Research Article

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Evaluating the HIV continuum of care and treatment in a low prevalence city in Iran: Kerman HIV-Friendly City initiative

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BACKGROUND
The Kerman HIV-Friendly City (KHFC) is a five-year multi-disciplinary population-level intervention designed to meet the UNAIDS 90-90-90 targets by 2020. This study was a baseline assessment of the KHFC and analyzed the cascade of HIV testing, treatment and retention.

METHODS
We reviewed reported HIV cases in Kerman city from 1997 to 2016. We calculated the numbers of cases with an HIV diagnosis, enrolled in HIV care within six months, initiated on antiretroviral treatment (ART), retained on ART at 12 months, and with suppressed viral load after 12 months on ART. We estimated the number of people living with HIV (PLWH) using point and uncertainty intervals (UI) for national PLWH estimates.

RESULTS
We estimated 1113 (UI 762-1982) PLWH in Kerman, of whom 437 (39.3%, UI 22.0 -57.3%) had been diagnosed, 347 (31.2%, UI 17.5-45.5%) had enrolled in care, 190 (17.1%, UI 9.6-24.9%) had initiated ART, 112 (10.1%, UI 5.7-14.7%) remained on ART, and 81 (7.3%, UI 4.1-10.6%) were virally suppressed.People who inject drugs (PWID) had the lowest indicators compared to other groups. In 2016, 23 people (43.5% male, 87.0% $\geq$25 years old, 17.4% PWID, and 26.1% heterosexuals) were diagnosed with HIV. Of these, 22 enrolled in care, 19 initiated ART, 18 remained on ART and seven were virally suppressed.

CONCLUSION
HIV diagnosis is the biggest gap in the HIV continuum of care and treatment in Kerman. Recent improvements in HIV care and treatment need to be intensified to achieve 90-90-90 targets.

Key words: HIV, continuum of care, HIV diagnosis, engagement in care, antiretroviral therapy

BACKGROUND

As of 2015, 28,663 cases of HIV had been reported in Iran (Ministry of Health and Medical Education (MOHME), 2015). SPECTRUM models suggest there are 73,000 (95% CI 50,000-130,000) people living with HIV (PLWH), with an increasing proportion of women among new infections (The Joint United Nations Programme on HIV/AIDS (UNAIDS), 2015). The prevalence of HIV in Iran is low in the general population (<0.1%) (Haghdoost et al., 2011) but considerably higher among specific key populations like people who inject drugs (PWID) (13.8% in 2014) (Regional knowledge Hub and WHO Collaborating Centre for HIV surveillance (HIVHUB), 2014), fe-

male sex workers (2.1% in 2015) (Regional knowledge Hub and WHO Collaborating Centre for HIV surveillance (HIVHUB), 2015b), prisoners (0.8% in 2017) (HIV/STI Surveillance Research Center and WHO Collaborating Center for HIV Surveillance (HIVHUB), 2017), injecting female partners of PWID (7.7% in 2010), non-injecting female partners of PWID (2.8% in 2010) (Alipour, Haghdoost, Sajadi, & Zolala, 2013), and street children (4.5% in Tehran in 2010) (Foroughi, 2016). To our knowledge, no data are available for men who have sex with men in Iran.

Iran has committed to the fast-track cities initiative which aims to end the AIDS epidemic as a public health threat by 2030 (The Joint United Nations Programme on HIV/AIDS (UNAIDS), 2016a). Iran's national HIV program has included the 90-90-90 global targets (The Joint United Nations Programme on HIV/AIDS (UNAIDS), 2016b) and framework into its current strategic plan and has targeted resources to achieve them. The 90-90-90 global targets to end the AIDS epidemic by 2020 are: 1) 90% of all PLWH will know their HIV status; 2) 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy (ART); and 3) 90% of all people receiving ART will have viral suppression. Iran has recently implemented several strategies to improve HIV testing such as scaling up HIV rapid testing by integrating testing and counseling services into numerous public and private health and harm reduction centers; expanding the national HIV guidelines to include provider-initiated HIV testing and counseling; implementing several campaigns for public awareness on HIV and HIV testing; and successfully implementing several mobile HIV testing units (Ministry of Health and Medical Education (MOHME), 2015). In July 2017, ART eligibility changed in Iran from specific clinical and CD4 criteria (<350 CD4 cells/μL in 2008 (Center for Disease Control (CDC), 2008) to <500 cells/μL in 2014 (Center for Disease Control (CDC), 2014)) to universal ART (Center for Disease Control (CDC), 2017).

