

Effect of Case Management on Unmet Needs and Utilization of Medical Care and Medications among HIV-Infected Persons

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Background: Although case management has been advocated as a method for improving the care of chronically ill persons, its effectiveness is poorly understood.

Objective: To assess the effect of case managers on unmet need for supportive services and utilization of medical care and medications among HIV-infected persons.

Design: Baseline and follow-up interview of a national probability sample.

Setting: Inpatient and outpatient medical facilities in the United States.

Participants: 2437 HIV-infected adults representing 217 081 patients receiving medical care.

Measurements: Outcomes measured at follow-up were unmet need for supportive services, medical care utilization (ambulatory visits, emergency department visits, and hospitalizations), and use of HIV medication (receipt of antiretroviral therapy and prophylaxis against *Pneumocystis carinii* pneumonia and toxoplasmosis).

Results: At baseline, 56.5% of the sample had contact with a

case manager in the previous 6 months. In multiple logistic regression analyses that adjusted for potential confounders, contact with a case manager at baseline was associated with decreased unmet need for income assistance (odds ratio [OR], 0.57 [95% CI, 0.36 to 0.91]), health insurance (OR, 0.54 [CI, 0.33 to 0.89]), home health care (OR, 0.29 [CI, 0.15 to 0.56]), and emotional counseling (OR, 0.62 [CI, 0.41 to 0.94]) at follow-up. Contact with case managers was not significantly associated with utilization of ambulatory care (OR, 0.77 [CI, 0.57 to 1.04]), hospitalization (OR, 1.13 [CI, 0.84 to 1.54]), or emergency department visits (OR, 1.30 [CI, 0.97 to 1.73]) but was associated with higher utilization of two-drug (OR, 1.58 [CI, 1.23 to 2.03]) and three-drug (OR, 1.34 [CI, 1.00 to 1.80]) antiretroviral regimens and of treatment with protease inhibitors or non-nucleoside reverse transcriptase inhibitors (OR, 1.29 [CI, 1.02 to 1.64]) at follow-up.

Conclusions: Case management appears to be associated with fewer unmet needs and higher use of HIV medications in patients receiving HIV treatment.

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Case management has been advocated as a strategy to decrease unmet need for supportive services, improve utilization of ambulatory services, and avoid costly institutional care for HIV-infected persons (1–7). Previous studies have demonstrated that HIV-infected persons with case managers are more likely to receive benefits advocacy, psychological services, and emotional and practical support (2, 8–13). However, because many studies used process indicators (for example, receipt of benefits counseling) rather than outcome indicators (for example, receipt of Medicaid) and relied on non-probability-based samples, the generalizability of their results is limited. Moreover, most studies had cross-sectional designs, which limits the ability to draw causal inferences.

Few studies have evaluated the relationship between case management and utilization of medical services by HIV-infected persons, and results from these studies have been somewhat contradictory (4). The impact of case management on medication use is particularly im-

portant given that receipt of antiretroviral and prophylactic treatment has been shown to decrease morbidity and mortality among HIV-infected persons (14–17).

We assessed the effect of case management on unmet need for supportive services and on utilization of medical care and medications in a longitudinal probability sample of HIV-infected adults.

METHODS

Design

The HIV Cost and Services Utilization Study is a national multistage probability sample of HIV-infected adults drawn from medical providers in the contiguous United States (18, 19). In the first stage, we randomly selected 28 metropolitan statistical areas and 24 clusters of rural counties. In the second stage, we randomly selected 58 providers known to care for patients with HIV in urban areas and 28 providers in rural areas. We also selected 87 “other providers” in urban areas and 23 in

rural areas who had confirmed in a screening survey of approximately 4000 physicians that they cared for eligible patients with HIV. In the third stage, we randomly selected anonymous patients (using unique codes) from lists of all eligible patients seen at the participating providers during January and February 1996. In the first two stages, we set sampling rates proportional to case-load. In the third stage, we set sampling rates to equalize the probability of selection within subgroups while increasing the overall sampling rate for women and members of private staff-model health maintenance organizations.

