

# Understanding the Impact of Migration on HIV Risk: An Analysis of Mexican Migrants' Sexual Practices, Partners, and Contexts by Migration Phase

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**Abstract** HIV risk among Mexican migrants varies across migration phases (pre-departure, transit, destination, interception, and return), but there is limited knowledge about specific sexual behaviors, characteristics of sexual partners, and sexual contexts at different migration stages. To fill the gap, we used data from a cross-sectional population-based survey conducted in Tijuana, Mexico. Information on migration phase and last sexual encounter was collected from 1219 male migrants. Our findings suggest that compared to pre-departure migrants, repeat migrants returning from communities of origin were more likely to have sex with male partners, use substances before sex, and not use condoms; migrants in the transit phase in the Mexican border were more likely to have sex with casual partners and sex workers; and migrants in the interception phase were more likely to engage in anal sex and use substances

before sex. Sexual behaviors, partners, and contexts vary significantly among migrants at different migration phases. Tailored HIV prevention programs targeting Mexican migrants need to be developed and implemented at all migration phases.

**Resumen** Investigaciones previas han demostrado que el riesgo de contraer la infección por VIH entre migrantes mexicanos depende de la fase migratoria en que éstos se encuentran (ej. en México antes de migrar, durante el tránsito hacia o desde el Norte, en las comunidades de destino en los Estados Unidos, durante la detención y deportación, y tras retornar a México). Sin embargo, se tiene un conocimiento todavía insuficiente sobre las conductas sexuales específicas, las características de las parejas sexuales, y los contextos en que los migrantes tienen sexo durante estas distintas fases del proceso migratorio. Para cubrir este vacío, se usaron datos de una encuesta poblacional transversal realizada en Tijuana, México. La encuesta recogió información sobre la fase migratoria y los detalles del último encuentro sexual de 1,219 hombres migrantes. Los resultados sugieren que, comparado con la fase que precede a la migración, los migrantes de retorno en sus comunidades de origen presentan una mayor probabilidad de tener sexo con otros hombres, sexo bajo la influencia de las drogas, y sexo sin protección. Los migrantes en la fase de tránsito en la frontera Norte de México presentan mayor probabilidad de tener sexo con parejas esporádicas y sexo servidoras. Los migrantes en la fase deportación reportaron con mayor probabilidad sexo anal y sexo bajo la influencia de las drogas ( $p < 0.05$ ). Las fases de migración se asocian con distintas conductas sexuales, tipo de parejas, y contextos en los cuales los migrantes practican el sexo. Es preciso desarrollar intervenciones para reducir el riesgo de adquirir el VIH en

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migrantes mexicanos. Estas intervenciones deben enfocarse en las necesidades específicas de cada una de las fases migratorias.

**Keywords** Mexican migrants · Migration phase · Sexual behavior · HIV

**Términos clave** Migrantes mexicanos · Fases migratorias · Conductas sexuales · VIH

## Background

The U.S.-Mexico border is the most frequented migration path in the world, with approximately 350 million legal crossings [1] and about 420,000 apprehensions of illegal crossings each year [2]. As of 2013, approximately 11.6 million Mexican migrants resided in the United States, representing by far the largest immigrant group in the country [3]. Among them, about 29% engage in circular migration [4], repeatedly crossing the border for employment, family reunification, and other reasons.

Population movements play a critical role in the transmission and relocation of diseases across different regions, including HIV infections. Mexican migrants are considered a potential bridge for HIV transmission, as they link populations with different prevalence levels in Mexico and the U.S. Previous research has found that increased HIV rates in rural Mexico was associated with migration to the U.S. [5–7]. Studies have shown that migration-related structural and contextual factors, such as being away from home, poverty, poor living conditions, isolation, mobility, limited access to health care and HIV prevention resources, more liberal norms regarding sex behaviors and drug use in the U.S., are associated with an increase in risk for HIV/AIDS among Mexican migrants [8, 9]. Mexican migrants have reported higher rates of sexual risk behaviors [10], including having multiple sexual partners, having sex with casual partners [10, 11] and commercial sex workers [11–13], compared to their peers who never migrate. The former are also more likely to use illicit drugs compared to individuals without a history of migration [14]. A more complete understanding of the HIV prevention needs of Mexican migrants is needed to direct new HIV prevention and control programs of high impact for migrants crossing the Mexican and U.S. border. Successful reduction in HIV incidence is of great importance to both the U.S. and Mexico, especially considering the size of Mexican migrant population engaged in circular migratory patterns

In recent years, Zimmerman et al. proposed to view migration as a complex process that occurs in five phases: pre-departure, transit, destination, interception, and return

[15]. These phases are not mutually exclusive and migrants can enter in and out of phases multiple times for different reasons. Migrants are likely to face a multitude of environments with risk-inducing and protective factors while in different phases of the migration process. The behavioral ecological model (BEM) theorizes that health behaviors are determined by multilevel factors, including individual, interpersonal, community and society-level factors [16]. Applying this model to HIV risk, the BEM predicts that risk-taking behaviors may vary during the migration process as migrants' are exposed to different structural and contextual factors in each phase. This hypothesis has been supported by previous studies examining sexual behavior and substance use among Mexican migrants across migration phases [17, 18].

*Project Migrante* was a binational project between the U.S. and Mexico and it aimed at increasing understanding of the factors influencing HIV risk and health care utilization among Mexican migrants guided by the BEM. *Migrante* consisted of a series of probability surveys of Mexican migrants traveling through the Mexican border city of Tijuana between 2007 and 2015 ([www.migrante.weebly.com](http://www.migrante.weebly.com)). Tijuana was selected because it alone concentrates about 30% of the migrants that travel between Mexico and the U.S., with fluctuations over time [19]. Migrants were recruited from four distinct migration flows that represent different spatial trajectories and include migrants at different migration phases.