In addition to specific initiatives to improve coverage of HIV testing and treatment programs, in 2015 Iran started city-wide population-level interventions aimed at creating HIV stigma-free cities (Karamouzian, Madani, Doroudi, & Haghdoost, 2017). Several stakeholders, including public health authorities, the education department, social welfare organizations and religious leaders from national and local institutes, met to create a five-year strategic plan to reduce HIV stigma and to increase access to HIV prevention, care and treatment services. The first of these meetings took place in the city of Kerman in 2015.

The Kerman HIV-Friendly City (KHFC) initiative is a community-based intervention focused on creating an HIV stigma-free city. The KHFC initiative operates seven city-wide strategies: 1) increasing knowledge on HIV risk, prevention and treatment services (activities: advocacy and training meetings for government staff, community and key populations members; and public education by TV and radio series, short movies, pamphlets, handbooks, and billboards); 2) reducing stigma (activities: street art and music exhibitions and theaters; documentary movies; and case stories of affected families and harms associated with HIV stigma and discrimination); 3) integrating prevention and treatment services for key populations (activities: identifying and mapping of key and priority populations; expanding outreach team services; and adding harm reduction activities to routine health services); 4) strengthening case finding and linkage to services (activities: public and social media campaign to encourage testing by offering free HIV testing and counselling more broadly; mobile clinics to test and treat; integrating HIV testing into routine care for vulnerable populations; extensive pre- and post-test counseling to improve linkage to care; and expanding health coverage and housing services); 5) eliminating mother-to-child HIV transmission (activities: expanding PMTCT services to private sector; improving timely referral and linkage; and improving family planning for women at high risk and sex workers); 6) supporting those living with or affected by HIV (activities: providing social, health support and counseling/relief services; positive club and hotline; and expanding community partnership and involvement); and 7) strengthening surveillance (activities: monitoring the HIV continuum of care and treatment and implementing the HIV test–treat–retain cascade analysis on available data to direct programming toward achieving the 90-90-90 targets).

A baseline assessment was critical to monitor the impact of the KHFC initiative. In this paper, we used the existing HIV case-reporting data from Kerman, collected from 25 March 1997 to 31 December 2016, to estimate the HIV testing, retention, and treatment indicators that make up the 90-90-90 targets. This paper is an example of the use of existing surveillance data to answer key public health questions.