After replacement of a single urban provider with an equivalent one in the same community, we obtained agreement to participate from 100% of known providers in urban areas and 79% in rural areas, 70% of other providers in urban areas and 83% in rural areas, and 84% of the selected patients.

We completed baseline interviews for 2864 of the 4042 (76%) selected patients between January 1996 and April 1997 (20). Follow-up interviews were conducted between December 1996 and July 1997; 2466 persons responded (69% of surviving sampled persons). The median interval between the two interviews was 243 days (range, 36 to 517 days). The study was approved by institutional review boards at RAND and at local institutions.

For each respondent, we constructed an analytical weight to adjust the sample to represent the entire reference population. Each weight is the product of the sampling weight, which adjusts for differential sampling probabilities; a “multiplicity weight,” which adjusts for patients who could have entered the sample through their visits to multiple providers; a “nonresponse weight”; and an “attrition weight” (21).

Measurements

Case Management

At baseline, participants were asked whether they had a case manager and, if so, the number of times that they had seen or spoken with the case manager in the previous 6 months. Participants were told that “case manager” meant “a social worker, nurse, AIDS service organization staff member, staff in other service organizations, or anyone else who is assigned to help you get and coordinate care.” Participants were considered to

have contact with a case manager if they reported seeing or talking to a case manager at least once in the 6 months before the baseline interview.

Unmet Need for Supportive Services

Unmet need for supportive services was assessed only among persons who had an identified need for a specific service at the baseline interview. We defined need for income assistance as being unemployed and not receiving public income assistance (Social Security Income, Social Security Disability Insurance, or Aid for Families with Dependent Children) other than general welfare at the time of the baseline interview. Participants were considered to have an unmet need for income assistance if they were not receiving any form of public income assistance other than general welfare at the time of the follow-up interview. We defined need for health insurance as having no insurance (Medicaid, Medicare, private insurance, Civilian Health and Medical Program of the Uniformed Services [CHAMPUS], or Veterans’ Administration benefits) at the time of baseline interview. Unmet need for health insurance was defined as not having a form of insurance at the time of the follow-up interview. Need for housing was defined as being unstably housed (living in shelter; single-room occupancy hotel; doubled up with a friend or relative; hospital; nursing home; residential care facility; or situation other than one’s own house, own apartment, or AIDS housing) during the 6 months before the baseline interview or self-reported as homeless or with no usual place to live at the time of the baseline interview. Unmet need for housing was defined as being unstably housed during the interval between the baseline and follow-up interviews. Need for home health care (for example, someone to help with medical or personal care at home) was based on self-reported need at baseline. Unmet need for home health care was based on having no paid or volunteer home health care workers (excluding family members) in the interval between the baseline and follow-up interview. Need for emotional counseling was based on self-reported need in the 6 months before the baseline interview. Unmet need for emotional counseling was defined as not having seen a mental health provider, attended a support group, or seen a spiritual provider (such as a minister) during follow-up. Need for substance abuse services was based on reporting drug

dependence during the year before the baseline interview. Drug dependence was defined as use of illicit drugs or prescription drugs known to cause dependence (such as tranquilizers), use of more drugs than intended, or the presence of an emotional or psychological problem associated with drug use during the year before the baseline interview. Unmet need for treatment of substance abuse was defined as not having received professional substance abuse services or participated in a self-help group during follow-up. We defined any unmet need as needing at least one of the six services at the baseline interview and having at least one unmet need at follow-up.

Utilization of Medical Care and HIV Medications

We constructed three measures of utilization of medical care during the interval between baseline and follow-up visit: an average of at least one ambulatory visit per 3-month period, at least one hospitalization, and at least one emergency department visit not leading to a hospitalization. We selected one ambulatory visit per 3 months because it is the upper limit of an acceptable interval for monitoring progression of disease and response to treatment. Participants who had a follow-up interview within 90 days of the baseline interview ($n = 68$) were excluded from this analysis because insufficient time had passed to judge the appropriateness of outpatient care. Although some hospitalizations and emergency department visits are inevitable, higher rates of hospitalization and emergency department visits (22) are more likely to occur among persons receiving inadequate outpatient care and those with unstable living situations.