Using data from the 2009 to 2010 HIV Risk Migrante survey, Martinez-Donate et al. found that HIV risk varied across the five migration phases. Generally, male migrants presented higher rates of HIV risk behaviors, such as having multiple sexual partners and sex with high-risk partners (casual partners, sex workers, and intravenous drug users etc.) at post-migration phases relative to the pre-departure phase [17]. Also using the same HIV data, Zhang et al. found that male migrants in the U.S. had higher odds of using illicit drugs compared to their peers who had not migrated to the U.S. [18]. Although these studies shed some important light on risk variations across migration phases, we still have limited understanding of ways in which migration may influence HIV risk. For example, little is known about the specific sexual behavior practices, the characteristics of the sexual partners, and the contexts in which Mexican migrants have sex while they are at different migration stages. According to the BEM, the characteristics of sexual partners and contexts where sex takes place may also impact the HIV-related risk behaviors of Mexican migrants. Information on the relationship between HIV risk and sexual partners' characteristics can help to inform future prevention programs targeting migrants and their sexual partners at different phases of the migration continuum.

The 2009–2010 HIV *Migrante* survey collected information on migrants' last sexual encounter at their most recent migration phase. These data provide a snapshot of the characteristics of migrants' sexual partners, the specific types of sexual practices they engage in, and the contexts in which sexual practices take place. Leveraging these data, we sought to deepen our knowledge of HIV risks across migration phases among male Mexican migrants. Due to the small size of the female subsample, this current study was restricted to males. Based on the BEM and previous research, this study aimed to test the following specific hypotheses:

- (1) Compared to pre-departure migrants, those at post-migration phases will report a riskier last sexual partner (female casual partners and female sex workers, compared to female stable partners) and a higher likelihood of engaging in unprotected sex with these partners during the last sexual event;
- (2) Proximity (i.e. access) to steady partners, such as spouses and romantic partners, will predict the type of partner with whom migrants have sex and the likelihood of having risk behaviors; and
- (3) The characteristics of the last sexual partner (e.g. HIV status, injection drug use, etc.) and context of the last sexual event (e.g. place where sex takes place, consumption of drug and alcohol, etc.) will be associated with risk behaviors during the last sexual event.

## Methods

### Study Population

The HIV *Migrante* survey used a multi-stage sampling design with a combination of geographic and temporal units. Mexican migrants were intercepted in transportation facilities that connect the U.S. and the rest of Mexico, including (1) the largest bus station in Tijuana, Central Camionera de Autobuses, (2) the Tijuana International Airport, and (3) the largest deportation station, Delegacion Federal de Migracion, San Ysidro. During data collection shifts, adult-looking migrants traveling through the data collection site were consecutively approached and screened for eligibility. Eligible individuals were defined as those who were at least 18 years old, born in Mexico or other Latin American countries, fluent in Spanish, not Tijuana residents (except for deportees), and not having participated in the survey before. A more detailed description of the methods has been provided elsewhere [17]. The study has approved by the investigators' institutional review boards.

Based on the spatial trajectory, four **migration flows** were identified: (1) migrants arriving to Tijuana from other Mexican towns (Northbound); (2) migrants departing from Tijuana after a recent stay in the U.S.-Mexico border (Border); (3) migrants heading voluntarily to their communities of origin after a stay in the U.S. (Southbound); and (4) migrants arriving to Tijuana from the U.S. via deportation by U.S. immigration officials (Deported). Study participants reported their status and behaviors in the place they were travelling *from*. Using the framework proposed by Zimmerman et al. [15] and combining information on place where the respondents' trip originated and their migration history, migrants in these flows were categorized into five **migration phases**. Migrants in the Northbound flow reported on their behavior in the communities of origin during the return or pre-departure phase of migration, depending on whether they had a previous history of migration to the U.S. or this was their first migration trip, respectively; migrants in the Border flow reported on their behavior during the transit phase in the Mexican border; migrants in the Southbound flow reported on their behavior in the U.S. during the destination phase; and migrants in the Deported flow represented the interception phase of migration. Thus, each group of migrants reported on their behavior during a specific migration phase and migration context. The key context was defined as the broad environment that encompasses each migration phase. Specifically, it refers to Mexican sending communities for the pre-departure and return phases; northern Mexican border region for the transit phase; and the U.S. for the destination and interception phases. Destination and interception phases were differentiated because, even if migrants in these two phases report about the same migration context, migrants in the interception phase represent an especially vulnerable segment of Mexican migrants. The vast majority of interception migrants were unauthorized to enter and/or work in the U.S., and therefore, they were more likely to experience insecure legal standing, marginalization, social isolation, limited access to medical and legal resources, and lack of social support in the destination country [17]. All these stressors might have put them at higher risk of engaging in risky behaviors, such as using illicit drugs and sex with sex workers. Henceforth, we refer to the most recent migration context for each migration phase as "key context." The categorization of migrants in these migration phases and contexts has been described in more details elsewhere [17].

In total, 6594 eligible migrants were screened and 3230 agreed to participate in the survey, yielding an overall response rate of 49.0%. For this study, we included only male migrants who reported having had sex in their most recent migration context during the last 12 months ( $n = 1219$ , approximately 42% of all male respondents).

About 99.4% of the study participants were born in Mexico and were therefore referred to as Mexican migrants.

## Measures

Eligible and consenting survey respondents completed an anonymous questionnaire administered by a trained interviewer using Questionnaire Development System software (QDS<sup>TM</sup> ACASI) on a laptop computer.

### *Sociodemographic and Migration Characteristics*

Respondents were asked about sociodemographic factors (age, education attainment, indigenous ethnicity, and marital status), and migration history (time spent in key context during last 12 months, plan to enter/return to the U.S., and deportation history).

### *Last Sexual Partner*

A section of the survey inquired about the participants' last sexual partner in the key context during the past year. Information was collected on the partner's sex and type of relationship (stable partners, casual partners, sex workers). Female stable partners are defined as women whom survey participants had a sexual relationship with as well as emotional or romantic relationship, such as a wife or girlfriend. Female casual partners are defined as women with whom participants had sex, but with whom participants do not have a romantic or emotional involvement, for example a *one night stand*, *friends with benefits*, *sex/fuck buddies*, or women with whom participants have sex *with no strings attached*. Parallel definitions were provided for male partners. However, given the small number of participants who reported same-sex practices, for this analysis we did not differentiate between different types of male partners. The participants also reported the last partner's sociodemographic factors (age, ethnicity, country of origin), HIV risk factors (injection drug use, HIV status, having other concurrent sexual partners), and relationship history. The latter included the context in which they met (country, venues, through whom they had met), time before their first sexual encounter, and types of sexual practices ever engaged in with this partner.

