Comorbidity-Based Payment Methodology for Medicaid Enrollees with HIV/AIDS

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Managed care organizations (MCOs) may be incurring financial losses from persons with human immunodeficiency virus (HIV) or acquired immunodeficiency syndrome (AIDS) (PWHA). This study developed a statistical model to examine which specific comorbidities are important contributors to the variations in health care costs of PWHA. Individuals were classified into cost groups to simulate biased selection in MCOs. Capitation payments for various cost groups under different methodologies were compared. The statistical model closely matched payments with the actual costs of care. Capitation payments for HIV/AIDS enrollees based on this model will better protect MCOs than the traditional risk-adjustment methods.

INTRODUCTION

Maryland's HealthChoice program, which became operational in mid-1997, was one of the first Medicaid managed care programs in the United States to implement a system that would pay risk-adjusted capitation rates to the contracting MCOs. The risk-adjusted capitation rates are based on Johns Hopkins' Adjusted Clinical Groups (ACGs). Since the beginning of the program, Medicaid enrollees with AIDS have been separated from the risk-adjusted capitation payment system and placed in an AIDS rate cell. Average payment for enrollees with AIDS was about $2,400 per member per month (PMPM) in calendar year 2001. In contrast, up until January 2001, non-AIDS, HIV-positive enrollees were included in the general, ACG-based risk-adjusted payment system, with capitation ranging between $50 and $1,400 PMPM. Weiner et al. (1998) describe various aspects of Maryland Medicaid's capitation rates.

One of the questions raised by MCOs in 1998 was whether Maryland's ACG-based payment system adequately recognizes the costs of treating non-AIDS, HIV-positive enrollees. The Maryland legislature mandated a study to evaluate the adequacy of payments for non-AIDS, HIV-positive enrollees. The study determined that the average PMPM cost of covered services for these enrollees was $1,022 in fiscal year (FY) (July-June) 1996. (FYs are used throughout the remainder of this article.) Then the average payment for all non-AIDS, HIV-positive enrollees who were assigned to the various risk-adjusted rate cells was estimated. Based on the 1999 capitation rates, the ACG-based average payment PMPM was approximately $480. For enrollees distributed among the geographic-demographic rate cells, the average payment was approximately $390. The geo-demographic rate cells are used for new enrollees for whom there is no historic Medicaid service utilization or ACG assignment data. Although ACG-based payments

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were somewhat higher than the geo-demographic-based payments, our analysis indicated that both are below the actual average cost of treating non-AIDS, HIV-positive enrollees. Therefore, the Maryland legislature directed the Medicaid program to implement a separate risk-adjusted payment model for the non-AIDS, HIV-positive managed care enrollees. The Medicaid program considered implementing a variation of comorbidity-based payment models that are presented in this article. However, some of the clinics, which specialize in the treatment of HIV/AIDS and contract with MCOs, recorded only the major diagnoses of their patients and did not record their other comorbidities. Consequently, some of the MCOs were not ready to provide adequate diagnostic information about their HIV-positive enrollees. Therefore, the Medicaid program implemented a risk-adjusted payment model for the non-AIDS, HIV-positive managed care enrollees based on their broad Medicaid eligibility category. The 2001 weighted average payment for non-AIDS, HIV-positive enrollees is about $1,100 PMPM. The comorbidity-based payment model for non-AIDS, HIV-positive enrollees will be reconsidered for implementing in the Maryland Medicaid program when the participating MCOs are prepared to provide adequate diagnostic information about their HIV-positive enrollees.

Comparisons of health care costs for Medicaid enrollees have shown that the costs for some HIV-positive individuals who have not yet developed AIDS are more than those for most enrollees who have been diagnosed with AIDS. In consultations, clinicians attending to PWHA have suggested that the treatment of comorbidities may account for the high health care costs of some non-AIDS, HIV-positive enrollees.

This study develops comorbidity-based payment methodologies for PWHA and analyzes the predictive power of these payment models. These comorbidities include HIV/AIDS opportunistic infections, AIDS-defining conditions, and other conditions that may be seen in the general population. Under this approach, MCOs that enroll more costly HIV/AIDS patients with the specified comorbidities would receive additional PMPM payments. The advantage of this method is closer matching of payments with costs of care. This closer matching reduces the incentives for MCOs to engage in risk selection and to underserve this group of enrollees.

Background and Previous Research

As has been discussed elsewhere (Kronick et al., 1996; Weiner et al., 1998), health policy experts have long identified the need for risk adjustment of MCO capitation payments. The well-known risk-adjustment models use the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) (American Medical Association, 1997) codes on patient claims or encounter records as the basis for determining the risk of an individual or a population. Three of these models are: ACGs, the Disability Payment System (DPS), and Hierarchical Co-existing Conditions (HCCs). Although all of these models take various health conditions and diagnoses into account to determine the level of risk associated with each individual or group of people, they are not designed for a specific disease like HIV/AIDS. As is shown in this article, PWHA have specific comorbidities that may not have been taken into account by models designed for more diverse groups of enrollees.

The issue of developing specific payment models for PWHA has risen because of concerns that capitation rates for the general population may not be adequate to cover the costs of care for PWHA. Inadequate payments can cause MCOs that enroll a disproportionate number of PWHA to

Table 1

Distribution of Maryland HIV and AIDS Enrollees Among MCOs: 1998

MCO	Number of HIV/AIDS Enrollees	Percent of HIV/AIDS Enrollees
All MCOs[1]	3,248	100
1	865	27
2	49	2
3	308	9
4	231	7
5	192	6
6	116	4
7	153	5
8	1,334	41

[1] Participating in the Maryland Medicaid managed care program.