Four measures of antiretroviral utilization in the period between the baseline and follow-up interviews were evaluated among persons with a lowest lifetime CD4 cell count less than 0.50×10^9 cells/L: 1) use of any antiretroviral medication, 2) simultaneous use of at least two antiretroviral medications, 3) simultaneous use of at least three antiretroviral medications, and 4) use of a protease inhibitor or non-nucleoside reverse transcriptase inhibitor. Prophylaxis against *Pneumocystis carinii* pneumonia or toxoplasmosis in the period between the baseline and follow-up interviews was assessed for participants whose lowest CD4 cell count was less than

0.20×10^9 cells/L, the accepted threshold for this treatment.

Multivariable Models

To assess the impact of case management on unmet need for supportive services and utilization of medical care and medications, we adjusted the analysis for covariates that may confound these relationships. The Behavioral Model of Health Services Use was chosen as the conceptual framework for our study because we believed that unmet need and utilization of medical care would be influenced by predisposing factors, enabling resources, and need (23). We included in our analysis predisposing factors (age, sex, ethnicity, HIV risk group, education, geographic region, and drug dependence), enabling resources (insurance status, income, housing status, and living with others), and need (sum of supportive services needed and CD4 lymphocyte count).

We categorized HIV risk group as “injection drug user” if participants had used any injection drug since 1979. Non-injection drug users were categorized as either men who have sex with men or other risk group (includes heterosexual transmission, persons who received infected blood products, and persons with other known or unknown exposures). Drug dependence (yes or no) was categorized as described above. Household income was categorized as \$0 to \$5000, \$5001 to \$10 000, \$10 001 to \$25 000, \$25 001 to \$40 000, or greater than \$40 000 and was treated as an interval variable. Insurance status was categorized as none, public insurance (Medicaid, Medicare, Veterans’ Administration benefits or Civilian Health and Medical Program of the Uniformed Services), or private insurance. Housing status was categorized as stable or unstable, as described above. Persons who said that they lived alone or were homeless at the time of the baseline interview were categorized as living alone. Sum of needs ranged from 0 to 6 (needing all six supportive services: income assistance, health insurance, housing, home care, mental health treatment, and substance abuse treatment). The CD4 lymphocyte count was based on the lowest lifetime count reported by the participant.

All analyses, with the exception of ambulatory utilization, were adjusted for the time between baseline and follow-up interview by using the interval as a covariate. Because ambulatory utilization was based on the average

number of visits per 3-month period, this variable already incorporated time between the two interviews.

Data Analysis

All analyses incorporate the analytic weights described above. We used linearization methods to adjust the standard errors and statistical tests for the differential weighting and complex sample design (24). We used randomly drawn responses within strata of respondents (“hot-deck” imputation) to impute missing values for 4.9% of CD4 count values, less than 4% of values for income, less than 2% of values for insurance status, and less than 0.5% of missing values in other independent variables (21, 25).

Of the 2466 participants who completed baseline and follow-up interviews, we excluded from all analyses persons for whom data on the case management variable ($n = 18$) or on sum of needs ($n = 11$) were missing. In addition, participants with missing data on hospitalization ($n = 2$), emergency department use ($n = 5$), anti-retroviral use ($n = 17$), use of protease inhibitors or non-nucleoside reverse transcriptase inhibitors ($n = 11$), and prophylaxis against *P. carinii* pneumonia or toxoplasmosis ($n = 11$) were excluded from analyses that used these outcome variables.