### *Last Sexual Event*

Respondents were also questioned about the last sexual event with the last partner. Specifically, migrants reported

sexual practices during the last sexual event (vaginal, anal, and oral), and whether they used condom for each type of sexual practice (yes/no). Based on these survey items, we created a binary variable to indicate unprotected vaginal and/or anal sex (0 = used a condom consistently for vaginal and/or anal sex, and 1 = did not use a condom consistently). Information was also collected on where the sexual event happened (home, hotel, etc.), and whether they consumed alcohol and illicit drugs before the event (yes/no).

## Statistical Analysis

We computed descriptive statistics by migration phase on characteristics of male Mexican migrants, their last sexual partner, their relationship history, and risk behaviors during the last sexual event. Weights, which were calculated following standard procedures for multistage sampling design, were used to produce population estimates [20]. We performed unadjusted binary logistic, multinomial logistic, and linear regressions to detect significant differences in migrants and their partners' characteristics, and their last sexual event across the migration phases. Pre-departure phase was used as the reference group in order to examine the effects of migration on behavioral risk for HIV infection.

We conducted multinomial logistic regression to investigate the association of partner type with migration phase and migrant's characteristics. Due to the small number of participants who reported same-sex practices, we excluded the category of male sexual partners from the multinomial analysis. We further examined factors associated with several selected risk behaviors using adjusted logistic regression models. The behaviors included (1) having anal sex during the last sexual event (only among those whose last partner was female), a riskier behavior for HIV infection compared to vaginal sex [21]; (2) using alcohol and/or illicit drugs before sex, which has been found to be associated with unprotected sexual practices; and (3) unprotected vaginal and/or anal sex (only among those who had vaginal and/or anal sex). For these multivariable logistic regressions, we examined variables on migration phase, migrant and partner's characteristics, and the context of the last sexual event (consumption of alcohol or drugs, location of last sexual event) as potential predictors. A stepwise procedure was employed to obtain parsimonious models: univariate logistic regressions were performed for each predictor and then all predictors that resulted in a  $p$  value  $< 0.10$  were entered in the final regressions. All regression models were unweighted. We conducted all analyses with the software STATA/MP13.1 (StataCorp LP, College Station, TX).



## Results

### Migrants' Sociodemographic and Migration Profile by Migration Phase

Out of the 1219 male Mexican migrants who reported having sex during the last 12 months in key context, 183 (15.0%) were classified as at the pre-departure phase given they did not have a previous history of migration to the U.S. and were reporting on their behavior and partners at their community of origin; 161 (13.2%) were classified as at the return phase because they had a previous history of migration to the U.S. and were reporting on their experiences during their recent stay back in their community of origin; 179 (14.7%) were considered to be at the transit phase, since they were reporting on their recent stay in the border region, an intermediate migration context; 414 (34.0%) were at the destination phase (i.e. they were reporting on their recent stay in the U.S.); and 282 (23.1%) at the interception phase (i.e. they were returning via deportation and were reporting on their behavior prior to being deported from the U.S.; Table 1). Male migrants represented by our sample were relatively young (ranging from 31.4 to 34.9 years old across the migration phases) and predominantly heterosexual (from 94.9% for transit migrants to 99.3% for migrants in the interception phase). Compared to pre-departure migrants, migrants at the return, destination and interception phases were less educated ( $p < 0.01$ ). Among married migrants, those at the transit, destination and interception phases were more likely to be living without a spouse or romantic partner in the key context ( $p < 0.01$ ).

Approximately, half of migrants (from 46.8% for pre-departure to 63.2% for return) arriving at Tijuana from other Mexican regions planned to cross the border to the U.S., and the majority of those returning from the U.S. planned to go back to the U.S. (77.2% for destination and 78.3% for interception). Among individuals who had a migration history to the U.S. (i.e. except for pre-departure migrants), 49.8% to 56.9% had been deported previously from the U.S.

**Hypothesis 1** Sexual partners, sexual risk behavior, and context of sex behavior will vary across migration phases.

#### Last Sexual Partner

Table 2 show that the characteristics of the last sexual partners varied by migration phase. Relative to male migrants on the pre-departure phase, those at the transit and interception phases had higher likelihood of having sex with a female sex worker ( $p < 0.05$ ). A higher proportion

of migrants at the return and transit stages met their partners at a bar or nightclub or a public area. In addition, it took transit and destination individuals a significantly shorter time than their pre-departure peers before having sex for the first time with their last partners ( $p < 0.05$ ). After adjusting for migrants' sociodemographic characteristics, transit migrants were more likely to report their last sexual partners as female casual partners instead of a female stable partner (AOR = 1.91, 95% CI 1.10–3.31, Table 3) compared to pre-departure migrants; transit migrants' odds of reporting their last partner was a female sex worker were also three times greater (AOR = 3.04, 95% CI 1.01–9.17) than those of pre-departure migrants.

#### Sexual HIV Risk Behaviors

During the last sexual event, and compared to pre-departure migrants, destination migrants were more likely to have a lower risk behavior (oral sex) combined with a higher risk behavior (vaginal and/or anal sex) compared to vaginal sex only ( $p < 0.05$ ). For vaginal and/or anal sex, migrants at the return phase were significantly less likely to use condoms consistently ( $p < 0.05$ ), in particular with female sex workers (8.3%). Multivariable analysis indicated that among those whose last partner was female, interception migrants were significantly more likely to engage in anal sex than pre-departure individuals during the last sexual encounter, after adjusting for migrant and partner's characteristics and the context in which sex took place (AOR = 3.39, 95% CI 1.35–8.56, Table 4). Unprotected vaginal and/or anal sex was also more likely reported by migrants in the return phase (AOR = 1.76, 95% CI 1.04–3.00) compared to migrants at pre-departure.

#### Context of Last Sexual Encounter

In general, migrants at the post-migration phases had higher odds for alcohol and illicit drugs consumption before sex than pre-migration migrants ( $p < 0.05$ ). Adjusted regression models indicated that the use of substances before sex was more likely reported by migrants at the return and interception phases (AOR = 2.62, 95% CI 1.50–4.59; AOR = 1.75, 95% CI 1.03–2.96, respectively).

The overall findings of this study along with the migration phase framework are depicted in Fig. 1.

