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Getting to 90: linkage to HIV care among men who have sex with men and people who inject drugs in India

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Abstract

UNAIDS set an ambitious target of “90-90-90” by 2020. The first 90 being 90% of those HIV-infected will be diagnosed; the second 90 being 90% of those diagnosed will be linked to medical care and on antiretroviral therapy (ART). While there has been dramatic improvement in HIV testing and ART use, substantial losses continue to occur at linkage-to-care following HIV diagnosis. Data on linkage among men who have sex with men (MSM) and people who inject drugs (PWID) are sparse, despite a greater burden of HIV in these populations. This cross-sectional study was conducted in 27 sites across India. Participants were recruited using respondent-driven sampling and had to be ≥18 years and self-identify as male and report sex with a man in the prior year (MSM) or injection drug use in the prior 2 years (PWID). Analyses were restricted to HIV-infected persons aware of their status. Linkage was defined as ever visiting a doctor for management of HIV after diagnosis. We explored factors that discriminated between those linked and not linked to care using multi-level logistic regression and area under the receiver operating curves (AUC), focusing on modifiable factors. Of 1726 HIV-infected persons aware of their status, 80% were linked to care. Modifiable factors around the time of diagnosis that best discriminated linkage included receiving assistance with HIV medical care (odds ratio [OR]: 10.0, 95% confidence interval [CI]: 5.6–18.2), disclosure of HIV-positive status (OR: 2.8; 95% CI: 2.4–6.1) and receiving information and counseling on management of HIV (OR: 2.3; 95% CI: 1.1–4.6). The AUC for these three factors together was 0.85, higher than other combinations of factors. We identified three simple modifiable factors around the time of diagnosis that could facilitate

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linkage to care among MSM and PWID in low- and middle-income countries to achieve UNAIDS targets.

Keywords

India; HIV care continuum; linkage to care; men who have sex with men; MSM; people who inject drugs

Introduction

In 2014, UNAIDS set an ambitious target of “90-90-90” by 2020 to help end the AIDS epidemic (UNAIDS, 2014). The goal is 90% of those HIV-infected will be aware of their diagnosis; 90% of those diagnosed will be linked to clinical care and on sustained antiretroviral therapy (ART) and, 90% of those on ART will achieve viral suppression. Fueled by recognized individual and community benefits of ART (Cohen, Chen, McCauley, Gamble, & Hosseinipour, 2011; Ledergerber et al., 1999; Montaner et al., 2014; Murphy et al., 2001), this approach promotes successful progression through all steps of the HIV care continuum (Gardner, McLees, Steiner, Del Rio, & Burman, 2011) while prioritizing equity for all affected by HIV, including men who have sex with men (MSM) and people who inject drugs (PWID).

While there has been a massive scale-up of HIV counseling and testing programs and access to life-saving ART over the past decade, substantial losses continue to occur between HIV diagnosis and linkage-to-care. Among resource-limited settings, attrition at this step has been best characterized in sub-Saharan Africa, where an estimated 35–88% were linked to care (Rosen & Fox, 2011). However, these data largely reflect generalized heterosexual HIV epidemics. Data suggest poorer access to ART among MSM and PWID (Arreola, Hebert, Makofane, Beck, & Ayala, 2012; Petersen, Myers, van Hout, Plüddemann, & Parry, 2013); however, information on linkage to care among these populations is lacking.

India, similar to other low- and middle-income countries (LMICs), has made dramatic progress in delivering HIV services to heterosexual populations resulting in overall reductions in HIV prevalence and incidence. However, MSM and PWID continue to bear high prevalence – 15–25 times higher than the general population – resulting in a heightened focus by the National AIDS Control Organisation [NACO] (Department of AIDS Control Indian Ministry of Health & Family Welfare, 2013). India, situated between Asia’s two main opium-producing areas, is the largest consumer of opiates worldwide with over 1 million PWID (Aceijas et al., 2006). Historically, injection drug use has been the major driver of the HIV epidemic in Northeast India with emerging epidemics in North and Central India (Lucas et al., 2015; Medhi, Mahanta, Akoijam, & Adhikary, 2012). Across India, there are an estimated 2.4 million high-risk MSM (National AIDS Control Organization [NACO], 2006) despite criminalization of homosexuality under the Indian penal code. Poor access to and utilization of HIV services as well as stigma and discrimination are common for both MSM and PWID (Latkin et al., 2010; Mawar, Sahay, Pandit, & Mahajan, 2005; Sarin & Kerrigan, 2012; Thomas et al., 2011).

