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Original Research

Frequent methamphetamine injection predicts emergency department utilization among street-involved youth

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SUMMARY

Objectives: Methamphetamine (MA) use has been associated with health problems that commonly present in the emergency department (ED). This study sought to determine whether frequent MA injection was a risk factor for ED utilization among street-involved youth.

Study design: Prospective cohort study.

Methods: Data were derived from a street-involved youth cohort known as the 'At Risk Youth Study'. Behavioural data including MA use were linked to ED records at a major inner-city hospital. Kaplan-Meier and Cox proportional hazards methods were used to determine the risk factors for ED utilization.

Results: Between September 2005 and January 2007, 427 eligible participants were enrolled, among whom the median age was 21 (interquartile range 19–23) years and 154 (36.1%) were female. Within 1 year, 163 (38.2%) visited the ED, resulting in an incidence density of 53.7 per 100 person-years. ED utilization was significantly higher among frequent (i.e. ≥daily) MA injectors (log-rank $P = 0.004$). In multivariate analysis, frequent MA injection was associated with an increased hazard of ED utilization (adjusted hazard ratio = 1.84, 95% confidence interval 1.04–3.25; $P = 0.036$).

Conclusions: Street-involved youth who frequently inject MA appear to be at increased risk of ED utilization. The integration of MA-specific addiction treatment services within emergency care settings for high-risk youth is recommended.

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Introduction

Homeless and street-involved youth experience many health problems and face a variety of structural and social barriers while seeking appropriate care to address them.[1] Among the most common health concerns identified by street-involved youth are pregnancy and sexually transmitted infections, depression and other mental health concerns, dental problems, acute trauma and injuries, and substance-related disorders.[2,3] Youth who are homeless (as opposed to those who are sheltered or unstable housed) are often uninsured and have unmet health needs;[4] furthermore, longer durations of homelessness tend to exacerbate underlying health conditions.[5] Street-involved youth who manage to access care tend to over-rely on emergency departments (EDs) as opposed to ambulatory clinics and other primary healthcare services.[2] One study, consisting of a nationally representative sample of sheltered and street-based youth in the USA, found that approximately one-third had been treated in an ED in the previous year.[6]

Methamphetamine (MA) use is a continuing public health concern in many urban settings due to large increases in its production, trafficking and consumption over the past decade.[7] The increasing use of MA among street-involved youth has been noted in numerous settings.[8,9] Preliminary studies have also demonstrated that adult MA users utilize EDs and other hospital resources more frequently than other drug-using populations.[10,11] Although few studies have examined MA use among street-involved youth, its consumption has been shown to be associated with deteriorating physical and mental health, and an increased risk of bloodborne disease acquisition.[8,12,13] Given the preliminary evidence indicating that MA use may exacerbate health problems experienced by street youth, this study sought to determine whether frequent MA injection was an independent risk factor for ED utilization among a prospective cohort of street-involved youth in a setting with universal access to healthcare. The study also sought to examine the reasons for ED admissions among street-involved youth who inject MA.

Methods

The At Risk Youth Study (ARYS) is an open prospective cohort of homeless and street-involved youth in Vancouver, Canada. Detailed sampling and recruitment procedures for this cohort have been described elsewhere.[14] In brief, participants were enrolled through self-referral, word of mouth and street outreach. Eligibility criteria included residing in the Greater Vancouver region, being between 14 and 26 years of age, and the self-reported use of illicit drugs other than or in addition to marijuana in the past 30 days. For this analysis, the sample was restricted to individuals <24 years of age in order to be consistent with prior studies that have assessed homeless youths' access to emergency health services and primary care.[6,15] All ARYS participants between 14 and 24 years of age who completed a baseline survey between September 2005 and January 2007 were eligible for inclusion in this analysis.

At baseline, ARYS participants completed a detailed interviewer-administered questionnaire, eliciting information pertaining to sociodemographic characteristics, drug use patterns, risk behaviours and health outcomes. Nurses provided basic medical care and referrals to appropriate healthcare services. Participants received $20 for each study visit.

