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Costs and cost-effectiveness of the Patient-centered HIV Care Model: A collaboration between community-based pharmacists and primary medical providers

Ram K. Shrestha, PhD[1], **Jon C. Schommer, PhD**[2], **Michael S. Taitel, PhD**[3], **Oscar W. Garza, PhD**[2,*], **Nasima M. Camp, MPH**[4], **Osayi E. Akinbosoye, PhD**[5,†], **Patrick G. Clay, PharmD**[6], **Kathy K. Byrd, MD, MPH**[1] **Patient-centered HIV Care Model Team**

[1]Division of HIV/AIDS Prevention, Centers for Disease Control and Prevention, Atlanta, GA, USA

[2]Department of Pharmaceutical Care & Health Systems, University of Minnesota, College of Pharmacy, Minneapolis, MN, USA

[3]Health Analytics, Research, and Reporting, Walgreen Co., Deerfield, IL, USA

[4]Department of Health, Research, Informatics, and Technology, ICF, Atlanta, GA, USA

[5]Pharmacy Analytics and Global Insights, Walgreen Co., Deerfield, IL, USA

[6]Department of Pharmacotherapy, University of North Texas Health Science Center System College of Pharmacy, Fort Worth, TX, USA

Abstract

Background: The Patient-centered HIV Care Model (PCHCM) is an evidence-informed structural intervention that integrates community-based pharmacists with primary medical providers to improve rates of HIV viral suppression. This report assesses the costs and cost-effectiveness of the PCHCM.

Setting: Patient-centered HIV Care Model

Methods: Three project sites, each composed of a medical clinic and one or two community-based HIV-specialized pharmacies, were included in the analyses. PCHCM required patient data sharing between medical providers and pharmacists and collaborative therapy-related decision making. Intervention effectiveness was measured as the incremental number of patients virally suppressed (HIV RNA <200 copies/mL at the last test in a 12-month measurement period). Micro-costing direct measurement methods were used to estimate intervention. The cost per patient, cost per patient visit, and incremental cost per patient virally suppressed were calculated from the health care providers' perspective. Additionally, the number of HIV transmissions averted, lifetime HIV treatment cost saved, quality-adjusted life years (QALYs) saved, and cost per QALY saved

Corresponding author: Ram Shrestha, PhD, Division of HIV/AIDS Prevention, Centers for Disease Control and Prevention, 1600 Clifton Rd., MS US8-4, Atlanta, GA, 30329, Ph: (404) 639-6245, Fax: (404) 639-8642, biu0@cdc.gov.

*Oscar W. Garza's affiliation has changed to School of Clinical Sciences, University of Louisiana Monroe, College of Pharmacy

†Osayi E. Akinbosoye's affiliation has changed to Astellas Pharma.

were calculated from the societal perspective, using standard methods and reported values from the published literature.

Results: Overall, the PCHCM annual intervention cost for the three project sites was $226,741. The average cost per patient, cost per patient visit, and incremental cost per patient virally suppressed were $813, $48, and $5,039, respectively. The intervention averted 2.75 HIV transmissions and saved 12.22 QALYs and nearly $1.28 million in lifetime HIV treatment costs. The intervention was cost saving overall and at each project site.

Conclusions: The PCHCM can be delivered at a relatively low cost and is a cost-saving intervention to assist patients in achieving viral suppression and preventing HIV transmission.

Keywords

HIV; cost analysis; cost-effectiveness; Patient-centered HIV Care Model; pharmacists; sustained virologic response

Introduction

An estimated 1.1 million persons are infected with HIV in the United States.[1] Despite potent treatment and prevention options, the number of new HIV cases has remained stagnant with approximately 38,000 new infections occurring each year since 2013.[1] An essential element of the U.S. Department of Health and Human Services *Ending the HIV Epidemic: A Plan for America* initiative is to treat people with HIV rapidly and effectively to reach sustained viral suppression.[2] Effective treatment is one of the initiative's four key strategies because people with HIV who are adherent to appropriate antiretroviral therapy and maintain an undetectable HIV viral load can live long healthy lives with effectively no risk of transmitting HIV to uninfected sex partners.[3–5] Despite the individual and public health benefits of viral suppression, it is estimated that 11% of persons with HIV are receiving care but are not virally suppressed; these individuals are responsible for 20% of new infections.[6]

