

Hot Spot Mapping and Size Estimation of Illicit Drug Users in Iran: A Pilot Study

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Research

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Abstract

Background: Mapping and size estimation of people who use (PWUD) or inject drugs (PWID) are important issues for control of drug use. The aim of this pilot study is to mapping and estimate the number of PWUD and PWID in Iran.

Methods: We used the hotspot mapping and size estimation method to estimate the number of illicit drug users in four cities of Iran from December 2017 to January 2019. We identified hotspots by local knowledge of key informants. For size estimation in each hotspot, three estimates were made during hotspot visit: a) KAP-KI (Key Affected Population Key Informant) estimate (drug users met in the hotspot), b) Non-KAP KI estimate (e.g. taxi drivers, shopkeepers nearby the hotspot); c) estimation made by field observers. Locations of hotspots were recorded by the field team and ArcGIS software was used for mapping.

Results: A total number of 335 hot spots were identified in four cities of them, 70 (20.9%) were in Ahvaz, 90 (26.9%) in Sari, 67 (20%) in Yazd and 108(32.2%) in district 2 of Tehran metropolitan. We identified nine high-density areas for PWUDs of them three were in Ahvaz, one in the south of Sari, two in district 2 of Tehran and three in Yazd. The total numbers of 1524 key informants were interviewed by the field team in 335 identified hot spots. Based on the median estimated number of PWUD, Ahvaz had the highest estimated number of PWUD (1242, range, 606-1285), followed by Sari (788, range, 373-1044), district 2 of Tehran (684, range, 642-728) and Yazd (123, range, 76-316). The median estimated number of PWID indicated that Ahvaz had the highest estimated number of PWID (843, range, 703-887), followed by Sari (346, range, 307-666), Yazd (228, range, 221-471) and Tehran (18, range, 18-34).

Conclusions: Findings highlight the importance of geographical targeting of illicit drug users to provide harm reduction programs with a broader reach in Iran.

Introduction

Illicit drug use is a major health problem worldwide and annually hundreds of millions of people consume at least one of a variety of illicit drugs. Based on world drug report in 2019, there was estimated 585,000 deaths and 42 million years of life lost due to drug use. Globally, the number of deaths and disability-adjusted life years (DALYs) in the past three decades have approximately doubled(1). Mental health problems and attempted and completed suicides that occur due to illicit drug use exacerbated this situation (2). The sexual high risk behaviors in this population including multiple sexual relationship and sexual networks with people who inject drugs (PWID) can lead to vulnerability for sexually transmitted infections (STIs) (3, 4). HIV prevalence among PWUD was reported 10 times greater and in PWID was 22 times higher than the general population (2, 5–7). Viral hepatitis C and B (HCV, HBV) are another infectious diseases with greater prevalence among PWUD (8, 9).

The injecting drug use is a major cause of HIV transmission in Iran. Based on the report of Iran's Ministry of Health and Medical Education (MOHME), there is estimated about 200, 000 to 230, 000 PWID in Iran

and more than 65% of HIV identified cases was related to injection drug use (10, 11). Accurate size estimation of illicit drug users can help in management of intervention and preventive plans, allocation of the resources and monitoring the interventions(12).

Various techniques are available to estimate the size and dynamics of at risk populations, including multiplier, capture recapture and network scale-up method (13–16). With these size estimation techniques, the reliable estimates can be obtained, but they cannot describe the geographical location of these populations and related hotspots. The objectives of mapping and size estimation method is to determine the illicit drug use hotspots, the high risk activities that occur in hotspots, peoples who are involved and to estimate the number PWUD and PWID and in totally we can access to detailed information of these locations (17, 18). The aim of this study was to determine the geographic distribution of illicit drug use hotspots and estimating the size of PWUD and PWID by using mapping and population size estimation method in four cities if Iran as a pilot study.

Material And Methods

In this study, we used the key informant-driven mapping and enumeration approach(12) to describe the geographic distribution of illicit drug hotspots and estimating the number of PWUD and PWID and prevalence of related high risk behaviors in hotspots. This study conducted during December 2017 to January 2019. Field team members started data collection activities in four cities of Iran (Ahvaz, Sari, Yazd and district 2 of Tehran metropolitan). Ahvaz is located in the southwest of Iran and the capital of Khuzestan province with a population size of about 1,300,000 populations; Sari located in the southern coast of the Caspian Sea in the north of Iran and is the capital of Mazandaran province with a population size of about 504,000 populations; Yazd is located in the middle of the Iranian plateau and is the capital of Yazd province with a population size of about 656,000 populations and district 2 of Tehran metropolitan is located in the west of Tehran and is neighboring both Azadi Square and the green gardens of Farahzad and Evin (with high prevalence of illicit drug use) with a population size of 700,000 populations.

