R.E.C.I.P.E.). Between 2018 and 2022 the model expanded from 9 to 38 posts in four provinces, with high testing yield, retention and viral suppression, particularly among men, at an estimated programme-wide operating cost of approximately US\$22 per client on treatment per year [8]. That analysis did not compare the CP model with conventional facilities operating in the same setting, and it could not show whether the model is cost-effective relative to standard care.

This study compares the costs and outcomes of CPs and centralised standard health facilities in Lusaka District over twelve months in 2020. Our objectives were to estimate and compare operating cost per site and per patient on treatment; to relate cost to case finding, linkage, retention and viral

*Corresponding author: gibstarm@gmail.com

suppression; to test how sensitive the conclusions are to uncertainty in the cost data; and to describe the implications for scale-up.

2. Materials and Methods

A. Study Design and Reporting

We conducted a retrospective economic evaluation from the perspective of the health service provider. It formed one component of a wider mixed-methods doctoral study of strategic decentralisation of HIV services in Lusaka District, Zambia [9]. The analysis is a cost-consequence comparison with incremental analysis and cost-effectiveness ratios. The time horizon was twelve months (January to December 2020), so costs were not discounted. Costs are expressed in US dollars. We followed the Consolidated Health Economic Evaluation Reporting Standards (CHEERS 2022) where applicable [10].

B. Setting and Comparators

The intervention was the COH Community Post model. CPs operate from simple structures in convenient community locations, run flexible hours, and are staffed by clinicians, outreach workers, data clerks and faith and community champions who are nominated by local institutions and trained in client-centred, confidential care [8]. Daily values-based briefings and supportive supervision reinforce the R.E.C.I.P.E. framework. Each CP receives a standardised, fixed programme allocation. The comparator was centralised standard care, defined as ART delivered in established health facilities within a conventional facility-based model.

Eight sites in Lusaka District were included: four CPs (Linda, Chawama, Jack and Kanyama), which were the first CPs established in 2018, and four centralised facilities (Circle of Hope Health Facility, Chreso, Coptic and Our Lady's), each of which had provided HIV services for more than ten years. Sites were selected by convenience sampling against predefined criteria: operational maturity, geographic representation, and availability of complete financial and patient records for the whole observation period. Each site contributed twelve monthly observations, giving 96 facility-months (48 per model).

C. Cost Data

Monthly operating costs for 2020 were abstracted from financial reports and approved annual budgets held by site leaders and administrators. The categories collected were staff salaries, stipends for community health workers, administrative staff, travel, laboratory costs, rent and indirect overheads. Antiretroviral medicines were not among the collected categories. Some costs shared between CPs and their parent facilities, such as transport of medicines and samples and maintenance of vehicles and equipment, could not be allocated to either type of site and were not included. Costs incurred by community stakeholders were not captured, and patient-borne costs were not measured quantitatively.

D. Outcome Data

Monthly programme data were extracted from the national electronic health record system (SmartCare) and cross-checked

against reports submitted to the national health information system and to the U.S. President's Emergency Plan for AIDS Relief. A sample of extracted records was compared with electronic records, paper files and submitted reports for data quality assurance. Eight indicators were analysed: number of HIV tests, number of positive results, positivity yield, new ART initiations, linkage to ART, retention on ART, viral load suppression, and number of patients currently on treatment (TX_CURR).

E. Analysis

The primary efficiency measure was cost per patient on treatment per month, calculated as total monthly site cost divided by TX_CURR in the same month, and annualised by multiplying by twelve. We estimated the difference between models using linear mixed models with model type as a fixed effect and facility as a random intercept, which accounts for the correlation among monthly observations from the same site [11]. Model-adjusted means, 95% confidence intervals and intraclass correlation coefficients (ICC) were derived from these models. As supplementary checks we used Mann-Whitney U and Welch t tests, which treat months as independent and are therefore reported for completeness rather than for inference. Effectiveness outcomes were analysed using the same random-intercept structure, and their full results are reported in the parent thesis [9].

For the cost-effectiveness analysis we combined model-adjusted mean cost with model-adjusted mean outcomes. Two ratio types were calculated. Cost per patient-year retained in care and per virally suppressed patient-year were obtained by dividing annualised cost per patient by the mean retention or suppression proportion of each model. Cost per HIV test, per positive result and per new ART initiation were obtained by dividing mean monthly site cost by the mean monthly count of each output. Because site costs also support the care of patients already on treatment, the second group attributes all site cost to each output in turn and should be read as upper bounds for comparison between models rather than as unit costs. Where one model had lower cost and equal or better outcomes it was considered dominant, and an incremental cost-effectiveness ratio was not calculated [12].