The National HIV/AIDS Strategy (NHAS) lists several priorities for improving outcomes along the HIV care continuum including increasing the capacity of health systems, increasing the diversity of available providers of clinical care and related services, and expanding models of team-based care that foster continuous care engagement.[7] Community-based pharmacies (pharmacies within the community that are not associated with a medical clinic or hospital) that have HIV specialty trained pharmacists are in a unique position to address the NHAS priorities by collaborating with clinicians to improve access to services, assist with antiretroviral therapy options, and support patients' adherence to therapy.[8]

The Centers for Disease Control and Prevention (CDC), Walgreen Co., and the University of North Texas Health Science Center System College of Pharmacy developed and implemented the Patient-centered HIV Care Model (PCHCM), a model of care that integrates community-based pharmacists with primary medical providers.[8] The PCHCM is an HIV evidence-informed structural intervention (an intervention that does not rely on individual behavior change to alter the environment but can be used to enhance the effectiveness of biomedical and behavioral interventions) that demonstrates pharmacists'

potential roles in improving HIV outcomes.[8–10] The PCHCM has been shown to improve viral suppression a relative 15% with improvements across most demographic groups and particular improvements among both young and non-Hispanic black persons (two populations most affected by the HIV epidemic).[1,10] This analysis assessed the costs and cost-effectiveness of the PCHCM based on primary data of programmatic costs and intervention effectiveness (i.e., rates of viral suppression), and on published estimates of HIV transmission rates and lifetime treatment costs.

Methods

Patient-centered HIV Care Model design

The PCHCM was a demonstration project that was conducted at ten project sites throughout the United States between August 2014 and September 2016. Each project site was composed of a medical clinic partnered with one or two community-based HIV-specialized pharmacies of a national pharmacy chain. Each project pharmacy was staffed with pharmacists and pharmacy technicians with previous training on HIV treatment and prevention, stigma, and cultural competency, and each pharmacy offered adherence support as part of its baseline program.[11] The PCHCM and the main model outcomes are described in detail elsewhere.[8,10] In short, the PCHCM was built upon the current Medication Therapy Management model implemented in pharmacies. Medication Therapy Management includes an assortment of pharmacist-led services meant to optimize therapeutic outcomes; these services may include medication therapy review, medication-related action planning, and patient education and support.[12] In addition, PCHCM incorporated clinical information sharing between medical clinic and pharmacy teams; collaborative therapy-related action planning between medical providers, pharmacists, and patients; and quarterly follow-up pharmacy visits.[8]

Project clinic staff provided their partnered pharmacists with participants' medical histories (e.g., medical problem lists, laboratory test results, current and failed medication regimens, immunization histories) at the beginning of the project and quarterly thereafter. This information enabled the pharmacists to more precisely conduct Medication Therapy Management. The pharmacists conducted an initial comprehensive medication therapy review and subsequent quarterly targeted or comprehensive reviews depending upon the pharmacists' assessment of clinical need. The project pharmacists also monitored prescription filling patterns, provided individualized adherence support, and tracked clinical and laboratory test results to assess treatment response and to identify potential therapy-related adverse events.[8] The project pharmacists worked directly with their partnered clinics to develop action plans to address any identified therapy-related problems. These plans were formulated in person (e.g., "morning huddle" face-to-face meetings between the pharmacists and clinic providers) or by phone, fax, or email. Medical providers, pharmacists, and patients then collaborated to implement the action plans, and progress was reviewed at subsequent project visits. Each participant received at least 12 months of model services. Two overarching objectives of the PCHCM were to improve adherence to antiretroviral therapy (ART) and HIV viral suppression.

The CDC determined that the PCHCM constituted a public health program activity and not research. In addition, the Office of Research Compliance, on behalf of the Institutional Review Board (IRB) of the University of North Texas Health Science Center, determined the project met criteria for exemption from full IRB review.