A comprehensive practical protocol was developed based on the key informant-driven mapping and enumeration approach (12), which includes: a) primary assessments and determine the field team members, primary and secondary key informants b) data collection methodology and data collection tools c) data synthesis, analysis and reporting the results. The study protocol was approved by the Research Ethics Committee of Iran University of Medical Sciences.

Field team, primary and secondary key informants

The field team consists of four people: 1) team manager, 2) interviewer, 3) person who is responsible for the counting of PWID and PWUD in hotspots. He also helps the team to recognize the right persons in the hotspots. 4) a driver who is also responsible for the executive process and security of the team. Field team members were selected among the service providers for PWID, e.g. members of mobile centers and

outreach team, or from persons who were current and former drug users. For every 50 hotspots, one field team was assigned.

Primary and secondary key informants were interviewed during the data collection process. Primary key informants were interviewed during focus group discussion and in-depth interviews at the first step of study. The two types of secondary key informants were interviewed at the field level including: a) Key affected population key informant (KAP KI); b) Non-key affected population key informant (Non-KAP KI). The details of key informant persons were explained in the Table 1.

Table 1
Types of key informants enrolled in the study

Group name	Organizational status	Role in data collection
Primary key informant (at the first step of study)	Persons who provided services to or interacted regularly with drug users, police officers, nongovernmental organization staff (NGO), outreach team staff, drop-in centers (DIC), welfare organization staff, municipality and the staff of AIDS and addiction office.	<ul style="list-style-type: none"> • They are knowledgeable about hot spots or drug users and provided the primary information about the hotspots and their locations during focus group discussion and in-depth interviews at the first step of the study. • They help to provide the master list of all known hot spots during focus group discussion and in-depth interviews.
Secondary Key informant (at the field visit stage)	a) Key affected population key informant (KAP KI)	They were interviewed at the field level and provide information about hotspots e.g. hot spot and its features including estimates of the number of people in which the hot spot is presenting, if available, information on the high risk activities that people do in the hot spot and introducing new hot spots.
	b) Non-key affected population key informant (Non-KAP KI)	
	Peoples who do not use substances but have information about hotspots e.g. taxi drivers, shopkeepers, park security officer and so on.	

Data collection

Primary hot spots were identified by primary key informant as a master file. Secondary hot spots were identified by secondary key informants through field team interview in those primary hotspots. Interview with key-informant covered some topics such as geographic information of hotspots, estimated number of PWID by age groups and gender, number of female PWID sex workers, type of health services in hot spots such as needle, syringe and condom, reported illegal activities in hotspot, frequency of hotspot turnover by PWUD and estimated number of non-injection drug use, non-injection opium use and non-injection stimulant use. Three estimates were collected during interviews in hot spot visiting by field team

including KAP KI estimates, Non-KAP KI estimates and the enumeration and observations by field team members.

Data synthesis

To estimate the illicit drug use population size in each hotspot, we used three enumeration methods; a) KAP KI estimates b) Non-KAP KI estimates c) the enumeration by field team member's observations. The data gathered by KAP KI and Non-KAP KI in every hotspot was cross-validated by the local knowledge of primary and secondary key informants and field observations. We triangulated the estimations from key informants and using the median of estimations to arrive at best estimation of illicit drug use in hotspots. We used the same method for the lower and upper limit of estimations to calculate the acceptability intervals for all hotspot estimations. In some conditions the hotspots candidates for revisiting by field team members e.g. if the hotspot was not in the normal situations at the time of field team visitation due to police intervention in the hotspot, bad weather conditions, the extent and complexity of hotspot that need to several visitations to have complete information about the hotspot dynamic and turnover of drug users and when there are a wide range of estimations for hotspots and there is hard to consider the median of estimations to reach more accurate estimation. We used the Microsoft Excel software and SPSS version 22 to manage and analysis the data. The Arch GIS software was used for mapping the hotspots.

Results

Hotspot mapping

In this study, a total number of 335 hot spots were identified of them, 70 (20.9%) were in Ahvaz county, 90 (26.9%) in Sari county, 67 (20%) in Yazd county and 108(32.2%) in district 2 of Tehran metropolitan. Based on the field team observations, the density mapping of PWUDs and PWIDs in hotspots by each city was presented in Fig. 1 & Fig. 2.

In Ahvaz county, the hotspots were spread in various part of county, however, we identified three high-density areas for PWUDs in the central and one high-density areas in the northeast of city. The high-density areas for PWIDs were located in the same areas as PWUDs, (Two of three high density areas in the central and the high density areas in the northeast of city) (Fig. 1 & Figure 2).

