Patterns of Responses on Health-Related Quality of Life Questionnaires Among Patients with HIV/AIDS

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BACKGROUND: Health-related quality of life (HRQoL) has become an important facet of HIV/AIDS research. Typically, the unit of analysis is either the total instrument score or subscale score. Developing a typology of responses across various HRQoL measures, however, may advance understating of patients' perspectives.

METHODS: In a multicenter study, we categorized 443 patients' responses on utility measures (time-tradeoff, standard gamble, and rating scale) and the HIV/AIDS-Targeted Quality of Life (HAT-QoL) scale by using latent profile analysis to empirically derive classes of respondents. We then used linear regressions to identify whether class membership is associated with clinical measures (viral load, CD4, time since diagnosis, highly active antiretroviral therapy [HAART]) and psychosocial function (depressed mood, alcohol use, religious coping).

RESULTS: Six classes were identified. Responses across the HAT-QoL subscales tended to fall into 3 groupings—high functioning (Class 1), moderate functioning (Classes 2 and 3), and low functioning (Classes 4 to 6); utility measures further distinguished individuals among classes. Regression analyses comparing those in Class 1 with those in the other 5 found significantly more symptoms of depression, negative religious coping strategies, and lower CD4 counts among subjects in Class 1. Those in Class 5 had been diagnosed with HIV longer, and members of Class 6 reported significantly less alcohol consumption, had higher viral loads, and were more likely to receive HAART.

CONCLUSION: Patients with HIV respond differentially to various types of HRQoL measures. Health status and utility measures are thus complementary approaches to measuring HRQoL in patients with HIV.

KEY WORDS: latent profile analysis; HIV; AIDS; health-related quality of life; utility.

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Health-related quality of life (HRQoL) has become an important facet of HIV/AIDS research. There are 2 approaches to measuring HRQoL: the health status approach, which describes functioning in one or more domains, and the utility/value/preference approach, which assesses the desirability of health states against an external metric.

In general, health status measures emanate from the social science paradigm via classical test theory, which assumes that a psychological construct is composed of a set of domains¹; the domains are generally composed of a set of related questions selected through empirical analyses and scale aggregation.² Patients' overall HRQoL, in turn, is determined by summing (weighted or unweighted) subscale scores. The advantage of the health status approach is that it usually yields instruments that are valid, reliable, and responsive to change.

Utility measures originate from an economic or health policy perspective in which the goal is to evaluate the effectiveness or cost-effectiveness of different tests or treatments. Scores range from 0.0 to 1.0 and are determined by having the respondent value health states against an external metric such as risk (usually of death), time, or money. Health status and utility measures have been used extensively in empirical research but correlations between the 2 types of measures tend to be modest at best,³ an indication that they tap distinct constructs.

Typically, the unit of analysis for health status measures is either the total instrument score or separate subscale (e.g., physical functioning) scores. Such analyses reduce the ability to understand how respondents experience the disease across domains of function. Furthermore, patients with a chronic disease such as HIV/AIDS often provide disparate accounts of their HRQoL, even when experiencing similar symptomatology, because responses are informed by their perception of functioning as well as by their internal beliefs and values regarding their health status.^{4–6} Identifying latent classes of patients-subpopulations where membership is not known but inferred from the data, may help one understand how patients experience life with HIV/AIDS across multiple domains, while at the same time identifying systematic differences in self-reported health among respondents.

Because physical and psychosocial functioning are not predictable solely from a clinical diagnosis, researchers have used cluster analysis to identify latent subclasses in a number of patient populations, including cardiac transplant candidates,⁷ patients with symptomatic peripheral arterial disease,⁸ and patients with malignant melanoma,⁹ to better identify the specific level of physical and psychosocial functioning common within a class. Information derived from such studies can be used in a number of ways. For example, Turk et al.^{10,11} identified a 3-class typology based on patients' responses on the Multidimensional Pain Inventory that appears to be

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consistent across pain-associated conditions, including fibromyalgia,¹⁰ temporomandibular joint disorder,¹² low back pain, headache,⁶ and cancer.¹³ Based on their conceptualization, the authors tailored patient interventions.^{14,15}