Statistical Analysis

Persons with and without contact with case managers were compared by using weighted chi-square analyses for dichotomous variables and weighted chi-square for trend for ordinal variables. Weighted multiple logistic regression was used to determine independent factors associated with unmet need and utilization of medical care and medications. In the analysis of unmet need for income assistance, income was omitted as a covariate because the analysis only included persons who were unemployed at baseline. Similarly, insurance status was omitted as a covariate in the analysis of unmet need for health insurance because only persons without insurance at baseline were included in this analysis. Housing status and living alone were excluded in the analysis of unmet need for housing because the analysis only included persons who were unstably housed at baseline and because homeless persons were categorized as living alone. Drug dependence was excluded in the analysis of unmet need for substance treatment because the analysis included

only persons who reported drug dependence. Finally, income, insurance status, housing status, living alone, and drug dependence were excluded from the analysis of any unmet need, since that category included unmet need for income assistance, insurance, housing, and substance abuse treatment.

Because of the range in time between baseline and follow-up interview, we repeated the multivariable analyses excluding persons whose interval may have been too short for certain outcomes (for example, income assistance) to have occurred (<90 days) or so long that there may have been major changes in the patient’s conditions (>360 days) ($n = 2180$). Because these results did not differ substantively, we report only the analyses from the full sample.

Role of the Funding Sources

The HIV Cost and Services Utilization Study project was funded by the Agency for Healthcare Research and Quality (formerly known as the Agency for Health Care Policy and Research), the Health Resources and Services Administration, the National Institute for Mental Health, the National Institute for Drug Abuse, the National Institutes of Health, Office of Research on Minority Health, the National Institute for Dental Research, the Robert Wood Johnson Foundation, Merck and Co., Glaxo Wellcome, and the National Institute on Aging. Federal funders were included in decisions about collection, analysis, and interpretation of the data; drug company funders were not involved in these decisions or in the decision to submit the paper for publication.

RESULTS

Of the 217 081 persons represented by the sample, we estimate that 122 560 (56.5%) had contact with a case manager in the 6 months before the baseline interview. Women; nonwhite persons; injection drug users; persons in another risk group; and those with less education, lower income, public or no insurance, and lower CD4 cell counts were more likely to have contact with case managers (Table 1). Persons living in the western United States were more likely to be male, white, and men who have sex with men, suggesting that differences in demographic characteristics across the United States might explain variation in contact with case managers.

Table 1. Sample Characteristics of Participants with and without Contact with Case Managers at Baseline

Variable	Sample Size	Weighted to Population	Weighted Sample		P Value
			Case Manager	No Case Manager	
			<i>n</i>	%	
All participants	2437	217 081	56.5	43.5	–
Age					
<38 y	1193	104 228	58.8	41.2	0.08
≥38 y	1244	112 853	54.3	45.7	
Sex					
Male	1728	167 967	52.2	47.8	<0.001
Female	709	49 114	71.0	29.0	
Race/ethnicity					
White	1241	107 512	43.7	56.3	<0.001
Nonwhite	1196	109 570	69.0	31.0	
HIV risk group					
Injection drug users	586	53 224	69.1	30.9	<0.001
Other risk group	712	58 690	65.8	34.2	
Men who have sex with men	1139	105 167	44.9	55.1	
Education					
Less than high school graduate	597	53 764	69.9	30.1	<0.001*
High school graduate	673	59 094	64.2	35.8	
Some college	701	61 484	53.1	46.9	
College graduate or more	466	42 740	33.6	66.4	
Region					
Northeast	579	54 159	66.9	33.1	<0.001
Midwest	278	22 941	68.8	31.3	
West	775	62 137	36.8	63.2	
South	805	77 843	61.3	38.7	
Drug dependence in the past year					
Yes	245	21 170	62.4	37.6	0.07
No	2192	195 911	55.8	44.2	
Household income					
≤\$5000	494	42 700	71.4	28.6	<0.001*
\$5000–\$10 000	612	54 292	70.2	29.8	
\$10 001–\$25 000	640	56 868	58.3	41.7	
\$25 001–\$40 000	302	26 775	42.4	57.6	
>\$40 000	389	36 446	25.8	74.2	
Insurance status					
Public	1158	102 772	72.9	27.1	<0.001
Private	773	70 147	28.0	72.0	
None	506	44 162	63.5	36.5	
Unstably housed					
Yes	157	13 039	63.8	36.2	0.08
No	2280	204 042	56.0	44.0	
Lives alone					
Yes	749	65 867	56.0	44.0	>0.2
No	1688	151 214	56.7	43.3	
Sum of needs					
0	872	80 348	48.3	51.8	<0.001*
1	839	75 169	54.2	45.8	
2	529	44 895	67.6	32.4	
3	144	12 124	78.8	21.2	
4	47	3 976	71.5	28.5	
5	6	569	53.3	46.7	
6	0	–	–	–	
Lowest CD4 cell count					
≥0.5 × 10 ⁹ cells/L	213	21 420	56.0	44.0	0.003*
0.200–0.499 × 10 ⁹ cells/L	963	85 170	51.3	48.7	
0.050–0.199 × 10 ⁹ cells/L	752	65 326	56.7	43.3	
<0.050 cells/L	509	45 166	66.0	34.0	