The primary endpoint for this study was time to first ED visit at St. Paul's Hospital (SPH), a major inner-city teaching hospital located in downtown Vancouver. SPH is the primary hospital for the street-involved and drug-using population in the city.[10] With appropriate consent, a confidential linkage to the SPH ED health records database was conducted to ascertain the exact date of the first ED visit following enrolment into the ARYS cohort. The linkage was performed using participants' personal health numbers (PHN), obtained at the time of study enrolment. In British Columbia, a PHN is provided to all residents and serves as a unique lifetime identifier used to access medical and healthcare services in the province. Participants who did not provide a valid PHN (<5% of the sample) were linked by sex, date of birth and surname. The SPH ED database contains information regarding the primary presenting diagnosis, including internal ED codes (e.g. ID = infectious disease, GI = gastrointestinal disorder) and string data describing the reason for the ED visit. These data were manually sorted and categorized by the primary author (BDLM) based on an *a priori* defined list of common ED presentations that have been described and published elsewhere.[10] Each classification was then reviewed independently by a second author (JAB) until all diagnoses were appropriately categorized. The most common classifications among daily MA injectors and non-injectors were then compared using Fisher's exact test. The SPH ED database also includes data regarding the time and day of ED utilization; this information was categorized to represent visits that took place during standard business hours (i.e. Monday to Friday between 9:00am and 5:00pm) compared with those in the evenings, nights and at weekends. Finally, in order to determine what proportion of visits led to hospital admission, the authors analysed discharge data, which included whether the individual was transferred to acute care, discharged with approval, or discharged without service or against advice.

The primary independent variable was self-reported MA injection in the past 6 months, defined as a categorical variable with the following levels: no MA injection, less than daily (i.e. infrequent) MA injection, and at least daily (i.e. frequent) MA injection. The following sociodemographic covariates were examined as potential confounders in the association between MA injection and ED utilization: age (per year older), years of illicit drug use (per year), sex (female vs male) and Aboriginal ancestry (yes vs no). Aboriginal ancestry was defined as all participants who self-identified as First Nations, Inuit, Métis or Aboriginal. Homelessness (yes vs no), crack use (yes vs no), heavy alcohol use [defined as consuming on average ≥four drinks/day (yes vs no)], frequent cocaine injection (≥daily vs <daily), frequent heroin injection (≥daily vs <daily), non-fatal overdose (yes vs no), engagement in sex work (yes vs no), enrolment in addiction treatment (yes vs no) and recent suicide attempt (yes vs no) were also assessed as potential confounders. Adjustment was also made for

depressive symptomatology based on a cut-off of ≥22 on the 20-item Center for Epidemiologic Studies Depression (CES-D) scale. The CES-D scale is a validated instrument for measuring depressive symptoms, and has been found to be reliable among samples of adolescents.[16] A cut-off of ≥22 has been used previously as a specific and sensitive measure of depressive symptomatology among adolescents.[16] Unless otherwise indicated, all variables refer to behaviours or activities in the 6 months prior to the date of the baseline interview.

To determine the cumulative incidence of ED utilization over the study period, the Kaplan-Meier method was used to generate the survival function of frequent MA injectors, non-frequent MA injectors and non-MA injectors. The log-rank test was used to compare the survival distributions of the three groups. Cox proportional hazards models were constructed to estimate the associations between each variable and the outcome of interest. As the primary objective of this analysis was to determine the independent association between MA injection and ED utilization, a series of confounding models were fit based on an approach described by Maldonado and Greenland.[17] First, bivariate screenings based on a conservative *P*-value of <0.20 were conducted. The variable 'years of drug use' was excluded from this procedure as it was found to be collinear with age ($r = 0.60$). All other covariates that achieved this cut-off were included in a 'full' multivariate model. Starting with this model, variables that did not alter the coefficient of the primary explanatory variable by >10% were removed in a sequential fashion. Since baseline MA injection was a categorical variable with two levels, covariates were considered significant if their removal from the 'full' model altered one or both coefficients by >10%.

As a final confirmatory subanalysis, the mean number of visits over the study period among frequent MA injectors, non-frequent MA injectors and non-MA injectors were compared using analysis of variance. All statistical analyses were conducted using SAS Version 9.1.3 (SAS Institute Inc., Cary, NC, USA), and all *P*-values are two-sided.