Researchers in the field of HIV/AIDS have used similar techniques to identify typologies of patients at risk of contracting HIV by studying a community-based sample¹⁶ and a sample of American Indians.¹⁷ Only one study, however, derived classifications using patients' perceptions of their HRQoL. In that study, Bult et al.¹⁸ used latent class analysis to classify a sample of HIV-positive and HIV-negative patients into 4 classes by analyzing responses to utility measures and to the SF-36 Health Survey.¹⁹

The purpose of this paper was to develop an alternative method of conceptualizing HRQoL by combining latent profile analysis (LPA) and regression modeling. LPA is similar to other methods of identifying latent classes, such as cluster analysis, but LPA (1) can accommodate a mixture of underlying probability distributions²⁰; (2) utilizes posterior membership probability estimates and maximum likelihood methods to classify cases and derive misclassification rates²¹; (3) does not require scaling observed variables when working with normal distributions having unknown variances²⁰; (4) does not require variables to have the same type of scaling, thus allowing for both dichotomous and polytomous items within the same analysis²⁰; (5) is model-based, allowing the clinical researcher to determine the optimal solution using fit indices to judge fit across models²²; and (6) LPA has been shown, using simulated data, to outperform K-means cluster analysis when group membership is known by the researchers.¹⁶ Despite its advantages, LPA is rarely used to derive subclasses of patients with chronic health conditions. Combining LPA and regression analyses may provide a more complete representation of patients' self-reported function.

METHODS

Participants

We interviewed patients with HIV/AIDS from 4 centers in 3 cities: the University of Cincinnati Medical Center and the Cincinnati Veterans Affairs Medical Center in Cincinnati, OH; the Veterans Affairs Pittsburgh Healthcare System in Pittsburgh, PA; and the George Washington University Medical Center in Washington, DC. The baseline interviews, which are the subject of this analysis, took place between February 2002 and February 2003. The Institutional Review Boards of each of the institutions approved the study, and each participant received \$30 per interview as compensation.

Measures

Clinical measures included CD4 count and viral load. Viral load was dichotomized by using a threshold of 400 copies/mL. Other clinical measures included time since diagnosis, and whether the patient was receiving highly active antiretroviral therapy (HAART).

We assessed health status and health concerns by using the HIV/AIDS-Targeted Quality of Life (HAT-QoL) measure.²³ The HAT-QoL consists of 9 multi-item subscales covering Overall Function, Sexual Function, Disclosure Worries, Health Worries, Financial Worries, HIV Mastery (level of comfort over

how HIV was contracted), Life Satisfaction, Medication Concerns, and Provider Trust. Each domain is scored from 0 (worst) to 100 (best). We excluded the Medication Concerns subscale, because it did not pertain to the 23% of patients who were not taking HIV medication.

The health rating and utility measures consisted of the health rating scale (RS), time tradeoff (TTO), and standard gamble (SG), each of which was administered by a trained interviewer using U-Maker[®] software (F. Sonnenberg, New Brunswick, NJ). The RS is a visual analogue scale and is often considered a rating rather than a utility because it does not involve risks or trade-offs. As such, RS scores are generally relatively lower than utilities. The RS question was posed in the form of a "feeling thermometer," in which subjects were asked to rate their health state from 0 (representing dead) to 100 (perfect health).

The TTO item was posed as a choice between living 15 years, which was estimated to be the approximate life expectancy for patients with HIV/AIDS in one's present state of health, versus a shorter life in perfect health. The length of time in perfect health was varied by using a ping-pong approach, which is designed to avoid anchoring bias.²⁴ The sequence of questions begins at the extremes of the scale and "ping-pongs" back and forth between high and low values until an indifference point is reached between the certain outcome (current health) versus a given shorter life expectancy with perfect health. The SG is the most orthodox instrument⁴ because it is the most consistent with the fundamental theory upon which utility measures have been developed²⁵; the SG assesses the maximum risk of death one is willing to take in exchange for a chance of living in perfect health. Here, too, the risk of death was varied using the ping-pong method.²⁴

Both the TTO and SG are scaled from death (0.0) to perfect health (1.0), with a higher value representing a more desirable health state (less willingness to trade time or take a risk of dying). For example, on the TTO, if a subject were willing to give up at most 25% of her remaining life expectancy in exchange for perfect health, the TTO utility would equal 0.75 ($1.0 - 0.25 = 0.75$). On the SG, if she were willing to risk at most a 10% chance of death in order to have perfect health, her SG utility would equal 0.90 ($1.0 - 0.10 = 0.90$).