In the Sari county, the majority of hotspots were concentrated in the southern areas and the high-density areas for both PWUDs and PWIDs were in the southern area of the county (Fig. 1 & Figure 2). In the district 2 of Tehran metropolitan, the hotspots were located across the highways and the main squares. However, we identified two high-density areas for PWUDs and PWIDs in the northern and southern areas of district 2 of Tehran metropolitan (Fig. 1 & Figure 2). In the Yazd county, the identified hotspots and the high-density areas for both PWUDs and PWIDs by field team observations were located in the southeast, eastern and southwest areas (Fig. 1 & Figure 2).

KAP-KI, Non-KAP KI and field team estimations

A total 1524 key informants were interviewed in identified hot spots in four cities of Iran, of them, 736 (48.3%) were KAP KI (key informant persons who are current and former PWUD or PWID) and 788 (51.7%) were Non-KAP KI. The majority of KAP KI (87%) and Non-KAP KI (86%) were male. The mean age for KAP KI and Non-KAP KI were 37.6 and 40.3, respectively (Table 2 & Table 3).

Table 2

Estimated numbers of people who use drugs and who inject drugs based on information from key affected population key informant person (KAP KI) in hot spots

Variables	Ahvaz	Sari	Yazd	Tehran (District 2)	Total
Total Number of Hotspots	70	90	67	108	335
Total Number of interviewed KAP KI	254	271	105	106	736
Age (mean)	34.83	36.47	38.68	40.42	37.6
Gender N (%)					
Male	237 (93)	224 (83)	103 (98)	78 (74)	642 (87)
Female	17 (7)	48 (17)	2 (2)	28 (26)	95 (13)
Estimated number of PWID (N %)					
Male	920 (93)	580 (87)	451 (96)	14 (78)	1965(92)
Female	67 (7)	86 (13)	20 (4)	4 (22)	177 (0.08)
Age < 18	40 (4)	27 (4)	36 (8)	1 (6)	104 (0.05)
Age 18–25	278 (28)	133 (20)	96 (20)	4 (22)	511 (24)
Age > 25	669 (68)	499 (76)	339 (72)	13 (72)	1520 (71)
Total	987	666	471	18	2142 (100)
Estimated number of PWID in hot spots in the last week	747	767	385	47	1946
Estimated number of PWID in hot spots in the last month	1559	1103	492	143	3297
Estimated number of male PWID sex workers	13	1	7	1	22
Estimated number of female PWID sex workers	55	91	11	25	182
Frequency of hotspot turnover by PWUD N (%)					
Daily	203 (81)	190 (70)	77 (73)	98 (92)	568(77)

*Receiving health services from centers providing services to injecting drug users or mobile teams of these centers

Variables	Ahvaz	Sari	Yazd	Tehran (District 2)	Total
Weekly	43 (17)	82 (30)	27 (26)	8 (8)	160 (22)
Monthly	4 (2)	0 (0)	1 (1)	0 (0)	5 (1)
Receiving health services in hot spots* N (%)					
Yes	111 (44)	201 (74)	48 (46)	31 (30)	391(53)
No	143 (56)	71 (26)	57 (54)	75 (70)	346 (47)
Type of health services in hot spots					
Needle and syringe	23 (21)	64 (32)	29 (60)	1 (3)	117(30)
Condom	1 (1)	73 (36)	5 (10)	24 (77)	103(26)
Both	87 (78)	64 (32)	14 (29)	6 (20)	171(44)
Type of reported activities in hotspots					
Drug sale	213 (29)	179 (27)	78 (29)	103 (42)	573(30)
Unsafe Sex	80 (11)	104 (15)	18 (7)	15 (6)	277(11)
Presence of children	70 (9)	35 (5)	8 (3)	1 (0.5)	114(6)
Sleep at night	153 (21)	101 (15)	65 (24)	22 (8)	341(18)
Non-injection drug use	221 (30)	244 (38)	102 (37)	106 (43.5)	673(35)
Police intervention in hotspots					
Yes	150 (63)	185 (68)	95 (90)	63 (60)	493(68)
No	89 (37)	87 (32)	10 (10)	43 (43)	229 (32)
Average number of hotspots turnover by drug users in last 24 hours					
	Mean:1.54	Mean:2.31	Mean:1.72	Mean:1.5	Mean:1.77
	Median:1	Median:2	Median:1	Median:1	Median:1
Estimated number of non-injection drug use					
	1242	788	317	642	2989
Estimated number of non-injection opium use					
	633	385	138	501	1657

*Receiving health services from centers providing services to injecting drug users or mobile teams of these centers

Variables	Ahvaz	Sari	Yazd	Tehran (District 2)	Total
Estimated number of non-injection stimulants use	752	853	191	390	2186
Estimated number of non-injection opium & stimulants use	523	432	49	638	1642
*Receiving health services from centers providing services to injecting drug users or mobile teams of these centers					

Table 3

Estimated numbers of people who use drugs and who inject drugs based on information from Non-KAP KI in hot spots