The objective of this analysis is to characterize linkage to HIV care among MSM and PWID diagnosed with HIV across 17 Indian states and to identify modifiable factors associated with linkage to care that could be targeted to improve outcomes.

Methods

Study design

This cross-sectional study was conducted in 27 study sites (12 MSM and 15 PWID) across 26 Indian cities (17 states) as the baseline assessment of a cluster-randomized trial (Solomon, Lucas, Celentano, Sifakis, & Mehta, 2013) ([ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT01686750) Identifier: NCT01686750). One site was established per city for either the MSM or PWID local population with the exception of New Delhi where both an MSM and PWID site were separately established. Eligibility criteria included: (1) age ≥ 18 years; (2) informed consent; and (3) possession of a valid referral coupon. For MSM, additional criteria were: (1) self-identify as male (hijra/transgender women were excluded) and (2) report oral/anal sex with a man in the prior 12 months. For PWID, an additional criterion was self-report of drug injection in the prior two years.

Study procedures

Detailed study procedures have been published elsewhere (Lucas et al., 2015; Solomon et al., 2015). Briefly, the study population was recruited utilizing respondent-driven sampling (RDS; target = 1000 per site), a chain-referral strategy for recruiting hard-to-reach participants (Heckathorn, 1997, 2002; Solomon et al., 2013; White et al., 2012). After oral consent, participants completed an interviewer-administered survey and underwent rapid HIV testing and pre- and post-test counseling on-site. The electronic survey captured information on socio-demographics, HIV-related risk factors, diagnosis, and care.

HIV infection was diagnosed on-site using three rapid tests in accordance with Indian guidelines using the following kits: Alere™ Determine™ HIV-1/2 (Alere Medical Co., Ltd., Chiba, Japan), First response HIV card test 1–2.0 (PMC Medical India Pvt Ltd, Daman, India), and Signal Flow Through HIV 1+2 Spot/Immunodot Test kit (Span Diagnostics Ltd, Surat, India). All study participants newly diagnosed with HIV were counseled and referred for medical management.

Statistical analyses

Analyses were restricted to HIV-positive persons aware of their status prior to our study. Linkage was self-reported and defined as ever seeing a doctor, excluding pharmacists or alternative/Ayurveda doctors, for HIV management. Site-level linkage to care weighted percentages were calculated using the Volz-Heckathorn (RDS-II) estimator which weights estimates for network size (i.e. the number of MSM/PWID in the city whom the participant saw in the prior 30 days) to compensate for non-random sampling thereby providing unbiased population estimates (Volz & Heckathorn, 2008). To estimate overall linkage to care and population summary statistics, we used a composite weight which accounts for the relative population size of adult men aged 15–59 years (Office of the Registrar General & Census Commissioner of India, 2011) or number of PWID in each city derived from state-

level data (National Institute of Medical Statistics and National Aids Control Organisation (India), 2010), in addition to the RDS-II weight.

Correlates of linkage to care were explored within the pooled sample of MSM and PWID using multi-level logistic regression models with a random intercept for site and scaled RDS-II weights as sampling weights. Regression models used a complete-case analysis since no covariate had more than 5% invalid or missing responses. Covariates of interest included socio-demographics, HIV-related risk behaviors, psychosocial factors, modifiable healthcare-related factors around the time of HIV diagnosis, and community-level access to care variables. The number of integrated counseling and testing centers (ICTCs), ART centers, and percentage of MSM- or PWID-focused targeted interventions in each state were calculated based on data from NACO (Department of AIDS Control Indian Ministry of Health & Family Welfare, 2013; National AIDS Control Organization [NACO], 2014a, 2014b). Depression was measured using the PHQ-9 questionnaire, which has been validated in India (Ganguly et al., 2013; Kochhar, Rajadhyaksha, & Suvarna, 2007; Patel et al., 2008), with a score greater than 10 defined as presence of depression (Kroenke & Spitzer, 2002; Manea, Gilbody, & McMillan, 2012). Stigma related to being MSM/PWID was measured using an adapted questionnaire with scores (range: 0–20) averaged across four scales (enacted, felt normative, vicarious, and internalized stigma); higher scores reflect greater stigma (Steward et al., 2008). Alcohol use was assessed using the AUDIT questionnaire and categorized as none/limited, harmful/hazardous, or alcohol dependence using validated cutoffs (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993).