We measured patients' depressive symptomatology by using the 10-item version of the Center for Epidemiologic Studies—Depression scale (CESD-10).²⁶ Although first developed for use with the elderly, the CESD-10 has been used in studies of patients with HIV/AIDS.²⁷ Scores range from 0 to 30, with a score ≥ 10 indicative of significant depressive symptomatology.

Religious coping is one method a patient can use to manage the stressors associated with having a chronic medical condition.²⁸ We assessed religious coping via the Brief RCOPE,²⁹ which measures how frequently the respondent uses positive and negative religious coping methods. The positive coping scale assesses patients' use of spiritual connection, spiritual support seeking, collaborative religious coping, religious focus, religious forgiveness, religious purification, and benevolent religious appraisal; the negative coping scale assesses spiritual discontent, punishing God reappraisals, reappraisals of God's powers, demonic reappraisals, and interpersonal religious discontent. Positive religious coping is generally associated with positive outcomes, such as less

psychological distress, while negative religious coping is generally associated with depression, poorer quality of life, and callousness toward others.²⁸

We assessed alcohol consumption via 2 items often included in clinical trials conducted by the AIDS Clinical Trial Group.³⁰ The first item assessed the average number of days in the prior 30 days on which the respondent consumed alcohol, and the second item assessed the average number of drinks consumed each time. Responses on the 2 items were then multiplied to derive the average number of drinks consumed per month.

Analysis

The main analyses were divided into 4 parts. The first set involved calculating means, standard deviations, normality statistics, Pearson correlations, and Cronbach's α s for the HRQoL measures (utilities and subscales of the HAT-QoL) and other measures of psychosocial functioning. Preliminary analysis showed that alcohol consumption had a skewed and kurtotic distribution, so it was normalized using a logarithmic transformation. In the second set of analyses, we explored the factor structure of the HAT-QoL by using a semiconfirmatory factor approach to eliminate potentially redundant subscales, which, if present, could undermine interpretation of the LPA (Appendix).

Next, we analyzed the remaining subscales of the HAT-QoL and the utility measures by using LPA. In LPA, patients are categorized based on the probability that a specific set of responses reflects the mean pattern of measures typifying that assemblage. To determine the appropriate solution, we tested LPA models iteratively (a 1-class model followed by a 2-class model, etc.) until adding a class neither improved the model nor allowed the model to converge, suggesting poor model fit.³¹ The model having both an interpretable solution and the lowest Bayesian Information Criterion (BIC) statistic, a population-based measure that takes sample size into account and penalizes model complexity,³² was considered to represent the optimal solution. We used the average posterior probability, which is the mean probability of all respondents within a class actually representing that class, to further validate the solution. Although there is no accepted absolute minimum value for the posterior probability, values >0.80 are preferred.³¹

For the fourth set of analyses, we ran 8 linear regression models to determine whether class membership was associated with other aspects of poor functioning: depressive symptoms, positive religious coping, negative religious coping, alcohol use, CD4 counts, viral load, time since diagnosis, and HAART. Because group membership is nominal, the variables were dummy coded and Class 1 was set as the reference group because responses typified best overall functioning. Analyses were conducted by using AMOS, version 5.0.1³³; Mplus, version 3.0³⁴; and SPSS, version 13.0.³⁵

RESULTS

Descriptive Statistics

Of the original 450 participants, 7 (1.6%) had missing data on at least 1 measure. The remaining 443 formed the study sample. The sample was predominantly male ($n=383$, 86.1%), heterosexual ($n=300$, 67.4%), and either white ($n=203$,

45.6%) or African American ($n=222$, 49.9%). The average age was 44.8 years ($SD=8.3$). Two hundred and sixty-eight participants (60.2%) attended college, and approximately half of the respondents were unemployed ($n=215$, 48.3%).