* Chi-square for trend.

Table 2. Association of Case Management with Unmet Need for Supportive Services and Utilization of Medical Services and Medications

Variable	Contact with a Case Manager			Sustained Contact with a Case Manager				
	Weighted Sample*		Multivariable Sample	Adjusted Odds Ratio (95% CI)†	Weighted Sample*		Multivariable Sample	Adjusted Odds Ratio (95% CI)†
	Yes	No			Yes	No		
	%	n	%	n				
Unmet need for supportive services								
Income assistance	56.7	73.8	417	0.57 (0.36–0.91)‡	56.6	69.4	406	0.57 (0.35–0.92)‡
Health insurance	65.4	78.9	498	0.54 (0.33–0.89)‡	62.3	77.5	487	0.45 (0.29–0.69)‡
Housing	37.0	35.8	157	0.63 (0.24–1.71)	35.1	35.4	153	0.53 (0.21–1.36)
Home health care	41.6	68.7	396	0.29 (0.15–0.56)‡	40.8	61.5	390	0.38 (0.21–0.67)‡
Emotional counseling	30.4	37.6	826	0.62 (0.41–0.94)‡	27.9	36.8	818	0.58 (0.36–0.94)‡
Substance abuse treatment	59.4	74.6	245	0.63 (0.27–1.46)	55.8	72.9	240	0.53 (0.25–1.12)
Any unmet need	58.0	66.9	1565	0.52 (0.38–0.72)‡	56.7	65.6	1542	0.55 (0.37–0.83)‡
Utilization of medical services								
Ambulatory visit per 3 months	87.0	91.1	2369	0.77 (0.57–1.04)	87.9	90.4	2336	0.96 (0.64–1.42)
Emergency department visits	23.6	14.0	2432	1.30 (0.97–1.73)	25.9	14.3	2396	1.58 (1.17–2.13)‡
Hospitalization	22.2	12.7	2435	1.13 (0.84–1.54)	23.1	14.6	2399	1.11 (0.83–1.50)
Utilization of medications								
Receipt of at least 1 antiretroviral drug	90.3	91.1	2207	1.19 (0.93–1.53)	91.9	90.4	2178	1.61 (1.15–2.27)‡
Receipt of at least 2 antiretroviral drugs	85.7	84.6	2207	1.58 (1.23–2.03)‡	87.1	84.5	2178	1.72 (1.36–2.16)‡
Receipt of at least 3 antiretroviral drugs	58.0	59.1	2207	1.34 (1.00–1.80)‡	60.2	58.0	2178	1.63 (1.20–2.21)‡
Receipt of a protease inhibitor or non-nucleoside reverse transcriptase inhibitor	66.2	66.1	2213	1.29 (1.02–1.64)‡	68.6	65.2	2184	1.53 (1.22–1.92)‡
Receipt of prophylaxis against <i>Pneumocystis carinii</i> pneumonia or toxoplasmosis	55.6	57.8	1250	1.16 (0.83–1.63)	59.6	53.7	1240	1.77 (1.28–2.46)‡

