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Cost-effectiveness of a chronic pain intervention for people living with HIV (PLWH)

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Author contributions

All authors were involved in conception, design, and interpretation of the analyses, as well as drafting and/or revising the manuscript. Authors AW and MK conducted the analyses. All authors agree to be accountable for all aspects of the work.

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Analyses and results from this manuscript were included in a presentation given at the International Workshop on HIV Observational Databases, March 2017.

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Abstract

Background—Chronic pain is a common, disabling, and costly comorbidity, particularly in people living with HIV (PLWH). We developed and pilot tested a pain self-management intervention for chronic pain tailored to PLWH called Skills TO Manage Pain (STOMP).

Objectives—Given the additional resources needed to deliver STOMP in HIV clinical settings, an important objective of the pilot study was to assess not only STOMP's preliminary efficacy, but also its cost-effectiveness.

Research Design and Subjects—The present study draws from a 44-participant, 2-arm randomized pilot trial of the STOMP intervention versus usual care among PLWH and at least moderate chronic pain (Clinicaltrials.gov: NCT02824562). Cost-effectiveness is presented as the incremental cost-effectiveness ratio (ICER). Costs were considered from the clinic perspective over a one-year time horizon using real costs from the pilot trial. We conservatively assumed no costs savings. The Standard Gamble (SG) method was used to directly measure utilities.

Results—Thirty-six participants met inclusion criteria for the present analyses. Mean age was 52 years; 61% were female and 86% were black. The total cost of STOMP was $483.83 per person. Using the SG method, the change in QALYs was 0.15, corresponding to an ICER of $3,225.

Conclusions—STOMP's cost/QALY is substantially lower than the $50,000 to $100,000/QALY benchmark often used to indicate cost-effectiveness. Although based on a pilot trial and therefore preliminary, our findings are promising and suggest the importance of cost analyses in future STOMP trials.

Keywords

self-management; pain; cost-effectiveness; utilities; HIV

Introduction

Chronic pain is a common, disabling, and costly comorbidity.[1] Due to the serious risks and limited benefits of medications to treat chronic pain, the 2016 U.S. Department of Health and Human Services National Pain Strategy called for the development of non-pharmacologic interventions to improve chronic pain sufferers' quality of life, especially in populations most affected.[2] These include Pain Self-Management (PSM) interventions, which are behavioral interventions tailored to the needs of a specific target population. PSM interventions are designed to improve quality of life by enhancing self-management skills such as thinking differently about pain and engagement in adaptive pain coping strategies.[3–5]

Chronic pain is of particular importance in people living with HIV (PLWH). The prevalence of chronic pain is high in PLWH (39–85%, as compared to 15% in the general population[6–8]) and chronic pain is associated with important outcomes such as suboptimal

retention in HIV primary care.[8] However, there is a relative paucity of interventions developed or tested in this population[9]. To that end, we developed a PSM intervention for chronic pain tailored to PLWH called Skills TO Manage Pain (STOMP). Extensive qualitative intervention development work highlighted the importance of incorporating three novel components in this population: 1) Group sessions: Group sessions are intended to enhance social support in this particularly isolated group of patients. 2) Peer leaders: The group sessions are peer co-led to allow participants to learn through observing peers who are successful pain self-managers; and 3) Learning self-management skills from an expert: The group sessions accompany a menu of one-on-one skill-building sessions that include the topics of pain education, physical activity to improve pain, thinking differently about your pain, sleep and pain, and relaxation, among other topics. The peer co-led group sessions and one-on-one sessions alternate over 12 weeks.[10] A recent pilot trial suggests that STOMP is feasible and acceptable to participants.

Given the additional resources needed to deliver this intervention in HIV clinical settings, research to advance this line of work requires investigation of not only STOMP's efficacy, but also its cost-effectiveness. There is some evidence from the chronic low back pain literature to suggest that non-pharmacologic approaches (including behavioral interventions) may be cost effective.[11–13] However, the cost-effectiveness of relatively labor intensive interventions such as PSM has not been established. Furthermore, the recent US Department of Health and Human Services' National Pain Strategy identified developing cost-effective approaches to pain management as a key next step.[2] Thus, an important aim of the pilot study was to assess STOMP's preliminary cost-effectiveness. One way to approach effectiveness is to assess the change in *utility* of the health state in question. Utility is the value one assigns to a given health state, in this case chronic pain. To our knowledge, no study to date has directly measured chronic pain utilities in PLWH.