The modified confirmatory factor analysis resulted in identification of 5 subscales of the HAT-QoL: Overall Health, Life Satisfaction, Health Worries, Financial Concerns, and Sexual Functioning (Appendix). Thus, the resultant LPA analyses included 8 scales: 5 from the HAT-QoL and the 3 health rating and utility scales.

Latent Profile Analyses

The LPA analyses yielded a 6-class solution having a lower BIC than solutions with fewer classes (1-class solution BIC = 33,682.52; 2-class solution BIC = 32,815.79; 3-class solution BIC = 32,349.21; 4-class solution BIC = 32,250.50; 5-class solution BIC = 32,170.84; 6-class solution BIC = 32,082.67). In the 6-class solution, the average posterior probability ranged from 0.9 to 1.0. Despite small differences among some classes in mean scores on one or more subscales, each class was distinct on at least 1 scale (Table 1).

Interpretation of Profiles

HAT-QoL subscale scores tended to cluster in 1 of 3 configurations: scores in Class 1 were consistently higher across all subscales; subscale scores in Classes 2 and 3 were moderately high; and subscale scores in Classes 4 to 6 were generally low across the board. The utility scores, however, differed widely across all classes, indicating widespread heterogeneity (Fig. 1).

- (1) *Class 1:* This class, the largest of the 6 ($n=168$; 37.9%), is characterized as having the best overall functioning (Table 1, Fig. 1). Those in this class tended not to want to trade time or gamble on their health. Furthermore, few ($n=22$, 13.1%) had significant depressive symptoms.
- (2) *Class 2:* This class is distinguished by their moderate to good functioning as assessed by the HAT-QoL and includes the second greatest number of individuals ($n=132$; 29.8%). Patients in this class were generally content with their current health, as reflected by high utilities. Interestingly, in contrast to individuals in Class 1, 89 (67.4%) patients reported having significant depressive symptoms, and Class 2 patients also had higher levels of negative religious coping.
- (3) *Class 3:* Similar to those in Class 2, patients in this class had moderately good HAT-QoL scores. Nevertheless, they were more willing to gamble for improved health than those in Classes 1 and 2 and were more likely to report significant depressive symptoms ($n=27$; 60.0%).
- (4) *Class 4:* Members of this class ($n=20$; 4.5%) had moderately low HAT-QoL scores compared with the first 3 classes, and despite having moderate RS scores, showed an extreme willingness to gamble for improved health. Nineteen (95.0%) patients in this class had significant depressive symptoms and, on average, had the highest mean level of negative religious coping.
- (5) *Class 5:* Members of this class ($n=24$, 5.4%) generally had low HAT-QoL and RS scores and were willing to trade more time or take bigger gambles in exchange for perfect health. All but one of the respondents (95.8%) reported having significant depressive symptoms.

