

Risk Factors Associated With HIV Infection Among Young Gay and Bisexual Men in Canada

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Objective: To assess risk factors associated with HIV prevalence and incidence among gay and bisexual men in two prospective Canadian cohorts.

Methods: The Vanguard Project and the Omega Cohort are prospective cohort studies of gay and bisexual men ongoing in Vancouver and Montreal, respectively. For this analysis, baseline sociodemographic characteristics, sexual behavior, and substance use data from these two cohorts were combined. Assessment of risk factors for HIV seroprevalence and seroconversion were carried out using univariate and multivariate analysis.

Results: This analysis was based on 1373 gay and bisexual men aged 16 to 30 years. Men who were HIV-seropositive at baseline ($n = 48$) were more likely to report living in unstable housing, to have had less than a high school education, and to have been unemployed than those who were HIV-negative ($n = 1325$). HIV-positive men were also more likely to report having engaged in sexual risk behavior, including having had consensual sex at a younger age, having had at least 6 partners during the previous year, ever having been involved in the sex trade, and having engaged in unprotected receptive anal intercourse. With respect to substance use, HIV-positive men were more likely to report the use of crack, cocaine, heroin, and marijuana and to use injection drugs. Similarly, men who seroconverted during the course of the studies ($n = 26$) were more likely to report having less than a high school education and having lived in unstable housing at baseline. Compared with HIV-negative men, men who seroconverted were more likely to report ever having been involved in the sex trade and engaging in unprotected receptive anal intercourse. Reports of cocaine use and injection drug use were also significantly higher for men who seroconverted compared with HIV-negative men.

Conclusions: Our data indicate that HIV-positive gay and bisexual men are more likely to be living in unstable conditions and to report more risky sexual and substance use behaviors than HIV-negative men.

Key Words: HIV/AIDS—Sexual behavior—Gay men—Seroconversion.

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Since the beginning of the HIV epidemic in North America, the majority of HIV infections have occurred among men who engage in sexual relations with other men. As the HIV epidemic enters its third decade, gay and bisexual men continue to have among the highest

rates of HIV infection. Previous studies have highlighted the decline in HIV incidence and risk behavior among gay and bisexual men (1,2). Nevertheless, several recent studies have suggested that young gay and bisexual men continue to engage in unprotected sexual behaviors and are at continued risk of HIV infection (3,4).

Numerous studies have examined risk factors for HIV infection among men who have sex with men (5–7). Important risk factors for HIV infection include marginalization (8,9); sex trade involvement (10,11); substance use, including the use of cocaine (12–14); and unprotected anal intercourse (14–17). Caceres and van Griensven (5) highlighted the facts that these studies have experienced methodologic problems and that risk factor analyses have produced contradictory results. Data on the specific predictors of HIV infection among young gay and bisexual men are also lacking.

This study aimed to assess risk factors for prevalent HIV infection and predictors of HIV seroconversion for men who have sex with men from two prospective cohorts of gay and bisexual men. The current study is of particular interest in that it focuses on young gay and bisexual men, who continue to comprise a large proportion of new HIV infections in North America.

METHODS

The Vanguard Project is a prospective study of more than 850 gay and bisexual men aged 15 to 30 years who live in the Greater Vancouver region. These men are recruited through outreach, clinics, and physicians' offices. To be eligible for this longitudinal study, the participants must have not previously tested positive for HIV and must self-identify as being gay or bisexual or having sex with other men. Since May 1995, Vanguard Project participants have completed a self-administered questionnaire and undergone HIV antibody testing on an annual basis. The questionnaire elicits information on sociodemographic characteristics; sexual behavior, including involvement in the sex trade; and substance use in addition to other psychosocial variables.

The Omega Cohort is similar to the Vanguard Project in that it is a prospective study of over 1400 HIV-negative men who self-identify as being gay or bisexual or having sex with other men. The Omega Cohort recruits men through outreach and publicity as well as through medical clinics and physicians. The minimum age for recruitment in the Omega Cohort is 16 years of age, and there is no maximum age limit. Follow-up procedures for the Omega Cohort consist of semiannual interviews, self-administered questionnaires, and HIV antibody testing.