NOTES: HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome. MCO is managed care organization. Columns may not add to totals shown because of rounding.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

absorb financial losses in order to maintain quality care. Also, without appropriate financial incentives, MCOs may attempt to avoid contracting with specialized HIV/AIDS health care providers in order to minimize the number of enrollees who have HIV or AIDS. Table 1 shows the 1998 distribution of HIV and AIDS enrollees among the eight MCOs participating in the Maryland Medicaid managed care program. The percentages indicate that a disproportionate number of persons with HIV or AIDS have enrolled in MCOs 1 and 8.

One of the main goals of this research was to develop a payment model that would provide adequate incentives for MCOs to contract with providers that specialize in treating PWHA. To achieve the objective of providing adequate reimbursement for HIV/AIDS, we assessed the feasibility and implications of a payment model that would establish capitation rates based on specified comorbidities. The intent is to make such capitation rates high enough to cover the costs borne by MCOs to prevent opportunistic infections and to provide incentives for MCOs to detect and identify HIV-positive individuals early, thereby providing better access to health care for PWHA.

IDENTIFICATION OF POPULATION AND THEIR COMORBIDITIES

One of the major tasks of this research was to create a data base that contains person-level health services costs, utilization, and diagnosis information for Medicaid enrollees with HIV or AIDS.

In order to identify the HIV/AIDS population and their comorbidity diagnoses, inpatient, outpatient, and physician claims data were searched for enrollees with HIV/AIDS diagnoses. This includes ICD-9-CM codes 042, 079.53, and V08. ICD-9-CM code 079.53 is for HIV type 2. The small number of individuals identified as HIV type 2 receive the same highly active anti-retroviral therapy (HAART) and prophylaxis as the HIV type 1 patients. They tend to have fewer opportunistic infections, but they do have problems with wasting syndrome. In addition, national drug codes for HIV/AIDS-specific drugs were used to identify Medicaid enrollees who were taking these medications. The number of persons identified only from usage of HIV/AIDS-specific drugs (that is, they did not have any of the ICD-9-CM diagnoses previously listed) was 602 enrollees in 1996 and 516 enrollees in 1997. Under strict confidentiality protocols, the data were matched with Maryland's AIDS Registry to differentiate between persons with AIDS and persons without AIDS who were HIV-positive. Persons with AIDS who were not identified through the diagnoses or drug-utilization screening process were also added to the data base.

The records of Medicaid enrollees who were identified from different health care settings as having HIV or AIDS were subsequently merged and unduplicated. In other words, if an enrollee was identified in two different health care settings as having HIV or AIDS, these records were merged

and unduplicated so that the data base would contain only one record pertaining to the enrollee.

The identification of HIV/AIDS enrollees was implemented for both 1996 and 1997. This process identified 5,780 Medicaid enrollees in 1996 and 5,867 enrollees in 1997. These persons were subsequently placed in one of the two groups:

- Eligible for managed care but still in fee-for-service (FFS) Medicaid (4,382 persons in 1996 and 4,136 in 1997).
- Not eligible for managed care (1,398 in 1996 and 1,731 in 1997).

Individuals were not eligible for enrollment in managed care if they were:

- Dually eligible for Medicaid and Medicare.
- In a nursing home or an institution for more than 30 days.
- Enrolled in a special Medicaid waiver program, such as home and community-based waiver program.
- Not residing in the State of Maryland.

Inpatient, outpatient, and physician claims data for these individuals were searched to identify about 5,000 diagnoses that were prevalent among the enrollees with HIV/AIDS. These diagnoses were derived from the 1996-1997 combined diagnostic records of all individuals identified as having HIV or AIDS. Then about 370 diagnoses were selected that had a high frequency among the HIV/AIDS population, that were AIDS-defining conditions, or that were presumed to be high-cost. For each person in the data base, variables were created to indicate presence or absence of the 370 HIV/AIDS-related comorbidities that were subsequently used in model development.

In addition to enrollees' demographic and Medicaid-eligibility information, their Medicaid-covered services costs by category of service (physician, pharmacy, inpatient hospital, etc.) are included in the data base. For this study, mental health services and their corresponding health care costs are included in the analysis. It should be noted that Maryland's capitation rates currently do not include payment for mental health services. Mental health services are provided and paid for under a separate public mental health system, so the HealthChoice MCOs are not at risk for these services. The analysis also includes payments for viral-load tests and protease inhibitor therapy in its projected capitation rates, which were not included in Maryland's capitation rates.

Table 2

Medicaid Eligibility Categories of Maryland HIV/AIDS Enrollees: 1996 and 1997

Medicaid EligibilityCategory	Number Eligible for Managed Care	
	1996	1997
Total	4,382	4,136
Families and Children	1,293	1,217
Disabled	3,062	2,897
Others	27	22

NOTES: Years are fiscal (June-July) years. HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

Tables 2 and 3 show the Medicaid-eligibility categories and age distribution of Maryland Medicaid's HIV/AIDS population for 1996 and 1997. The figures in Tables 2 and 3 are subject to the caution that the methodology used to identify non-AIDS, HIV-positive enrollees may result in an implied bias. Because this methodology relies on ICD-9-CM codes and drug codes found in claims data bases, HIV-positive enrollees must be users of medical services to be identified. Consequently, HIV-positive enrollees who did not use any medical services are not identified through this methodology. It is likely that a payment pool based solely on users of services would overstate per capita costs.