Table 1. Sample Size and Estimated Means for the 6-Class Typology

	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
n (%)	168 (37.9)	132 (29.8)	45 (10.2)	20 (4.5)	24 (5.4)	54 (12.2)
	Mean (SD)					
Certainty of classification*	0.9 (0.1)	0.9 (0.1)	1.0 (0.1)	1.0 (0.0)	1.0 (0.0)	0.9 (0.2)
HAT-QoL Overall Health	89.7 (10.8)	66.7 (14.8)	68.4 (22.5)	50.6 (21.3)	48.1 (18.6)	40.9 (16.6)
HAT-QoL Life Satisfaction	86.7 (12.8)	61.7 (18.4)	66.8 (20.4)	56.3 (25.3)	33.6 (19.0)	37.0 (18.3)
HAT-QoL Health Worries	89.7 (12.9)	67.5 (23.4)	66.0 (21.9)	46.3 (27.2)	54.2 (30.5)	35.0 (20.0)
HAT-QoL Financial Worries	82.7 (20.9)	48.1 (29.6)	53.3 (33.2)	35.0 (33.5)	32.3 (35.7)	22.8 (25.6)
HAT-QoL Sexual Functioning	81.4 (26.9)	60.5 (34.1)	67.5 (31.9)	34.4 (36.9)	33.3 (30.8)	35.4 (32.9)
Rating Scale	86.7 (10.7)	70.4 (17.1)	75.3 (19.6)	63.4 (22.8)	41.8 (23.7)	46.3 (17.0)
Time tradeoff	0.96 (0.11)	0.92 (0.17)	0.83 (0.24)	0.95 (0.11)	0.71 (0.03)	0.79 (0.29)
Standard gamble	0.96 (0.06)	0.95 (0.08)	0.50 (0.11)	0.02 (0.06)	0.07 (0.16)	0.92 (0.11)
CESD-10	5.5 (4.2)	12.2 (5.5)	11.6 (6.2)	16.8 (5.1)	18.9 (5.3)	19.1 (5.2)
RCOPE-Positive	17.2 (6.9)	17.9 (6.1)	17.8 (6.0)	20.0 (4.2)	16.7 (7.0)	17.8 (6.5)
RCOPE-Negative	9.3 (3.3)	10.8 (4.2)	10.8 (4.1)	15.4 (4.4)	12.2 (4.2)	12.8 (5.6)
Alcohol consumption per drinks/mo	1.5 (1.4)	1.5 (1.5)	1.5 (1.4)	1.7 (1.5)	1.5 (1.9)	1.0 (1.1)
CD4 count (cells/ μ L)	486.0 (287.6)	425.5 (306.2)	449.2 (348.6)	298.6 (291.0)	374.8 (265.4)	242.9 (213.5)
Duration since diagnosis	7.9 (5.0)	7.4 (5.5)	8.9 (5.1)	11.3 (7.7)	9.7 (5.0)	8.2 (5.1)

*Posterior probability of respondents within a class being categorized within that class.

HAT-QoL, HIV/AIDS-Targeted Quality of Life; CESD, 10-item Center for Epidemiologic Studies Depression scale.

(6) **Class 6:** Patients in this class ($n=54$, 12.2%) had the lowest HAT-QoL scores, but had relatively high utilities for their states of health. Fifty-one (94.4%) patients reported having significant depressive symptoms. Patients in this class consumed significantly less alcohol and utilized negative religious coping techniques to a greater extent than those in the referent class.

Linear Regression Models

Of the 8 linear regression models used to determine whether class membership was associated with responses on measures assessing other aspects of functioning, 3 models were statistically significant (Table 2). Class membership accounted for

50% of the variance for the CESD-10, 13% of the variance for the RCOPE-Negative, and 7% of the variance of the CD4 counts. Membership in any of Classes 2 to 6 was significantly associated with worse scores on the CESD-10 in comparison with Class 1, the referent class. Specifically, a patient not categorized in Class 1 scored 5 to 13 points worse on the CESD-10. Furthermore, compared with Class 1, the difference between scores on the CESD-10 became progressively greater for the more dysfunctional classes. Similarly, 4 of the 5 classes (all but Class 3) significantly differed from Class 1 in terms of negative religious coping scores—patients in Classes 2, 4, 5, and 6, on average, had higher negative religious coping scores than patients in Class 1. Membership in Class 4 was associated with the most dysfunctional religious coping and low CD4

FIGURE 1. Six class typology based on patients' responses to measures assessing health-related quality of life. Points on the graph indicate mean values for each group.

Table 2. Multivariate Relationships Between Classes and Various Measures

	Beta					<i>R</i> ²
	Class 2	Class 3	Class 4	Class 5	Class 6	
CESD-10	0.43*	0.26*	0.33*	0.43*	0.63*	.50 [†]
RCOPE-Negative	0.16*	0.11*	0.29*	0.15*	0.26*	.12 [†]
Alcohol consumption per mo	0.00	0.00	0.04	0.00	−0.11*	.33
Viral load	0.10	0.02	0.09	0.11	0.19*	.04
CD4	−0.09	−0.04	−0.13*	−0.08	−0.27*	.07 [†]
HAART	−0.10	−0.05	0.05	0.01	−0.10*	.02
Time since diagnosis	0.04	0.05	0.13	0.08*	0.02	.02

Note: Reference Class: Class 1.