To assess factors associated with HIV-positive serostatus, we combined the data from the two cohorts and conducted cross-sectional comparative analyses. To ensure comparability between the two cohorts, the age at enrollment was restricted to 16 to 30 years for participants in the Omega Cohort. There are currently no Vanguard Project participants younger than 16 years of age; thus, we were able to match the age of Vanguard Project subjects with that of Omega Cohort subjects. There were 770 eligible men from the Vanguard Project and 603 from the Omega Cohort. Seven hundred thirty-six (56%) of the HIV-negative men were participants in the Vanguard Project, with the remainder (44%) being participants in the Omega Cohort. Of the 48 men

who were HIV prevalent, 34 (71%) were participants in the Vanguard Project and 14 (29%) were from the Omega Cohort. We also examined baseline predictors of HIV seroconversion. Over the course of the respective study periods, 26 men seroconverted: 18 (69%) from the Vanguard Project and 8 (31%) from the Omega Cohort.

Variables of interest in these analyses included sociodemographic characteristics such as age, ethnicity, income, housing status, and education; sexual experiences such as age at first consensual sex, number of sexual partners during the previous 6 months or 1 year, ever having been paid for sex, and occurrences of unprotected insertive and receptive anal intercourse as well as substance use. For this analysis, unstable housing was defined as living in a hotel, boarding house, group home, or on the street or having no fixed address.

The time frame of the questions in the two cohorts was different. The Vanguard Project refers to situations that may have occurred ever or during the year before baseline. The Omega Cohort uses the 6 months before baseline as the reference period for some of the questions and lifetime for others. Whenever possible, we attempted to match the time frames for given questions; however, because of the lack of subsequent follow-up data for the seroprevalent men in the Omega Cohort, the reference time periods for the two groups may differ by 6 months for certain questions. A further data-related consideration was the difference in data collection methods employed by the two cohorts. Despite the fact that the Omega Cohort used both interviewer-administered and self-administered questionnaires, all but two pieces of data (date of birth and age of first consensual sex) were obtained through self-administered questionnaires.

Statistical Methods

Categorical variables were compared for the two groups using the Pearson χ^2 test. Contingency tables that contained one or more expected counts of <5 were analyzed by the Fisher exact test. Comparisons of continuous variables were carried out using the Wilcoxon rank sum test. All variables that were significant in the univariate analysis were made available for stepwise multivariate logistic regression. Multivariate logistic regression analyses were used to identify independent baseline factors associated with HIV-positive serostatus and HIV seroconversion. Multivariate logistic regression analyses were restricted to men reporting anal receptive intercourse during the 6 months to 1 year before baseline to assess the relation between condom use for receptive anal sex and HIV-positive serostatus. All probability values are two-sided.

RESULTS

Risk Factors for Baseline HIV-Positive Serostatus

There were 1373 gay and bisexual men between the ages of 16 and 30 years (770 from the Vanguard Project and 603 from Omega Cohort) who had completed a baseline questionnaire and HIV antibody test. Comparison of sociodemographic characteristics of HIV-negative men and men who were HIV-positive at baseline revealed no significant differences with respect to age, aboriginal status, or having a low income level (Table 1). HIV-positive men were more likely to report living in unstable housing (19% vs. 6%; $p < .002$) compared with HIV-negative men. Compared with HIV-negative men,

TABLE 1. Comparison of sociodemographic characteristics of HIV-positive and HIV-negative gay and bisexual men at baseline

	HIV-negative <i>n</i> = 1325 ^a <i>n</i> (%)	HIV-positive <i>n</i> = 48 ^a <i>n</i> (%)	<i>p</i> value
Age (in years)			
Median (IQR)	25 (22–28)	25 (22–28)	.992
Aboriginal			
Yes	73 (6)	5 (11)	.204
No	1124 (94)	41 (89)	
Unstable housing			
Yes	79 (6)	9 (19)	.002
No	1228 (94)	38 (81)	
Less than high school education			
Yes	150 (12)	16 (34)	<.001
No	1148 (88)	31 (66)	
Income <\$10,000 per year			
Yes	451 (37)	12 (29)	.272
No	772 (63)	30 (71)	
Employed			
Yes	953 (73)	27 (57)	.016
No	345 (27)	20 (43)	

^a Sum total is not equal to total because of missing values. IQR, interquartile range.