METHODS

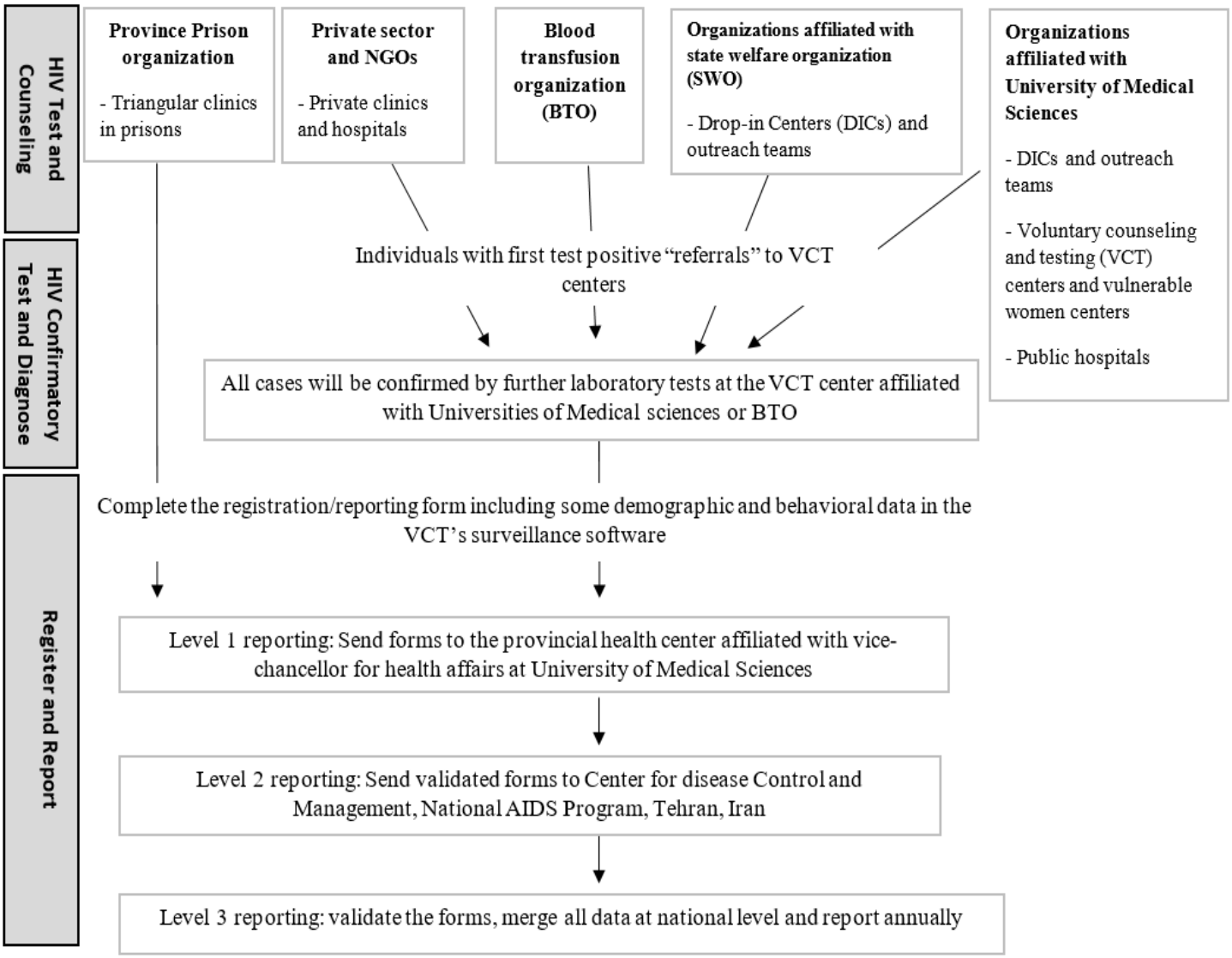
HIV surveillance data in Kerman

Kerman is located in southeast Iran and, according to the 2016 Iranian Census, has 738,724 residents (35% under 20 years old) (Statistical Center, 2016). The HIV/AIDS individual-based case reporting system in Kerman is part of the National HIV/AIDS Surveillance System which was established in 2009 (Nematollahi, Khalesi, Moghaddasi, & Askarian, 2012). Reportable cases are individuals diagnosed with HIV (tested positive with ELISA and confirmation by Western Blot), advanced HIV infection (WHO clinical stage 3 or AIDS), AIDS (WHO clinical stage 4) and AIDS-related deaths (confirmed by medical records and death certifications). As of 2016 in Kerman, one voluntary HIV counseling and testing (VCT) center is the referral center for all people who test positive (or reactive) for HIV at any health facility or laboratory in Kerman. This VCT center sends blood samples for confirmatory HIV diagnosis to the central public health laboratory. Both

the VCT center and the laboratory are supported and supervised by the Public Health Department at Kerman Medical University.

In Kerman, HIV testing and counseling services are offered by numerous facilities, including four public hospitals, more than 20 private laboratories, one blood transfusion organization, one antenatal clinic (that also provides PMTCT services), two centers for vulnerable women including female sex workers, one provincial prison organization, two drop-in centers affiliated with Kerman Medical University, and one drop-in center affiliated with a local social welfare organization. All individuals testing positive for HIV at these centers are referred to the VCT center affiliated with Kerman Medical University for confirmatory tests and upon diagnosis are offered membership in an HIV-positive club for further services and follow-up. All confirmed cases are reported to the local and national surveillance systems (Figure 1) (Regional knowledge Hub and WHO Collaborating Centre for HIV surveillance (HIVHUB), 2015a).

Figure 1. HIV case-based surveillance system and reporting in Iran



Indicators to assess HIV continuum of care and treatment

We used five indicators (HIV diagnosis, enrollment in HIV care, ART initiation, retention on ART and viral load suppression) from the WHO recommended definitions (Table 1) (World Health Organization (WHO), 2014). We calculated these indicators for all HIV reported cases in Kerman (from 1997 to 2016), and separately for cases diagnosed in three time periods since 2007 (2007-2009, 2010-2012, 2013-2015). For recent HIV reported cases (between 1 January and 31 December 2016), we calculated the indicators for enrollment in HIV care, ART initiation, retention on ART and viral load suppression (defined as <1000 copies/ml). We also calculated these indicators by transmission category using all reported HIV cases, as the number of recent HIV reported cases was too small for subgroup analysis.

Table 1: HIV continuum of care and treatment indicators, Iran

Indicator	Definition
% of people living with HIV who were diagnosed	Number of people diagnosed with HIV, divided by total estimated number of people living with HIV
% of people diagnosed with HIV who were enrolled in HIV care	Number of people diagnosed with HIV who enrolled in HIV care within 6 months after diagnosis, divided by number of people diagnosed with HIV
% of HIV-positive people in HIV care who initiated ART	Number of HIV-positive people in HIV care who initiated ART, divided by number of people in HIV care
% of HIV-positive people who initiated and were retained on ART	Number of HIV-positive people who initiated ART and were known to be alive and on ART within 12 months after initiating ART, divided by number of people who initiated ART
% of HIV-positive people who were retained on ART and were virologically suppressed, confirmed by laboratory testing	Number of HIV positive people who were virologically suppressed (<1000 copies/ml) confirmed by laboratory testing, divided by number of people who were retained on ART for 12 months

Data management and analysis

We exported de-identified data of all reported cases from the HIV registry (managed by Kerman University of Public Health, Deputy of Health, HIV/STI Office) to a master Excel spreadsheet and cleaned the data for further analysis. Exported variables included date of diagnosis, age at diagnosis, sex, transmission category, ART medication history and follow-up visits. When calculating indicators for enrollment or ART initiation, we excluded patients who had died.