We examined uncertainty with deterministic sensitivity analyses. Because CP costs may be understated, we increased CP costs by 25%, 50%, 100% and 200%. Because centralised facilities provide services beyond HIV care, we reduced centralised costs by 25% and 50%. We also combined an adverse scenario (CP costs +100% and centralised costs -25%) and calculated the threshold at which the two models had equal cost per virally suppressed patient-year. To illustrate scale-up, we applied the estimated annual saving per patient to hypothetical caseloads. Significance was set at $p < 0.05$, and all analyses are considered exploratory given the small number of sites.

F. Ethical Considerations

Ethical approval was obtained from the University of Zambia Biomedical Research Ethics Committee (UNZABREC

reference 4971-2024) and the National Health Research Authority (NHRA-2499/20/07/2025). Facility administrators authorised access to financial and programme records. The analysis used aggregated facility-level data and no individual patient identifiers.

3. Results

A. Costs of the Two Models

Community Posts cost a mean of US\$2,054 per month (SD 51; range 1,956 to 2,140), compared with US\$25,543 (SD 1,737; range 23,559 to 28,702) at centralised facilities, a 12.4-fold difference (Table 1 and Table 2). CPs served fewer patients, with a mean of 1,720 patients on treatment per month compared with 4,905 at centralised facilities. After accounting for clustering within facilities, CP monthly cost was lower by US\$23,489 (95% CI 21,839 to 25,139; $p < 0.001$). Annualised, the mean site cost was about US\$24,600 for a CP and US\$306,500 for a centralised facility. Facility identity explained most of the variation in cost (ICC 0.96), and CP costs were almost constant from month to month, consistent with the fixed programme allocation.

Cost per patient on treatment was US\$1.21 per month at CPs and US\$5.44 at centralised facilities (Table 2), a 4.5-fold difference. The model-adjusted difference was –US\$4.23 per

patient per month (95% CI –5.21 to –3.24; $p < 0.001$), equivalent to US\$14.52 versus US\$65.28 per patient per year, or a saving of about US\$51 per patient per year (95% CI US\$39 to US\$63). The distributions did not overlap at facility level (Figure 1).

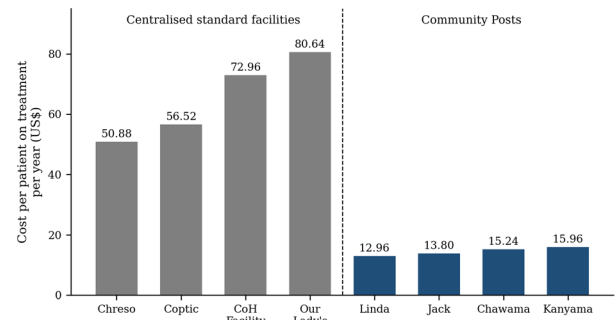


Fig. 1. Annualised cost per patient on treatment by site, Lusaka District, 2020

Grey bars: centralised standard facilities (CoH = Circle of Hope). Blue bars: Community Posts. Annual cost per patient is mean monthly cost per patient multiplied by 12.

The most expensive CP (Kanyama, US\$15.96 per patient-year) cost less than a third of the least expensive centralised facility (Chreso, US\$50.88), which also had the largest patient panel. Within each model, cost per patient fell as the number of

Table 1
Cost and caseload by site, Lusaka District, January to December 2020

Site	Model	Mean monthly cost (US\$)	Mean patients on treatment	Cost per patient per month (US\$)	Cost per patient per year (US\$)
Centralised standard facilities					
Chreso	Centralised	28,321	6,676	4.24	50.88
Coptic	Centralised	24,489	5,196	4.71	56.52
Circle of Hope Health Facility	Centralised	25,397	4,180	6.08	72.96
Our Lady's	Centralised	23,965	3,569	6.72	80.64
Community Posts					
Linda	Community Post	2,067	1,916	1.08	12.96
Jack	Community Post	2,064	1,809	1.15	13.80
Chawama	Community Post	2,050	1,616	1.27	15.24
Kanyama	Community Post	2,036	1,540	1.33	15.96

Costs are site-level operating costs in US dollars and exclude antiretroviral medicines, above-site costs and costs shared with parent facilities. Cost per patient per month is total monthly cost divided by patients currently on treatment; annual figures are monthly figures multiplied by 12.