HIV-positive men were also more likely to report having completed less than a high school education (34% vs. 12%; $p < .001$) and being unemployed at the baseline visit (43% vs. 27%; $p = .016$).

Table 2 outlines baseline sexual behavior of HIV-negative men compared with men who tested HIV-positive. Men who were HIV-positive were significantly more likely to report being younger at their first consensual sexual experience (median: 15 years vs. 17 years;

$p = .002$). HIV-positive men were also significantly more likely to have had 6 or more sexual partners during the previous 6 months or 1 year (65% vs. 49%; $p = .028$), to have ever been involved in the sex trade (51% vs. 25%; $p < .001$), and to have engaged in unprotected receptive anal intercourse during the previous 6 months or 1 year (56% vs. 40%; $p = .035$). HIV-positive men were also more likely to report having engaged in unprotected sex outside their province of residence and to have engaged in unprotected insertive anal intercourse, although these differences were not statistically significant.

Comparison of reported substance use revealed no significant differences between the two groups with respect to the use of nitrite inhalants (“poppers”) or acid (Table 3). HIV-positive men were significantly more likely to report ever having used crack (17% vs. 5%; $p < .003$), cocaine (58% vs. 30%; $p < .001$), heroin (15% vs. 6%; $p = .019$), and marijuana (80% vs. 65%; $p = .032$). With respect to injection drug use, men with a positive HIV test result were also more likely to report having ever used injection drugs (26% vs. 7%; $p < .001$).

Multivariate logistic regression analysis was used to assess risk factors associated with HIV-positive serostatus (Table 4). For all men, having less than a high school education, history of cocaine use, and having ever been involved in the sex trade were independently associated with HIV-positive serostatus. We also examined men who reported engaging in receptive anal intercourse to determine if unprotected anal sex was associated with HIV-positive serostatus. Only two factors, history of co-

TABLE 2. Comparison of sexual behaviors for HIV-positive and HIV-negative gay and bisexual men at baseline

	HIV-negative <i>n</i> = 1325 ^a <i>n</i> (%)	HIV-positive <i>n</i> = 48 ^a <i>n</i> (%)	<i>p</i> value
Age at first consensual sex			
Median (IQR)	17 (14–20)	15 (13–18)	.002
Number of partners (previous year or 6 months)			
0–5	630 (51)	30 (35)	.028
6 or more	662 (49)	16 (65)	
Unprotected sex outside the province			
Yes	317 (27)	16 (37)	.162
No	837 (73)	27 (63)	
Ever involved in sex trade			
Yes	320 (25)	24 (51)	.001
No	983 (75)	23 (49)	
Unprotected anal insertive intercourse			
Yes	455 (41)	21 (49)	.315
No	651 (59)	22 (51)	
Unprotected anal receptive intercourse			
Yes	438 (40)	24 (56)	.035
No	664 (60)	19 (44)	

^a Sum total is not equal to total due to missing values. IQR, interquartile range.

TABLE 3. Comparison of substance use for HIV-negative and HIV-positive gay and bisexual men at baseline

	HIV-negative <i>n</i> = 1325 ^a <i>n</i> (%)	HIV-positive <i>n</i> = 48 ^a <i>n</i> (%)	<i>p</i> value
Poppers			
Yes	331 (26)	16 (35)	.169
No	956 (74)	30 (65)	
Crack			
Yes	65 (5)	8 (17)	<.003
No	1220 (95)	38 (83)	
Acid			
Yes	253 (20)	13 (28)	.151
No	1034 (80)	33 (72)	
Cocaine			
Yes	387 (30)	26 (58)	<.001
No	907 (70)	19 (42)	
Heroin			
Yes	73 (6)	7 (15)	.019
No	1214 (94)	40 (85)	
Marijuana			
Yes	845 (65)	37 (80)	.032
No	452 (35)	9 (20)	
Injection drug use			
Yes	88 (7)	12 (26)	<.001
No	1212 (93)	35 (74)	

^a Sum total is not equal to total due to missing values

caine use and having ever been involved in the sex trade, were found to be independently associated with HIV prevalence.