Areas under the receiver operating curve (AUC) were used to evaluate combinations of factors that discriminated between those linked and not linked to care, with a focus on modifiable factors around the time of diagnosis. AUCs were calculated using a 10-fold cross validation technique (Hastie, Tibshirani, & Friedman, 2009). Models' predictive abilities were compared for equality using a nonparametric approach (DeLong, DeLong, & Clarke-Pearson, 1988). As sensitivity analyses, regression models were performed unweighted and separately for MSM and PWID. All statistical analyses were performed using RDS Analyst Software Version 1.0 (<http://hpmrg.org>) and Stata version 12.0 (Stata Corp., College Station, TX, USA).

Results

Among 26,447 MSM and PWID recruited between October 2012 and December 2013, 4051 were HIV-infected and 1726 were aware of their positive status (MSM = 503, PWID = 1223) and included in this analysis. Median age was 38 among MSM and 34 among PWID (Table 1); 275 (35.5%) of PWID were female. Disclosure of HIV-positive status to at least one person was 77.2% and 87.2% for MSM and PWID, respectively. Among those that disclosed, 68.8% told a spouse or primary sex partner and 72.1% told a family member. 52% of MSM and 57.2% of PWID received information and counseling on medical care and treatment options available for HIV immediately after their diagnosis. Unweighted estimates are in Supplementary Table 1.

Overall, 1356 (79.8%, 95% confidence interval [CI]: 77.5–82.1%) were linked to HIV care, 446 (87.7%, 95% CI: 83.8–91.7%) of MSM and 910 (78.0%, 95% CI: 75.0–81.0%) of PWID. There was considerable variability across sites (Figure 1); site-level percentages ranged from 15.7% (New Delhi-PWID) to 100% (Coimbatore and Mangalore-MSM). Unweighted estimates are presented in Supplementary Table 2. For persons not linked, primary reasons for not seeking care were not being ready/interested (51.4%) and not knowing where to go (10.2%). Almost half (45.8%) of those not linked to care had been diagnosed with HIV in the prior 6 months. Conversely, 65.0% of those linked to care had been diagnosed more than 2 years ago.

Factors associated with linkage to care

Socio-demographic factors significantly associated with higher odds of linkage to care in univariable analysis included older age (odds ratio [OR] for a 10-year increase: 1.83, 95% CI: 1.31–2.56), marital status (OR for married vs. never married: 2.10, 95% CI: 1.19–3.72), and higher education (OR for high school graduate vs. primary school or less: 2.51, 95% CI: 1.10–6.21) (Table 2). Female PWID (OR: 3.12, 95% CI: 1.92–5.07) and *bisexuals* among the MSM (OR: 6.03, 95% CI: 1.29–28.1) had higher odds of linkage. Recent injection drug use, alcohol use, and stigma were not significantly associated with the odds of linkage. Depressive symptoms were associated with decreased odds of linkage (OR: 0.51, 95% CI: 0.30, 0.85). We also observed higher odds of linkage among those who had disclosed their HIV-positive status (OR: 2.82, 95% CI: 2.41–6.07), received information and counseling on care and treatment of HIV at diagnosis (OR: 2.25, 95% CI: 1.09–4.64), and received assistance with HIV-related medical care (OR: 10.0, 95% CI: 5.55–18.2).

PWID living in Northeastern India had significantly higher odds of being linked to care compared to other states (OR: 5.97, 95% CI: 1.79–19.9). For MSM, living in the southern state of Tamil Nadu was associated with higher odds of being linked compared to those in North/Central states (OR: 80.4, 95% CI: 34.7–186.4). Persons living in districts with more ICTCs had higher odds of linkage (OR for an increase of five centers: 1.18, 95% CI: 1.03–1.36).