Table 3

Age Distribution of Maryland Medicaid Enrollees with HIV/AIDS: 1996 and 1997

Age	Eligible for Managed Care	
	1996	1997
Total	4,382	4,136
Under 1 Year	100	102
1-5 Years	398	298
6-14 Years	188	208
15-20 Years	98	71
21-44 Years	2,902	2,736
45-64 Years	691	712
Over 65 Years	5	9

NOTES: Years are fiscal (June-July) years. HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

UNIFORM HIV-BASED PAYMENT MODEL

Besides the ACG-based risk-adjusted capitation rates discussed in the introduction, the advantages and disadvantages of a uniform non-AIDS, HIV-positive capitation payment model were evaluated.

Non-AIDS, HIV-positive individuals have a higher average cost than do other Medicaid enrollees in the same geo-demographic or ACG-based capitation rate cells. Thus, MCOs that enroll a disproportionate number of non-AIDS, HIV-positive individuals would likely receive less payment than they would receive with a non-AIDS, HIV-specific capitation rate. One option for addressing the problem of inadequate general capitation rates is to develop a uniform capitation rate for non-AIDS, HIV-positive enrollees. Under this approach, the associated costs of these enrollees would be subtracted from the payment pool for the general Medicaid managed care population and set aside in a separate payment pool, similar to the payment pool for Medicaid enrollees with AIDS.

To evaluate the adequacy of this option, the 1996 percentile cost distributions of HIV and AIDS enrollees were examined separately, as shown in Tables 4 and 5. The significant difference between the average health care costs of non-AIDS, HIV-positive enrollees and enrollees with AIDS justifies distinguishing between them and separating their capitation payment rates. After actuarial adjustments, the separate capitation rate for non-AIDS, HIV-positive enrollees would be about $1,100 PMPM in year 2001. The corresponding rate for individuals with AIDS is about $2,400 PMPM.

In addition to simplicity of administration, the main advantage of this approach is that it segregates payments for health care costs of non-AIDS, HIV-positive enrollees from the health care costs of the general Medicaid population. Therefore, in the absence of biased selection, payments to MCOs that enroll a disproportionate number of non-AIDS, HIV-positive individuals would correspond to their actual health care costs.

As shown in Table 4, the average PMPM cost of covered services for non-AIDS, HIV-positive enrollees was $1,022 in 1996. However, the median PMPM cost was about $400. Also, payments for 10 percent of non-AIDS, HIV-positive enrollees (the 240 highest cost enrollees in the 90th-100th percentile group) account for more than 50 percent of total payments for all of them. These statistics indicate that the distribution of costs is highly skewed and that there is substantial variability in the health care costs of enrollees within the non-AIDS, HIV-positive group. Similar conclusions can be drawn about the cost distribution of enrollees with AIDS. To further illustrate this point, Figure 1 shows the distributions of the HIV and AIDS populations among PMPM cost categories. The graphs in Figure 1 illustrate that the distributions of the HIV and AIDS populations among cost categories overlap extensively and are skewed. In addition, the graphs indicate that the HIV-positive enrollees are spread

Table 4

Percentile Distribution of Costs for HIV-Positive, Non-AIDS Enrollees Eligible for Maryland Managed Care: 1996[1]

Decile Range	Number of Members	Total Adjusted Payments	Number of FFS-Eligible Months	Average PMPM Cost
Total	2,391	$22,825,210	22,334	$1,022
0-10th	239	44,292	1,812	24
10th-20th	239	169,009	1,911	88
20th-30th	239	319,074	2,080	153
30th-40th	239	517,698	2,309	224
40th-50th	239	764,249	2,434	314
50th-60th	239	1,061,155	2,453	433
60th-70th	239	1,503,847	2,429	619
70th-80th	239	2,297,966	2,351	977
80th-90th	239	4,129,962	2,232	1,850
90th-100th	240	12,017,957	2,323	5,173

[1] Fiscal year (June-July).

NOTES: HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome. FFS is fee-for-service. PMPM is per member per month.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

Table 5

Percentile Distribution of Costs of Care for AIDS Enrollees Eligible for Maryland Managed Care: 1996[1]

Decile Range	Number of Members	Total Adjusted Payments	Number of FFS-Eligible Months	Average PMPM Cost
Total	1,912	$31,342,412	16,817	$1,864
0-10th	191	95,687	1,100	87
10th-20th	191	362,974	1,488	244
20th-30th	191	657,722	1,732	380
30th-40th	191	1,025,061	1,731	592
40th-50th	191	1,531,038	1,794	853
50th-60th	191	2,142,519	1,792	1,196
60th-70th	191	3,000,000	1,726	1,738
70th-80th	191	4,272,131	1,778	2,403
80th-90th	192	6,388,350	1,798	3,553
90th-100th	192	11,866,931	1,878	6,319

[1] Fiscal year (June-July).

NOTES: AIDS is acquired immunodeficiency syndrome. FFS is fee-for-service. PMPM is per member per month.