Variables	Ahvaz	Sari	Yazd	Tehran (District 2)	Total
Total number of hotspots	70	90	44	108	312
Total Number of interviewed Non-KAP KI	241	346	99	102	788
Age (mean)	36.14	43.8	39.49	41.93	40.34
Gender N (%)					
Male	218 (90)	88 (98)	91 (92)	59 (58)	456 (86)
Female	23 (10)	2 (2)	8 (8)	43 (42)	76 (14)
Estimated number of PWID (N %)					
Male	771 (91)	316 (91)	210 (95)	30 (88)	1327 (92)
Female	72 (9)	30 (9)	11 (5)	4 (12)	117(8)
Age < 18	28 (3)	3 (1)	6 (3)	4 (12)	41 (3)
Age 18–25	210 (25)	32 (9)	30 (14)	8(24)	280(19)
Age > 25	605 (72)	311 (90)	185 (83)	22 (64)	1123 (78)
Total	843	346	221	34	1444
Estimated number of PWID in hot spots at last week	587	242	239	61	1129
Estimated number of PWID in hot spots at last month	981	346	282	245	1854
Estimated number of non-injection drug use	1285	1044	123	728	3180
Estimated number of non-injection opium use	613	16	81	563	1273
Estimated number of non-injection stimulants use	740	51	81	427	1299
Estimated number of non-injection opium & stimulants use	422	5	28	728	1183

*Receiving health services from centers providing services to injecting drug users or mobile teams of these centers

Variables	Ahvaz	Sari	Yazd	Tehran (District 2)	Total
Estimated number of male PWID sex workers	7	0	4	6	17
Estimated number of female PWID sex workers	58	18	0	34	110
Type of reported activities in hotspots					
Drug sale	210 (29)	5 (26)	79 (33)	101 (39)	395 (32)
Sex	61 (8)	5 (26)	29 (13)	18 (7)	113(9)
Presence of children	86 (12)	0 (0)	10 (5)	1 (0)	97(8)
Sleep at night	160 (22)	3 (16)	45 (21)	37 (14)	245 (20)
Non-injection drug use	211 (29)	6 (32)	62 (28)	102 (40)	381(31)
Police intervention in hotspots					
Yes	156 (66)	90 (100)	95 (96)	54 (53)	395 (75)
No	82 (34)	0 (0)	4 (4)	48 (47)	134 (25)
Receiving health services in hot spots* N (%)					
Yes	69 (29)	90 (100)	15 (15)	28 (27)	202 (38)
No	172 (71)	0 (0)	84 (85)	74 (73)	330 (62)
Type of health services in hot spots					
Needle and syringe	28 (41)	0 (0)	11 (73)	0 (0)	39 (19)
Health package	8 (12)	90 (100%)	0 (0)	0 (0)	98(49)
Syringe and condom	33 (47)	0 (0)	4 (27)	28 (100)	65 (32)
*Receiving health services from centers providing services to injecting drug users or mobile teams of these centers					

The estimated number of PWID, based on the key-informant opinions and field team observations was shown in Table 2 to 4. Most key informants across all regions indicated that the injection drug use was decreasing in their areas. In contrast, based on their opinion, stimulant drug use has been significantly increased in all regions.

Table 4

Estimated numbers of people who use drugs and who inject drugs based on field team observations

Variables	Ahvaz	Sari	Yazd	Tehran (District 2)	Total
Total number of hotspots	70	90	40	108	308
Estimated number of PWID (N %)					
Male	651 (93)	307 (100)	220 (96)	15 (83)	1193(95)
Female	52 (7)	0 (0)	8 (4)	3 (7)	63(5)
Age < 18	34 (5)	0 (0)	10 (4)	2 (11)	46(4)
Age 18–25	268 (38)	5 (2)	42 (18)	4 (22)	319(28)
Age > 25	401 (57)	302 (98)	76 (78)	12 (67)	791(68)
Total	703	307	228	18	1256
Estimated number of non-injection drug use	606	373	76	684	1739
Type of reported activities in hotspots					
Drug sale	62 (28)	43 (30)	24 (28)	106 (43)	235(34)
Sex	22 (3)	5 (3)	10 (12)	9 (4)	46(7)
Presence of children	23 (3)	1 (1)	2 (2)	0 (0)	26(4)
Sleep at night	47 (7)	13 (1)	21 (24)	24 (10)	105(15)
Non-injection drug use	65 (59)	78 (65)	29 (34)	106 (43)	278(40)
*Receiving health services from centers providing services to injecting drug users or mobile teams of these centers					

The highest median estimated number of PWID was in Ahvaz county (843, range 703–987) followed by Sari county (346, range 307 – 66) and district 2 of Tehran metropolitan (18, range 18–34).