Table 2
Comparison of monthly cost between Community Posts and centralised facilities (48 facility-months per model)

Measure	Centralised, mean (SD)	Community Post, mean (SD)	Adjusted difference (95% CI)	p
Total monthly cost (US\$)	25,543 (1,737)	2,054 (51)	–23,489 (–25,139 to –21,839)	<0.001
Patients on treatment per month	4,905 (1,190)	1,720 (198)	–3,185 (–4,347 to –2,023)	<0.001
Cost per patient per month (US\$)	5.44 (1.02)	1.21 (0.14)	–4.23 (–5.21 to –3.24)	<0.001
Cost per patient per year (US\$)*	65.28	14.52	–50.74 (–62.52 to –38.88)	<0.001

Adjusted differences are from linear mixed models with a random intercept for facility; the intraclass correlation was 0.956 for total monthly cost and 0.979 for cost per patient. The difference in patients on treatment is from the mixed model for that outcome. *Annual cost per patient is the monthly estimate multiplied by 12; its confidence interval is the monthly interval multiplied by 12.

Table 3
Model-adjusted service outcomes at Community Posts and centralised facilities, 2020

Outcome (per site per month)	Centralised	Community Post	Adjusted difference (95% CI)	p
HIV tests conducted	179.0	70.2	–108.9 (–212.1 to –5.6)	0.039
Positive results	11.9	27.8	+15.9 (1.1 to 30.7)	0.036
Positivity yield (%)	10.9	40.3	+29.4 (23.2 to 35.6)	<0.001
New ART initiations	11.0	27.8	+16.8 (2.2 to 31.5)	0.025
Linkage to ART (%)	89.9	99.9	+10.1 (4.3 to 15.8)	<0.001
Retention on ART (%)	95.1	98.9	+3.8 (1.8 to 5.9)	<0.001
Viral load suppression (%)	95.2	96.9	+1.6 (–1.0 to 4.3)	0.224
Patients currently on treatment	4,905	1,720	–3,185 (–4,347 to –2,023)	<0.001

Values are model-adjusted means per site per month from linear mixed models with a random intercept for facility. Centralised facilities are the reference. Differences in tests conducted and patients on treatment reflect the larger scale of facility-based services and are not performance measures.

Table 4
Cost-effectiveness ratios, Community Posts versus centralised facilities, 2020

Measure (US\$, annual)	Centralised	Community Post	Ratio (centralised ÷ CP)
Cost per patient outcome			
Cost per patient-year on treatment	65.28	14.52	4.5
Cost per patient-year retained in care	68.67	14.68	4.7
Cost per virally suppressed patient-year	68.55	14.99	4.6
Cost per output (all site cost attributed to each output)			
Cost per HIV test conducted	143	29	4.9
Cost per positive result identified	2,139	74	29.0
Cost per new ART initiation	2,322	74	31.4

Community Posts had lower cost and equal or better outcomes on all measures (dominant), so an incremental cost-effectiveness ratio was not calculated. Cost per patient outcome is annualised cost per patient divided by the mean proportion retained or virally suppressed. Cost per output divides mean monthly site cost by mean monthly counts (179.0 and 70.2 tests, 11.9 and 27.8 positives, 11.0 and 27.8 new initiations at centralised facilities and Community Posts respectively). Because site cost also supports patients already on treatment, these ratios attribute all cost to each output in turn and are upper bounds intended for comparison between models.

Table 5
Sensitivity and threshold analysis: cost per virally suppressed patient-year (US\$)

Scenario	Community Post (US\$)	Centralised (US\$)	Ratio (centralised ÷ CP)
Base case	14.99	68.55	4.6
CP cost +25%	18.74	68.55	3.7
CP cost +50%	22.49	68.55	3.0
CP cost +100%	29.98	68.55	2.3
CP cost +200%	44.98	68.55	1.5
Centralised cost -25%	14.99	51.41	3.4
Centralised cost -50%	14.99	34.27	2.3
CP cost +100% and centralised cost -25%	29.98	51.41	1.7
Break-even (CP cost ×4.57)	68.55	68.55	1.0

Base-case costs are US\$14.99 (Community Post) and US\$68.55 (centralised). Scenarios adjust recorded cost only; outcomes are held at their model-adjusted means.

patients rose. Supplementary tests agreed: every CP monthly observation was lower than every centralised observation (Mann-Whitney $U=2,304$, the maximum possible, $r=0.86$, $p<0.001$).