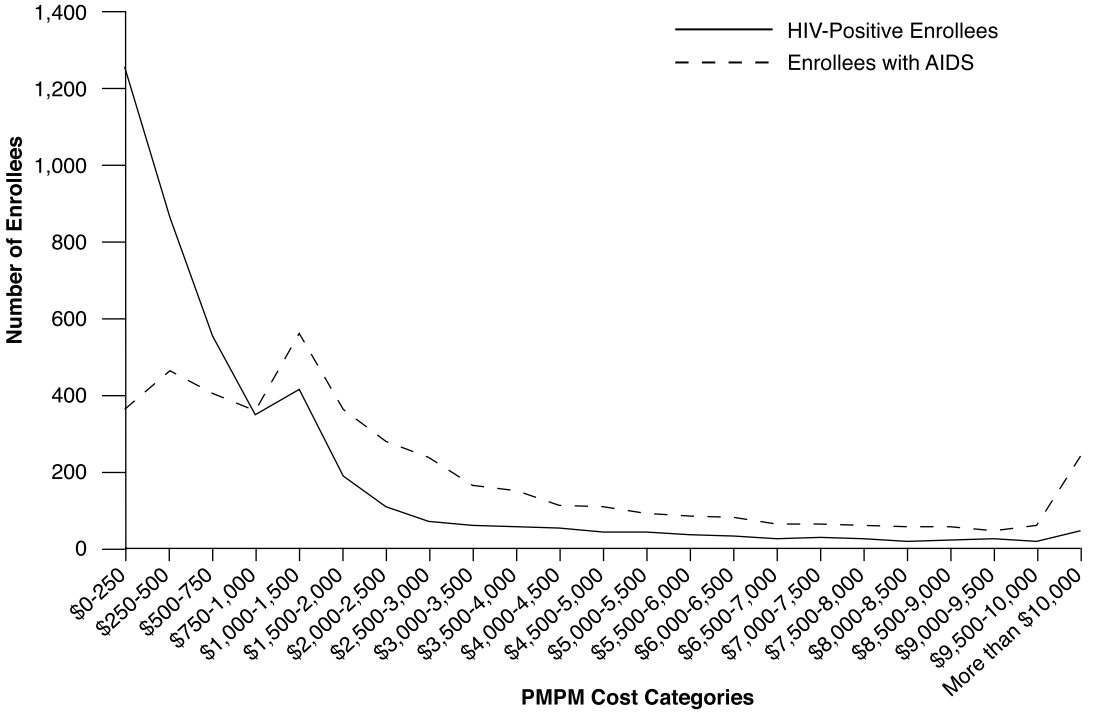
SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

among all of the PMPM cost categories in which the AIDS enrollees are distributed. In other words, health care costs of many non-AIDS, HIV-positive enrollees are higher than costs of some enrollees with AIDS. The major difference between the cost distributions of the two groups is that there are more enrollees with HIV in the lower cost categories and more enrollees with AIDS in the higher cost categories.

The conclusion that can be drawn from the foregoing discussion is that, compared with the inclusion of non-AIDS, HIV-positive enrollees in the general payment system, a separate HIV-specific capitation rate significantly increases the payment for non-AIDS, HIV-positive enrollees. However, the tables and graphs indicate that separate AIDS and non-AIDS, HIV-specific capitation rates would not take into account the wide variations in costs of individuals with HIV or AIDS. In light of the cost variations among the HIV/AIDS cohort, although setting separate capitation rates for non-AIDS, HIV-positive enrollees and AIDS enrollees is a significant improve-

Figure 1

Distribution of Costs of Maryland Managed Care Eligible Enrollees: 1996 and 1997



NOTES: Years are fiscal (June-July) years. HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome. PMPM is per member per month.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

ment over the prior payment system, it may not fully compensate MCOs that enroll disproportionate numbers of sicker-than-average individuals with HIV or AIDS. Factors affecting the cost distribution of HIV/AIDS patients, including the relatively small number of high-cost individuals, suggest that other approaches to risk adjustment of payments for enrollees with HIV/AIDS should be considered.

COMORBIDITY-BASED PAYMENT

The similarity of skewed distributions of health care costs in the HIV and AIDS populations indicate that a combined HIV/AIDS payment model, which would take into account factors that cause the variations in costs of individuals, is a better method of matching payments with the cost of care. According to this model, MCOs that enroll the more costly HIV/AIDS patients, with the indicated comorbidities, would receive additional payments. Note that the costs of comorbidities included in both full and reduced models presented in this section are additive. An enrollee with HIV or AIDS may have several comorbidities. In such a case, the estimated treatment cost of each comorbidity would be added to the corresponding base payment amount for that enrollee.

Prospective and Retrospective Risk-Adjustment Methods

There are two different methods for using these models for payment purposes: prospective and retrospective. The simpler method is to use the model for prospective

adjustment of capitation rates at the plan level, by developing payment weights for each MCO. According to this approach, diagnosis codes of individuals enrolled in each MCO would be used as input to the model. Then the model would predict PMPM costs for each enrollee based on comorbidity diagnoses of that enrollee. Each diagnosis would generate an incremental payment for that enrollee. Member months of each enrollee would be used as weights to predict a monthly weighted average cost for each MCO. The ratio of each MCO's weighted average cost to the weighted average cost of all MCOs' HIV/AIDS enrollees would determine the payment weight for each MCO. This payment weight would represent the relative cost of enrollees in each MCO to all HIV/AIDS enrollees. Capitation rates for each MCO would be determined by multiplying that MCO's relative payment weight to the average capitation rate established for all MCOs. This methodology assumes that the relative morbidity of enrollees in each MCO remains constant in one contract year. The relative weights can then be updated every year, based on encounter data submitted by MCOs. The full model presented here is more suitable for prospective adjustment of capitation rates at the plan level.

The second method is retrospective adjustment of capitation rates. Under this approach, treatment for each one of the indicated comorbidities would qualify for an additional or incremental payment. The incremental comorbidity-based payments would be made retroactive to when a patient was first diagnosed with and treated for the indicated comorbidities. This means that in each contract period, an MCO would receive additional payments for treating comorbidities of its enrollees in that contract period. To maintain budget neutrality, all comorbidity-based payments should be reset to zero at the beginning of each contract period. The reduced model presented here is more suitable for this purpose.