Predictors of Seroconversion

Comparative analyses of baseline variables of HIV-negative men (*n* = 1325) and men who were HIV-negative at baseline and subsequently seroconverted (*n* = 26) were conducted (Table 5). Comparison of sociodemographic variables revealed that men who seroconverted were significantly more likely to report having less than a high school education (27% vs. 12%; *p* = .027) and to have been living in unstable housing at baseline (19% vs. 6%; *p* = .020). There were no significant differences between the two groups with respect to baseline age, aboriginal status, having a low income, or being unemployed (data not shown).

Men who seroconverted were of similar age to HIV-negative men at their first consensual sexual experience. Similar proportions of the two groups reported having had at least 5 sexual partners during the previous 6 months or 1 year. Men who seroconverted were more likely to report ever having been involved in the sex trade (50% vs. 25%; *p* = .003) and having engaged in unprotected receptive anal intercourse during the 6 months to 1 year before baseline (60% vs. 40%;

p = .041), however. Although not statistically significant, men who seroconverted were also more likely to report ever engaging in unprotected sex outside their province of residence (44% vs. 27%; *p* = .068).

With respect to substance use, only reported history of cocaine use was significantly different between the two groups, with 54% of seroconverters reporting ever using cocaine compared with 30% of HIV-negative men (*p* = .009). Further, men who seroconverted were significantly more likely to report having ever injected drugs (19%) compared with HIV-negative men (7%) (*p* = .031).

After adjusting for cohort, analysis of baseline predictors of seroconversion revealed that for all men, having ever been involved in the sex trade was associated with a threefold increase in the odds of seroconversion (odds ratio [OR] = 3.08, 95% confidence interval [CI]: 1.41–6.73). Among men reporting receptive anal intercourse, living in unstable housing (OR = 4.26, CI: 1.48–12.29) and unprotected receptive anal intercourse (OR = 2.35, CI: 1.04–5.30) were found to be predictive of HIV seroconversion.

Subanalyses

To ensure comparability of the two cohorts, the univariate analysis was stratified by cohort (Vanguard Project vs. Omega Cohort). With respect to the comparison of seroprevalent and seronegative men, the trends were the same for the men from both cohorts for all variables with the exceptions of the use of crack (for Vanguard Project, OR = 3.21, CI: 1.39–7.39; for Omega Cohort, no crack use), having unprotected receptive anal intercourse (for Vanguard Project, OR = 2.41, CI: 1.18–4.93; for Omega Cohort, OR = 0.96, CI: 0.27–3.46), and having had at least 6 partners during the previous 6 months (for Vanguard Project, OR = 2.52, CI: 1.16–5.50; for Omega Cohort,

TABLE 4. Multivariate logistic regression models: risk factors associated with baseline HIV-positive serostatus for all men (*n* = 1373) and men who reported anal receptive intercourse (*n* = 1145), adjusted for cohort

	Adjusted odds ratio	95% confidence interval
Model 1: all men		
Cocaine use	2.23	1.14–4.35
Less than a high school education	2.15	1.06–4.41
Ever involved in sex trade	2.05	1.05–4.00
Model 2: men reporting engaging in anal receptive intercourse		
Ever involved in sex trade	2.49	1.26–4.93
Cocaine use	2.31	1.16–4.58

TABLE 5. Comparison of sociodemographic, sexual, and substance use behavior for HIV-negative and HIV-seroconverted gay and bisexual men

	HIV-negative <i>n</i> = 1325 ^a <i>n</i> (%)	HIV-positive <i>n</i> = 26 ^a <i>n</i> (%)	<i>p</i> value
Demographics			
Less than a high school education			
Yes	150 (12)	7 (27)	.027
No	1148 (88)	19 (73)	
Unstable housing			
Yes	79 (6)	5 (19)	.020
No	1228 (94)	21 (81)	
Sexual behavior			
Ever involved in sex trade			
Yes	320 (25)	13 (50)	.003
No	983 (75)	13 (50)	
Unprotected anal receptive intercourse			
Yes	438 (40)	15 (60)	.041
No	664 (60)	10 (40)	
Substance use			
Cocaine			
Yes	387 (30)	14 (54)	.009
No	907 (70)	12 (46)	
Injection drug use			
Yes	88 (7)	5 (19)	.031
No	1212 (93)	21 (81)	

^a Sum total is not equal to total because of missing values.