* For unmet need, the weighted percentage is the percentage of participants with a need whose need was not met. For utilization of services, the weighted percentage is the percentage of participants who used the services in the interval between the baseline and the follow-up interviews. For utilization of medications, the weighted percentage is the percentage of participants who were eligible for the medications and were using them between the baseline and follow-up interview. Participants were eligible for antiretroviral treatment if their lowest CD4 cell count was less than 0.50×10^9 cells/L and were eligible for prophylaxis against *Pneumocystis carinii* pneumonia and toxoplasmosis if their lowest CD4 cell count was less than 0.20×10^9 cells/L.

† Multivariable analyses adjusted for sex, age, ethnicity (white or nonwhite), HIV risk group, education, geographic region, drug dependence, income, insurance status, housing status, living alone, sum of needs, lowest CD4 cell count, and interval between the baseline and follow-up interviews. Income was excluded as a covariate in the analysis of unmet need for income assistance; insurance status was excluded as a covariate in the analysis of unmet need for health insurance; housing status and living alone were excluded as covariates in the analysis on unmet need for housing; and income, insurance status, housing status, and living alone were excluded in the analysis of any unmet need.

‡ $P \leq 0.05$.

After adjustment for potential confounders, participants who had contact with case managers at baseline reported less unmet need for income assistance, health insurance, home care, emotional counseling, and any unmet need at follow-up (Table 2). Persons who had contact with case managers had less unmet need for housing and substance abuse treatment, although the associations were not statistically significant.

Case management was not significantly associated with utilization of ambulatory care, hospitalization, or emergency department. Participants who had contact with case managers were more likely to have taken at least two antiretroviral medications, at least three antiretroviral medications, and a protease inhibitor or non-nucleoside reverse transcriptase inhibitor between the

baseline and follow-up interviews. Those who had contact with a case manager were not significantly more likely to have taken at least one antiretroviral medication or prophylaxis against *P. carinii* pneumonia or toxoplasmosis.

We were concerned that the association between having a case manager and greater use of medication might have occurred either because patients placed on medication are more likely to be assigned case managers or because well-run medical practices may provide both case managers and medications. Therefore, we repeated the analysis limiting the sample to participants who were not receiving medication at baseline. After adjustment for the same confounders as in Table 2, we found that sustained case management was significantly associated

with increased utilization of one (OR, 1.96 [95% CI, 1.08 to 3.56]), two (OR, 1.99 [CI, 1.14 to 3.49]), or three antiretroviral medications (OR, 2.32 [CI, 1.15 to 4.70]), as well as receipt of a protease inhibitor/non-nucleoside reverse transcriptase inhibitor (OR, 1.68 [CI, 1.24 to 2.27]).

Sustained Contact with a Case Manager

Sustained contact with a case manager may be necessary to accrue the full benefits of having a case manager. Therefore, we repeated our analysis comparing persons with sustained contact with a case manager (those who had contact at baseline and still had a case manager at follow-up) with persons who had no contact with a case manager at baseline or no case manager at follow-up. Among persons who had contact with a case manager at baseline, 76.3% had a case manager at follow-up, 22.6% did not, and data were missing for 1.1%. Among persons who did not have contact with a case manager at baseline, 20.4% had a case manager at follow-up, 77.1% did not, and data were missing for 2.5%.

Sustained contact with a case manager was associated with an equally strong relationship with decreased unmet need (Table 2). The associations between sustained case management and medical care were similar to those seen with having contact with a case manager, except that the likelihood of being seen in the emergency department was significantly increased among those who had sustained contact with a case manager. The association between sustained contact with a case manager and receipt of HIV therapy was stronger; sustained case management was associated with increased receipt of all medication categories.