We estimated the number of PLWH in Kerman using the point and 95% confidence interval (95% CI) of the estimated number of PLWH in Iran and the proportion of all HIV cases diagnosed at the national level to all diagnosed in Kerman:

- Estimated number of PLWH in Iran in 2015 = 73,000 (95% CI 50,000 – 130,000)
- All cases diagnosed in Iran by the end of 2016 = 28,663
- All cases diagnosed in Kerman by the end of 2016 = 437
- Estimated number of PLWH in Kerman in 2016 = 437*73,000 (95% CI 50,000 – 130,000) /28,663= 1,113 (95% CI 762, 1,982)

In Iran until 2015, ART was initiated for patients with a CD4 count <500 cells/uL; however the treatment strategy changed to universal ART in July 2017 (Center for Disease Control (CDC), 2017). Since CD4 count at baseline was not collected or reported systematically, we were not able to assess it in our analysis.

We reported the number of all and recent HIV reported cases by sex (male, female), age groups (<5, 5-24, 25-34, 35-44 and 45 or older), and transmission category (unsafe injection, unsafe heterosexual sex, unsafe homosexual sex, blood or blood products, mother-to-child, high-risk spouse, HIV-infected spouse, needle stick, other routes and unknown reasons). Fisher's exact test was used to assess the differences between all and recent HIV reported cases regarding sex, age, and transmission category. To test for trend in reported cases by sex, age and transmission category in three time periods, we used Cuzick nonparametric test, which is an extension of the Wilcoxon rank-sum test (Cuzick, 1985). P-values <0.05 were considered statistically significant. We used STATA v.13 (StataCorp, College Station, TX) for all analyses.

The Kerman University of Science and Medical Education Institutional Review Board does not require ethics approval for secondary analysis of routinely collected data. All data for this analysis were program and surveillance data that were routinely collected for HIV surveillance and HIV case management. Therefore, the Institutional Review Board did not require ethical review for the study. The data were de-identified prior to our analysis.

RESULTS

From 25 March 1997 to 31 December 2016, a total of 1942 individuals in Kerman had been counseled and tested for HIV, and cumulatively 437 HIV cases had been reported. Overall, 36 (out of 437) people died and were dropped from our analysis when calculating indicators for enrollment or ART initiation. The number of individuals tested for HIV in 2016 was 656; of these, 23 persons were HIV-infected.

Table 2 shows all people diagnosed with HIV by the end of 2016 and in 2016 by sex, age groups and transmission categories. Of the 437 cases, 330 (75.5%) were male. The number of female patients increased significantly by year; in 2016, 56.5% of reported cases were women. The majority of patients was 35-44 years old in both time periods. Unsafe injection (54.2 %) and unsafe heterosexual sex (10.5 %) were reported as the two main routes of HIV transmission. During the three consecutive time periods, the proportion of cases reporting unsafe injection as the route of HIV transmission decreased from 65.4% to 17.5%. The proportion of cases reporting unsafe heterosexual sex and having an HIV-infected spouse as the routes of HIV transmission increased from 10.3% to 26.3% and 2.6% to 3.5%, respectively.

The number of HIV-infected individuals by HIV care indicator and each step of the cascade is shown in Table 3. Such gaps in HIV care and treatment has been improved in recent years, but are still highest among those infected by unsafe injection than others (the trend presented in supplementary Table 1). A total of 347 patients (79.4% of

those diagnosed with HIV) enrolled in care within six months after HIV diagnosis, and of these, 190 (54.7%) began ART. In addition, 112 patients (58.9% those who received ART) were retained on ART and were alive and on ART at 12 months. Finally, 81 (72.3 %) of those retained on ART had suppressed viral load.