**Hypothesis 2** Differences in type of last sexual partner and HIV risk behaviors by proximity to stable partners.

Compared to individuals who were married and living with their spouses in key context, those who were unmarried were more likely to have sex with a high-risk partner (Table 3; female casual partner: AOR = 5.68,

**Table 1** Sociodemographic and migration characteristics of sexually active male Mexican migrants, by migration context and phase (N = 1219), Tijuana, Mexico, 2009–2010

	Sending communities		Border	Receiving communities		P <sup>a</sup>
	Pre-departure (n = 183)	Return (n = 161)	Transit (n = 179)	Destination (n = 414)	Interception (n = 282)	
Sociodemographics						
Age, Mean (SD)	32.6 (8.4)	34.9 (9.7)	33.1 (11.1)	34.2 (11.5)	31.4 (11.5)	0.091
Completed high school (%)	48.7	15.5 **	43.0	16.0 **	14.4 **	<0.001
Indigenous ethnicity (%)	1.6	8.8 *	0.4	3.9	5.4	0.004
Marital status (%)						0.001
Unmarried	48.0	34.1	43.2	57.4 *	45.9	
Married, living with spouse in key context <sup>c</sup>	40.5	48.5	22.1	25.3	29.3	(Ref)
Married, not living with spouse in key context <sup>c</sup>	11.5	17.4	34.7 **	17.3 *	24.8 **	
Sexual orientation						0.140
Heterosexual	97.8	95.4	94.9	98.4	99.3	(Ref)
Homosexual	2.2	2.7	0.1	0.6	0.2	
Bisexual	0.0	1.9	5.0	1.0	0.5	
Migration history						
Time in the key migration context <sup>b</sup> during last 12 months (months), mean (SD)	7.7 (4.4)	5.7 (4.4) *	5.3 (5.6) *	10.3 (4.3) **	9.6 (6.3) **	<0.001
Plans to enter the U.S., %	46.8	63.2 *	57.9	NA	NA	0.105
Plans to return to the U.S., %	NA	NA	NA	77.2 <sup>Ref</sup>	78.3	0.845
Previous history of deportation, %	NA	54.2 <sup>Ref</sup>	49.8	56.9	53.2 <sup>c</sup>	0.922

Ref: reference group

<sup>a</sup> P value for overall effect of migration phase, based on logistic (for binary outcomes), multinomial logistic (for categorical outcomes), and multiple linear (for continuous outcomes) regression models. All models were unadjusted. The referent migration phase was pre-departure unless otherwise indicated

<sup>b</sup> The key migration context refers to the most recent migration context for which migrants were asked to report on their sexual partners, behaviors, and contexts. For pre-departure and return migrants, the context was the sending communities in Mexico; for transit migrants, the context was the border region; for destination and interception migrants, the context was the U.S

<sup>c</sup> Prior to the most recent deportation

\*  $p < 0.05$  \*\*  $p < 0.01$  for comparison to the reference migration phase

95% CI 3.70–8.74; female sex worker: AOR = 13.5, 95% CI 4.65–39.2; male partner: AOR = 26.4, 95% CI 3.38–206). Those who were married but not living with their spouses were more likely to engage in sex with a female casual partner and a female sex worker than their counterparts who were living with their spouses or steady partners (AOR = 4.01, 95% CI 2.49–6.45; AOR = 7.89, 95% CI 2.56–24.2, respectively). Proximity to stable partners also predicted the engagement in unprotected vaginal and/or anal sex, after the adjustment for other factors (Table 4; unmarried versus married and living with spouse: AOR = 0.38, 95% CI 0.27–0.56; married but not living with spouse: AOR = 0.43, 95% CI 0.29–0.66).

**Hypothesis 3** The last sexual partner's characteristics and last sexual event context will predict HIV risk behaviors.

After adjusting for migration phase, migrants' and their partners' characteristics, and the last sexual event context, we found that substance use before or during sex was also more likely to happen among migrants whose last partner was a female casual partner (AOR = 2.55, 95% CI 1.75–3.70), a female sex worker (AOR = 4.27, 95% CI 1.99–9.15), an injection drug user (AOR = 2.67, 95% CI 1.09–6.50), or with someone who had other concurrent sex partners (AOR = 1.74, 95% CI 1.08–2.80), had an unknown HIV status (AOR = 1.69, 95% CI 1.22–2.36), or with whom they had vaginal and/or anal sex combined with oral sex (AOR = 1.81, 95% CI 1.33–2.46). The engagement in unprotected vaginal and/or anal sex was predicted by type of partner, being less likely with female casual partner (AOR = 0.37, 95% CI 0.26–0.54) and with female sex workers (AOR = 0.17, 95% CI 0.08–0.37) compared to female stable partners.

**Table 2** Characteristics of last sexual partner and last sexual event among male Mexican migrants by migration context and phase (N = 1219), Tijuana, Mexico, 2009–2010

	Sending communities		Border	Receiving communities		P <sup>a</sup>
	Pre-departure (n = 183)	Return (n = 161)	Transit (n = 179)	Destination (n = 414)	Interception (n = 282)	
Last sexual partner's characteristics						
Gender and relationship (%)						0.047
Female stable partner	81.9	68.9	71.3	71.3	74.4	(Ref)
Female casual partner	15.2	23.9	18.4	23.7	19.3	
Female sex worker	1.9	2.6	9.9*	4.0	5.8*	
Male partner (stable, casual, or sex worker)	1.1	4.6	0.4	1.0	0.5	
Age (%)						0.130
25 or under	41.9	43.2	37.8	32.1	37.0	(Ref)
26–35	35.9	30.4	38.7	39.3	39.9	
36–45	17.3	11.8	20.3	24.3	18.6	
46 or older	4.9	14.5	3.2	4.3	4.5	
Indigenous ethnicity (%)	2.3	6.4	0.1**	2.9	1.8	0.001
Country of origin (%)						<0.001
Mexico	97.9	89.0	98.4	65.8	64.4	(Ref)
U.S.	1.5	10.4	1.4	27.1**	28.6**	
Other countries	0.6	0.6	0.2	7.1**	7.0**	
Injection drug user (%)	4.0	1.9	0.7	3.6	3.8	0.415
Partner's HIV status (%)						0.764
Sure/believe negative	72.5	76.5	71.4	68.1	74.3	(Ref)
Don't know	27.6	23.5	28.1	31.8	25.7	
Sure/believe positive	0.0	0.0	0.5	0.1	0.0	
Relationship history						
Met the partner in (%)						<0.001
Mexico	99.9	84.4 <sup>Ref</sup>	92.5	34.5	36.5	(Ref)
U.S.	0.0	15.6	7.5	64.2**	63.4**	
Other countries	0.1	0.0	0.0	1.3	0.1	
Where partner was met (%)						<0.001
At work/school	51.7	23.1	31.5	38.0	42.8	(Ref)
At a family/community/religious event/ private house party	24.5	39.3**	31.6	33.8	22.7	
At a bar or nightclub/a public area/other	23.9	37.6**	36.8*	28.2	34.6	
Through whom met partner (%)						0.927
Family/friends/co-workers/other	46.9	52.8	55.1	47.1	55.3	(Ref)
Nobody	53.2	47.2	44.9	52.9	44.7	
Time before first sexual encounter (months), median (IQR)	12.2 (3.0–24.3)	8.0 (2.0–36.5)	6.0* (2.0–12.2)	6.0* (2.0–12.2)	6.0 (2.0–24.3)	0.025
Sex history with this partner (not mutually exclusive) (%)						
Ever vaginal sex	97.8	95.4	97.8	96.7	98.8	0.434
Ever anal sex	14.6	20.6	13.3	23.3	24.7	0.271
Ever oral sex	45.0	26.7	47.3	56.7	46.1	0.389
Partner had other concurrent sexual partners (%)	8.2	10.0	14.5	10.3	16.3	0.365