Prevention of Unmet Needs

The major focus of case management for HIV-infected patients is assessment and fulfillment of service needs. However, effective case management might prevent clients from becoming uninsured or unstably housed. We found that having sustained case management was not associated with preventing lack of insurance (OR, 1.28 [CI, 0.75 to 2.17]; $n = 1895$) but was associated with preventing patients from becoming unstably housed (OR, 0.58 [CI, 0.40 to 0.82]; $n = 2248$).

DISCUSSION

Consistent with results of previous studies, (2, 8–13), we found that contact with a case manager was strongly associated with decreased unmet need for supportive services. By linking clients with income assistance, health insurance, home health care, and emotional counseling, case managers improve the economic, social, physical, and emotional well-being of HIV-infected persons. Although the associations between contact with a case manager and unmet need for housing and substance abuse treatment were not statistically significant, the magnitude of the associations were similar to those for other unmet needs. In addition, case managers appeared to prevent clients from becoming unstably housed.

The strength of the association between contact with a case manager and decreased unmet need is particularly noteworthy given that we used outcome measures, rather than process measures, to determine that a need had been met. For example, to demonstrate that the need for health insurance had been met, those who lacked insurance had to obtain insurance.

Since case managers cannot prescribe antiretroviral therapy, some may find it surprising that having a case manager was associated with increased utilization of medications. However, case managers may help patients overcome fears about treatment, may help them adhere to medication regimens, and may advocate to physicians to initiate treatment of their patients. Case managers may also help patients to attend medical visits more regularly; missed appointments have been associated with lower rates of antiretroviral treatment (26) and lower likelihood of viral suppression (27). Given that other studies have shown disparities in the use of antiretroviral treatment by sex, ethnicity, and socioeconomic status (28–30), case management may provide an opportunity to increase receipt of treatment and thereby improve health outcomes.

We did not find improved utilization of medical care among persons who had contact with case managers. It is likely that case management decreased unmet needs and improved medication utilization but did not decrease emergency department utilization because HIV case managers focus on linking clients to services rather than serving as “gate-keepers.” Similarly, the lack of association between case management and hospitalization

should not be considered definitive; a case management program focused on reducing avoidable hospitalizations might be successful (31).

Because participants were not randomly allocated to have a case manager, our study does not prove that the associations between case management and decreased unmet need, and increased utilization of antiretroviral treatment, are causal. However, our longitudinal design makes a causal link more likely. Contact with a case manager and need were determined at baseline, whereas fulfillment of the need was determined at follow-up. Therefore, fulfillment of the need could not have resulted in contact with a case manager. In the case of utilization of antiretroviral medications, limiting the analysis to persons eligible for but not receiving medication at baseline, confirmed that case management increased utilization of treatment; since these patients had case managers before receiving medication, receipt of medication could not have led to contact with case managers. To exclude the possibility that the associations between case management and outcome were due to confounding, we adjusted our analysis for several potential confounders. Although we could not adjust for unmeasured differences between persons with and without case managers, we believe that such differences would favor clients without case managers. Numerous studies, including ours, indicate that disadvantaged clients and those with greater needs are more likely to seek out or be referred to a case manager (2, 8, 13). These are the same groups that are known to have lower rates of medication use (28–30).

Although the HIV Cost and Services Utilization Study is representative of HIV-infected persons receiving medical care in the United States, our results are not generalizable to HIV-infected persons not in care. A second important limitation of our study is that we relied on self-reports for several key variables, including CD4 cell count. However, previous studies have substantiated the validity of self-reported CD4 cell counts (32).

Because an increasing proportion of HIV-infected persons are living in poverty, needing both supportive services and medical treatment, case managers may be particularly useful allies to clinicians and their patients. Additional studies are needed to determine the most beneficial models of case management and to calculate the cost-effectiveness of this intervention.

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