The overall estimated numbers of PWID based on median of three estimations (field team observations, KAP KI and KI) was calculated. Based on median of three estimations, Ahvaz had the highest estimated

number of PWID (843, range, 703–887), followed by Sari (346, range, 307–666), Yazd (228, range, 221–471) and Tehran (18, range, 18–34) (Tables 2–4).

Table 5 also shows the estimated number of PWID by region, gender, age and per 100,000 populations over the age of 15. The highest and lowest estimated number of male PWID was in Ahvaz (771 males, 72 females) and Tehran Ahvaz (14 males, 4 females), respectively. Yazd had the highest estimated Male: Female ratio (M: F ratio = 27.5), followed by Ahvaz (M: F ratio = 10.71), Sari (M: F ratio = 10.53), and Tehran (M: F ratio = 3.50) (Table 5).

Table 5

The overall estimated numbers of people who use drugs and who inject drugs based on median of three estimations (field team observations, KAP KI and KI).

Variables	Ahvaz county	Sari	Yazd	Tehran (District 2)
Total number of hotspots	70	90	120	108
Estimated number of PWID* (N %)				
Male	771 (91)	316 (91)	220 (96)	14 (78)
Female	72 (9)	30 (9)	8 (4)	4 (22)
Total	843	346	228	18
PWID M:F ratio	10.71	10.53	27.50	3.50
PWID per 100,000**	87.35	85.01	71.97	0.25
Male PWID per 100,000	159.66	155.03	128.81	0.39
Female PWID per 100,000	14.93	14.76	12.74	0.11
Estimated number of non-injection drug use	1242	788	123	642
Non-injection drug use per 100,000	128.70	193.60	25.58	8.9
Non-injection opium use per 100,000 ***	64.56	49.26	22.78	7.38
Non-injection stimulants use per 100,000 ***	77.30	111.05	28.29	5.67
* PWID: People who inject drugs. All data in this table is based on the median of three estimations (field team observations, KAP KI and Non-KAP KI).				
** Per 100,000 adults 15 years and older.				
***The mean of estimated numbers by KAP KI and Non-KAP KI.				

The number of PWID per capita was ranged from 0.25 per 100,000 adults 15 years and older in Tehran to 87.3 per 100,000 in Ahvaz. In male subgroup, per capita number of PWID was estimated from 0.39 per

100,000 in Tehran to 159.66 per 100,000 in Ahvaz. Moreover, female PWID per capita ranged from 0.11 per 100,000 in Tehran to 14.93 per 100,000 in Ahvaz (Table5).

The median estimated number of non-injection drug use based on three estimations (field team observations, KAP KI and KI) was shown in Table 2 to 4. Ahvaz had the highest estimated number of non-injection drug use (1242, range, 606–1285), followed by Sari (788, range, 373–1044), Tehran (684, range, 642–728) and Yazd (123, range, 76–316) (Tables 2–4). Based on KAP KI estimation, 391 (58%) of all hotspots receive the health services of them 171 (44%) received both needle and syringe and condom services. The unsafe sexual contact was reported in 277(11%) of hotspots and 493 (68%) of hotspots reported the history of police intervention (Table2).

The estimated number of non-injection drug use per capita ranged from 8.9 per 100,000 adults 15 years and older in Tehran to 193.60 per 100,000 in Sari. The estimated number of non-injection opium and stimulant use per capita showed that using stimulants is significantly higher than the opium in Ahvaz (stimulant use = 77.3 and opium use = 64.5 per 100,000 adults 15 years and older), Sari (stimulant use = 111 and opium use = 49.2 per 100,000 adults 15 years and older) and Yazd (stimulant use = 28.3 and opium use = 22.9 per 100,000 adults 15 years and older). However, pattern of drug use was different in Tehran, so that opium consumption was more than stimulant (stimulant use = 5.67 and opium use = 7.38 per 100,000 adults 15 years and older) (Table 5).

Discussion

The results of mapping and population size estimation which is carried out in four cities of Iran showed that drug use disseminated in most areas of these cities. Based on Key informant's opinion, the injecting drug use was decreasing and stimulant drug use has been increased in all regions. This result is in accordance with the results of some studies that reported the increasing use of stimulants among clients of drug treatment centers and high school students in recent years (19). Also, a two-decade analysis of global illicit drug use indicated that the cannabis had the higher growth rate in the last 5 years(20). However, the results of Iranian household Mental Health survey in 2011 indicated that opium use disorder was the most common drug use in Iran (21). In this study, the estimated rate of PWID was varied from 0.25 per 100,000 adults 15 years and older in District 2 of Tehran to 87.35 per 100,000 adults 15 years and older in Ahvaz. The estimated rate of non-injection drug use was varied from 8.9 per 100,000 adults 15 years and older in district 2 of Tehran to 193 per 100,000 adults 15 years and older in Sari. The results of mapping and size estimation of illicit drug users with the similar methodology in Tanzanian hinterland showed that the estimated rate of PWID was varied from < 1 to 47 per 100,000 adults 15 years and older that is lower than the result of our study. However, the estimated rate of PWUD was varied from 6 to 452 per 100,000 adults 15 years and older among various regions that is higher than the result of our study (12). Based on the global statistics on substance use, cannabis and opioid with the age-standardized rates of 259.3 and 220.4 per 100,000 populations were the most common of illicit drug dependence and amphetamine and cocaine with 86 and 52.5 per 100,000 population were less prevalent(22).