Study participants and project sites

Patients aged ≥18 years who were on or planning to start ART and who met the eligibility criteria (e.g., agreed to follow-up clinic and pharmacy visits, were willing to use project pharmacies to fill prescriptions, had an unmet immunological or virologic goal, failed a previous ART regimen) were enrolled in the project.[8] Three of the ten project sites (Albany, GA, Chicago, IL, Kansas City, MO), which reported complete cost data, were included in the cost and cost-effectiveness analyses. The clinic in Albany, GA, was a Ryan White clinic and Federally Qualified Health Center (FQHC). The majority of the clinic's patients were black, non-Hispanic and from rural areas. The partnered pharmacy was located within the same building as the project clinic and had operated for one year (at the time of model implementation) as an HIV-specialized pharmacy. The clinic in Chicago, IL was an FQHC-Look Alike clinic. The majority of the clinic's patients were white, non-Hispanic. The clinic was partnered with two separate pharmacies. One pharmacy was located within the same building as the project clinic and the second was located approximately one mile away. The first partnered pharmacy had operated for 17 years as an HIV-specialized pharmacy; the second for two years. The clinic in Kansas City, MO was a Ryan White clinic within an academic medical center. The majority of the clinic's patients were black, non-Hispanic. The partnered pharmacy was located within the medical center and had operated for eight years as an HIV-specialized pharmacy.

Cost data collection and analysis

Micro-costing direct measurement methods were used to estimate the cost of the PCHCM intervention. A cost data collection form was developed in collaboration with project investigators and clinic and pharmacy program managers. The clinics and pharmacies reported labor (staff time spent on intervention activities) and non-labor costs, and number of clinic and pharmacy patient visits. The data were collected weekly for two four-week periods between January 2016 and August 2016. The weekly costs, labor hours, and number of patient visits were annualized for the analyses. Each project site had implemented the intervention for a minimum of one year prior to collecting the data.

To determine labor costs, staff time spent on the following intervention activities was collected: preparing to meet patients, meeting or interacting with patients and providers, attending intervention related meetings, documenting model processes, supervising staff for project related activities, performing general administrative tasks, and completing staff training. The labor hours were multiplied by the hourly wage and fringe benefit rate of each person contributing time. Wage and fringe benefit rates for clinic staff were obtained directly from the project clinics. For pharmacy staff, state-specific median wage rates of pharmacists, pharmacy technicians, and pharmacy aides (the types of pharmacy staff involved in the intervention) were used. Pharmacy staff wage rates were based on the 2016 state-level U.S. Bureau of Labor Statistics (BLS) Occupation Employment Statistics Survey.[13] A 35% fringe

benefit rate for pharmacy staff was included in the cost calculation; the fringe benefit rate was based on the BLS National Compensation Survey of Employer Cost for Employee Compensation.[14]

Reported non-labor costs for both the clinics and pharmacies included the costs for office supplies, durable material and equipment, facility space, and utilities. The costs of durable goods and equipment were annuitized evenly over the useful life of the item. Intervention costs for facility space and utilities were based on the proportion of these costs attributable to the intervention; attributable costs were estimated by each project site from its monthly rental and utility payments. Research costs not related to program implementation were excluded from the analyses; these costs included costs associated with patient recruitment and the extra documentation and reporting needed for project initiation, monitoring, and evaluation.

The annual total intervention cost, cost per patient, and cost per patient visit were calculated and reported for all three sites combined (i.e., “overall” costs), by project site, and separately for the clinics and pharmacies.

Cost-effectiveness analysis

Intervention effectiveness was measured as the incremental number of patients virally suppressed (i.e., the number of patients suppressed post-intervention implementation compared to the number suppressed pre-implementation). Viral suppression was defined as HIV RNA <200 copies/mL at the last test in a 12-month measurement period, pre- and post-implementation.[10] Viral load data were abstracted from clinic records.

The cost-effectiveness of the intervention was estimated as the incremental cost per quality-adjusted life year (QALY) saved (i.e., incremental cost-effectiveness ratio [ICER]).[15–17] The ICER was defined as [(C−AT)/AQ], where “C” is the incremental intervention cost, “A” is the number of HIV transmissions averted, “T” is the lifetime HIV treatment cost saved per transmission averted, and “Q” is the number of QALYs saved per transmission averted.[15,17] The following parameters were used to calculate QALYs saved: 0.061 HIV transmissions averted for each HIV patient with a suppressed viral load;[6] and 4.45 QALYs saved per transmission averted.[18] The parameter value for transmissions averted was obtained from the Progression and Transmission of HIV (PATH 2.0) model that assumed a 100% reduction in transmission for persons taking ART and virally suppressed.[6,19] A lifetime HIV treatment cost of $466,000 (discounted at 3%) per infection averted was used to calculate the total lifetime treatment cost saved.[18]

A cost-effectiveness threshold (willingness to pay for one QALY saved) of $100,000 was assumed. The $100,000 threshold is commonly used in cost-effectiveness analyses in the United States.[20–22] The intervention was considered cost saving if the program cost was lower than the lifetime treatment cost averted (C < AT).[23] Cost-effectiveness was calculated and reported for all three sites combined (i.e., “overall” cost-effectiveness) and by project site.