**Table 2** continued

	Sending communities		Border	Receiving communities		P <sup>a</sup>
	Pre-departure (n = 183)	Return (n = 161)	Transit (n = 179)	Destination (n = 414)	Interception (n = 282)	
Risk during last sexual event						
Sexual practice (%)						<0.001
Only vaginal sex	69.2	77.5	68.6	54.9	59.1	(Ref)
Only anal sex	1.5	4.6	0.0**	0.0**	0.4	
Only oral sex	1.5	0.0**	1.1	1.2	0.9	
Vaginal and anal, without oral sex	1.3	2.1	0.6	1.3	0.4	
Vaginal and/or anal, with oral sex	26.5	15.9	29.8	42.6*	35.4	
Use condom consistently for vaginal and/ or anal sex						
Overall (%)	39.3	22.0*	42.3	29.6	29.7	0.096
With female stable partner (%)	36.7	15.8*	35.0	17.9*	22.7*	0.034
With female casual partner (%)	52.3	39.3	48.3	54.1	47.5	0.917
With female sex worker (%)	81.9	8.3*	87.4	97.9	59.0	0.005
With male partner (%)	0.0	31.9 <sup>Ref</sup>	0.0	39.8	41.4	0.962
Context of last sexual event						
Location of sexual encounter (%)						0.410
Home	78.9	80.9	80.0	78.0	84.8	(Ref)
Hotel/motel	12.9	13.9	18.0	18.4	10.4	
Car	4.3	3.7	1.6	2.3	1.6	
Other places (e.g. jail, public place)	4.0	1.5	0.5	1.3	3.2	
Consumed alcohol before/during the event (%)	15.3	32.3**	23.1	32.3**	33.4**	0.014
Used illicit drugs before/during the event (%)	0.2	9.0**	10.2**	6.2**	9.3**	0.007

Ref: reference group

Data represent behavior, partners, and context of last sexual event in the key migration context. This refers to the most recent migration context for which migrants were asked to report on their sexual partners, behaviors, and contexts. For pre-departure and return migrants, the context was the sending communities in Mexico; for transit migrants, the context was the border region; for destination and interception migrants, the context was the U.S.

<sup>a</sup> P value for overall effect of migration phase, based on logistic (for binary outcomes), multinomial logistic (for categorical outcomes), and multiple linear (for continuous outcomes) regression models. All models were unadjusted. The referent migration phase was pre-departure unless otherwise indicated

\* p < 0.05 \*\* p < 0.01 for comparison to the reference migration phase

## Discussion

This study expanded upon previous research on Mexican migrants' behavioral risk for HIV infection at different migration phases by conducting a more in-depth examination of the type of partners, sexual practices, and contexts surrounding sex behaviors among this at-risk population. The study also examined the extent to which these behavioral, interpersonal, and contextual factors change along the migration continuum. The results offer a more complete understanding of the sexual network of migrants and how the interactions between migrants, their partners, and the context in which they find themselves impact the risk for HIV transmission.

Our findings indicate that compared to male Mexican migrants at the pre-departure phase, those at the post-migration phases have riskier sexual networks, as indicated by the greater odds of reporting their last sexual partners as high-risk partners, including female casual partners, female sex workers, or male partners. The results also suggest that male migrants at post-migration phases are more likely to meet their partners at a bar/nightclub/public area, which are considered to be riskier venues to meet sexual partners relative to other types of settings [22], and wait a shorter time before having sex for the first time with their sexual partners, which could elevate risk due to insufficient knowledge of the partner's risk profile, including their HIV status. Furthermore, they were more likely to use alcohol or



**Table 3** Multinomial logistic regressions examining the association of type of sexual partner with migration phases and marital status among male Mexican migrants (N = 1197<sup>a</sup>), Tijuana, Mexico, 2009–2010

	Female stable partner (n = 885)	Female casual partner (n = 250) AOR and 95% CI	Female sex worker (n = 62) AOR and 95% CI
Migration phase	Ref		
Pre-departure		Ref	Ref
Return		1.66 (0.92–2.98)	1.65 (0.49–5.49)
Transit		<b>1.91 (1.10–3.31)</b>	<b>3.04 (1.01–9.17)</b>
Destination		1.36 (0.84–2.21)	1.58 (0.57–4.35)
Interception		1.00 (0.59–1.70)	1.46 (0.51–4.19)
Access to stable partners			
Marital status	Ref		
Unmarried		<b>5.68 (3.70–8.74)</b>	<b>13.5 (4.65–39.2)</b>
Married, living with spouse in key context		Ref	Ref
Married, not living with spouse in key context		<b>4.01 (2.49–6.45)</b>	<b>7.89 (2.56–24.2)</b>

Bold values indicate statistical significance at the level of  $p < 0.05$

Ref: reference group

<sup>a</sup> Migrants whose last sexual partners were male sexual partners were excluded from the analysis due to small number of participants who reported same-sex practices

The multinomial logistic regression model is also adjusted for migrant's age, education attainment, and indigenous ethnicity status

other substances before or during sex, and have unprotected vaginal and/or anal sex. The risk behaviors were associated with migration phase. Such results are in agreement with our first hypothesis, which predicted that migrants would be at increased risk for adopting HIV risk behaviors at post-migration stages [16].