*Class significantly different from the reference group.

[†]Multivariate statistic $P < .05$.

CESD-10, Center for Epidemiologic Studies Depression scale, HAART, highly active anti-retroviral therapy.

counts in relation to the referent class, while those in Class 6 had significantly worse CD4 counts, significantly higher proportions of participants with viral loads below 400 copies/mL, significantly higher proportions of patients receiving HAART, and significantly lower proportions of patients drinking alcohol. The models found that membership in the class with the lowest scores was associated with significantly less alcohol consumption than membership in the highest functioning class.

DISCUSSION

The purpose of this study was to develop a typology of HRQoL across several types of measures, using various modeling techniques, for patients with HIV/AIDS. The findings from our preliminary analyses and CFA are consistent with previous research^{28,31} and identified scale constructs that are likely to impact the daily lives of patients with HIV. Meanwhile, the LPA yielded a 6-class model with distinct patterns of patient responses on measures of health status and health concerns, health ratings, and health utilities. Linear regressions further explicated the tendencies of those within each class (as compared with a referent class) to have significant depressive symptoms and to use negative religious coping.

We believe that the findings are intriguing and also yield interesting questions. First, the analyses indicate that the HAT-QoL responses yielded 3 general classes, and that the utilities added distinct information that further separated the classes, implying that both types of measures are complementary. Thus, one should strongly consider incorporating both types of measures to better characterize patients' HRQoL.

Of the clinical measures, only CD4 count was significantly associated with class membership, for Classes 4 and 6 in relation to Class 1. Previous research indicates that clinical measures are not usually related to HRQoL,^{36,37} but our study indicates that they may be in some circumstances. Nevertheless, clinical measures were not consistently associated with function, which raises the question of what HRQoL measures in this population are tapping. It certainly is possible that an unidentified biological variable may account for patients' responses, but absent such findings, our results may relate to patients' ability to adapt to life with HIV/AIDS, once a uniformly fatal disease but now a relatively manageable condition.

Tsevat and associates³⁸ theorized that adaptation of patients with HIV/AIDS is manifested through patients' re-

sponses to both TTO and SG measures. Specifically, a substantial proportion of patients seem to be unwilling to accept a (hypothetical) opportunity to live shorter-but-healthier lives or to take a risk of death in exchange for perfect health, a phenomenon that Tsevat et al.³⁸ referred to as "will to live." In fact, many patients with HIV/AIDS indicate that life is better post-diagnosis than it was prediagnosis.^{38,39}

We found that patients in Classes 1, 2, and 6 report TTO and SG scores consistent with the "will to live" phenomenon. Variations in their HAT-QoL scores indicate some heterogeneity among these patients. Specifically, those in Class 1 or 2 had relatively good health status while those in Class 6 had worse lab results and worse health status, in particular, low overall health and health-related worries scores. Thus, it seems that a large portion of patients with HIV/AIDS with generally good HRQoL have adapted well to their lives, but there is a small class that has adapted equally well (or perhaps better) in the face of poor health status.

The analyses also yielded combinations of health status and utility scores that Tsevat and associates³⁸ had not identified. Classes 3 and 4 include patients with a greater disposition to gambling than to trading time (relatively low SG scores and relatively high TTO scores). Interestingly participants in Class 4 had lower CD4 counts on average than the comparison class, which may be the reason why those in Class 4 are willing to gamble more than Class 3. Qualitative analysis⁴⁰ has found such apparent discrepancies to make sense because the SG does not specify life expectancy whereas the TTO does (in this case, 15 years). Classes 3 and 4 may represent patients with moderate to poor functioning across the HAT-QoL and other health status scales and "intermediate" levels of adaptation. Meanwhile, patients in Class 5 may represent those who are adapting poorly, willing to trade large amounts of time and take very large risks of death for a chance to improve their health.

Although the regression models yielded associations between class and psychosocial functioning, despite their statistical significance, they were not helpful in better conceptualizing differences among classes. Ideally, in relation to the best functioning class, one class could have, for example, had many depressive symptoms while another could have been characterized by negative religious coping and high level of alcohol use. Rather, it seems that patients in Class 1 reported such high levels of function that those in all of the other classes fared poorly by comparison.