Cost and cost-effectiveness results were presented from the health care provider and societal perspectives. The cost per patient virally suppressed and the cost per HIV transmission averted represent the perspective of medical clinics and community pharmacies. The cost per QALY gained represents the societal perspective (e.g., the benefits of HIV treatment costs saved and QALYs gained).[16] All costs are reported in 2016 U.S. dollars.

Results

Intervention costs

The three PCHCM sites had a combined 279 participants; the number of site participants ranged from 77 at the Chicago project site to 101 each at the Albany and Kansas City sites (Table 1). Overall, there were 4,732 annual patient visits (range across sites (r): 962–2,470), including 2,132 clinic (r: 364–1,326) and 2,600 pharmacy visits (r: 520–1,144).

Overall, the annual intervention cost (i.e., combined clinic and pharmacy costs) was $226,741 (r: $50,377–$93,764); this cost was composed of the annual clinic cost of $74,043 (r: $19,570–$28,711) and the annual pharmacy cost of $152,698 (r: $30,806–$65,053). The overall average cost per patient was $813 (r: $654–$928); this cost included the average clinic cost of $265 (r: $254–$284) and the average pharmacy cost of $547 (r: $400–$644). The overall average cost per patient visit was $48 (r: $33–$72); this cost included the average clinic cost per patient visit of $35 (r: $19–$79) and the average pharmacy cost of $59 (r: $50–$70) (Table 1).

Distribution of intervention costs

Labor was the predominant cost category with 81% of all intervention costs attributed to this category (r: 73%–86%). The clinics attributed 79% (r: 67%–91%) and the pharmacies attributed 82% (r: 78%–87%) of all costs to labor. A total of 3,782 labor hours were committed to intervention activities (r: 963–1,643 hours) annually. Clinic staff spent a total of 1,499 hours (r: 412–588 hours) providing intervention services, whereas the pharmacy staff spent 2,283 hours (r: 550–1,144 hours) providing these services, annually (Table 1). Distribution of labor costs among different intervention activities varied across sites (Supplemental Tables 1 and 2). However, each pharmacy's highest cost per patient visit was staff time spent preparing to meet with patients; at least 23% (Albany: $11.27 of $49.68) of the pharmacies' costs per patient visit were attributed to this activity (Supplemental Table 2).

Cost-effectiveness

A total of 155 (r: 40–69) and 200 (r: 54–80) patients were virally suppressed, pre- and post-intervention implementation, respectively, meaning an additional 45 patients were virally suppressed post-implementation (r: 11–20). Overall, the incremental cost per patient virally suppressed was an estimated $5,039 (r: $2,519–$8,524). The number of HIV transmissions averted, QALYs saved, and lifetime HIV treatment costs saved were an estimated 2.75 (r: 0.67–1.22), 12.22 (r: 2.99–5.43), and $1.28 million (r: $0.32–$0.57 million), respectively. Overall and at each project site, the intervention was cost saving as the program cost was lower than the lifetime HIV treatment cost averted (Table 2). With no change in the overall PCHCM cost, the intervention could remain cost saving if it resulted in at least eight

additional patients virally suppressed and would be cost effective if as few as four additional patients were virally suppressed (Figure 1).

Discussion

The Patient-centered HIV Care Model averted 2.75 HIV transmissions and saved 12.22 QALYs and nearly $1.28 million in lifetime HIV treatment costs. The intervention had an overall annual intervention cost of $226,741. The average cost per patient, cost per patient visit, and incremental cost per patient virally suppressed were $813, $48 and $5,039, respectively. The intervention was cost saving overall and at each project site.