Results

Between September 2005 and January 2007, 427 eligible individuals were enrolled in the ARYS cohort. The median age of the sample was 20.9 (interquartile range 19.1–22.5) years, 154 (36.1%) were female, and 81 (19.0%) were of Aboriginal ancestry. In total, 211 (49.4%) reported using MA in the past 6 months, among whom 65 (30.8%) reported MA injection. One-third ($n = 22$, 33.8%) of MA injectors reported doing so at least daily. The majority ($n = 50$, 76.9%) of MA injectors also reported using MA through other modes of consumption (e.g. snorting, smoking) at least once in the past 6 months. Other baseline sociodemographic characteristics and MA use patterns are shown in Table 1. No deaths or human immunodeficiency virus (HIV) seroconversions were observed during the study period.

Among the 427 participants, 163 (38.2%) visited the ED at least once within the year following the date of their baseline interview. Approximately three-quarters of these visits ($n = 122$, 74.9%) occurred outside of regular business hours.

Table 1 – Baseline sociodemographic characteristics and methamphetamine (MA) use among a cohort of street-involved youth ($n = 427$).

Characteristic	
Age (median, IQR)	20.9 (19.1–22.5)
Years of illicit drug use (median, IQR)	6.4 (4.3–8.6)
Sex, *n* (%)	
Female	154 (36.1)
Male	273 (63.9)
Ethnicity, *n* (%)	
Aboriginal	81 (19.0)
Other	346 (81.0)
Homeless[a], *n* (%)	
Yes	335 (78.5)
No	92 (21.5)
Non-injection MA use[a], *n* (%)	
None	238 (55.7)
<Daily	139 (32.6)
≥Daily	50 (11.7)
Injection MA use[a], *n* (%)	
None	362 (84.8)
<Daily	43 (10.1)
≥Daily	22 (5.1)

IQR, interquartile range.
a Activities in the 6 months prior to the baseline interview.

The vast majority ($n = 132$, 81.0%) of visits resulted in discharge with approval, six (3.7%) resulted in discharge against advice and six (3.7%) led to admittance. Notably, 18 (11.0%) visits resulted in discharge without service.

The incidence density of ED utilization was 53.7 [95% confidence interval (CI) 45.9–62.5] per 100 person-years. In a Kaplan-Meier analysis stratified by baseline MA injection frequency (see Fig. 1), significant differences were observed in the survival distributions between the groups (log-rank $P = 0.004$). Among participants reporting daily or greater MA injection, the cumulative incidence of ED utilization was 68%, approximately twice that of non-daily MA injectors (35%) and non-MA injectors (37%), respectively.

In bivariate Cox regression analyses, MA injection was significantly associated with time to first ED visit (type III $P = 0.006$). Although the hazard of ED utilization among non-daily MA injectors was similar to that of non-MA injectors [unadjusted hazard ratio (HR) = 1.00, 95% CI 0.89–1.71; $P = 0.999$], frequent MA injectors were at a significantly increased risk of an ED visit during the study period (HR = 2.39, 95% CI 1.40–4.08; $P = 0.001$). Other factors associated with time to first ED utilization are shown in Table 2. Frequent MA use through non-injection routes of consumption (i.e. smoking or snorting) was not associated with ED utilization (HR = 1.37, 95% CI 0.87–2.17; $P = 0.177$).

In a multivariate model adjusting for other variables observed to confound the relationship between MA injection and time to first ED visit, frequent MA injection remained associated with an elevated hazard of ED utilization [adjusted hazard ratio (AHR) = 1.84, 95% CI 1.04–3.25; $P = 0.036$). Older age (AHR = 1.09/year, 95% CI 1.01–1.17; $P = 0.026$) was also significant in the final confounding model (see Table 2).