Discrimination of linkage to care

Predictive accuracy for linkage (AUCs) among single factors ranged from 0.66 to 0.84 (Table 2). Assistance with HIV-related medical care had the highest AUC, 0.84. Multivariable prediction models and their AUCs are presented in Table 3. Considering only socio-demographics (model 1), the AUC was 0.79. Alternatively, considering whether individuals had disclosed their HIV-positive status, received assistance with obtaining HIV-related medical care, and received information and counseling on HIV care and treatment at diagnosis (model 3) had an AUC of 0.85. When these factors are added to socio-demographics (model 6), the AUC increased marginally and improvement was not statistically significant (Supplementary Table 3 and Figure 2). Further addition of other factors such as stigma, substance use, depression, community access to care, and region did not improve predictive accuracy. Of those who disclosed their status, received assistance with medical care, and received information and counseling on care and treatment, 95.2% were linked to care. Among those who responded positively to at least one of these factors,

82.3% were linked. In contrast, 55.4% of those that responded negatively to all three factors were *not* linked.

Sensitivity analyses

Relative predictive accuracy of different multivariable prediction models remained similar when stratified by group (MSM/PWID) (Supplementary Table 4). Inferences from unweighted analyses (Supplementary Tables 5–7) generally remained similar.

Discussion

Across 26 Indian cities, linkage to HIV clinical care after diagnosis among vulnerable populations was high though varied considerably by region. We identified three modifiable factors around the time of diagnosis that predicted linkage: (1) disclosure of HIV-positive status to at least one other person; (2) assistance with HIV-related medical care; and (3) receiving information on care and treatment of HIV. Linkage ranged from 45% when none of these factors occurred to 95% when all three occurred. Together, these represent the minimal bounds of care that all newly diagnosed HIV-infected persons should receive.

In India, the public sector delivers the majority of HIV care and treatment aided by nongovernmental organizations. Most receive a diagnosis at a government ICTC or hospital followed by a referral to an ART center for assessment of treatment eligibility and initiation of free first-line ART. Previous studies in India among general population adults have found approximately 70–80% are linked to ART centers after diagnosis (Alvarez-Uria, 2013; Parchure, Kulkarni, Kulkarni, & Gangakhedkar, 2015; Sarna, Sebastian, Bachani, Sogarwal, & Battala, 2014; Shastri et al., 2013). In our sample of MSM and PWID, we found a comparable number were linked after diagnosis, 80%.

By contrast, in a previous analysis, we found a median of 30% of MSM and 41% of PWID were aware of their positive status (Mehta et al., 2015), representing the largest drop in the care continuum. Considering all persons HIV-infected, both undiagnosed and diagnosed, a median of 23% of MSM and 36% of PWID, were linked to care. Therefore, MSM and PWID in India fall dramatically short of the UNAIDS target. Our high estimates of linkage among those previously diagnosed may reflect that these individuals were highly motivated to be tested and seek out medical care.

We found factors that were associated with awareness of HIV-positive status in our prior analyses (Mehta et al., 2015), were also associated with linkage such as older age, being married, higher educational attainment, and female sex. The same regional variation was seen for linkage to care with better outcomes among regions with longstanding HIV epidemics and HIV prevention and treatment efforts (Northeast for PWID, Southern India for MSM) (Department of AIDS Control Indian Ministry of Health & Family Welfare, 2013). Indeed, those who lived in districts with more ICTCs were more likely to be linked. In contrast, in cities with evidence of emerging epidemics and comparatively fewer resources for HIV prevention and treatment, linkage was suboptimal.

Beyond these demographic differences, we found that modifiable factors during or immediately after diagnosis were independent predictors of linkage. Receiving assistance with HIV-related medical care after diagnosis, such as help arranging a doctor's appointment, receiving directions for where to go for care, and help with transportation and paperwork, was the factor that best discriminated between those linked and not linked. At least a quarter of MSM and PWID did not receive this basic assistance following diagnosis. Similarly, receiving information and counseling on options available for care and treatment of HIV had high discriminative ability but only approximately half received this information. This is lower than Sarna et al. (2014) who found 83% of general population adults received information regarding availability of free ART. Inadequate information and counseling on HIV care and treatment may be more pronounced among stigmatized and marginalized groups. Two qualitative studies identified barriers to accessing free ART among MSM and PWID including the perception that some counselors did not have the knowledge or skills to effectively counsel them and using members of the MSM/PWID community as counselors could improve sensitivity and understanding (Chakrapani, Newman, Shunmugam, & Dubrow, 2011; Chakrapani, Velayudham, Shunmugam, Newman, & Dubrow, 2014).