Table 2: The overall (1997-2016) and recent (2016) number of people diagnosed with HIV in Kerman city among demographic subgroups and modes of transmission

	All people diagnosed with HIV by the end of 2016 n (%)	People diagnosed with HIV in 2016 n (%)	P-value*	Diagnosed between 2007-9 n (%)	Diagnosed between 2010-12 n (%)	Diagnosed between 2013-15 n (%)	P-value for trend **
Total	437	23		78	65	57	
Sex							
Male	330 (75.5)	10 (43.5)	0.001	60 (76.9)	41 (63.1)	27 (47.4)	0.001
Female	107 (24.5)	13 (56.5)		18 (23.1)	24 (36.9)	30 (52.6)	
Age groups							
<5	7 (1.6)	2 (8.7)	0.093	2 (2.6)	0 (0)	2 (3.5)	0.001
5-24	33 (7.6)	1 (4.3)		6 (7.7)	3 (4.6)	7 (12.3)	
25-34	168 (38.4)	5 (21.8)		31 (39.7)	21 (32.3)	18 (31.6)	
35-44	175 (40.0)	11 (47.8)		29 (37.2)	27 (41.5)	23 (40.3)	
45≤	54 (12.4)	4 (17.4)		10 (12.8)	14 (21.6)	7 (12.3)	
Modes of transmission							
Unsafe injection	237 (54.2)	4 (17.4)	0.001	51 (65.4)	24 (36.9)	10 (17.5)	0.001
Unsafe heterosexual sex	46 (10.5)	6 (26.1)		8 (10.3)	5 (7.7)	15 (26.3)	
Unsafe homosexual sex	2 (0.5)	0 (0)		0 (0)	1 (1.5)	0 (0)	
Blood/blood products	0 (0)	0 (0)		0 (0)	0 (0)	0 (0)	
Mother to child	8 (1.8)	2 (8.7)		2 (2.6)	1 (1.5)	2 (3.5)	
Mother to child	8 (1.8)	2 (8.7)		2 (2.6)	1 (1.5)	2 (3.5)	
High-risk spouse	22 (5.0)	3 (13.0)		2 (2.6)	12 (18.5)	2 (3.5)	
HIV-infected spouse	40 (9.1)	5 (21.7)		7 (8.8)	11 (16.9)	11 (19.3)	
Needle stick	2 (0.5)	0 (0)		0 (0)	0 (0)	2 (3.5)	
Other	9 (2.1)	2 (8.7)		8 (10.3)	8 (12.3)	12 (21.1)	
Unknown	71 (16.3)	1 (4.4)		0 (0)	3 (4.7)	3 (5.3)	

* Fisher's exact test p-value that compares the distribution of HIV cases diagnosed in 2016 to distribution of HIV cases diagnosed before 2016.
** Cuzick nonparametric test for trend across groups, which is an extension of the Wilcoxon rank-sum test (Cuzick, 1985).

Only 17.1% of all PLWH received ART, and only 7.3% were virologically suppressed (Figure 2). Among those who were diagnosed with HIV in 2016, 83.0% received ART, and 30.4% were virologically suppressed as confirmed by laboratory testing (Figure 3). The biggest gap in the HIV cascade for all HIV cases was HIV diagnosis, and in those HIV cases who were diagnosed in 2016, the biggest gap was viral suppression.

DISCUSSION

We successfully used the available surveillance data to assess the baseline indicators for 90-90-90 targets for the HIV continuum of care and treatment before the KHFC intervention. We found that fewer than 10% of all PLWH in Kerman had received ART and were virally suppressed. The major gaps in the HIV continuum of care and treatment are HIV diagnosis and ART initiation. The majority of cases was infected through unsafe drug injection; they were less likely to be enrolled in HIV care and to receive ART than the other subgroups.

Our findings are consistent with previous studies that suggest that the major gap in the HIV continuum of care and treatment in Iran is the first step, HIV screening and diagnosis (Shokoohi, 2016). The KHFC intervention

should prioritize strategies and activities toward strengthening case finding and linkage to services. It is estimated that only 37% (95%CI, 26-54%) of PLWH in the Middle East and North Africa region in 2015 knew their HIV status (The Joint United Nations Programme on HIV/AIDS (UNAIDS), 2016a). The primary testing approaches in Iran have focused on facility-based VCT (Fahimfar, Sedaghat, Hatami, Kamali, & Gooya, 2013), which provided limited access to and uptake of HIV testing services for key populations. Recent efforts to improve coverage of HIV testing in Iran include community testing campaigns, introducing mobile testing units, and integrating HIV testing services into basic health-care facilities (including primary health care for pregnant women and tuberculosis clinics) and in facilities serving key populations (e.g. drop-in centers and methadone clinics for PWID and vulnerable women centers for female sex workers) and adopting the WHO provider-initiated HIV testing approach (Ministry of Health and Medical Education (MOHME), 2015). Our data indicate that, despite these efforts, many PLWH are still not getting tested, perhaps because efforts to improve coverage of HIV testing have begun recently and in few locations. Such testing strategies need to be expanded and their effectiveness needs to be monitored carefully. Moreover, innovative testing strategies such as HIV self-testing (Jahanbakhsh, Mostafavi, & Haghdoost, 2015) that remove the structural barriers of having to go to a health center for HIV testing need to be considered to reach at-risk stigmatized and hard-to-reach populations like female sex workers, men who have sex with men and PWID.