The most common presenting diagnoses at first ED visit among study participants are presented in Table 3. Among

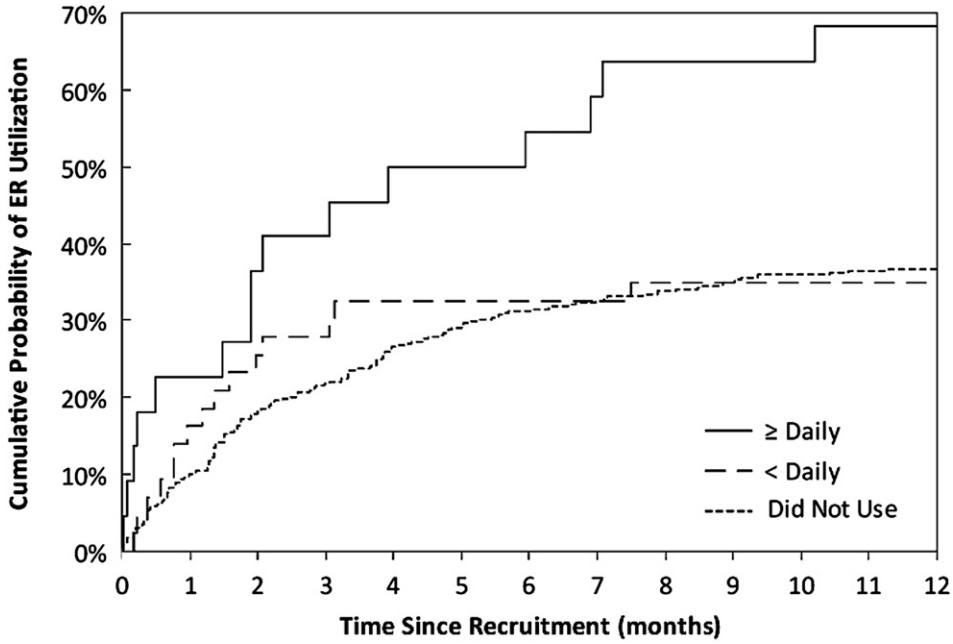

Fig. 1 – Time to emergency department (ER) utilization among a cohort of street-involved youth, stratified by baseline injection of methamphetamine ($n = 427$). Log-rank P-value = 0.004.

non-MA injectors, the most common types of diagnoses included: musculoskeletal injuries; abscesses, cellulitis and other skin infections; and psychiatric disorders. Abscesses, cellulitis and other skin infections were also most common among non-daily MA injectors. The most common ED presentations among daily MA injectors were those related to substance misuse. These presentations were significantly more common among those who reported injecting MA at least daily compared with the non-MA injecting group (Fisher's exact test $P = 0.020$).

Table 2 – Factors associated with time to emergency department utilization among a cohort of street-involved youth ($n = 427$).

Characteristic	Unadjusted HR (95% CI)	P-value	Adjusted HR (95% CI)	P-value
Injection MA use[a] (ref: none)				
Infrequent (<daily)	1.00 (0.89–1.71)	0.999	0.83 (0.47–1.44)	0.498
Frequent (≥daily)	2.39 (1.40–4.08)	0.001	1.84 (1.04–3.25)	0.036
Sociodemographic characteristics				
Age (per year older)	1.11 (1.03–1.19)	0.006	1.09 (1.01–1.18)	0.026
Years of illicit drug use (per year)	1.04 (1.00–1.09)	0.087		
Sex (female vs male)	0.86 (0.62–1.20)	0.373		
Ethnicity (Aboriginal vs other)	1.05 (0.71–1.54)	0.821		
Homeless[a] (yes vs no)	1.12 (0.77–1.64)	0.556		
Other drug use variables				
Crack use[a] (yes vs no)	1.24 (0.91–1.70)	0.170		
Heavy alcohol use[a] (yes vs no)	0.72 (0.53–0.99)	0.040	0.78 (0.57–1.08)	0.141
Cocaine injection[a] (≥daily vs <daily)	2.73 (0.68–11.00)	0.159	2.77 (0.66–11.59)	0.164
Heroin injection[a] (≥daily vs <daily)	1.21 (0.70–2.09)	0.501		
Overdose[a] (yes vs no)	0.85 (0.51–1.40)	0.516		
Other variables				
Sex work[a] (yes vs no)	1.69 (1.10–2.59)	0.016	1.47 (0.94–2.30)	0.089
Addiction treatment[a] (yes vs no)	1.05 (0.74–1.49)	0.799		
Depression (CES-D score ≥22 vs <22)	0.87 (0.63–1.19)	0.380		
Attempted suicide[a] (yes vs no)	1.24 (0.76–2.02)	0.390		

MA, methamphetamine; CES-D, Center for Epidemiologic Studies Depression; HR, hazard ratio; CI, confidence interval.
a Activities in the past 6 months.