Model Development

An analysis was conducted to develop comorbidity-based payment models. As noted earlier, a data base of eligible enrollees was created, costs of Medicaid-covered services for these individuals were calculated, and their geo-demographic information was identified. Inpatient, outpatient, and physician claims data for these enrollees were searched to identify about 370 diagnoses that were presumed to be high-cost comorbidities.

The data were used in a regression analysis to determine which comorbidities were important contributors to health care costs of enrollees with HIV or AIDS. To avoid overspecification of the regression model, three-digit ICD-9-CM codes were used to identify most of the comorbidities. However, for specific HIV/AIDS-related comorbidities (e.g., cytomegaloviral disease, ICD-9-CM code 078.5), four or five-digit ICD-9-CM codes were used. Initially, separate regression models were estimated for 1996 and 1997. There was considerable variability in the magnitude of the coefficients between 1996 and 1997, which was the result of the fact that some of the comorbidities had a low frequency or were few in numbers in one year but not in the other. Therefore, the data for the two years were combined to achieve stability in the magnitude of coefficients. Based on actuarial estimates of increase in costs of disabled Medicaid enrollees, 1996 health care costs were adjusted for a price increase of 4.7 percent to bring them to the 1997 level. The data for the two years were subsequently concatenated and used in the model estimation. Some individuals with

Table 6

Estimated PMPM Costs Used to Group Diagnostic Variables

Diagnostic Cost Group	Cost Range
1	$150-500
2	$501-1,000
3	$1,001-1,500
4	$1,501-2,000
5	$2,001-3,500
6	$3,501-5,000

NOTE: PMPM is per member per month.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

HIV/AIDS are present in both years. Hence, two records (observations) in the data base represent each of these individuals. However, because of the progressive nature of HIV/AIDS disease, their costs and comorbidity diagnoses are different in the two data years. Therefore, the data for the two years are not duplicated and do not pose any analytical problem.

Subsequently, all of the diagnoses were used in a regression analysis to determine which ones should be retained in the model. Based on the statistical significance and sign of the coefficients, some of the diagnosis variables were excluded from the model. However, to prevent gaming and preserve flexibility in the final capitation model, some of the comorbidity variables were retained and combined with other comorbidities even if their individual contributions to health care costs were statistically insignificant. For example, ICD-9-CM codes 320 through 322 are for different meningitis conditions. Codes 320 and 321 (meningitis due to bacterial or other organisms) contribute about $1,000 PMPM to health care costs, but code 322 (meningitis due to unspecified cause) has only a marginal contribution of about $200. All meningitis-related diagnoses were combined into one variable, regardless of their contribution to costs. The magnitude of the estimated coefficient ($834) represents a weighted average of contribution of all the meningitis-related diagnoses. Similarly, all diagnoses related to a major type of illness (e.g., pneumonia or wasting disease) were combined together to form a single variable.

FULL MODEL

To establish a comorbidity-based payment model, diagnoses that were not statistically significant or that had anomalous coefficients were excluded from further analysis. Fewer than 100 diagnoses that either contribute significantly to the cost of care for enrollees with HIV/AIDS, are AIDS-defining conditions, or have a high frequency in the HIV/AIDS population, were retained.

Subsequently, diagnosis variables with similar costs were combined to form diagnostic groups. Table 6 shows the ranges for values of coefficients, which are estimates of PMPM costs associated with treatment of comorbidities, that were used to group the diagnosis variables.

Generally, variables whose coefficients were less than 150 were not statistically significant. There are a total of six diagnostic groups. Table 7 shows estimated results of the fully specified model using the six diagnostic groups as the explanatory variables. Ratios of estimated coefficients to the model average (mean=2,118.59) are shown under Estimated Relative Factors. Estimated capitation payments are based on the 1997 average monthly cost of $1,661 for the total HIV/AIDS population, without applying trends or managed care discounts. (Refer to the note at the end of this section about model calibration.)

According to the model in Table 7, a PMPM payment of $207.62 would be made for asymptomatic HIV-positive enrollees. For HIV-positive enrollees who have developed symptoms that are not AIDS-defining, the MCOs would receive the higher base

Table 7

Full Model of Average Monthly Payments for Persons with HIV/AIDS as a Function of Comorbidities

Description	Estimated Model Coefficients[1]	*T*-Statistic	Estimated Relative Factors	Estimated Capitation Payments
Average (Mean)	2,118.59	—	—	$1,661.00
Asymptomatic HIV[2]	264.84	3.35	0.125	207.62
HIV Without Comorbidities	565.26	9.96	0.267	443.49
AIDS Without Comorbidities	731.46	2.00	0.345	573.04
Diagnostic Group 1	313.48	6.82	0.148	245.83
Diagnostic Group 2	685.26	18.92	0.323	536.50
Diagnostic Group 3	1,310.87	16.48	0.619	1,028.16
Diagnostic Group 4	1,586.53	18.30	0.749	1,244.09
Diagnostic Group 5	2,562.89	12.87	1.210	2,009.81
Diagnostic Group 6	4,321.54	7.47	2.040	3,388.44
Number of Observations	8,465			
Adjusted R^2	0.31			
F-Statistic	478.5			

[1] Model derived from Maryland Medicaid data for 1996 and 1997.

[2] Asymptomatic HIV is code V08 from the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) (American Medical Association, 1997). ICD-9-CM diagnoses included in each diagnostic group are available upon request from the primary author.

NOTES: HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

payment of $443.49. For enrollees with AIDS, the monthly base payment would increase to $573.04.