Moreover, the results of this investigation showed that injection drug use was more in males than in females and varied from M: F = 3.5 in District 2 of Tehran to M: F = 27.5 in Yazd that is consistent with the results of other studies who reported the female drug users were fewer than male drug users (23, 24). The male to female ratio in PWID that reported in Tanzania was reported 3:1 to 11:1 is consistent with the result of this study(12).

This result indicates a higher rate of non-injection drug use than injection, and among the non-injection drugs, the stimulant drugs have been widely used. In the cities under study, the stimulant drug use was varied from 5.6 to 111 per 100,000 adults 15 years and older and opium use was from 7.3 to 64.5 per 100,000 adults 15 years and older. This result is similar to the result of Shokoohi et al. study that drug use was higher in female sex workers(25). The global statistics on illicit drug use in 2017 indicated that the high-income North America region had one of the most prevalent rates of cannabis and opioid with 748 and 650 per 100,000 people that is about 10 times more than our study(22).

Based on the key informant's opinion, the health services coverage was 58% of all hotspots of them 44% received both needle and syringe and condom services. This result indicates that health service providers and drop-in centers have not yet identified approximately 40% of new hotspots. The survey conducted in 22 countries indicated that only three countries (Slovakia, India, and Bangladesh) reached the internationally recommended target of 200 syringes per person and the proportion of the opioid substitution therapy (OST) for PWID was less than 3% for most countries. In the study of South Africa cities with similar methodology, needle and syringe facilities was not reportedly available at any of the PWID locations and only 25% of them felt that their health needs were being met (18, 26).

In this study, geographical distribution of new hotspots showed that many of these hotspots were located in areas which are far from the centers that provide the harm reduction services. This issue highlights the need to identify new hotspots and the importance of relocating the harm reduction centers or to develop new centers in areas where new hotspots were identified.

In addition, the police intervention was reported in 68% of hotspots by key informant persons that could be one of the reasons for establishing the new hotspots or deactivate of some hotspots. Similar studies reported that law enforcement was the major cause of drug user's movement (18).

The geographical distribution of injection and non-injection drug use hotspots was similar across all regions. The existing of high-risk behaviors reported in hotspots such as unsafe sex in men and women, injection drug use, as well as the presence of children at night in hotspots highlighted the importance of identifying new hotspots and increasing the coverage of harm reduction program to prevent HIV, hepatitis B and C infections.

This study results subject to several limitations; mapping results subject to underestimate the number of PWID especially in Tehran metropolitan, as that estimates the visible section of the group; primary and secondary key informants tend to under-report the number of PWID in their areas. Also, in some cases, field team members subject to some misunderstanding about the study protocol about frequency and

duration of PWID and only recorded the current use of PWID during the interview with the key informants. Another limitation was about women who use drugs. Women are less visible and identifiable in public places than men, so they were less likely to be counted or interviewed in the hotspots than men. On the other hand, male key informants may not have accurate information about female drug users and this may lead to underestimation of female drug users in hotspots. However, we tried to find the new hotspots when we interviewed to key informants inside the hotspots. In addition, because the estimation of drug users depended on key informants, it may lead to overestimation due to one person being counted in several hotspots or it may lead to underestimation due to their lack of sufficient knowledge about drug users. The estimation may depend on visiting time of hotspots by the field team and the peak time of drug use. On the other hand, due to the presence of several environmental teams in hotspots, there may be differences in the accuracy of the information collected in different regions. To dealing with these issues, we repeat the hotspot visiting if there are not visited in the peak time and all environmental teams tried to follow the same protocol to achieve the better results.

Conclusion

This pilot study describes the geographic location of active hotspots and size of PWUD and PWID in the four cities of Iran. These findings provide valuable evidence on geographical targeting of illicit drug users to provide harm reduction and preventing programs and to identify the best location for drop-in centers (DIC) in every city. However, the size estimation of PWUD and PWID in this pilot study subject to some underestimations especially in the district 2 of Tehran metropolitan and should be used and interpreted with caution. The result of this pilot study highlights the need to establish this methodology at the national level to provide the evidence base interventions and preventive programs.