Cost and cost-effectiveness studies of HIV prevention interventions often focus on outcomes proximal to viral suppression on the HIV care continuum (e.g., diagnosis, linkage to care, retention in care); studies on the cost-effectiveness of interventions aimed at improving rates of viral suppression are limited.[22,24–27] This report provides the first estimates of the cost and cost-effectiveness of the PCHCM. The study's cost-effectiveness estimates are comparable with results reported in the literature. For example, Lin et al. used published values from the literature, health department reports, and HIV surveillance data and applied an HIV transmission model to make standardized comparisons of cost-effectiveness across 20 HIV biomedical and behavioral interventions. They found that the intervention promoting ART adherence leading to viral suppression was cost-saving.[22] Freedberg et al. estimated the cost-effectiveness of an antiretroviral therapy adherence intervention (twice weekly home nurse visits for six weeks) using data from a randomized controlled trial (HAART to HEART) as inputs into a computer simulation model. Intervention effectiveness was measured as the incremental number of persons virally suppressed at end of the study.[28] They estimated the intervention to be cost-effective at $21,083/QALY saved ($US 2016).

When comparing the study's estimates to published cost estimates (from the health care providers' perspective) of other care-continuum outcomes (e.g., cost per participant and per person linked to care [$1,900 and $12,700],[24] and cost per participant and per patient retained in care [$500 and $4,600 in $US 2016][29]), the PCHCM intervention costs appear modest, which suggests that the model can be implemented at relatively low cost. Further, we conducted threshold analyses to simulate potential additional health care sector or societal costs and calculated that programs could spend as much as $28,400 per additional person virally suppressed (more than five times the base case of $5,039 per person virally suppressed) and remain cost saving, and spend up to $55,600 per person and remain cost-effective. These costs correspond to relatively small increases in patients achieving viral suppression (8 and 4, respectively) indicating that the model would be cost-effective even with very modest improvements in viral suppression.

The total intervention cost and average cost per patient were higher in the project pharmacies than in the clinics. This finding is not surprising given that pharmacists provided more labor hours (2,283 compared with 1,499 in clinics) toward intervention activities including time spent conducting labor intensive Medication Therapy Management. In both settings, most costs were related to staff time (79% of all costs in clinics and 82% in pharmacies), which is consistent with costs of other HIV prevention programs.[30] Notably,

at least 23% of the pharmacies' costs per patient visit were attributed to staff time spent preparing to meet with patients. These costs are likely reflective of additional time demands placed on pharmacists reviewing patient clinical data. While the intervention is cost saving and can be implemented at relatively low cost, the number of labor hours required to implement the model could be daunting for smaller clinics or pharmacies. Reimbursement for model services might, therefore, be needed to scale the model.

Although total intervention costs were higher in the pharmacies than the clinics, project site variation in the average cost per patient visit was greater in clinics ($19–$79) than in pharmacies ($50–$70). This was due, in part, to wide differences among project clinics regarding facility and administration costs and costs related to interacting with project pharmacists. Additionally, the overall cost per patient visit varied by site ($33–$72), partly due to a large variation in the number of patient visits by site (962–2,470). Other site level variations in costs were potentially due to differences in individual site work processes and program efficiencies.

The analyses have limitations. First, all project pharmacies were community-based HIV-specialized pharmacies staffed by personnel with previous training on HIV treatment and prevention. Costs, therefore, do not reflect start-up costs related to ensuring appropriately trained pharmacy staff. For community-based pharmacies staffed by personnel without HIV specialty training, the total intervention cost will need to account for pharmacy staff training. Second, although a standard reporting form was used and project staff were trained on data collection, there was significant variation in completeness of cost data collection between sites (e.g., reporting gaps, missing cost data). To minimize the reporting biases, only three out of the ten project sites were included in the analyses. However, inclusion of only three sites might also bias the estimates if these sites were more effective or efficient in conducting the intervention.

Third, the additional number of patients virally suppressed was based on participants' last viral load test result in the 12-months pre- and post-model implementation. The analyses, therefore, do not account for sustained viral suppression; any change in viral suppression outcomes beyond the last viral load test result in the measurement period could make the intervention more cost-effective or less cost-effective. Fourth, the study's cost-effectiveness estimates are dependent on the modeling and parameter inputs used in the analysis. Published estimates were used for some parameters (e.g., HIV transmissions averted, QALYs saved per transmission averted, lifetime HIV treatment cost per infection averted); using different values could change the estimates. However, the study's estimates showed that the intervention is highly cost saving; if more conservative parameter values were used, the intervention would likely remain at least cost-effective. Lastly, the analyses were focused on the health care provider perspective and included societal perspective for cost per QALY estimates; the estimates do not account for patients' time and effort, societal costs or health care sector costs.