Among migrants at the four post-migration phases, those at the return phase represent an especially at-risk group as they appeared to engage in more risk behaviors vis-à-vis other post-migration phases. After adjustment for migrants' sociodemographic characteristics, return migrants in their communities of origin had greater odds of using alcohol and/or illicit drugs before sex, compared to their peers who had not yet migrated to the U.S. They were also less likely to use a condom consistently for vaginal and/or anal sex, reporting disturbingly low rates of condom use with female sex workers (8.3%) and female stable partners (15.8%). All these findings are suggestive of a negative impact of migration on the sexual network, sexual practices, use of condom, and conditions under which sex takes place, which may put migrants at an elevated risk for HIV and other sexually transmitted diseases (STDs). Furthermore, many female stable partners in the sending communities may be migrants' spouses or steady partners left behind as the male migrants headed north. Thus, limited condom use with steady female partners would result in increased risk for HIV and other sexually transmitted infections for these partners. Thus, the bridging of higher and lower risk sexual networks may be a pathway through which

Mexican migrants may increase HIV rates in communities with high out-migration rates in Mexico [23].

Transit and interception were migration phases in which male Mexican migrants experienced particularly higher levels of behavioral risk for HIV infection. Transit migrants were more likely to have had sex with a female casual partner and a female sex worker than pre-departure individuals. This group of migrants also had the highest rate of using illicit drugs before having sex across the migration phases. These elevated rates may be the result of their exposure to the precarious environment of the Mexico-U.S. border region, which is characterized by quasi-legal commercial sex, crossing-border drug trafficking, and drug-related violence [24–26]. The result may also help explain the relatively higher HIV prevalence rate among this group of migrants (1.36%) compared to migrants at other phases identified by previous research [17].

Interception migrants' risk for HIV infection and transmission was increased by higher likelihood of engaging in anal sex (with female partners) and substance use before or during sex. These risky sexual practices may be indicative of these migrants' greater social vulnerability before they were detained and deported. For example, previous research has shown that migrants in the interception phase have poorer working conditions, less stable housing, and very limited access to medical care prior to deportation from the U.S. [17, 27].

In spite of the changing scenarios between the migration phases, we found that male Mexican migrants used condoms at suboptimal levels across all the migration phases.

**Table 4** Logistic regressions examining the association of risk behaviors during last sexual event with migration phase, partners' characteristics and last sexual event context among male Mexican migrants, Tijuana, Mexico, 2009–2010

	Had anal sex (only among those whose last partner was female) N = 1197		Used alcohol and/or illicit drugs before sex N = 1219		Unprotected vaginal and/or anal sex <sup>a</sup> (only among those who had vaginal and/or anal sex with a female partner) N = 1197	
	Univariate <sup>b</sup> OR (95% CI)	Multivariate <sup>c</sup> AOR (95% CI)	Univariate <sup>b</sup> OR (95% CI)	Multivariate <sup>d</sup> AOR (95% CI)	Univariate <sup>b</sup> OR (95% CI)	Multivariate <sup>e</sup> AOR (95% CI)
Migration phase						
Pre-departure	Ref*	Ref	Ref*	Ref	Ref*	Ref
Return	2.67 (0.99–7.21)	2.46 (0.89–6.81)	<b>2.54 (1.55–4.17)</b>	<b>2.62 (1.50–4.59)</b>	<b>1.69 (1.05–2.72)</b>	<b>1.76 (1.04–3.00)</b>
Transit	2.32 (0.86–6.27)	2.15 (0.79–5.87)	<b>1.86 (1.13–3.06)</b>	1.34 (0.77–2.36)	1.02 (0.70–1.47)	1.12 (0.74–1.70)
Destination	<b>2.97 (1.24–7.18)</b>	2.48 (0.99–6.19)	<b>1.89 (1.23–2.92)</b>	1.22 (0.74–2.02)	0.90 (0.58–1.40)	1.06 (0.65–1.74)
Interception	<b>4.45 (1.84–10.8)</b>	<b>3.39 (1.35–8.56)</b>	<b>2.39 (1.53–3.75)</b>	<b>1.75 (1.03–2.96)</b>	1.33 (0.89–1.99)	1.51 (0.96–2.38)
Access to stable partners						
Marital status						
Unmarried	<b>2.24 (1.37–3.68)</b>	<b>1.83 (1.06–3.17)</b>	<b>3.03 (2.23–4.12)</b>	<b>1.80 (1.24–2.61)</b>	<b>0.23 (0.17–0.32)</b>	<b>0.38 (0.27–0.56)</b>
Married, living with spouse in key context	Ref*	Ref	Ref*	Ref	Ref*	Ref
Married, not living with spouse in key context	1.42 (0.76–2.68)	1.17 (0.34–4.04)	<b>1.75 (1.20–2.56)</b>	1.22 (0.79–1.88)	<b>0.33 (0.23–0.49)</b>	<b>0.43 (0.29–0.66)</b>
Last partner's characteristics						
Type of partner						
Female stable partner	Ref	–	Ref*	Ref	Ref*	Ref
Female casual partner	1.11 (0.69–1.80)		<b>3.54 (2.64–4.76)</b>	<b>2.55 (1.75–3.70)</b>	<b>0.30 (0.22–0.41)</b>	<b>0.37 (0.26–0.54)</b>
Female sex worker	1.11 (0.46–2.66)		<b>8.61 (4.91–15.1)</b>	<b>4.27 (1.99–9.15)</b>	<b>0.12 (0.07–0.21)</b>	<b>0.17 (0.08–0.37)</b>
Male partner	NA		2.12 (0.88–5.14)	2.40 (0.71–8.11)	<b>0.39 (0.15–0.99)</b>	0.47 (0.17–1.28)
An injection drug user	<b>2.54 (1.02–6.34)*</b>	1.19 (0.42–3.36)	<b>5.76 (2.71–12.2)*</b>	<b>2.67 (1.09–6.50)</b>	0.59 (0.29–1.20)	–
Partner had other concurrent sex partners	<b>1.90 (1.13–3.21)*</b>	1.23 (0.68–2.23)	<b>5.05 (3.50–7.31)*</b>	<b>1.74 (1.08–2.80)</b>	<b>0.39 (0.27–0.56)*</b>	1.09 (0.68–1.74)
Partner's HIV status						
Sure/believe negative	Ref	–	Ref*	Ref	Ref*	Ref
Don't know	1.16 (0.74–1.82)		<b>2.49 (1.90–3.27)</b>	<b>1.69 (1.22–2.36)</b>	<b>0.49 (0.38–0.65)</b>	0.80 (0.58–1.10)
Sure/believe positive	NA		NA	NA	NA	NA
Last sexual event practice and context						
Sexual practice						
Only vaginal sex	NA	NA	Ref*	Ref	Ref	–
Only anal sex	NA	NA	0.31 (0.04–2.44)	0.10 (0.01–1.08)	0.40 (0.12–1.33)	
Only oral	NA	NA	1.77 (0.51–6.12)	0.70 (0.17–2.96)	NA	
Vaginal and anal, without oral sex	NA	NA	1.97 (0.76–5.16)	1.17 (0.39–3.53)	0.60 (0.24–1.55)	
Vaginal and/or anal, with oral sex			<b>2.15 (1.66–2.80)</b>	<b>1.81 (1.33–2.46)</b>	1.18 (0.91–1.55)	
Location of sexual encounter						
Home	Ref	–	Ref*	Ref	Ref*	Ref
Hotel/motel	1.56 (0.94–2.60)		<b>2.89 (2.08–4.03)</b>	1.23 (0.80–1.89)	<b>0.32 (0.23–0.45)</b>	0.70 (0.46–1.06)
Car	1.62 (0.55–4.74)		<b>4.10 (1.98–8.49)</b>	2.26 (0.98–5.19)	0.65 (0.31–1.39)	1.13 (0.49–2.61)
Other places (e.g. jail, public place)	NA		1.48 (0.66–3.33)	0.47 (0.17–1.27)	<b>0.38 (0.17–0.82)</b>	0.81 (0.35–1.91)
Consumed alcohol before/during the event	<b>1.74 (1.15–2.63)*</b>	1.23 (0.79–1.93)	NA	NA	<b>0.69 (0.53–0.90)*</b>	1.30 (0.94–1.79)