OR = 1.03, CI: 0.34–3.09). Comparison of HIV-negative men and those men who seroconverted in the two cohorts revealed trends similar to the combined results for all variables with the exception of unprotected receptive anal intercourse at baseline (for Vanguard Project, OR = 3.13, CI: 1.16–8.46; for Omega Cohort, OR = 1.08, CI: 0.24–4.90). Two-way interactions between the independent variables and the cohort variable were examined in the multivariate analyses. No significant interactions were detected ($p < .15$).

As a further subanalysis, men who reported a history of injection drug use were excluded so as to explore sexual transmission of HIV among young gay and bisexual men. Thus, 142 and 41 men who reported a history of injection drug use were excluded from the seroprevalence and seroconversion analyses, respectively. Examination of sociodemographic variables for HIV-positive and HIV-negative men revealed that living in unstable housing (11% vs. 3%; $p = .036$) was significantly associated with HIV prevalence. With respect to sexual behavior, HIV-positive men were found to report a significantly younger age at their first consensual sexual encounter (16 years vs. 17 years; $p = .024$). Forty percent of HIV-positive men reported ever having been involved in the sex trade compared with 21% of HIV-negative men ($p = .009$). Several differences were found between HIV-positive and HIV-negative men with respect to the use of drugs, including poppers (40% vs. 25%; $p = .049$), cocaine

(44% vs. 26%; $p = .017$), and marijuana (80% vs. 64%; $p = .048$). Comparison of HIV-negative men and men who seroconverted revealed significant sexual behavior differences for unprotected sex outside the province of residence (48% vs. 27%; $p = .047$) and having ever been paid for sex (43% vs. 21%; $p = .030$). There were no other significant differences found between the two groups.

DISCUSSION

HIV Prevalence

The results of this study confirm many of the previously suggested risk factors for HIV infection. Among the sociodemographic variables examined, a marginalized lifestyle characterized by a low level of education, unstable housing, and unemployment was associated with an elevated risk of prevalent HIV infection. Several sexual risk behaviors, including younger age at initiation into sexual behavior, higher numbers of recent sexual partners, a history of involvement in the sex trade, and engagement in unprotected receptive anal intercourse, were identified for men who were HIV-positive at baseline. Substance use, particularly the use of crack, cocaine, heroin, and marijuana, was found to be associated with HIV-positive prevalence. HIV-positive men were also more likely to report having ever injected drugs.

Multivariate analysis of risk factors associated with baseline seroprevalence revealed low education to be an independent risk factor. This finding supports the results of studies by Osmond et al. (8) and Ruiz et al. (9), both of whom found a high level of education to be inversely associated with HIV prevalence. Level of education may be a surrogate marker for lifestyle stability in that persons with higher levels of education may lead more stable lives and thereby be less inclined to engage in behaviors that put them at increased risk of HIV. Involvement in the sex trade was also identified as an independent risk factor for HIV-positive serostatus. Several studies have shown that working in the sex trade increases the risk of HIV infection (10,11). The high number of sexual partners and the potential for unprotected sexual behavior in exchange for money may substantially increase the risk of HIV transmission. Lifetime history of cocaine use was found to be independently associated with HIV prevalence. The relation between cocaine use and HIV prevalence may have two possible explanations. First, the use of drugs, including cocaine, has been associated with unprotected sex, thereby increasing the possibility of HIV infection. Second, cocaine is often administered through a syringe, and injection drug use is a known risk factor for HIV. Injection drug use was found to be significant in univariate analysis but was not found to be an independent risk factor for HIV prevalence.

Among men reporting having engaged in anal receptive intercourse in the previous year, use of cocaine and having ever been involved in the sex trade were found to be independently associated with HIV prevalence. As stated previously, use of cocaine may increase the risk of HIV infection by leading to a decrease in protective behaviors. Cocaine has been shown to be one of the most important predictors of unsafe sex or seroconversion for gay and bisexual men (12–14). Additionally, the biologic interaction model suggests that during unprotected anal receptive intercourse, certain drugs, especially cocaine and poppers, increase the number of physical pathways for HIV infection by relaxing the anal sphincter and triggering vasodilatation (13). Men involved in the sex trade may be more likely to engage in anal sex because of the financial incentive, thereby increasing their risk of HIV infection. There may be potential for greater financial gain by engaging in unprotected sex, increasing the risk of HIV infection.