Conclusions

The Patient-centered HIV Care Model (PCHCM), an HIV structural intervention that requires a collaborative effort of community-based pharmacists and primary medical providers to improve HIV viral suppression, averted 2.75 HIV transmissions and saved 12.22 QALYs and nearly $1.28 million in lifetime HIV treatment costs. Moreover, the intervention can be implemented at a relatively low cost. Interventions like the PCHCM that broadly facilitate viral suppression (and consequently prevent HIV transmission) are needed to end the HIV epidemic in the United States. This report contributes to the sparse literature on the cost-effectiveness of adherence and viral suppression interventions and can aid HIV care and prevention decision making.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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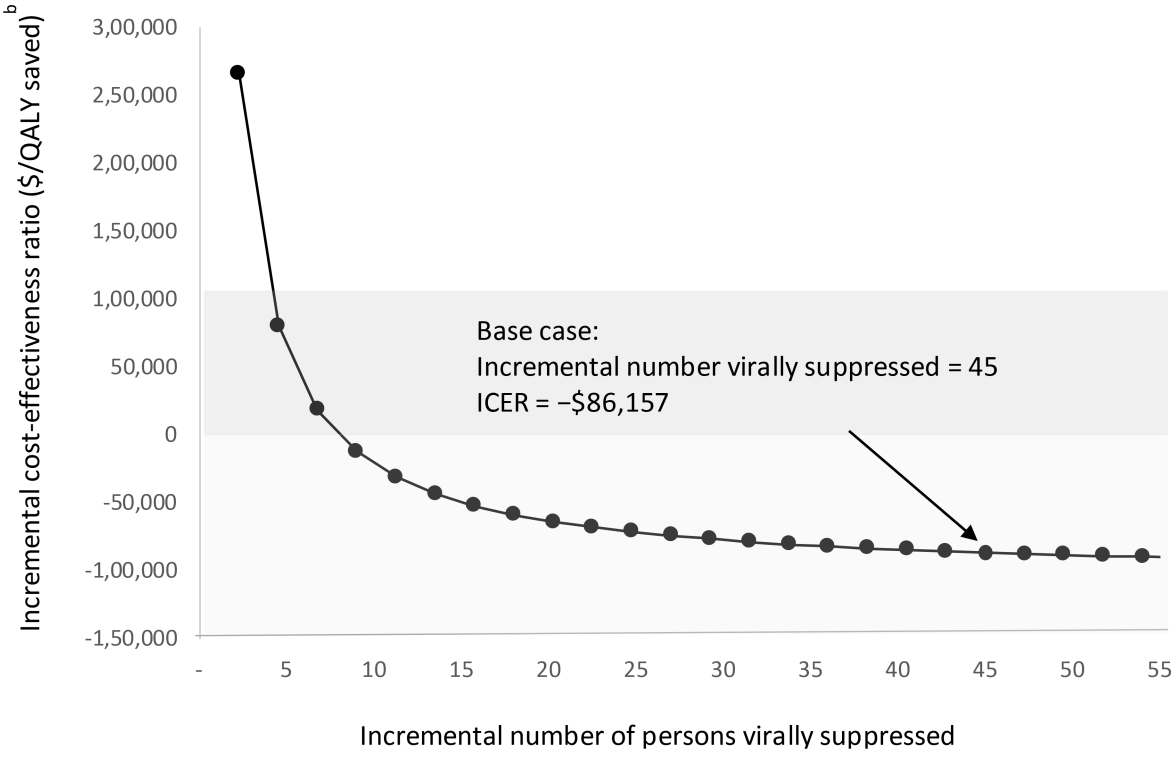

Figure 1:

Relationship between the incremental number of persons virally suppressed and the incremental cost-effectiveness ratio (ICER), Patient-centered HIV Care Model, 2014–2016 [a]

[a] Costs are calculated for three project sites. Cost are reported in 2016 U.S. dollars.

[b] QALY = quality-adjusted life year; ICER = incremental cost-effectiveness ratio.

Darker gray shaded area indicates values that fall within the cost-effectiveness threshold (ICER between $0 and $100,000).

Lighter gray shaded area indicates values that fall within the cost-savings threshold (ICER <$0).

