Cost and Threshold Analysis of Housing as an HIV Prevention Intervention

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Abstract The Housing and Health study examines the effects of permanent supportive housing for homeless and unstably housed persons living with HIV. While promising as an HIV prevention intervention, providing housing may be more expensive to deliver than some other HIV prevention services. Economic evaluation is needed to determine if investment in permanent supportive housing would be cost-saving or cost-effective. Here we ask—what is the per client cost of delivering the intervention, and how many HIV transmissions have to be averted in order to exceed the threshold needed to claim cost-savings or cost-effectiveness to society? Standard methods of cost and threshold analysis were employed. Payor perspective costs range from $9,256 to $11,651 per client per year; societal perspective costs range from $10,048 to $14,032 per client per year. Considering that averting a new case of HIV saves an estimated $221,365 in treatment costs, the average cost-saving threshold across the three study cities is 0.0555. Expressed another way, if just one out of every 19 Housing & Health intervention clients avoided HIV transmission to an HIV seronegative partner the intervention would be cost-saving. The intervention would be cost-effective if it prevented just one HIV transmission for every 64 clients served.

Keywords Housing · HIV · Prevention · Economic evaluation · Cost-effectiveness

For the Housing and Health Study Team. Disclaimer: The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

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Introduction

In this special issue of *AIDS & Behavior* focused on housing and HIV, Kidder et al. describe the delivery of immediate permanent supportive housing for homeless and unstably housed persons living with HIV as an intervention that has the potential to improve access to care as well as serve as a type of HIV *prevention* intervention (this "Housing & Health" study is presented in detail by Kidder et al., this issue). Because housing status has been clearly associated in

cross-sectional studies with levels of HIV-related risk behavior, the prospective delivery of housing holds great promise as an intervention to avoid the transmission of HIV (Aidala et al. 2005). The study described by Kidder et al. (this issue) was a prospective randomized trial that compared (a) the Housing & Health study intervention to (b) a current standard of care intervention in which persons living with HIV on waiting lists for housing continued to work through the usual system for obtaining housing services (the Housing & Health study intervention accelerated the availability of housing assistance by providing special, additional permanent supportive rental assistance in the three study cities of Baltimore, Chicago and Los Angeles).

While promising as an HIV prevention intervention, housing may be relatively expensive compared to other HIV prevention interventions. HIV prevention interventions such as small group interventions, community-level interventions and HIV counseling and testing generally cost a few dozen to a few hundred dollars per client to deliver, and often avert sufficiently many HIV infections that they actually are cost-saving in terms of medical care costs avoided (Holtgrave 1998; Pinkerton et al. 2001; Varghese et al. 1999). In contrast, even one month's rent in a modest apartment can easily top $700 or more in major US cities (Department of Housing and Urban Development 2007).

However, just because an intervention may have a higher cost per client than some other types of service, it does not mean that the intervention is unworthy of investment. In fact, the real issue is what public health benefits are returned for a particular level of investment in a certain type of program. Therefore, in the Housing & Health study, economic evaluation was determined to be an integral part of the study design.

The economic evaluation component of the Housing & Health study will address three questions: (a) what is the cost per client of the Housing & Health study service delivery bundle? [this question can be informed by cost analysis]; (b) what is the number of HIV transmissions that must be prevented from Housing & Health study intervention clients in order for this the intervention to be considered cost-saving or cost-effective? [this question can be addressed via threshold analysis]; and (c) what is the cost per quality adjusted year of life saved by the Housing & Health study intervention [this question requires a full-scale cost-utility analysis]? In this article, we address the first two of these three questions; the last question must await final Housing & Health study outcome data analysis.

Methods

Standard methods of cost and threshold analysis were employed (Gold et al. 1996; Gorsky 1996; Holtgrave 1998;

Trentacoste et al. 2004). Gorsky has identified several steps for conducting cost analysis (Gorsky 1996). These steps include (a) selecting a time period for the analysis; (b) counting clients served during the time period; (c) inventorying resources consumed in specific units; (d) estimating cost per unit of each resource type; (e) counting the number of units consumed in each resource category; (f) calculating total costs of the intervention; and (g) expressing this cost on a per client basis. Here, we focused on estimating the per-client, per-year cost of the Housing & Health study intervention. We employed a societal perspective so as to include all costs consumed regardless of who pays, and a payor perspective designed to isolate those costs incurred by the funding entity alone (here the payor perspective excludes costs that would be incurred by clients, but not by funding agencies). We estimated the service delivery costs and *not* the costs of doing research. All costs are express in 2005 dollars.