Table 3: HIV care indicators for all people diagnosed with HIV by the end of 2016 in Kerman city, overall, by modes

Modes of transmission	Diagnosed with HIV	Number (%)[1] Enrolled in care	Number (%)[2] Received ART	Number (%)[3] Retained on ART	Number (%)[4] Virologically suppressed as confirmed by lab
Total	437	347 (79.4)	190 (54.7)	112 (58.9)	81 (72.3)
Modes of transmission					
Unsafe injection	237	180 (75.9)	70 (38.9)	35 (50.0)	21 (60.0)
Unsafe heterosexual sex	46	39 (84.8)	27 (69.2)	14 (51.8)	10 (71.4)
Unsafe homosexual sex	2	1 (50.0)	0 (0)	0 (0)	0 (0)
Blood/blood products	0	0 (0)	0 (0)	0 (0)	0 (0)
Mother to child	8	8 (100.0)	7 (87.5)	5 (71.4)	4 (80.0)
High-risk spouse	22	22 (100.0)	21 (95.4)	11 (52.4)	9 (81.8)
HIV-infected spouse	40	38 (95.0)	30 (78.9)	25 (83.3)	17 (68.0)
Needle stick	2	2 (100.0)	2 (100.0)	2 (100.0)	2 (100.0)
Other	9	9 (100.0)	9 (100.0)	4 (44.4)	4 (100.0)
Unknown	71	48 (67.6)	24 (50.0)	16 (66.7)	14 (87.5)

Figure 2. HIV test and treatment cascade in all people estimated to be living with HIV in Kerman, Iran, 1997-2016.

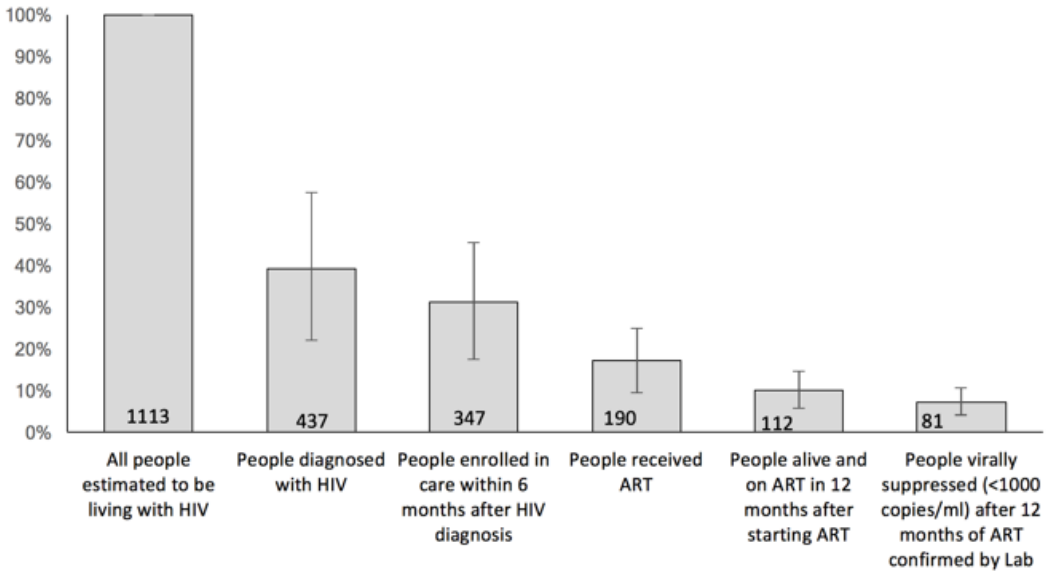
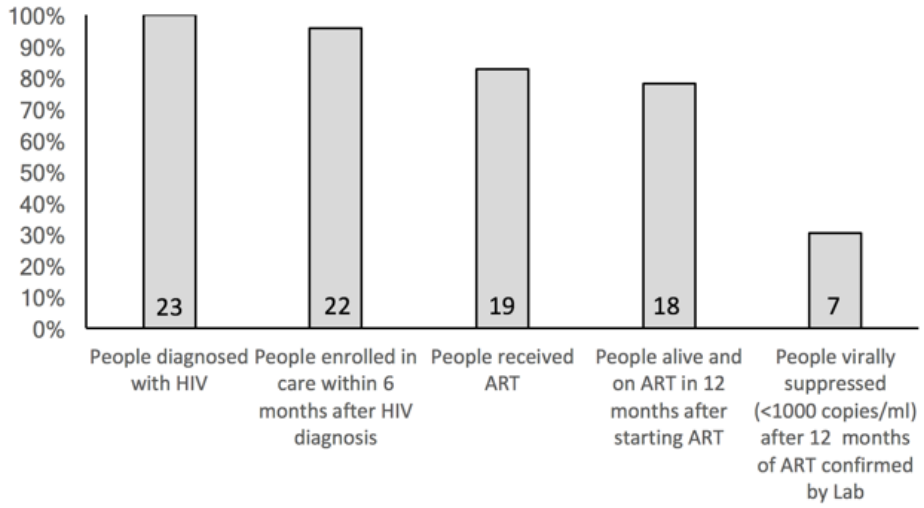


Figure 3. HIV test and treatment cascade in all people estimated to be living with HIV in Kerman, Iran, 2016.