Table 1.

Annual intervention costs of the Patient-centered HIV Care Model, 2014–2016, United States [a]

	Overall [b]	Albany, GA	Chicago, IL	Kansas City, MO
Total no. of patients in the intervention	279	101	77	101
Patient-centered HIV care model [c]				
No. of patient visits	4,732	2,470	962	1,300
Total intervention cost ($)	226,741	82,601	50,377	93,764
Labor hours	3,782	1,177	963	1,643
Labor cost (percentage of total)	81%	73%	86%	84%
Average cost per patient in the intervention ($)	813	818	654	928
Average cost per patient visit ($)	48	33	52	72
Clinic				
No. of patient visits	2,132	1,326	442	364
Total intervention cost ($)	74,043	25,762	19,570	28,711
Labor hours	1,499	588	412	498
Labor cost (percentage of total)	79%	67%	91%	80%
Average cost per patient in the intervention ($)	265	255	254	284
Average cost per patient visit ($)	35	19	44	79
Pharmacy				
No. of patient visits	2,600	1,144	520	936
Total intervention cost ($)	152,698	56,839	30,806	65,053
Labor hours	2,283	589	550	1,144
Labor cost (percentage of total)	82%	78%	80%	87%
Average cost per patient in the intervention ($)	547	563	400	644
Average cost per patient visit ($)	59	50	59	70

[a] Costs are calculated for three project sites and are reported in 2016 U.S. dollars.

[b] Includes cost variables and costs from the three project sites combined; numbers may not add up to the totals due to rounding.

[c] Includes cost variables and costs from each project clinic and pharmacy combined.

Table 2.

Cost-effectiveness of the Patient-centered HIV Care Model, 2014–2016, United States [a]

	Overall [b]	Albany, GA	Chicago, IL	Kansas City, MO
Intervention outcomes				
No. patients virally suppressed, pre-intervention	155	40	46	69
No. patients virally suppressed, post-intervention	200	54	66	80
Incremental no. of patients virally suppressed (N)	45	14	20	11
HIV transmissions averted per patient virally suppressed (t) [c]	0.061	--	--	--
QALYs saved per HIV transmission averted (Q) [d]	4.45	--	--	--
No. of HIV transmissions averted (A=tN)	2.75	0.85	1.22	0.67
No. of QALYs saved (AQ)	12.22	3.80	5.43	2.99
Costs and cost-effectiveness ($)				
Intervention cost, incremental (C)	226,741	82,601	50,377	93,764
Lifetime HIV treatment cost saved per transmission averted (T) [e]	466,000	--	--	--
Total lifetime treatment cost saved (AT)	1,279,170	397,964	568,520	321,686
Cost per patient virally suppressed (C/N)	5,039	5,900	2,519	8,524
Cost per HIV transmission averted (C/A)	82,602	96,722	41,292	139,738
Cost per QALY saved (C−AT)/AQ [a,f]	(86,157)	(82,984)	(95,440)	(73,317)

[a] Cost-effectiveness was defined as the incremental cost per quality-adjusted life year (QALY) saved (i.e., the incremental cost-effectiveness ratio [ICER]) and calculated as [(C−AT)/AQ], where “C” is the incremental intervention cost, “A” is the number of HIV transmissions averted, “T” is the lifetime HIV treatment cost saved per transmission averted, and “Q” is the number of QALYs saved per transmission averted. The cost-effectiveness threshold was assumed to be $100,000, and the cost saving threshold was assumed to be ICER = [(C−AT)/AQ] < 0, or (C−AT) < 0, or C < AT. Costs are calculated for three project sites and are reported in 2016 U.S. dollars.

[b] Includes cost variables and costs from the three project sites combined; numbers may not add up to the totals due to rounding.

[c] HIV transmissions averted per patient virally suppressed (t) is based on the estimated HIV transmissions attributable to patients who are taking antiretroviral therapy and are virally suppressed (0.0) compared with those who are receiving HIV care but are not virally suppressed (0.061).

[d] QALYs saved per HIV transmission averted (Q) is based on HIV diagnosed patients.

[e] Lifetime treatment cost saved per HIV transmission averted (T) is based on HIV diagnosed patients who have entered HIV care; discounted at 3%.

[f] Results in parentheses denote a negative ICER which indicates that the program is cost saving.