The Housing & Health study intervention included rental and utility assistance, housing advocacy, case management, follow-up support, and related services. We focused on the costs incurred at several stages of service delivery: recruiting; screening for eligibility; permanent supportive housing and utility assistance provision; housing advocacy; case management; and follow-up services. In addition, we included costs for materials consumed, administrative costs, and several types of costs incurred by clients. The clients' costs included their share of rent and utilities, transportation to periodic services (such as case management) not delivered in the client's home; client time for such periodic services; and child care induced by periodic services. These costs were obtained by interviewing project leaders at each of the three service Housing & Health study service delivery sites (in Baltimore, Chicago and Los Angeles) who in turn examined cost records at their site. Other costs were obtained via interviewing staff of the main organization conducting the research (RTI International) because RTI provided some staff for some of the service delivery sites. Finally, other costs were obtained from the literature and online resources (primary examples include obtaining the cost of minimum wage used for client time valuation from the Bureau of Labor Statistics website, and cost of various modes of transportation from public transportation websites for the cities).

The only service provided by the Housing & Health study that was not included in the cost analysis presented here is a brief two-session HIV prevention counseling intervention. This HIV prevention service was considered essential to offer to all clients in both arms of the Housing & Health randomized trial. As a result, it will not be possible in the Housing & Health study to tease out the effects of the prevention counseling intervention on any of the study outcomes. The cost analysis presented here may be

interpreted as the incremental costs of the Housing & Health study intervention over the standard of care intervention.

For simplicity, we refer to the cost of Housing & Health study services per year per client in a given city as "C." To conduct a threshold analysis, we need to introduce three other parameters: "T" or the medical costs averted each time an HIV transmission is prevented; "Q" or the number of quality adjusted life years (QALYs) saved for each HIV transmission averted; and "W" or the price society appears to be willing to pay to "buy" a quality-adjusted life year (QALY). T, Q and W may all be obtained from the literature (Holtgrave 1998; Holtgrave and Pinkerton 1997; Hutchinson et al. 2006; Pinkerton et al. 2001; Schackman et al. 2006). T has been estimated at between $221,365 to over $300,000 (expressed in net present value terms at a 3% discount rate); to be cautious, we employed the lower value in our threshold analyses. Q has been estimated in the literature at 11.23 (again expressed in net present value terms). W is the subject of some debate in the literature, but if an intervention can save a QALY for $50,000, it is quite easy to make the argument that the intervention appears cost-effective relative to other interventions in medicine and public health.

The number of HIV transmissions that must be prevented in order to claim that the Housing & Health study intervention is cost-saving can be expressed as C/T. The number of HIV transmissions that must be prevented to claim the Housing & Health study intervention is cost-effective (even if not cost-saving) is C/(T + (W*Q)). The transmissions averted could be "downstream transmissions" prevented among HIV seronegative partners of Housing & Health study participants, or they could be "downstream transmissions" averted among partners of the partners of Housing & Health study participants.

Results

Table 1 displays the cost of the Housing & Health study intervention by stage of service delivery for each of the three cities. This table also displays the total cost by both the societal and the payor perspective. Payor perspective costs range from $9,256 to $11,651 per client per year; societal perspective costs range from $10,048 to $14,032 per client per year. There are four major reasons for the range of service delivery costs across the three sites. First, there are some slightly different models of service delivery especially regarding the intensity of case management offered (this can be seen in the case management and housing advocacy lines in Table 1). Second, there are some slightly different ways of handling indirect or administrative costs by site (as can be seen in that line from Table 1). Third,

there are some differences across the cities in terms of average hourly wage; the Bureau of Labor Statistics reports that the medical hourly range for the job type "community and social service" worker is $17.86 in Baltimore, $17.42 in Chicago, and $18.42 in Los Angeles. Fourth, there are differences in the real estate market in these cities. From the Housing and Urban Development website (Department of Housing and Urban Development 2007), it is seen that the fair market rent for a one bedroom apartment in Baltimore is $727, in Chicago it is $797, and in Los Angeles it is $807. Hence, there are a variety of economic pressures and slight service delivery differences that account in large part for the cost differences across sites.