Abbreviations

PWID: People who inject drugs; PWUD: People who use drugs; KAP-KI: Key Affected Population Key Informant; Non-KAP KI: Non-key Affected Population Key Informant; STIs: Sexually transmitted infections; HIV: Human immunodeficiency virus; DALYs: Disability-adjusted life years

Declarations

Ethics approval

The study methodology and ethical considerations was approved by the Research Ethics Committee of Iran University of Medical Sciences.

Consent for publication

Not applicable.

Availability of data and materials

The datasets collected in this study are not available for public access due to sensitive information of PWID hotspot locations but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

HS, NG, AM, AH, PA and HF contributed to the protocol development, MK, AB, NG, EG, TK, JV, FZ, MH and RD involved in oversight of implementation and data gathering process. NG, MK and HS contributed to the data analysis, AM, MK, NG, HS, AH, HF, PA involved in drafts of manuscript. All authors read and approved the final manuscript.

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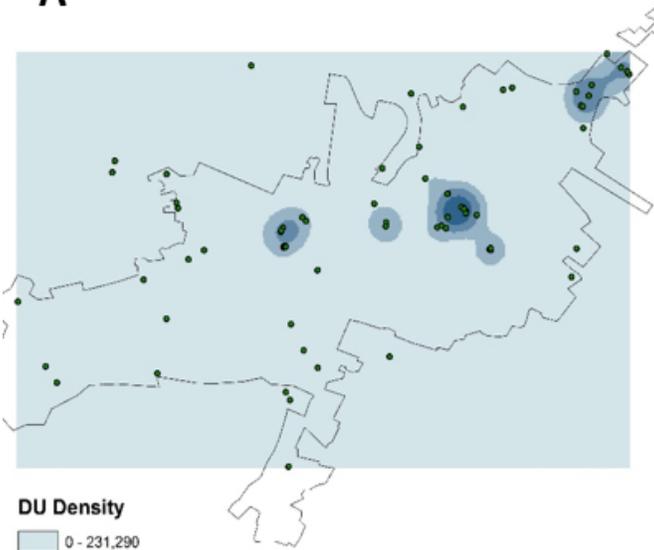
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Figures



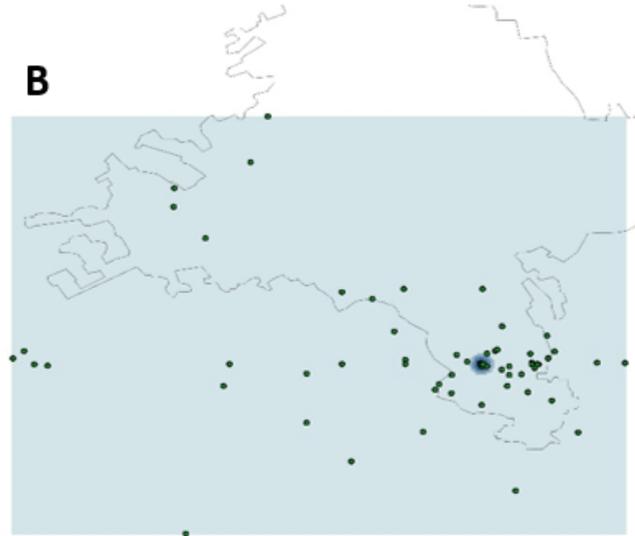
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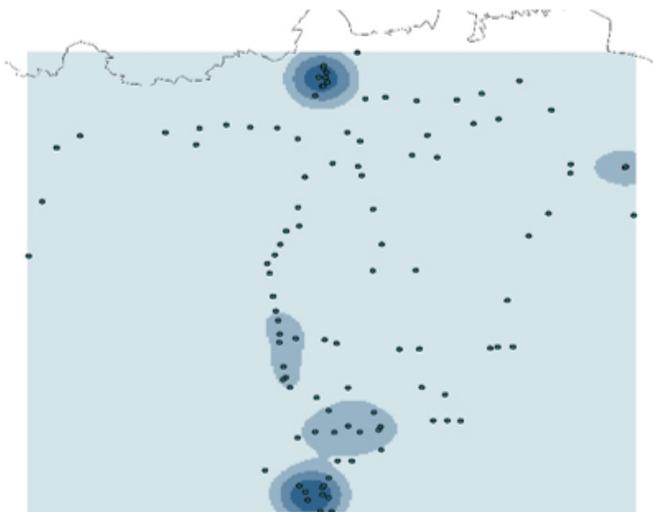
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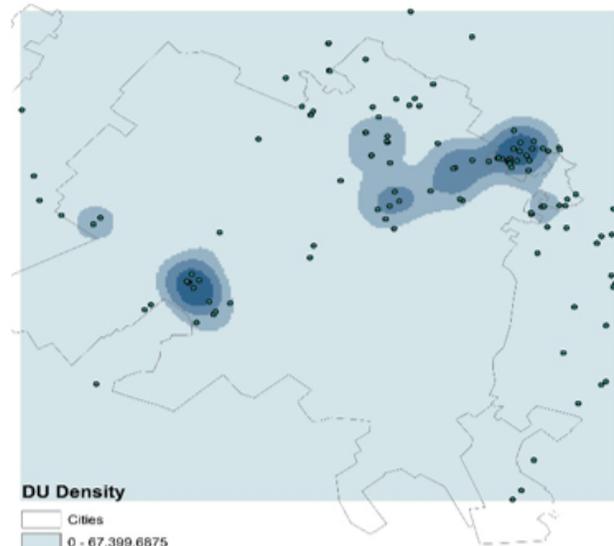
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D