Table 3 – Primary reasons for visiting the emergency department among a cohort of street-involved youth, stratified by baseline injection of methamphetamine (MA)[a] ($n = 163$).

Characteristic	No MA use[a] ($n = 133$) N (%)	<Daily MA use[a] ($n = 15$) N (%)	≥Daily MA use[a] ($n = 15$) N (%)
Musculoskeletal injuries	21 (15.8)	1 (6.7)	1 (6.7)
Abscesses, cellulitis and other skin infections	16 (12.0)	4 (26.7)	1 (6.7)
Psychiatric disorders	16 (12.0)	2 (13.3)	2 (13.3)
Gastrointestinal and urological disorders	14 (10.5)	2 (13.3)	1 (6.7)
Wounds, lacerations and contusions	8 (6.0)	0 (0.0)	0 (0.0)
Cardiac and circulatory system diseases	7 (5.3)	0 (0.0)	0 (0.0)
Dental pain	7 (5.3)	2 (13.3)	0 (0.0)
Substance dependence, misuse and overdose	6 (4.5)	1 (6.7)	4 (26.7)[b]
Neurological disorders, seizures and headaches	6 (4.5)	0 (0.0)	1 (6.7)
Medication refills and aftercare	6 (4.5)	1 (6.7)	0 (0.0)
Respiratory infections and disorders	5 (3.8)	1 (6.7)	2 (13.3)
Miscellaneous bacterial and viral infections	4 (3.0)	0 (0.0)	1 (6.7)
Trauma (blunt or penetrating)	4 (3.0)	0 (0.0)	0 (0.0)
Fractures and dislocations	1 (0.8)	0 (0.0)	0 (0.0)
Other	12 (9.0)	1 (6.7)	2 (13.3)

a Activities in the past 6 months.
b Significantly more common among ≥daily MA injectors compared with non-MA injectors (Fisher's exact test $P = 0.020$).

In a subanalysis examining ED utilization over the one-year study period, 163 participants were found to contribute 599 unique visits. The majority ($n = 508$, 84.8%) of vists led to discharge with approval, while only 21 (3.5%) led to admission. Results of an analysis of variance comparing the mean number of annual visits among frequent, non-frequent and non-MA injectors demonstrated significant heterogeneity between the groups (F-test $P = 0.018$). The mean number of ED visits was greatest among frequent MA injectors [mean = 3.1, standard error (SE) = 0.69] compared with only 1.9 (SE = 0.50) and 1.2 (SE = 0.17) among non-frequent and non-MA injectors, respectively.

Discussion

This study found a significantly increased risk of ED utilization among street-involved youth who reported frequent MA injection. Within 1 year of enrolment into the ARYS cohort, the cumulative incidence of ED utilization among frequent MA injectors was approximately 70%, compared with only 35% among occasional MA injectors and non-MA injectors. Furthermore, in a confirmatory subanalysis, a dose–response relationship was found to exist between the mean number of annual ED visits and the frequency of MA injection. The most common ED presentations among frequent users of MA were those related to substance dependence, misuse or overdose, followed by psychiatric disorder diagnoses. These findings support recent research indicating that substance-related conditions, including those related to MA use, are significant contributors of ED utilization in North America, and that acute injuries, overdose and psychiatric problems are the most common presentations among substance users.[18,19] This study may inform public health interventions that more effectively reduce the negative health consequences of frequent MA use, and improve access to appropriate health services for street-involved youth who require care.

The finding that frequent MA injectors are more likely to visit the ED for substance-related disorders has important implications for interventions that seek to improve the health of this population. The utilization of emergent care for substance dependence and misuse may indicate that youth are unable to access other forms of treatment modalities; an absence of treatment programmes for MA-dependent youth has been observed previously in the study setting.[20] A scale-up of residential and outpatient programmes that meet the needs of this patient population is urgently required. While some studies have demonstrated that mechanisms which formally link adult addiction treatment services with direct access to primary medical care are effective in emergency settings,[21] to the authors' knowledge, no studies have evaluated similar programmes for MA-using youth. Although integrated service models may be as effective for young people as for adults, providers must address multiple barriers that street-involved youth experience while attempting to access traditional health services. These include, but are not limited to, confusion over issues regarding confidentiality and consent, transportation problems, and lack of respect and perceived judgmentalism from service providers.[6,22] Further examples of structural barriers include services that are perceived as being too rigid (e.g. by appointment only), inflexible (e.g. require ID) or inaccessible (i.e. inconvenient hours of operation).[23] The finding that 11% of visits resulted in discharge without service suggests a need to enhance the capacity of the ED to provide prompt, accessible and low-barrier health services for this population.