Previous research by Bult et al.¹⁸ resulted in a 4-class typology of patients with HIV/AIDS. The incongruity between their study and ours regarding the number of classes or patterns across scales may result from their inclusion of generally healthier primary care patients and use of different HRQoL measures.

To wit, one limitation of this study is that the identified typology is a function of the HRQoL measures. In other words, if one were to use instruments other than those included in this study, or to use only some of our instruments, it is possible that a different typology would result. Even if one uses the same measures as we did, it is not a given that our results would be replicated perfectly, in part because the number of classes can be a function of sample size. Turk et al.,^{4,6} for example, identified a 3-class typology based on patients' responses on the Multidimensional Pain Inventory that appeared to be consistent across various pain-associated conditions, but the specific means and standard deviations varied across the studies. Another limitation may lie in using utility measures per se; some would argue that patients might have misunderstood utility tasks, thereby resulting in the unusual patterns identified, but our interviewers do not believe this to be the case.⁴⁰ Finally, our findings may result from an artifact of a large sample size. Replication through multiple approaches, qualitative and quantitative, is necessary to determine whether, or to what extent, the typology and theory are valid. Finally, our findings may not generalize to patients from other sites, and particularly, to patients with HIV not receiving care.

Those limitations notwithstanding, we conclude that HRQoL is a complex construct in a disease such as HIV, resulting in heterogeneous profiles of responses across seemingly related measures. In studies assessing HRQoL in HIV, the most information stands to be gained by incorporating both health status and utility measures.

APPENDIX

Confirmatory factor analysis (CFA), a statistical approach within structural equation modeling, is a heuristic tool for testing whether the hypothesized structure of a measure (the relationship between the latent variable and the subscales and/or items of a measure) is consistent with the observed data. Ideally, subscales and/or indicators of a latent variable are related but do not strongly correlate; when 2 or more measures are strongly related, the association is modeled by covarying the variables.

Table A1. Descriptive and Internal Consistency Statistics of Measures for Subscales of the HAT-QoL, Utilities, and Other Measures

	Cronbach's α	Mean	SD	Ranges
HAT-QoL Overall Health	0.86	70.1	27.2	95.8
HAT-QoL Life Satisfaction	0.87	66.9	24.9	0 to 100
HAT-QoL Health Worries	0.86	70.0	27.2	0 to 100
HAT-QoL Financial Worries	0.89	57.2	34.6	0 to 100
HAT-QoL Disclosure Worries	0.82	57.3	28.4	0 to 100
HAT-QoL Sexual Functioning	0.90	63.4	35.6	0 to 100
HAT-QoL Medication Worries	0.84	76.8	22.3	0 to 100
HAT-QoL HIV Mastery	0.85	67.8	32.5	0 to 100
HAT-QoL Provider Trust	0.80	79.5	24.1	0 to 100
Health Rating Scale	—	72.3	21.2	0 to 100
Time tradeoff	—	0.9	0.3	0 to 100
Standard gamble	—	0.8	0.3	0 to 100
Alcohol consumption (drinks per mo)*	—	1.4	1.4	0 to 5.71
CESD-10	0.87	11.0	7.0	0 to 30.0
RCOPE-Positive	0.92	17.6	6.4	7.0 to 28.0
RCOPE-Negative	0.82	10.7	4.3	7.0 to 28.0
CD4	—	420.5	300.9	0 to 1792
Time since diagnosis	—	8.4	5.3	0 to 24

*Logarithmic transformation.

HAT-QoL, HIV/AIDS-Targeted Quality of Life; CESD-10, 10-item Center for Epidemiologic Studies Depression scale.