In addition, our results suggest that about 80% of diagnosed people were enrolled in HIV care within six months after diagnosis, of whom ART was initiated among only half. Therefore, only 30% of PLWH were on ART in Kerman, an estimate which is much higher than the estimate for the MENA region (17%) (The Joint United Nations Programme on HIV/AIDS (UNAIDS), 2016a). A recent study of HIV continuum of care in 53 countries reported that the proportion of PLWH who received ART was 48% (range from 12% to 86%), and in the top ten countries, the range was 61% to 86% (Granich et al., 2017). Many countries that used a test-and-treat strategy (i.e., start ART at the time of diagnosis regardless of CD4 count or WHO clinical stage) (Govindasamy et al., 2014; Mavegam, Pharr, Cruz, & Ezeanolue, 2017; Nsanzimana, Kanters, & Mills, 2015) were more successful in reducing the gap in ART treatment. Iran recently adapted the test-and-treat strategy, which may close this gap in the continuum of care (Ministry of Health and Medical Education (MOHME), 2015).

We observed the highest gap in the continuum of care indicators among those who were likely infected by unsafe injection, i.e., people who inject drugs (PWID), in comparison to other risk groups. Aside from individual and structural barriers, a higher incarceration rate among PWID in Vancouver, Canada has been shown to have a disruptive role (Milloy, Montaner, & Wood, 2014). Efforts to improve the continuity of care before, during and after incarceration are needed to improve the HIV care and treatment indicators among PWID and other individuals retained in the criminal justice system (Iroh, Mayo, & Nijhawan, 2015). In a review of the continuum of care among PWID in European countries, the percentage of HIV-infected PWID on ART ranged from 73.0% in Azerbaijan to 90.9% in Bulgaria (Risher, Mayer, & Beyrer, 2015). A review of interventions to improve linkage, retention in care and ART initiation in resource-limited settings showed that patient navigation, rapid ART initiation and mobile phone technology are effective interventions (Govindasamy et al., 2014). Given that most HIV transmission in Iran occurs among men and through unsafe injection, adapting these strategies to improve HIV testing and linkage to care and treatment in this key population and their partners is critical.

Although only 7% of PLWH in Kerman have suppressed viral loads, the majority of those who initiated ART remained on treatment, and more than 70% of these were virally suppressed at 12 months. This number is much improved from our previous assessment of mortality and loss to follow-up (34.7% by six months follow-up) among HIV patients from a referral treatment center in Tehran (Moradmand Badie, Nabaei, Rasoolinejad, Mirzazadeh, & McFarland, 2013). In other countries in the region including Egypt and Yemen, peer support and patient transportation have been shown to decrease loss to follow-up among patients initiated on ART (The Joint United Nations Programme on HIV/AIDS (UNAIDS), 2016a). Overall, our estimated prevalence of viral suppression is likely to underestimate the actual number, as several patients had had no viral load laboratory tests. Such underestimation is expected to be slightly higher in our analysis of HIV cases diagnosed in 2016, as few cases diagnosed in late 2016 were not tested for viral load because they had initiated ART less than 12 months previously.

Our analysis had several limitations. To the extent possible, we identified and removed individuals who had died from the indicator denominators, but there might have been more deaths, and so we may have underestimated the care and treatment indicators. We estimated the number of PLWH in Kerman from a national estimate using a multiplier method, and so we are assuming the proportion of PLWH who are being diagnosed in Kerman is the same as the proportion in the whole country. We

used the existing routine data collected and reported for HIV cases, and so we were not able to assess the continuum of care by all key demographic and key populations. Nevertheless, our study provided a justifiable baseline assessment and trends for indicators of the 90-90-90 targets for the HIV continuum of care and treatment.

CONCLUSION

We are the first group to use routinely collected surveillance data to systematically study the HIV continuum of care and treatment at a subnational level in Iran and show considerable gaps in reaching the 90-90-90 targets. Massive scale-up of HIV testing for persons at risk for HIV is urgently needed. Moreover, to better monitor the HIV epidemic and progress toward the 90-90-90 targets, HIV case-based surveillance needs to be strengthened and the data need to be analyzed carefully and regularly to help local public authorities evaluate and customize effective strategies to reduce the gaps in HIV testing and treatment.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHOR CONTRIBUTIONS

SHH and AM conceived and designed the study and carried out the data analysis. SHH carried out the data collection and cleaning. SHH and AM drafted the manuscript. All authors read, revised and approved the final manuscript.