In addition to the base payment amounts, comorbidities included in the model generate incremental PMPM payments. Important comorbidities are classified into one of six diagnostic groups, shown in Table 7. Data (available upon request from the primary author) show descriptions and frequencies of diagnoses within each diagnostic group for 1996 and 1997. As previously mentioned, costs of comorbidities are additive. Under the full model, a patient may have several comorbidities within each diagnostic group or multiple comorbidities across different diagnostic groups; in such cases, the cost of treatment for each comorbidity would be added to the corresponding base payment amount.

REDUCED MODEL

The model just presented is a fully specified model, with maximum predictive power. As mentioned previously, because of better predictive power, the full model is more suitable for prospective adjustment of capitation rates at the MCO level. However, a more practical model, with a reduced number of diagnoses, was needed for implementing a retrospective risk-adjusted payment system for the HIV/AIDS managed care population. The reduced model would balance the predictive power of the model with both the MCOs' ability to provide the diagnostic data required for reimbursement and the ability of the purchasing authorities (e.g., the Medicaid agencies) to confirm these diagnostic data to make the appropriate payments.

To achieve this objective, an alternate model was developed to reduce the administrative burden of implementing a risk-adjusted payment model by decreasing the number of included diagnoses. The diagnoses included in the reduced model are a subset of the diagnoses included in the full model already presented and are directly related to their prevalence in the HIV and AIDS populations. In addition, payments for treatment of AIDS-defining conditions are embedded in the base payment amount for AIDS. Both the full and reduced mod-

Table 8

Reduced Model of Average Monthly Payment for Persons with HIV/AIDS as a Function of Comorbidities

Description	Estimated Model Coefficients[1]	*T*-Statistic	Estimated Relative Factors	Estimated Capitation Payments
Average (Mean)	2,118.59	—	—	$1,661.00
Asymptomatic HIV[2]	402.14	2.06	0.1898	315.26
HIV Without Comorbidities	606.60	9.60	0.2863	475.54
AIDS Without Comorbidities	1,485.19	9.96	0.7010	1,164.36
Hepatitis	917.95	4.05	0.4333	719.71
Wasting Disease	1,190.51	11.12	0.5619	933.32
Renal Diseases	1,691.06	9.85	0.7982	1,325.81
Respiratory Conditions	1,755.53	18.63	0.8286	1,376.30
Meningitis	1,861.20	7.29	0.8785	1,459.19
Number of Observations	8,465			
Adjusted R^2	0.16			
F-Statistic	231.8			

[1] Model derived from Maryland Medicaid data for 1996 and 1997.

[2] Asymptomatic HIV is code V08 from the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) (American Medical Association, 1997). ICD-9-CM diagnoses included in each diagnostic group are shown in Table 8.

NOTES: HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

els are additive in nature, that is, each diagnosis generates an incremental payment, and the diagnosis treatment costs will be added to the base capitation payments.

One major difference between the reduced model and the full model is that in the full model, an individual may have multiple comorbidities within each diagnostic group, and they would each generate an additional payment. However, in the reduced model, all of the comorbidities within each diagnostic group are counted as one. Hence, each diagnostic group generates only one additional payment. Another major difference between the two models is that the full model includes all diagnoses that are statistically significant. However, the reduced model only includes high-cost diagnoses that significantly increase the explanatory power of the model. For example, pneumocystosis (ICD-9-CM code 136.3) is a high-cost condition that is statistically significant. However, if this diagnosis is added to the reduced model, it does not substantially increase the explanatory power of the model. Therefore, this diagnosis was not included as one of the explanatory variables of the model.

Estimated relative factors and capitation payments are calculated in the same way as in the full model. Capitation rates for the reduced model are shown in Table 8, and ICD-9-CM diagnoses included in each diagnostic group are shown in Table 9.

It is important to note that, as for the full model, "Asymptomatic HIV (V08)," "HIV without comorbidities," and "AIDS without comorbidities" are three separate base payment amounts. However, payments for the remaining five diagnostic groups (hepatitis, wasting, renal disease, respiratory conditions, and meningitis) generate an incremental payment and are additive to the corresponding base payment amounts. MCOs' treatment of comorbidities of the indicated diagnostic groups would qualify for an additional payment. For example, if an MCO treats an individual for multiple comorbidities in two different diagnostic groups (e.g., wasting and renal diseases), then the MCO would receive two additional payments for treating the two comorbidities.

Table 9

Diagnoses Included in the Reduced Model

Diagnostic Group	Description or ICD-9-CM Code	Two-Year[1] Frequency
Asymptomatic HIV	V08	1,817
HIV Without Comorbidities	042	4,130
AIDS Without Comorbidities	CD4 Count Below 200 or with an AIDS-Defining Condition[2]	4,335
Hepatitis	070	280
Wasting Disease	260-269, 276, 728.2, 783, 799.4	1,939
Renal Diseases	403, 404, 584-588, 250.4	542
Respiratory Conditions	480, 481, 482, 483, 485, 486, 511, 512, 514, 518	3,115
Meningitis	320, 321, 322	221

[1] Fiscal years (June-July) 1996-1997.

[2] Indicated by any one of ICD-9-CM codes 007.4, 031, 038, 046.3, 054, 078.5, 112, 130, 136.3, 261, 348.3, 484.1, 728.2, or 799.4.