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Figure 1

The density mapping of peoples who use drugs in hotspots by each province (*A=Ahvaz, B=Sari, C=Tehran, D=Yazd). Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

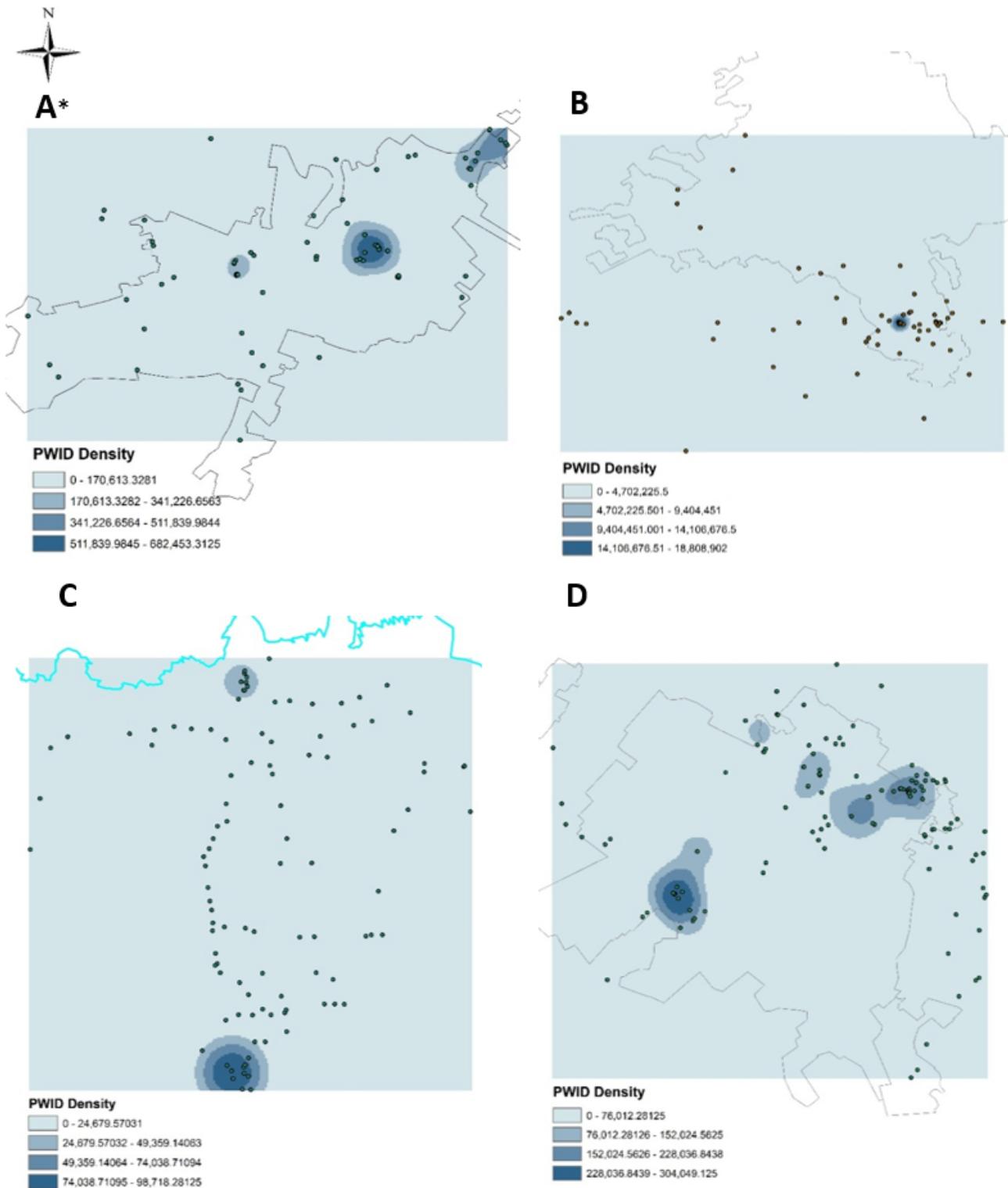


Figure 2

The density mapping of PWID in hotspots by each province (*A=Ahvaz, B=Sari, C=Tehran, D=Yazd). Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.