This analysis uses costs from the pilot trial and direct measures to assess chronic pain utilities. Exploratory analyses of STOMP's impact on chronic pain utilities were conducted. We also placed these results in context by investigating the association of these utility values with other commonly-used measures of pain and quality of life.

Methods

Participants

This study draws from a 44-participant, 2 arm randomized pilot trial of STOMP intervention vs. usual care (Clinicaltrials.gov: NCT02824562). This pilot trial recruited from the University Alabama Birmingham (UAB) 1917 HIV Clinic Cohort, one of eight sites of the national Center for AIDS Research Network of Integrated Clinical Systems (CNICS) cohort[14]. Participants were surveyed at baseline and within one month of pilot trial completion or within one month after the last group session for the control participants. Analyses are limited to individuals who met trial inclusion criteria (≥ moderate pain for ≥ three months [pain of at least moderate severity for at least months on the Brief Chronic Pain Questionnaire[15] and an average score of ≥4 on the 3-question PEG, which measures pain severity and pain-related impairment in enjoyment of life and general activities[16]], no upcoming surgical procedures, ability to attend intervention sessions) and who completed

baseline and follow-up outcome assessments. This study was approved by the UAB Institutional Review Board.

Demographic information was obtained from the CNICS database. Study-specific baseline and outcome assessments included the SF-12, a population normed measure of health status.[17] The SF-6D score, a preference-based single index measure developed to calculate health utilities using general population values, was derived from the SF-12 data.[18] Assessments also included the 11-question Brief Pain Inventory (BPI)[17], from which the BPI-total score was calculated by averaging all responses on a scale of 0–10, which is a measure of pain and pain-related functional impairment, the PHQ-8, a measure of depressive symptoms[19] (score ≥ 10 indicates moderate or greater symptoms), and direct utility measures as described below.

Utilities

This study used the Standard Gamble (SG) to measure utility. Participants were asked to imagine a hypothetical pill that would cure them of chronic pain for the rest of their life, but might cause an immediately fatal allergic reaction. They were asked to report the maximum chance of death between 0–100% that they would be willing to accept to take the pill.

Chronic pain utility is the chance of fatal reaction offered by the participant subtracted from 100, given as decimal. Thus, if a respondent said he or she would accept a 100% chance of death, the utility associated with chronic pain would be zero (i.e. the same utility as death); if no chance of death were acceptable, the health state would be rated as one. Utility averages were calculated for both arms at baseline and after the intervention. Post-intervention utilities were compared using a t-Test.

Preliminary cost-effectiveness

Cost-effectiveness is commonly summarized by the Incremental Cost-Effectiveness Ratio (ICER). For an intervention such as STOMP, the ICER is calculated as the change in cost (cost spent on the intervention minus costs saved), divided by the change in quality adjusted life years (QALYs). Participants were not followed after the pilot concluded, so cost savings, if any, could not be calculated, and we conservatively assumed there were none. Costs were calculated as average fixed costs plus variable costs per person. Costs were considered from a clinic perspective, since it is likely a clinic director who would decide whether to implement a program like STOMP. Behavioral interventions are often evaluated over at least one year. Therefore, we chose a one year time horizon; we then tested the effect of varying the duration of benefit in sensitivity analyses described below. We assumed a clinic would need to train one staff person for all interventionist functions and two peers to provide adequate “coverage.” Based on lessons learned from our pilot, one staff and one peer interventionist worked with a group of 10 participants over 16 weeks, equating to 40 study participants annually. Fixed costs consist of up-front training, and variable costs include staff costs to conduct one-on-one and group sessions, reminder calls, and other participant incidentals (snacks, travel vouchers, and manuals). Change in QALYS was calculated using the SG utility × time. The ICER was then calculated as the costs of the intervention divided by the difference in QALYs between the STOMP intervention and control arms. The ICER

was evaluated at a willingness to pay (WTP) of $50,000 per QALY. Cost-effectiveness analyses were conducted using TreeAge Pro Version 2015 (TreeAge Software, Inc., Williamstown, MA).

Sensitivity Analysis

One-way sensitivity analyses were conducted to assess the influence of each of the cost effectiveness analysis model parameters (costs and QALYs for the STOMP arm, and QALYs for the control arm). Probabilistic sensitivity analyses were conducted using Monte Carlo simulations, drawing from random distributions of cost and QALY estimates. Results from the simulations were then use to construct a CE Acceptability Curve, plotting the probability the intervention would be considered cost-effective at a willingness to pay from 0 to $100,000 per QALY.

Associations of utility measures with outcomes

Spearman correlation was used to investigate the relationship between each participant's SG utility value and other outcomes: 1) the Brief Pain Inventory-Total Score and 2) the SF-6D.