B. Outcomes of the Two Models

CPs achieved higher positivity yield (40.3% versus 10.9%; difference +29.4 percentage points, $p<0.001$), more positive results per month (27.8 versus 11.9), and more new ART initiations per month (27.8 versus 11.0) than centralised facilities, despite conducting fewer tests (70 versus 179 per month) (Table 3). Linkage to ART (99.9% versus 89.9%) and retention (98.9% versus 95.1%) were also higher at CPs (both $p<0.001$). Viral load suppression was high in both models and did not differ significantly (96.9% versus 95.2%; difference +1.6 percentage points, 95% CI -1.0 to 4.3; $p=0.22$).

C. Cost-effectiveness

CPs had lower cost and equal or better outcomes on every effectiveness measure, so they dominated centralised facilities and an incremental cost-effectiveness ratio was not calculated (Table 4). The cost per virally suppressed patient-year was US\$14.99 at CPs and US\$68.55 at centralised facilities, and the cost per patient-year retained in care was US\$14.68 and US\$68.67 respectively. On case-finding measures, attributing all site cost to each output gave US\$74 per positive result at CPs and US\$2,139 at centralised facilities, and US\$74 versus US\$2,322 per new ART initiation. These figures overstate unit costs for both models, but the between-model ratios, about 29-fold and 31-fold, are informative because CPs identified and initiated more patients at a fraction of the cost.

D. Sensitivity and Scale-up

The conclusion of dominance was robust to substantial changes in the cost assumptions (Table 5 and Figure 2). Increasing CP costs by 100% gave US\$29.98 per virally suppressed patient-year, still less than half the centralised base case. Reducing centralised costs by 50% left CPs cheaper (US\$14.99 versus US\$34.27). Under the combined adverse scenario, the ratio remained 1.7 to 1 in favour of CPs. CP costs would have to be about 4.6 times higher than recorded before the two models had equal cost per virally suppressed patient-year. If the estimated saving of US\$50.74 per patient per year were realised for 10,000 patients, the annual provider-side saving would be approximately US\$507,000.

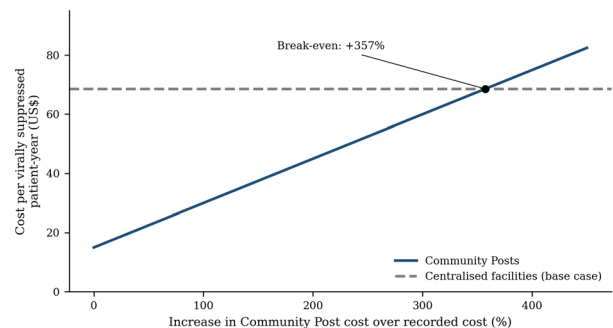


Fig. 2. Threshold analysis: cost per virally suppressed patient-year as Community Post cost is increased

The dashed line is the centralised base case (US\$68.55). Community Post cost per virally suppressed patient-year equals this value only if recorded Community Post cost is increased by about 357%.

4. Discussion

In this comparison of four Community Posts and four centralised facilities in Lusaka District, the CP model delivered

HIV treatment at about one quarter of the cost per patient and achieved higher case finding, linkage and retention, with viral suppression that was high and not significantly different between models. On the evidence available, CPs were the dominant option. The annualised cost of about US\$15 per patient on treatment is consistent with the programme-wide estimate of US\$22 per client reported for COH posts between 2018 and 2022 [8], although the two figures come from different periods, sites and cost sources and are not directly comparable.

The size of the difference is larger than would be expected from decentralisation alone, and several features of the model plausibly contribute. CPs rely on lay champions and outreach workers, task-shifting that has been shown to preserve clinical outcomes at lower cost [4,5]. They operate from community spaces with small overheads, and their standardised funding allocation limits variation in spending. Centralised facilities, by contrast, carry higher fixed costs for infrastructure, clinical staff and equipment, and part of their cost may support services other than HIV care. The centralised facility with the largest patient panel had the lowest unit cost in its group, which suggests economies of scale in facility-based care that were still insufficient to close the gap. Within CPs, unit cost fell as caseload rose because the allocation was fixed, but whether this continues at higher caseloads is untested.