NOTES: ICD-9-CM is *International Classification of Diseases, 9th Revision, Clinical Modification* (American Medical Association, 1997). HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

Note on Model Calibration

The estimated models should be calibrated for payment purposes, as shown in the "Estimated Capitation Payments" columns in Tables 7 and 8. The reason for this is that, for estimation purposes, PMPM costs of each individual are calculated and used in the model. Hence, coefficients are calculated from averages of individual PMPM costs, based on the formula:

$$\frac{(pmpm_1+pmpm_2+...+pmpm_n)}{n}=2{,}118$$

In other words, the model average is not weighted by member-months. However, in the ratesetting process, PMPM costs are calculated for all enrollees combined, from the following formula

$$\frac{(cost_1+cost_2+...+cost_n)}{(mm_1+mm_2+...+mm_n)}=1{,}661$$

where mm_i is member months for enrollee i.

Model calibration can be done using relative factors shown in Tables 7 and 8. For example, multiplying relative factors by the average capitation payment of $1,661 derives the corresponding estimated capitation payments in Tables 7 and 8.

EVALUATION OF MODEL PREDICTIVE POWER

A simulation analysis was developed to evaluate and compare the performance of different payment models for various ranges of costs. The simulation analysis was based on 4,115 managed care-eligible members diagnosed in 1997 as either HIV-positive or as having AIDS. For each member record, the actual PMPM costs were determined based on the payments made for that member divided by the number of FFS-eligible months. The comorbidity-based payments for each enrollee were determined based on the calibrated full and reduced models.

The average monthly payment for both the actual and comorbidity-based payments was $1,661. This average is based on 1997 FFS costs and does not include actuarial adjustments. The $1,661 average cost is consistent with costs seen nationally. According to Bozzette et al. (1998), the 1996 national monthly average expenditure per HIV/AIDS patient was about $1,670. This estimate was derived from data for a national sample of individuals with HIV/AIDS. Sixty-eight percent had public health insurance or no insurance.

The 4,115 enrollees were ranked by their actual 1997 PMPM costs. Then seven scenarios were developed based on various cost distributions of HIV/AIDS populations that an MCO could encounter. Each scenario consisted of a group of 411 enrollees, which is 10 percent of the 1997 HIV/AIDS managed care-eligible population.

A summary of the seven scenarios is presented in Table 10. The comorbidity-based payments for each group were compared with the FFS costs and with a uniform payment of $1,661 PMPM. Also, Maryland's actual risk-adjusted capitation payments for HIV/AIDS enrollees who were identified in 1997 data and who were still enrolled in MCOs during 1998 were determined. Capitation payments were adjusted upward to reflect the inclusion of costs of services (such as mental health treatment and protease inhibitors) that were carved out from Maryland's managed care program. In addition, the actual 1998 capitation payments were increased by 2.98 percent to convert them to the 1997 FFS equivalent numbers. For each scenario shown in Table 10, the ratios of average payments to actual 1997 FFS costs are also shown.

Comparison of Payment Model Scenarios

All payment models provide more-than-adequate payments in the first two scenarios presented in Table 10. For example, in Scenario 2, the average of actual costs was $827. Capitation payments for this group of enrollees under the uniform model would be $1,661, which is twice the actual average cost. The 1997 FFS equivalent actual capitation payments for these enrollees was $1,277 in 1998, which is 54 percent higher than the actual average cost. Capitation payments under the full model would be $1,169, which is 41 percent higher than the actual, and $1,496 under the reduced model, which is 81 percent higher than the actual average cost per enrollee.

Scenario 3 is for a group of enrollees whose average cost of $1,674 is close to the mean of the total HIV/AIDS population ($1,661). For this group of enrollees, the uniform $1,661 payment model performs better than both of the comorbidity-based payment models and actual capitation payments. In this scenario, the full comorbidity-based payment is $1,798, which is 7 percent more than the actual, and the reduced comorbidity-based payment is $2,019, which is 21 percent more than actual in Scenario 3. The actual capitation payments were $1,616, which is 3 percent less than the average actual costs.

Scenario 4 represents enrollees with average costs of $2,523, which is about 150 percent of the mean. Capitation payments for this group of enrollees under the uniform model would be $1,661, or 66 percent of the actual average cost. The 1997 FFS equivalent capitation payments for these enrollees was $1,670 in 1998, or 66 percent of the actual average cost. Capitation payments under the full model would be $2,713, or 8 percent higher than the actual costs; payments under the reduced model would be $2,535, which is almost equivalent to the actual average cost.

Scenario 5 is for a group of enrollees whose average cost is $3,116, which is about 190 percent of the mean. For this group of high-cost enrollees, capitation payments under the uniform model would be $1,661, which is 53 percent of the actual average cost. The 1997 FFS equivalent capitation payments for these enrollees was $1,655 in 1998, or 53 percent of the actual average cost. Capitation payment under the full model would be $3,116, which is equivalent to the actual costs.

Table 10

PMPM Actual and Predicted Payments for Maryland Medicaid HIV/AIDS Managed Care Enrollees: 1998

Scenario	Average Cost of Patient Group	Payment: Actual 1997[1] PMPM	Payment: Uniform PMPM Amount	Payment: Uniform PMPM Ratio to Actual	Payment: Actual Capitation Amount	Payment: Actual Capitation Ratio to Actual	Comorbidity-Based PMPM Payment: Full Model Amount	Comorbidity-Based PMPM Payment: Full Model Ratio to Actual	Comorbidity-Based PMPM Payment: Reduced Model Amount	Comorbidity-Based PMPM Payment: Reduced Model Ratio to Actual
1	Very Low Cost (≈ 15 Percent of Mean)	$221	$1,661	7.52	$857	3.88	$674	3.05	$871	3.94
2	Low Cost (≈ 50 Percent of Mean)	827	1,661	2.01	1,277	1.54	1,168	1.41	1,496	1.81
3	Average Cost (≈ at Mean)	1,674	1,661	0.99	1,616	0.97	1,798	1.07	2,019	1.21
4	High Cost (≈ 150 Percent of Mean)	2,523	1,661	0.66	1,670	0.66	2,713	1.08	2,535	1.00
5	Very High Cost (≈ 190 Percent of Mean)	3,116	1,661	0.53	1,655	0.53	3,116	1.00	2,733	0.88
6	Very High Cost (≈ 210 Percent of Mean)	3,523	1,661	0.47	1,660	0.47	3,277	0.93	2,818	0.80
7	Extremely High Cost (≈ 530 Percent of Mean)	8,832	1,661	0.19	1,682	0.19	5,355	0.61	3,480	0.39

[1] Fiscal (June-July) year.