Disclosure of HIV-positive status to a friend or family member was highly predictive of linkage. In prior research, lack of disclosure was associated with two times higher risk of non-registration at the ART center within 60 days (Sarna et al., 2014). However, fears regarding rejection and stigma from family, friends, and the community once their status is known are important to consider and mitigate (Kumarasamy et al., 2005). Utilization of peer navigators could be useful for MSM and PWID for whom a peer may be a trusted confidant and source of support and information (Blacksher et al., 2012; Govindasamy et al., 2014; Okeke, Ostermann, & Thielman, 2014). These three modifiable factors – disclosure, assistance with medical care, and information and counseling on care and treatment – together were predictive of whether or not individuals were linked to care with high accuracy independently of demographic differences and other barriers to linkage including substance use, depression, and stigma.

However, these three modifiable factors by themselves may not be enough to improve linkage for all MSM and PWID living with HIV, especially those most difficult to reach and engage in care. Prior research found incentives were effective for timely initiation of ART among people who use drugs in Chennai (Solomon et al., 2014). A systematic review by Govindasamy et al. (2014) found several other interventions to be effective in facilitating linkage in LMICs including integration of care and point-of-care CD4 count. Moreover, while not addressed in this study, discrimination by healthcare providers, threat of jail, or criminal prosecution, as well as travel or waiting time, could be additional barriers for MSM and PWID in accessing appropriate HIV-related health care (Chakrapani et al., 2011, 2014; Joglekar et al., 2011).

Limitations of this study include self-report of linkage and other factors of interest. Cross-sectional data have the potential for recall bias and we are unable to confirm a temporal relationship between factors of interest and linkage. We did not collect data on the time between diagnosis and their first encounter with a doctor to assess timely linkage to care. We

could not assess retention in HIV care, though 79% of those linked reported seeing a doctor in the prior 6 months. Some study sites had small numbers aware of their HIV-positive status, resulting in less precision for site-level linkage proportions.

Our study demonstrated that a majority of Indian MSM and PWID who are aware of their HIV status are linked to HIV clinical care after their diagnosis and prevalence of linkage is similar to that seen in the general population. However, there remains a long way to go to reach the UNAIDS targets of “90-90-90” by 2020, as awareness of HIV among positives remains low. We identified three low-cost and simple modifiable factors around the time of diagnosis that could facilitate linkage to care among MSM and PWID in India and other resource-limited settings.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Linkage to HIV care among MSM and PWID aware of their status across 26 sites in India (N = 1726).

Note: Linkage to care 95% confidence intervals (weighted): MSM sites: Bengaluru = 29.6–100%; Belgaum = 11.1–100%; Bhopal = 0–100%; Chennai = 57.6–100%; Coimbatore = non calculable; Delhi = 42.4–98.7%; Hyderabad = 26.1–100%; Madurai = 54.1–100%; Mangalore = non calculable; Vijaywada = 32.6–100%; Vishakhapatnam = 39.4–100%. PWID sites: Aizawl = 58.2–71.1%; Amritsar = 0–68.4%; Bhubaneswar = 60.3–100%; Bilaspur = 0–77.6%; Chandigarh = 0–91.0%; Churhandpur = 59.7–100%; Delhi = 0–64.9%; Dimapur = 82.4–100%; Gangtok = 87.7–95.6%; Imphal = 72.8–100%; Kanpur = 8.6–100%; Ludhiana = 53.4–100%; Lunglei = 58.3–100%; Moreh = 56.6–100%; Mumbai = 27.5–100%.

Figure 2.

Comparison of area under the receiver operating curves (AUCs) for multivariable models of linkage to care. Note: Model 1 includes demographics only (age, marital status, and education); Model 3 includes disclosure of HIV-positive status + assistance with HIV-related medical care + information and counseling on care and treatment of HIV; Model 6 includes demographics + all covariates in model 3.

Table 1 Characteristics^a of HIV-infected MSM and PWID aware of their status across 26 sites in India (*N* = 1726).