The pattern of outcomes supports the view that lower cost did not come at the expense of quality. Higher yield at lower testing volume indicates more targeted case finding through index testing and community networks, and higher linkage and retention are consistent with the closeness, convenience and values-based approach described by clients and providers in the wider study. Qualitative data from the same sites frequently described savings in transport and time, so the provider-perspective analysis probably understates the total societal advantage, although we did not quantify patient costs. Findings on retention are stronger than those reported for some community ART delivery models in other settings, where retention was broadly similar to facility care [6,7]. Poor retention at some of the comparator facilities may partly explain this, and comparison against high-performing facilities could narrow the gap.

The magnitude of the cost difference also needs cautious reading. Published comparisons of community-supported ART models have generally reported more modest savings, in the order of 20% to 30% [7]. The difference here reflects, in part, the fixed and low-cost allocation of the CP model, and it may also reflect costs that were not captured at CPs. Support from parent facilities, such as supply chain, laboratory services, supervision and transport, was not allocated, and community-borne costs were not recorded. The threshold analysis is therefore central to interpretation: CP costs would need to be more than four times higher than recorded, and the analysis remained favourable even when centralised costs were reduced by half. Any real correction is unlikely to be of that size, but a prospective full-cost evaluation is needed to establish it.

For policy, the results support continued investment in and scale-up of CPs, particularly where the goal is to reach people

who are not engaged by conventional services and where budgets are tight. The stable, predictable cost structure of CPs allows budgets to be set with confidence. We caution against reading the illustrative saving of about US\$507,000 per 10,000 patients as a guaranteed budget reduction. It assumes that unit costs remain constant as caseload grows, that patients shifted to CPs resemble those currently served, and that centralised facilities can realise savings when caseloads fall. Centralised facilities will continue to be needed for complex care, referral and specialist services, so the most realistic use of the findings is as a guide to the mix of models rather than as an argument to replace facilities.

A. Strengths and Limitations

This study has several strengths. It compares two models operating in the same district and period, links financial records to routine clinical indicators, reports cost per outcome rather than cost alone, and tests the robustness of the conclusion with explicit sensitivity and threshold analyses. Effect estimates were obtained using mixed models that respect the clustered structure of the data.

The limitations are substantial. First, only eight sites were studied, selected by convenience, and only twelve months of data were analysed during the COVID-19 pandemic, which may have affected the two models differently. Findings apply most directly to urban and peri-urban Lusaka. Second, the near-zero variation in CP cost indicates that CP figures reflect a standardised allocation and may not equal full economic cost. Antiretroviral medicines, laboratory commodities, above-site administration, shared costs with parent facilities and community stakeholder costs were not captured, and costs were not broken down by category. Third, the design is observational. Facility-level data prevented adjustment for patient characteristics, and CPs may serve patients who are more stable or easier to retain, which would lower unit costs. Fourth, the supplementary tests and very large effect sizes treat 48 monthly observations per group as independent although they come from four sites, and confidence intervals based on a normal approximation may be too narrow when clusters are few [11]. The mixed-model estimates and the facility-level comparison are the more reliable evidence. Fifth, cost-per-output ratios were calculated from group means, all-cost attribution overstates unit cost for testing and initiation, and TX_CURR counts current patients rather than unique patients followed. Finally, we did not estimate health gains such as disability-adjusted life years averted, and Circle of Hope both implements the CP model and operates one of the comparator facilities.

5. Conclusion

In Lusaka District in 2020, Community Posts delivered HIV treatment at substantially lower provider cost per patient than centralised facilities, with higher case finding, linkage and retention and similar viral suppression. The cost advantage persisted under conservative assumptions. These findings support the Community Post model as a cost-effective component of HIV service delivery and justify prospective,

full-cost and societal-perspective evaluations across more sites and settings before national scale-up decisions are finalised.

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Competing Interest

Though the first author is affiliated with Circle of Hope, which implements the Community Post model and operates one of the centralised comparator facilities the authors report no competing interests.

Data Availability Statement

The aggregated monthly facility-level data supporting the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions

GM conceived and wrote the draft of the article's manuscript. KC and AK reviewed and commented on early drafts of the article. All authors read and approved the final version of the manuscript

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