CFA is also considered an acceptable method of exploratory data analysis⁴¹ and is considered to be superior to regression, correlational, and factor analytic methods in evaluating reliability and validity.⁴² Rather than using a standard CFA approach, we used a modified CFA approach because our goal was not to identify the ideal factor structure, but rather to identify highly correlated (overlapping) subscales and remove those with weaker relationships to the latent variable, thereby creating a parsimonious model for the LPA. We did not include the utility measures in the CFA because previous research indicated that such measures tend not to be highly correlated with health status measures.³ We used the following criteria to determine acceptable fit for the CFA: (1) the standardized β s were both in the expected direction and were statistically significant for each of the regressions, and (2) the overall model fit met exceeded prespecified criteria ($\chi^2 > 0.05$; RMSEA < 0.08 , and CFI > 0.95).⁴³ A χ^2 difference test was used to determine whether further refinement of a good fitting model resulted in one that was significantly better.

The internal consistency for each of the HAT-QoL subscales was high ($\alpha = 0.80$ to 0.90), suggesting that the items within each of the scales tap a similar construct (Table A1). Correlations among the scales ranged from weak to moderate

Table A2. Pearson-Product Moment Correlations for Measures Included in the Latent Profile Analysis

	1	2	3	4	5	6	7	8
1. HAT-QoL Overall Health	1.00							
2. HAT-QoL Life Satisfaction	0.65*	1.00						
3. HAT-QoL Health Worries	0.60*	0.46*	1.00					
4. HAT-QoL Financial Concerns	0.59*	0.56*	0.56*	1.00				
5. HAT-QoL Sexual Function	0.36*	0.35*	0.29*	0.35*	1.00			
6. Health Rating Scale	0.63*	0.57*	0.43*	0.49*	0.39*	1.00		
7. Time tradeoff	0.31*	0.41*	0.13	0.24*	0.24*	0.40*	1.00	
8. Standard gamble	0.39*	0.36*	0.27*	0.31*	0.27*	0.34*	0.55*	1.00

* $P < .05$.

HAT-QoL, HIV/AIDS-Targeted Quality of Life; CESD-10, 10-item Center for Epidemiologic Studies Depression scale.

(Table A2). The baseline model regressed the 8 subscales of the HAT-QoL onto a latent variable called "quality of life." Factor loadings for the baseline model (Step 1) were in the positive direction (range 0.25 to 0.80) and statistically significant. The overall fit of the model, however, was marginal, with fit indices outside suggested ranges ($\chi^2=116.20$, $df=20$, $P<.05$; comparative fit index [CFI]=0.90, root mean square error of approximation [RMSEA]=0.10). Modification indices suggested covarying the HIV Mastery and Disclosure Worries subscales to achieve the greatest improvement in model fit. Because the HIV Disclosure Worries scale did not load as strongly on the latent variable quality of life ($\beta=0.54$ for HIV Mastery vs $\beta=0.35$ for Disclosure Worries) and because interpretation of LPA can hinder interpretation of nonredundant measures, Disclosure Worries was removed from the baseline model. Standardized regression coefficients were significant (range: 0.25 to 0.80). Fit improved to some degree with the reanalysis of the model (Step 2), but resulting fit was still outside prespecified criteria ($\chi^2=59.49$, $df=14$, $P<.05$; CFI=0.95, RMSEA=0.09). The modification indices suggested that the greatest model improvement would be achieved by covarying the Health Worries and HIV Mastery scales. Because the HIV Mastery scale did not load as well ($\beta=0.74$ vs $\beta=0.51$), it was removed.

The model was then reanalyzed (Step 3); standardized regression coefficients were statistically significant (range 0.26 to 0.82) and found to have good fit ($\chi^2=16.74$, $df=9$, $P=.05$; CFI=0.99, RMSEA=0.04). The modification indices indicated that model fit could be further improved by covarying the Life Satisfaction and Provider Trust subscales. The Life Satisfaction scale was retained because it had a higher factor loading than Provider Trust ($\beta=0.74$ vs $\beta=0.26$). The model was again tested to assess fit (Step 4), resulting in significant standardized regressions coefficients (range 0.45 to 0.83) and significantly improved fit indices ($\chi^2=4.53$, $df=5$, $P=.48$; CFI=1.00, RMSEA=0.00). No further model refinement was suggested by the modification indices. The third and fourth models both had good fit, but a χ^2 difference test showed that the fourth model was found to have significantly better fit than the third model ($\chi^2=12.21$, $df=4$, $P=.02$).

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