	MSM (<i>N</i> = 503; 11 sites)		PWID (<i>N</i> = 1223; 15 sites)	
	<i>N</i>	%	<i>N</i>	%
Median age (IQR)	38	(32–44)	34	(28–38)
Sexual identity (MSM)				
Panthi ^b	73	21.0	N/A	N/A
Kothi ^b	250	41.8		
Double-decker	135	23.9		
Gay/MSM	16	5.3		
Bisexual	28	8.0		
Sex (PWID)				
Male	N/A	N/A	948	64.5
Female			275	35.5
Marital status to opposite sex				
Never married	141	25.1	315	23.8
Currently married/long-term partner	313	63.8	641	58.8
Widowed/divorced/separated	49	11.1	267	17.4
Education				
Primary school or less	148	33.8	351	34.0
Secondary school	250	50.0	638	50.9
High school and above	105	16.2	233	15.1
Median personal monthly income in US dollars (IQR)	88	(64–121)	48	(0–97)
Homeless	8	2.1	55	3.7
Median network size (IQR)	20	(7–50)	15	(5–30)
History of tuberculosis	132	29.0	284	22.4
History of STI	194	30.2	N/A	N/A
History of sex work	222	38.6	104	4.8
Alcohol use				
None/limited use	390	81.1	867	75.3
Harmful/hazardous use	66	12.5	156	12.6
Alcohol dependence	47	6.3	200	12.1
Ever injected drugs	13	3.0	1223	100
Injected drugs in prior 6 months	5	1.8	908	60.1
History of needle exchange	5	1.3	647	32.8
History of opioid agonist therapy	2	0.3	437	22.9
History of incarceration	N/A	N/A	1113	91.5
Depression ^f	181	35.6	520	44.4
Median composite stigma score ² (IQR)	5.7	(3.5–10.4)	8.7	(6.1–10.5)
Disclosed HIV-positive status	414	77.2	1052	87.2
Received assistance with HIV-related medical care	368	68.5	873	74.2

	MSM (<i>N</i> = 503; 11 sites)		PWID (<i>N</i> = 1223; 15 sites)	
	<i>N</i>	%	<i>N</i>	%
Received information and counseling on care and treatment of HIV	271	52.0	622	57.2
Person/people available to help with health needs	363	72.3	811	53.6
Median CD4 count (cells/mm ³) (IQR)	406	(259–561)	293	(204–402)
Median log ₁₀ viral load (copies/mL) (IQR)	1.9	(1.9–4.1)	2.6	(1.9–4.4)
Region (MSM)				
North/Central	42	6.6	N/A	N/A
Karnataka	63	15.3		
Tamil Nadu	222	50.7		
Andhra Pradesh	176	27.3		
Region (PWID)				
North/Central	N/A	N/A	330	21.5
Northeast			893	78.5
Community-level characteristics	Median	Site range	Median	Site range
Number of ICTCs in district	28	5–101	7	3–17
Number of ART centers in district	3	1–9	1	1–12
Number of MSM/PWID-focused targeted interventions in state	11	5–31	23	3–55
Percent of TIs in state that were MSM/PWID-focused	13	3–23	36	2–74

^aAll medians/IQRs and percentages calculated using a composite weight including relative city size and RDS-II weights with the exception of network size and community-level variables, see supplementary materials for unweighted model results.

^bPanthi: predominantly prefer penetrative sex with masculine appearance; kothi: predominantly prefer receptive anal sex with some appearing more feminine. MSM, men who have sex with men; PWID, people who inject drugs; IQR, interquartile range; STI, sexually transmitted infection; ICTC, integrated counseling and testing centers; ART, antiretroviral therapy; TI, targeted interventions; N/A, not applicable.

¹Depression defined as a score >10 on PHQ-9 questionnaire;

²Composite stigma score was estimated by averaging stigma scores from four scales: vicarious stigma, enacted stigma, felt normative stigma, and internalized stigma; score ranged from 0 to 20 with higher scores reflecting more stigma.

Table 2

Predictive accuracy of factors associated with linkage to care among HIV-infected MSM and PWID across 26 sites in India ($N = 1726$).^a