HIV Incidence

Many previous studies have focused on risk factors for HIV prevalence (4,6–9,18). As much as these analyses

provide information that is useful to identify associations, we believed it was also important to examine risk factors associated with seroincidence in an attempt to investigate more causative relations. Evaluation of sociodemographic variables revealed that a marginalized lifestyle characterized by low education and unstable housing was associated with HIV seroconversion. Most seroconverting men reported risky sexual behavior, in particular, having ever been involved in the sex trade and engaging in unprotected anal receptive intercourse during the year before baseline. Lifetime use of cocaine and injection drugs was also found to be reported by a significantly higher proportion of men who seroconverted compared with HIV-negative men.

Multivariate analysis of baseline predictors of HIV seroconversion revealed involvement in the sex trade to be an independent predictor of seroconversion. Male prostitutes often engage in identified risk behaviors, including multiple partners and engaging in activities that place them at high risk for HIV infection (19). Men who are involved in the sex trade also frequently engage in injection drug use, which puts them at increased risk of HIV seroconversion. Among men who reported engaging in anal receptive intercourse during the year before their baseline visit, unstable housing was found to be an independent predictor of HIV seroconversion. Homelessness has been recognized in the United States and elsewhere as an important public health concern. Street-involved individuals, particularly youth, may engage in behaviors that put them at an elevated risk of HIV infection and transmission (20–22).

Unprotected anal intercourse, particularly receptive anal intercourse, has long been identified as an important route of transmission for HIV. In this analysis, unprotected receptive anal sex was found to be an independent predictor of HIV seroconversion. This finding is corroborated by many other epidemiologic studies (14–17,23). Despite widespread dissemination of information regarding the risk of HIV transmission through unprotected sex, young gay and bisexual men continue to engage in high-risk sexual behavior. Among our sample, 40% of men who were HIV-negative at the time of this study reported engaging in unprotected receptive anal intercourse. It is important, however, to note that the type of partnership between men was not accounted for in this analysis. As reported by Alary et al. (24), the odds of seroconversion for men who reported unprotected anal sex with a regular HIV-negative partner was 0.4, whereas the odds of seroconversion for any other partner whether regular or casual was 7.8. These findings highlight the importance of careful definition of unsafe sex among gay and bisexual men.

As is the case with many population-based studies, this is a sample of convenience. Thus, our sample may not be representative of the general population of gay and bisexual men. Further, the inclusion criteria stipulate that men have not previously tested HIV-positive; thus, the population, particularly for the seroprevalence analysis, is likely not representative of gay and bisexual men in general. A second limitation of this study is the small number of men who seroconverted. The small number may have resulted in a decreased power to detect other predictors of seroconversion in this population. In this study, we combined data from two cohort studies to examine risk factors for HIV-positive serostatus. As with any study of this nature, there are limitations. There were particular questions, for example, those relating to oral sex, that could not be combined because of differences in the manner in which the data were collected. Thus, there were potential risk factors that were not investigated in this study. The time frame for some questions also differed between the two cohorts. For example, one cohort inquired about a given activity during the previous year, although the other asked about that activity during an individual's lifetime. The issue of temporality must be considered in the interpretation of the multivariate analysis of the seroprevalence data.

Further analysis of risk factors for seroconversion may provide a better idea of important causal risk factors for HIV infection among young gay and bisexual men. For the purpose of this analysis, however, baseline predictors were used as a proxy for behaviors that may have occurred just before the time of seroconversion. We believe that the use of baseline variables as predictors of seroconversion in this data set was appropriate to limit the effect of learning associated with participation in a cohort study. Because data from two different studies were combined, there was no way to control for the effect of cohort participation (i.e., changes of responses over time as a result of cohort participation and the effect of prevention counseling), which may differ between the two studies. By using data from the baseline visit, the effect of participation and learning was minimized. Further, analysis of changing risk behavior over time for the two cohorts indicated no significant change over the course of follow-up. Thus, we believe that baseline data were a fair proxy for later behavior.

In summary, this study supports previous research findings as to the risk factors associated with HIV infection. Despite many years of intervention programs targeted at the gay community, young gay and bisexual men continue to engage in behaviors that put them at risk for HIV infection. Innovative HIV prevention campaigns are

necessary to reduce the spread of this disease in at-risk populations.

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