Table 2 presents the results of the threshold analyses by and across cities. For illustration, we see that the average cost-saving threshold is 0.0555. This means that for each Housing & Health study client, if 0.0555 HIV transmissions were avoided, the intervention would be cost-savings in terms of medical costs averted. Expressed another way (and for ease of illustration focusing just on first generation transmissions), if one out of every 19 Housing & Health study clients avoided HIV transmission to an HIV seronegative partner, the intervention would be cost-saving. The intervention would be cost-effective if it prevented one HIV transmission for every 64 clients (again, just focusing on first generation transmissions for ease of interpretation).

Discussion

With the cost analysis results presented in this article, we can now answer any "affordability" questions that service providers or other funders may have. Further, the threshold analyses provide us with performance standards that the Housing & Health study permanent supportive rental assistance intervention would need to meet if it is to be considered cost-saving or cost-effective (in HIV prevention terms).

There are some clear limitations to this study. First, as the final outcome data are not yet available from the Housing & Health study, we cannot yet calculate the overall cost-utility ratio for the intervention. Second, for cost estimates, we did not perform time-motion studies that would have extensively tracked study staff day-in and day-out as they provided services (we did not do this as such studies can be extremely intrusive to staff and expensive to conduct; further, the major cost driver here is the cost of the permanent supportive housing and utility assistance, hence time-motion studies would have added relatively little to study precision). Third, our threshold analyses here focus only on housing as a type of HIV prevention. Housing can improve quality of life for the clients themselves as it provides a safe place to live and potentially

Table 1 Cost of 2005–2007 Housing and Health Study Intervention, per client, per year (rounded to nearest 2005 dollar)

Cost category	Baltimore	Chicago	Los Angeles
Recruiting to service program	$0	$0	$1
Screening for eligibility	$12	$250	$13
Housing & utilities assistance	$8199	$9600	$9180
Housing advocacy services	$248	[a]$300	$15
Case management services	$513	[a]$1500	$524
Follow-up services	$12	$0	$328
Materials	$1	$1	$7
Client share of rent and utilities	$777	$1260	$1980
Client transport to and from services (such as case management)	$4	$621	$42
Client time spent in receipt of services (such as case management)	$10	$500	$124
Child care while client receiving services (such as case management)	$1	$0	$0
Indirect	$270	7% fee incorporated above	$571
Payor total	$9256	$11651	$10639
Societal total	$10048	$14032	$12785

[a] In Chicago, there were two models of case management. The more routine case management is listed here under housing advocacy. The more intensive case management is listed here under case management

Table 2 Threshold numbers of HIV transmissions to be averted per client so as to claim cost-savings or cost-effectiveness for the 2005–2007 Housing & Health Study Intervention (using 2005 dollar costs)

	Cost-saving threshold	Cost-effectiveness threshold
Baltimore	.0454	.0128
Chicago	.0634	.0179
Los Angeles	.0578	.0163
Average	.0555	.0157
Inverted Average	1 per every 19 clients	1 per every 64 clients

increases access to HIV care. Also, housing may reduce other undesirable outcomes such as incarceration, other infectious diseases, and untreated chronic diseases; all of these potential consequences have economic ramifications and could legitimately be included in the threshold analysis. By focusing here on only HIV prevention thresholds, we are actually biasing against the intervention and setting a standard that is either fair or higher than necessary. Thus, we have taken care not to bias in favor of the Housing & Health study intervention.

Even though the standards are set fairly or perhaps too high, they appear potentially quite achievable. In the 315 clients who received permanent supportive housing assistance through the Housing & Health study intervention, only five (first generation or downstream) transmissions would have to be prevented in order to claim cost-effectiveness and be included among such well-accepted interventions as kidney dialysis, hepatitis A vaccination, hormone replacement therapy (Tuft-New England Medical Center 2007), and childhood influenza vaccination (Prosser et al. 2006). While we must await the outcome data to know if this number of transmissions is indeed averted, the threshold appears highly achievable.

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