Results

Thirty-six participants met inclusion criteria for the present analyses. Table 1 summarizes their baseline characteristics by group. Overall, mean age was 52 years (SD 6.3), 22 (61%) were female, and 31 (86%) were black. All patients reported being prescribed anti-retroviral therapy for their HIV disease, and one had a detectable viral load. Pain locations included hands and feet (18), lower back (27), knee (21), and hip (15). Mean BPI was 7.4 (SD 2), and mean SF-6D was 0.6 (SD 0.1). Mean PHQ-8 score was 9.1 (SD 5.5).

Utilities

Utilities are summarized in Table 2. The baseline utilities using SG were 0.785 for the STOMP arm compared with 0.685 for controls ($p = 0.387$). Post-intervention utilities were 0.878 for the STOMP arm and 0.629 for controls ($p = 0.022$).

Cost-effectiveness

Cost calculations are summarized in Table 3.The total cost of STOMP = fixed costs + variable costs = $204.20 + 279.63 = $483.83 per person. The change in QALYs was 0.15 so ICER would be $3,225 per QALY gained.

One-way sensitivity analyses found that the baseline effects differed only for the estimate of QALYs for the STOMP intervention arm. As long as the intervention prevented deterioration in QALYs by less than 0.02, the intervention would be considered cost-effective (at Willingness to Pay (WTP) > $50,000). The probabilistic sensitivity analysis (Figure 1) found that if WTP per QALY were $5,000 per QALY there would be a greater than 50% probability that the intervention would be considered cost-effective; the probability rises to 80% at $12,000 per QALY. The Cost Effectiveness Acceptability Curve is asymptotic at 90% for a WTP > $36,000, indicating that there is a 10% chance that the estimated QALYs for the STOMP arm would be less than those for the control arm.

Associations of utility measures with outcomes

No correlations between SG utilities and the BPI or SF-6D before or after the intervention were significant.

Discussion

To our knowledge, this is the first cost-effectiveness evaluation of a chronic pain intervention for PLWH, and also the first direct measurement of chronic pain utilities among people living with both HIV and chronic pain. Although based on a pilot trial, STOMP's cost/QALY is far lower than the commonly referenced $50,000–100,000/QALY benchmark.[20] Also, prior to STOMP, participants reported SG utilities comparable to those reported in other studies of chronic pain conditions[21] such as low back pain[22] and osteoarthritis[23], and other painful conditions such as rheumatoid arthritis.[24] These findings underscore the profound negative impact of pain on contemporary HIV-infected patients' quality of life, and the need for efficacious, cost-effective interventions.

Our findings also underscored STOMP's potential impact on participant quality of life. Differences in utilities between groups after the intervention were sizeable and statistically significant. This suggests that after receiving the STOMP intervention, participants were willing to accept a smaller probability of death to receive an efficacious but potentially dangerous treatment, compared to their pre-intervention assessment. In other words, in regard to their chronic pain, participants placed a greater value on their lives after STOMP than before. This may have real-world implications. For example, opioids are widely prescribed for chronic pain, and are associated with serious risks, including death.[25.26] STOMP may cause participants to be less willing to accept these risks, as participants realize they can control their pain with the skills they have learned.

Both before and after the STOMP intervention, there was no correlation between SG utilities and the BPI or SF-6D. This reflects the difference between utility measurement and the constructs measured by these instruments. For example, BPI reflects pain and pain-related functional impairment, while the SG more broadly measures participants' overall impressions and feelings about having chronic pain. Utility measures are likely to encompass intangibles beyond the direct disutility of pain, such as its effects on emotional and physical well-being, as well as a person's resilience or ability to cope with pain. To the extent that interventions seek to alleviate suffering rather than resolve pain, however, SG may be more relevant. Additionally, lack of correlation between direct utility measurements and the SF-6D suggests that the SF-6D may need to be renormalized for PLWH who have chronic pain.

This study has limitations. This was a small pilot study and our findings are therefore preliminary. Utilities were measured on trial participants, who may not represent the general population of PLWH with chronic pain. Furthermore, this pilot study did not follow participants long enough to provide an estimate of the duration of beneficial effects. It is also possible that STOMP could have an impact on other health care utilization, potentially resulting in cost savings. These savings would be, however, unlikely to affect the costs to the clinic, which was the perspective taken in this study. A larger study could consider a broader

perspective. Although the sensitivity analyses indicate that STOMP is likely to be cost-effective, there remains considerable uncertainty as to the precise value in costs per QALY. Finally, although randomization occurred at the patient level. We did not account for potential clustering within groups or interventionists.