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Supplementary Table 1. : HIV care indicators for all people diagnosed with HIV by the end of 2016 in Kerman city, by four time periods and by modes of transmission categories

Modes of transmission	Diagnosed with HIV	Number (%)[1] Enrolled in care	Number (%)[2] Received ART	Number (%)[3] Retained on ART	Number (%)[4] Virologically suppressed as confirmed by lab
Total	437	347 (79.4)	190 (54.7)	112 (58.9)	81 (72.3)
2007-2009					
Unsafe injection	51	41 (80.3)	21 (51.2)	19 (90.4)	15 (78.9)
Unsafe heterosexual sex	8	6 (75.0)	4 (66.6)	4 (100.0)	1 (25.0)
Unsafe homosexual sex	0	0 (0)	0 (0)	0 (0)	0 (0)
Blood/blood products	0	0 (0)	0 (0)	0 (0)	0 (0)
Mother to child	2	2 (100.0)	2 (100.0)	2 (100.0)	1 (50.0)
High-risk spouse	2	2 (100.0)	2 (100.0)	2 (100.0)	1 (50.0)
HIV-infected spouse	7	7 (100.0)	6 (85.7)	6 (100.0)	4 (66.6)
Needle stick	0	0 (0)	0 (0)	0 (0)	0 (0)
Other	8	7 (87.5)	5 (71.4)	5 (100.0)	3 (60.0)
Unknown	0	0 (0)	0 (0)	0 (0)	0 (0)
2010-2012					
Unsafe injection	24	23 (95.8)	13 (56.5)	12 (92.3)	10 (83.3)
Unsafe heterosexual sex	5	5 (100.0)	5 (100.0)	4 (80.0)	3 (75.0)
Unsafe homosexual sex	1	1 (100.0)	1 (100.0)	1 (100.0)	0 (0)
Blood/blood products	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mother to child	1	1 (100.0)	0 (0)	0 (0)	0 (0)
High-risk spouse	12	12 (100.0)	12 (100.0)	10 (83.3)	8 (80.0)
HIV-infected spouse	11	10 (90.9)	8 (80.0)	7 (87.5)	6 (85.7)
Needle stick	0	0 (0)	0 (0)	0 (0)	0 (0)
Other	8	7 (87.5)	5 (71.4)	5 (100.0)	4 (80.0)
Unknown	3	3 (100.0)	3 (100.0)	2 (66.6)	2 (100.0)
2013-2015					
Unsafe injection	10	10 (100.0)	10 (100.0)	9 (90.0)	6 (66.6)
Unsafe heterosexual sex	15	13 (86.6)	10 (76.9)	9 (90.0)	7 (77.7)
Unsafe homosexual sex	0	0 (0)	0 (0)	0 (0)	0 (0)
Blood/blood products	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mother to child	2	2 (100.0)	2 (100.0)	2 (100.0)	2 (100.0)
High-risk spouse	2	1 (50.0)	1 (100.0)	1 (100.0)	0 (0)
HIV-infected spouse	11	11 (100.0)	9 (81.8)	9 (100.0)	6 (66.6)
Needle stick	2	2 (100.0)	2 (100.0)	2 (100.0)	2 (100.0)
Other	12	12 (100.0)	11 (91.6)	10 (90.9)	8 (80.0)
Unknown	3	3 (100.0)	3 (100.0)	3 (100.0)	3 (100.0)
2016					
Unsafe injection	4	4 (100.0)	4 (100.0)	3 (75.0)	0 (0)
Unsafe heterosexual sex	6	6 (100.0)	5 (83.3)	5 (100.0)	2 (40.0)
Unsafe homosexual sex	0	0 (0)	0 (0)	0 (0)	0 (0)
Blood/blood products	0	0 (0)	0 (0)	0 (0)	0 (0)
Mother to child	2	2 (100.0)	2 (100.0)	2 (100.0)	0 (0)
High-risk spouse	3	3 (100.0)	3 (100.0)	3 (100.0)	1 (33.3)
HIV-infected spouse	5	4 (80.0)	3 (75.0)	3 (100.0)	2 (66.6)
Needle stick	0	0 (0)	0 (0)	0 (0)	0 (0)
Other	2	2 (100.0)	1 (50.0)	1 (100.0)	1 (100.0)
Unknown	1	1 (100.0)	1 (100.0)	1 (100.0)	1 (100.0)

ART: Antiretroviral Therapy; [1] Percent of all diagnosed cases; [2] Percent of those enrolled in care; [3] Percent of those received ART; [4] Percent of those retained on ART