Although the long-term health and social consequences of chronic MA use among adult populations have been well described,[24,25] there is little evidence to inform effective interventions to address health issues experienced by MA-using youth.[26] The results of this study suggest that street-involved youth who inject MA, particularly those who do so frequently, may require a comprehensive set of interventions to address and reduce MA-related comorbidities. While behavioural

counselling programmes remain the standard of practice in treating MA dependence, few have been evaluated rigorously and their effectiveness in younger populations remains to be fully determined.[27] Peer educator interventions that seek to reduce MA use among youth and their social and drug-using networks have shown some success, particularly for young people who are disenfranchised, homeless or disconnected from the school system.[28,29] Finally, environmental–structural interventions, including the provision of low threshold supportive housing services and reforms to punitive enforcement practices that adversely impact street youths' access to health and social services, are thought to have potential to reduce underlying vulnerability to the harmful effects of substance use and thus are in need of evaluation.[30]

In the USA, lack of insurance has been found to be a primary barrier experienced by street youth who attempt to access care.[22] Although health care in Canada is publicly funded and thus all patients have universal access to hospital and primary care services, disparities in health service utilization, particularly among the most disadvantaged, continue to exist.[31] This study characterized the ED utilization patterns of a population of youth who are among the most marginalized, and thus probably experience some of the greatest disparities in access to care. While clinics and services designed specifically for street-involved young people may help to reduce health inequities and over-reliance on acute services, some studies have shown that many programmes are heavily underutilized by youth in greatest need of care.[6] For these reasons, interventions that aim to reduce MA-related harms and connect MA-using street youth with appropriate primary care should seek not only to provide youth-friendly services but also commit to the meaningful engagement of young people in the development, implementation and evaluation of these programmes. Furthermore, the vast majority of ED visits were found to occur outside of standard clinic operating hours. This finding suggests that expanding the range of services for young patients presenting with substance use problems within the ED setting may be more cost-effective, and address this population's health concerns more appropriately than the provision of additional youth-friendly ambulatory clinics.

This study has several limitations. Firstly, ED utilization was probably underestimated as participants may have received care at other settings not evaluated in this analysis. Secondly, although there is no reason to believe that individuals receiving care at other hospitals would differ with respect to MA use from those who accessed the ED under study, it is possible that the SPH ED may be preferred by certain types of patients and for certain types of health complaints. Therefore, the diagnoses observed in this study are probably not representative of the true disease burden in the population. Thirdly, the authors were unable to determine the number of participants who moved outside of Vancouver after enrolment. Fourthly, although ED utilization was determined with certainty through a confidential linkage to ED records, all other variables were self-reported. Fifthly, the authors were unable to determine what proportion of ED visits observed in this sample were suitable uses of emergent care, or whether the health concern may have been more appropriately treated in a primary care setting. For example, the authors were unable to disaggregate 'psychiatric disorders' into acute psychotic episodes and those related to chronic conditions. Finally, the small sample size (particularly with regard to the subgroups of occasional and frequent MA injectors) may have limited the study's power to detect significant associations. The small sample size and relatively short follow-up period also explains why no HIV seroconversions or deaths were observed among study participants, when other studies have demonstrated a high incidence of both outcomes in street youth populations.[32,33]

In summary, street-involved youth who report frequent injection of MA were found to be at an increased risk of ED utilization. Effective interventions to reduce the adverse health consequences of MA use and improve access to subacute and ambulatory settings will require not only the integration of services to address underlying health concerns experienced by this population, but also the meaningful engagement of youth to lessen barriers to care.

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Ethical approval

University of British Columbia/Providence Health Care Research Ethics Board.

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Competing interests

None declared.

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