	OR	95% CI	AUC (95% CI)
Population group			
MSM	REF		0.774 (0.748, 0.800)
PWID	0.30	0.08–1.21	
Age (per 10 years)	1.83	1.31–2.56	0.792 (0.767, 0.827)
Sex (PWID)			
Male	REF		0.772 (0.741, 0.802)
Female	3.12	1.92–5.07	
Sexual identity (MSM)			
Panthi	REF		0.768 (0.714, 0.822)
Kothi	2.61	0.97–7.01	
Double-decker	3.97	0.98–16.1	
Gay/MSM	8.39	0.64–109.6	
Bisexual	6.03	1.29–28.1	
Marital status			
Never married	REF		0.780 (0.754, 0.805)
Currently married/long-term partner	2.10	1.19–3.72	
Widowed/divorced/separated	2.30	1.37–3.88	
Education			
Primary school or less	REF		0.775 (0.749, 0.801)
Secondary school	1.83	1.05–3.20	
High school graduate	2.51	1.01–6.21	
Personal monthly income (US dollars)			
<50	REF		0.772 (0.745, 0.798)
50–115	1.18	0.71–1.96	
>115	1.19	0.59–2.38	
Homeless	0.73	0.44–1.22	0.774 (0.748, 0.800)
Injection drug use in prior 6 months	0.50	0.23–1.10	0.772 (0.745, 0.798)
Alcohol use			
None/limited use	REF		0.771 (0.744, 0.798)
Harmful/hazardous use	0.67	0.37–1.20	
Alcohol dependence	1.29	0.60–2.75	
History of sex work	1.31	0.63–2.72	0.775 (0.749, 0.801)
Depression	0.51	0.30–0.85	0.781 (0.755, 0.807)
Composite stigma (per 1 point increase)	0.96	0.90–1.03	0.767 (0.740, 0.795)
Disclosed HIV-positive status	2.82	2.41–6.07	0.799 (0.774, 0.824)
Received assistance with HIV-related medical care	10.0	5.55–18.2	0.841 (0.819, 0.863)
Received information and counseling on care and treatment of HIV	2.25	1.09–4.64	0.801 (0.777, 0.824)
Person/people available to help with health needs	1.43	0.91–2.25	0.775 (0.749, 0.802)

	OR	95% CI	AUC (95% CI)
Region/State (MSM)			
North/Central	REF		0.662 (0.601, 0.722)
Karnataka	1.20	1.03–1.39	
Tamil Nadu	80.4	34.7–186.4	
Andhra Pradesh	1.41	1.01–1.97	
Region (PWID)			
North/Central	REF		0.760 (0.728, 0.792)
Northeast	5.97	1.79–19.9	
Number of ICTC centers in district (per five centers)	1.18	1.03–1.36	0.774 (0.748, 0.800)
Number of ART centers in district (per one center)	1.12	0.90–1.38	0.775 (0.749, 0.801)
Number of MSM/PWID-focused TIs in state (per one TI)	1.01	0.98–1.03	0.774 (0.747, 0.800)
Percent of TIs MSM/PWID-focused (per 10%)	1.06	0.88–1.27	0.773 (0.747, 0.799)

^a Models incorporated scaled RDS-II weights; see supplementary materials for unweighted model results. OR, odds ratio; CI, confidence interval; AUC, area under the receiver operator curve; MSM, men who have sex with men; PWID, people who inject drugs; ICTC, integrated counseling and testing centers; ART, antiretroviral therapy; TI, targeted interventions.

Table 3

Multivariable prediction models for linkage to care among HIV-infected MSM and PWID across 26 sites in India ($N = 1726$).^a

	AUC (95% CI)
Model 1	
Age	0.789 (0.763, 0.814)
Marital status	
Education	
Model 2	
Disclosure of HIV-positive status	0.848 (0.826, 0.869)
Received assistance with HIV-related medical care	
Model 3	
Disclosure of HIV-positive status	0.851 (0.830, 0.873)
Received assistance with HIV-related medical care	
Received information and counseling on care and treatment of HIV	
Model 4	
Disclosure of HIV-positive status	0.848 (0.826, 0.869)
Received assistance with HIV-related medical care	
Number of ART centers in district	
Model 5	
Disclosure of HIV-positive status	0.850 (0.829, 0.872)
Received assistance with HIV-related medical care	
Received information and counseling on care and treatment of HIV	
Depression	
Model 6	
Age	0.855 (0.833, 0.876)
Marital status	
Education	
Disclosure of HIV-positive status	
Received assistance with HIV-related medical care	
Received information and counseling on care and treatment of HIV	
Model 7	
Disclosure of HIV-positive status	0.844 (0.822, 0.866)
Received assistance with HIV-related medical care	
Received information and counseling on care and treatment of HIV	
Stigma	
Model 8	
Disclosure of HIV-positive status	0.848 (0.827, 0.870)
Received assistance with HIV-related medical care	
Received information and counseling on care and treatment of HIV	
Alcohol use	

^aModels incorporated scaled RDS-II weights, see supplementary materials for unweighted model results. AUC, area under the receiver operator curve; MSM, men who have sex with men; PWID, people who inject drugs; ART, antiretroviral therapy.

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