Conclusion

In sum, this study contributes to the literature on cost-effectiveness of interventions to address chronic pain in PLWH. The next step in this line of research is to conduct a full-scale efficacy trial of the intervention and a more comprehensive cost-effectiveness evaluation. If the intervention demonstrates efficacy, such an evaluation will be central to understanding the intervention's scalability and broader public health impact.

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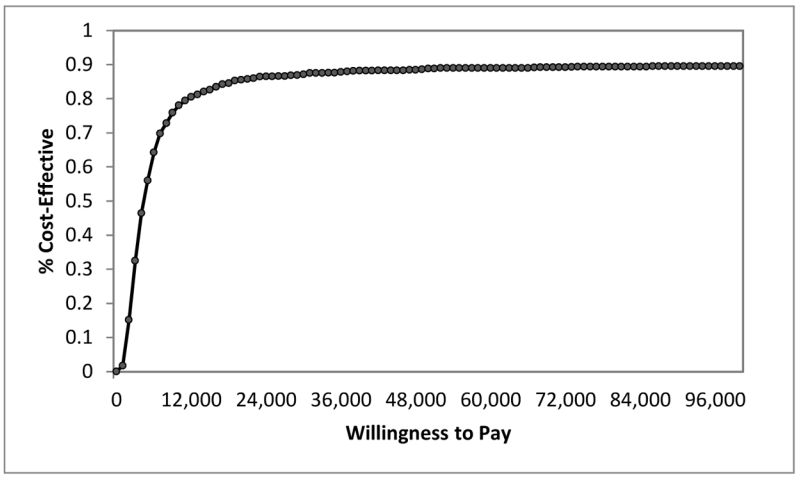

Figure 1.
Cost-Effectiveness Acceptability Curve from Monte Carlo Simulations

Table 1

Baseline Sample Characteristics (N=36)

	Intervention (N=19)	**Control (N=17)**
Female (n, %)	10 (53%)	12 (71%)
CD4+ T-cell count (cells/mL – mean, SD)	811 (405)	617 (372)
Viral Load < 200 (n, %)	18 (95%)	17 (100%)
Race		
African-American	16 (84%)	15 (88%)
White	3 (16%)	1 (6%)
Other	0 (0)	1 (6%)
Brief Pain Inventory-Total score (mean, SD)	7.3 (2.3)	7.5 (1.7)
SF6-D (mean, SD)	0.6 (0.2)	0.6 (0.1)

Table 2

Standard Gamble Utilities Pre- and Post-Intervention for STOMP and Control Arms

	Intervention (N=19)	**Control (N=17)**	**p-Value***
Pre-Intervention (Baseline)	0.785	0.685	0.387
Post-Intervention	0.878	0.629	0.022

* 2-tail ed independent sample t-test, comparing intervention and control.

Table 3

Preliminary estimates of cost-effectiveness

Fixed costs				
	Hours	**Personnel***	**Cost****	**Cost/participant**
Two day-long initial training	16	SI, PI, SP	16 *$32+$500x2+16 *100=	$3112/40=$77.80
Mock one-on-one sessions	10	SI, PI	10 *$32 + 10 *$50x2=	$1320/40=$33.00
Hour-long debriefing sessions: weekly × 1 month then monthly × 11 months	15	SI, PI, SP	15 *($32+$50x2+$100)=	$3480/40=$87.00
Listening to tapes of pilot intervention sessions	8	SI	8 *$32=	$256/40=$6.40
Total fixed costs per person = $77.80+33.00+87.00+6.40=$204.20				
Variable costs (per participant)				
	Hours	Personnel	Cost	
6 One-on-one sessions, 35 minutes + 10 min prep	0.75	SI	6 *0.75 *$32=$144	
6 Group sessions, 1 hour + 10 minute prep	1.2	SI, PI	6 *1.2 *$32 + 100=$330.40	
Reminder calls, 2.4 hours total	2.4/10=0.24	SI	0.24x$32=7.68	
Snacks	---	---	$29.75	
Travel vouchers (gas, bus)	---	---	$45.40	
Participant manuals	---	---	$19.40	
Total variable costs per person = $144+33.40+7.68+29.75+45.40+19.40=$279.63				

*SI = staff interventionist. PI = peer interventionist, SP=supervising psychologist.

**Assuming staff interventionist rate = $32/hour including fringe, peer interventionist is paid a combination of hourly and flat rates ($500 for two-day training, $50/hour for mock sessions and debriefing sessions, $100/group), supervising psychologist is paid $100/hour