NOTES: PMPM is per member per month. HIV is human immunodeficiency virus. AIDS is acquired immunodeficiency syndrome.

SOURCE: Fakhraei, S.H., et al., University of Maryland Baltimore County, Baltimore, MD, 2000.

Capitation payment under the reduced model would be $2,733, which is 88 percent of the actual average cost.

Scenario 6 is for a group of enrollees whose average costs of $3,523 are about 210 percent of the mean of $1,661. For this group of high-cost enrollees, capitation payments under the uniform model would be $1,661, or 47 percent of the actual average cost. The 1997 FFS equivalent capitation payments for these enrollees was $1,660 in 1998, which is also 47 percent of the actual average cost. Capitation payment under the full model would be $3,277, which is 93 percent of the actual costs. Payment under the reduced model would be $2,818, or 80 percent of the actual average cost.

Scenario 7 is for a group of HIV/AIDS enrollees with extremely high average costs of $8,832, or 530 percent of the mean. For this group of high-cost enrollees, capitation payments under the uniform model would be $1,661, or 19 percent of the actual average cost. The 1997 FFS equivalent capitation payment for these enrollees was $1,682 in 1998, which is also 19 percent of the actual average cost. Capitation payment under the full model would be $5,355, or 61 percent of the actual costs. Payment under the reduced model would be $3,480, or 39 percent of the actual average cost.

For an MCO to have an HIV/AIDS population similar to Scenario 7 would mean that the average morbidity of all its enrollees fell into the 90th-100th percentile cost range of all the managed care-eligible HIV/AIDS population. It should be noted that Scenarios 2-6 are more likely to occur in the real world than Scenarios 1 or 7, where the average cost per enrollee is either extremely low or extremely high. Also, in evaluating these scenarios, one should bear in mind that one of the objectives of managed care is to replace high rates of hospitalization with preventive care. As Shapiro et al. (1999) mention: "While some hospitalizations are probably inevitable as HIV disease progresses, higher hospitalization rates clearly result from failure to receive outpatient therapy. Ambulatory care that is sufficiently frequent, ... should prevent some complications and decrease the rate of hospitalization, even in the advanced stages of the disease." Therefore, overprediction of FFS costs in the lowest cost groups by the comorbidity-based payment models and underprediction in the extremely high-cost group may promote a more desirable pattern of care than that represented by the actual FFS costs.

Overall, this simulation analysis shows that the comorbidity-based payment models reimburse MCOs with higher cost patients more equitably than the traditional risk-adjusted, demographic-based, or uniform-payment models do. Scenarios 4 and 5 support this conclusion. As previously indicated, for a group of enrollees whose average costs were about twice the average cost of the entire HIV/AIDS population, the uniform and actual capitation payments were about one-half of the actual cost. However, payments under the full model would be about 95 percent of actual average cost. Payments under the reduced model would be about 84 percent of actual average cost.

CONCLUSION

Although the ACG-based risk-adjusted capitation system improves upon the geodemographic payment model, it does not fully recognize the health care costs of non-AIDS, HIV-positive enrollees. Furthermore, a separate capitation rate for non-AIDS, HIV-positive enrollees significantly improves the payment system. However, given the broad variations in costs of individuals with HIV or AIDS, a single capitation rate for non-AIDS, HIV-positive enrollees can still be improved to achieve

the goal of matching payments to associated costs. The similarity of skewed distributions of health care costs in the HIV and AIDS populations indicates that a combined HIV/AIDS payment model, with higher reimbursement to MCOs that enroll the more costly individuals, is a better method of matching payments with costs of care.

The overall result from implementing a comorbidity-based payment mechanism is that enrollment of the HIV/AIDS population in MCOs may not have an adverse financial impact for the MCOs. This would encourage MCOs to contract with HIV/AIDS specialized providers whom they may have avoided in the past. The inclusion of these providers into more MCO networks should improve the efficiency and quality of care for the HIV/AIDS population.

As the simulation results indicate, comorbidity-based payment seems to be the better approach for setting capitation rates. This payment model resolves the problem of risk selection for people with serious illness and supports the promotion of efficient and high-quality care. The advantage of this method is a closer matching of payments with costs of care, which reduces the incentives for favorable selection and underservice to this group of enrollees. The disadvantage of this method is the existing limitations on the MCOs' ability to provide diagnostic information necessary for implementing the system.

It is important to remember that, because of the introduction of protease inhibitors, the average PMPM cost of the HIV/AIDS population is expected to change over time. Inpatient hospital utilization and expenditures are expected to decrease, but expenditures for drugs are expected to increase. Changes in treatment modalities will continue to affect the overall utilization of services and costs. Also, the prevalence rates of various comorbidities are likely to change. Hence, it will be necessary to frequently monitor the trends in the average health care costs of persons with HIV/AIDS.

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