**Table 4** continued

	Had anal sex (only among those whose last partner was female) N = 1197		Used alcohol and/or illicit drugs before sex N = 1219		Unprotected vaginal and/or anal sex <sup>a</sup> (only among those who had vaginal and/or anal sex with a female partner) N = 1197	
	Univariate <sup>b</sup> OR (95% CI)	Multivariate <sup>c</sup> AOR (95% CI)	Univariate <sup>b</sup> OR (95% CI)	Multivariate <sup>d</sup> AOR (95% CI)	Univariate <sup>b</sup> OR (95% CI)	Multivariate <sup>e</sup> AOR (95% CI)
Used drugs before/during the event	<b>2.93 (1.62–5.28)*</b>	1.65 (0.84–3.23)	NA	NA	0.91 (0.56–1.47)	–

Bold values indicate statistical significance at the level of  $p < 0.05$

\* Indicates the variable was included in subsequent adjusted regression models

<sup>a</sup> Unprotected vaginal and/or anal sex during the last sexual event means inconsistent condom use for vaginal and/or anal sex

<sup>b</sup> Univariate logistic regressions were performed for each predictor. In addition to the variables listed in the table, the predictors also include migrant's age, education attainment, indigenous ethnicity status, partner's age, country of origin, and time before first sexual encounter. All predictors that resulted in a  $p$ -value  $< 0.10$  were entered in the multivariate logistic regressions

<sup>c</sup> The final model was also adjusted for migrant's age, partner's age, and partner's country of origin

<sup>d</sup> The final model was also adjusted for migrant's age, partner's age, country of origin, and time before first sexual encounter

<sup>e</sup> The final model was also adjusted for migrant's age, partner's age, and time before first sexual encounter

We hypothesized that partner's characteristics would be associated with risk behaviors and our findings were supportive of this hypothesis. Migrants were less likely to engage in unprotected vaginal and/or anal sex with female sex workers and casual partners than they did with female stable partners, suggesting that migrants accurately perceive female sex workers and casual partners to be riskier sexual partners. Nonetheless, almost half of migrants who had sex with a female casual partner did not use a condom consistently for vaginal/anal sex with this type of partner. This is especially high risk because migrants are unlikely to know the HIV status of these partners. Indeed, our data show that 40% of migrants were not aware of the casual partner's HIV status. Having sex with a partner of unknown HIV status can increase risk of HIV acquisition and transmission to other partners. The level of condom use with male partners was also low- more than half of migrants did not use a condom with their male partners during the last sexual event. This is particularly disturbing because men who have sex with men (MSM) are 19 times more likely to contract HIV than the general population [28]. As a modifiable behavior, consistent condom use needs to be strongly encouraged among all male Mexican migrants, especially with non-steady female partners, male partners, and partners perceived as having concurrent sexual partnerships.

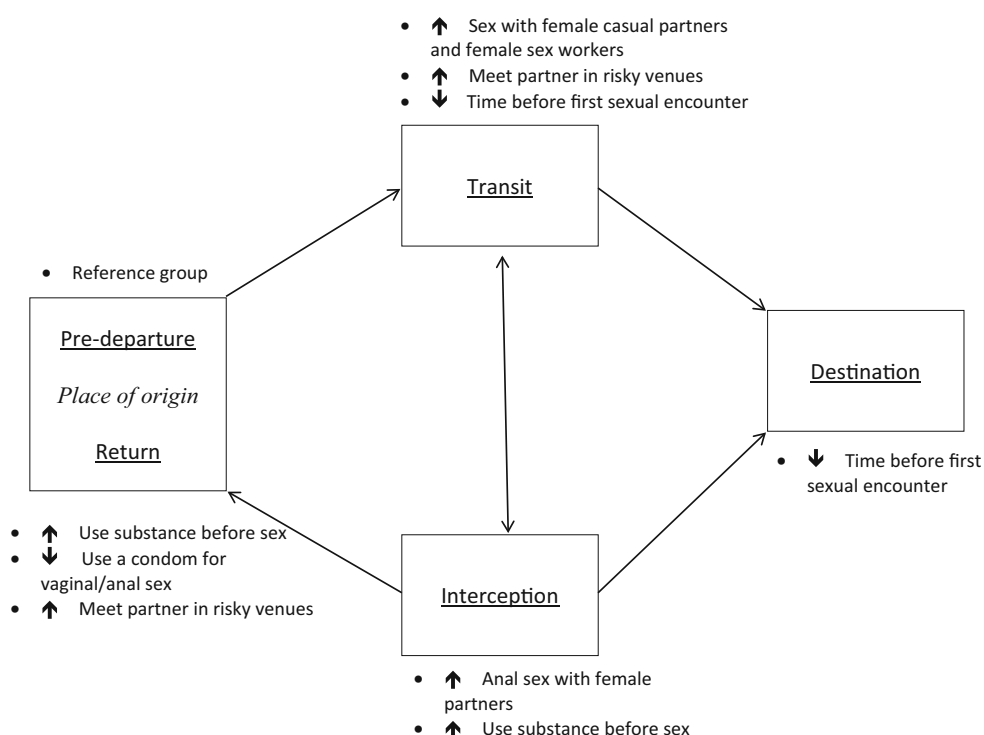
Finally, we found that compared to their peers who were married and living with their spouses, migrants who were married but did not have access to their spouses were more likely to have sex with female casual partners and sex workers. This is consistent with the second hypothesis and suggests that separation from a spouse or steady partner increases likelihood of unprotected sex with a casual partner. The *Migrante* Project did not collect information

on why migrants were separate from their spouses. This could be both due to restrictive immigration policies that make it very difficult for low-skilled workers to enter the U.S. legally and/or due to family preferences. Future research should explore factors that may facilitate migrants' remaining close to their steady partners so as to inform policies and programs to reduce HIV risk among Mexican migrants at different migration phases.

### Implication for Practice

This study has important implications for public health efforts aiming to prevent HIV infection among Mexican migrants. Due to the high mobility of this population, this issue deserves attention and investment from both the U.S. and Mexico to curtail the spread of HIV among migrants and their partners. First, migrants at all migration stages are in need of interventions promoting condom use when having vaginal and anal sex, especially with high-risk partners. When used consistently and correctly, condoms are highly effective in preventing HIV and other sexually transmitted infections. For migrants at high risk for HIV infection and unable or unwilling to adhere to consistent condom use, pre-exposure prophylaxis (PrEP) should be considered. Studies examining knowledge, acceptability, and feasibility of PrEP as an HIV prevention strategy for migrants need to be conducted. Second, migrants at the transit, interception, and return phases are at higher risk for HIV infection than migrants at the pre-departure phase. Hence, intensified public health programs should target migrants at these three stages. For the above two purposes, interventions can be carried out at similar sites where the *Migrante* project recruited participants. These locations have proven good sites to reach migrants from different

**Fig. 1** Association between migration phase and likelihood of risk behaviors for HIV infection (pre-departure phase is the reference category). The arrows between the phases represent possible flows of migrants between different phases



migration phases. Currently, migrant health clinics, which have been established, in part, as a result of findings from the *Migrante* project, provide prevention resources (e.g. counseling, HIV/STI testing, condoms) and primary care services to deported migrants in deportation stations along the Mexico-U.S. border. Such clinics should also be set up in transportation facilities to provide services to more migrants.

## Limitations

This study is subject to several limitations, which also suggest possible future research directions. The cross-sectional design of the study makes it difficult to establish temporal relationships between migration phase and type of partner. Our findings suggest that a particular migration environment provides more opportunities or creates a more favorable ambience for migrants to engage in risk behaviors. However, we cannot rule out that migrants self-select into certain migration phases and the factors driving this self-selection also contributes to decisions regarding types of sexual partners, sex behavior, and use of alcohol/drugs. Future research is needed to increase understanding of the direction of the relationship between migration phase and HIV risk behavior. The survey participants were recruited at the Mexico-U.S. border when the Mexican migrants were in the process of migrating. As a result, those who engaged in circular migration were more likely to be sampled compared to those who were relatively stable in

receiving communities in the U.S. or who have returned to Mexico permanently. Yet results from the study can complement existing epidemiologic research, most of which has focused on stationary migrant populations in the U.S. or Mexico. The study population was limited to migrants who had sex in the key context of each migration phase during the past year (42% of male migrants, ranging from 37.8% among migrants in the return phase and 46.1% among migrants in the destination phase). The low rate of sexual activity may be explained by the high mobility of this population and the limited time they spent in the key context—for those who had spent the whole year in the key context during the past 12 months, 81% had sex in the key context. In addition, migrants might have had sex elsewhere other than the key context during the last 12 months and these sexual practices would also have contributed to their risk profile. By focusing strictly on the last sexual partner, our analysis used a limited indicator of the respondents' sexual network. Future studies should examine more partners in order to better understand how migrants' sexual network change as a result of migration and the impact of these changes on the risk of HIV acquisition and transmission. The overall response rate is moderate (49.0%) but it still falls within the range recommended for a survey to inform decisions on important policies and resources allocation [29]. Based on the screening survey, we found that non-respondents were older and had a higher education level than respondents. Hence, survey respondents may represent a higher risk

profile for HIV infection. Information about the demographic and risk profile of the last sexual partner relied on the respondent's perception. Overall, about 25% of the partners fell in the categories of female casual partners and sex workers, and migrants may not have known them well to report their sociodemographic characteristics and HIV factors. Finally, our study was restricted to male, mostly heterosexual migrants. Future research should explore variations in sex partners and sexual contexts among sexual minority migrants and female migrants.

## Conclusions

In conclusion, our analysis of last sexual events suggests that male Mexican migrants at post-migration phases are at increased risk of having sex with high-risk sexual partners and engage in risk behaviors for HIV infection. Variations in proximity to stable partners, characteristics of sexual partners, and context of sexual practices contribute to HIV risk across migration phases. Tailored HIV prevention programs need to be developed to target Mexican migrants, particularly at post-migration phases. Future research is needed to better characterize variations in sexual networks associated with the different phases and contexts of the migration process. This research must expand the analysis to more partners in order to increase our understanding of HIV risk and transmission among migrants and their sexual networks.

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## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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