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## Illicit drug users in the Tanzanian hinterland: population size estimation through key informant–driven hot spot mapping

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### Abstract

We mapped hot spots and estimated the numbers of people who use drugs (PWUD) and who inject drugs (PWID) in 12 regions of Tanzania. Primary (ie, current and past PWUD) and secondary (eg, police, service providers) key informants identified potential hot spots, which we visited to verify and count the number of PWUD and PWID present. Adjustments to counts and extrapolation to regional estimates were done by local experts through iterative rounds of discussion. Drug use, specifically cocaine and heroin, occurred in all regions. Tanga had the largest numbers of PWUD and PWID (5190 and 540, respectively), followed by Mwanza (3300 and 300, respectively). Findings highlight the need to strengthen awareness of drug use and develop prevention and harm reduction programs with broader reach in Tanzania. This exercise provides a foundation for understanding the extent and locations of drug use, a baseline for future size estimations, and a sampling frame for future research.

### Keywords

people who use drugs; people who inject drugs; population size estimation; mapping; Tanzania

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#### Compliance with Ethical Standards

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The protocol was reviewed and approved by the National Institute for Medical Research in Tanzania, the Centers for Disease Control and Prevention (CDC), and the Institutional Review Board of the University of California, San Francisco.

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

Conflict of Interest: The authors declare no conflicts of interest.

## Introduction

People who use drugs (PWUD) are vulnerable to HIV infection due to unsafe sexual behaviors, including transactional sex and multiple concurrent relationships, and the sexual networks they share with people who inject drugs (PWID).[1] A subset of the PWUD population, PWID are particularly vulnerable to acquiring and transmitting blood-borne infections, including HIV, due to their risky injection practices. Globally, the burden of HIV among PWID is high, accounting for an estimated 30% of new HIV infections outside of sub-Saharan Africa.[2] In 2014, about 1.65 million PWID were estimated to be living with HIV, corresponding to a 13.5% prevalence of infection among PWID worldwide.[2] The same report estimated that Africa is home to more than 1 million PWID, among whom HIV prevalence is estimated to be 11.2%.

HIV prevalence in Tanzania is high (5.1%),[3] and the potential for expansion of injection drug use could provide a new avenue for HIV transmission in the country. Anecdotal evidence suggests that injection drug use is occurring in some parts of the country. A 2014 study estimated that there were as many as 10,000 PWID in Dar es Salaam, with an HIV prevalence of 15.5%.[4] Another study conducted in Dar es Salaam found that 90% of used syringes collected in a neighborhood near the city center tested positive for HIV.[5] Data on PWID are also emerging from Zanzibar, the archipelago off the coast of Tanzania, where the HIV epidemic is concentrated among PWID and other key populations. A 2011/2012 seroprevalence survey of PWID in Zanzibar found HIV prevalence at 11.3%, hepatitis C at 25.4%, hepatitis B at 5.9%, and syphilis at 0.8%.[6] For comparison with other key populations, the same survey estimated that there were approximately 2157 men who have sex with men and 3958 female sex workers in Zanzibar, with HIV prevalence rates of 2.6% and 19.3%, respectively. Biobehavioral surveys conducted in 2013 estimated there were as many as 32,650 men who have sex with men and 5767 female sex workers in Dar es Salaam, with HIV prevalence rates of 22.2% and 32.0%, respectively.[7,8]

Although there are drug use data available for Zanzibar and Dar es Salaam, very little is known about injection drug use in the rest of the country, including along routes where drugs are believed to be trafficked, such as coastal regions and transportation corridors. We conducted this research as a rapid assessment aimed at using population-size estimation techniques to gain insight on where drug use may be taking place and to inform future (targeted) studies. The focus was to help determine the extent of drug use in 12 of the 31 regions of Tanzania, selected for being outside Dar es Salaam and Zanzibar and on the coast or along major transportation corridors of the interior. The objectives of our study were (1) to locate drug-use hot spots within the selected 12 regions and (2) to estimate the number of people using illicit drugs (combined heroin and cocaine), by sex and by injection or non-injection, within each region.

## Methods

The objectives of the study (to describe the geographic extent of illicit drug use and to estimate the number of PWUD) were accomplished through a key informant-driven mapping and enumeration approach.[9] The study entailed successive rounds of key-

informant interviews to identify hot spots and mapping with enumeration of PWUD associated with hot spots, which were combined with expert opinions for interpretation and for arriving at final numbers of PWUD, by sex and injection route, for each region. The mapping and size estimation exercise was conducted from July 2013 through August 2014 in 12 regions (Mtwara, Dodoma, Morogoro, Pwani, Kilimanjaro, Arusha, Tanga, Mbeya, Mwanza, Geita, Shinyanga, and Kigoma). The first round of data collection was in 5 regions and took place over 6 weeks, from July to September 2013. The second round of data collection was in the remaining 7 regions and took place over 10 weeks, from May to August 2014.

### Primary and secondary key informants

Interviews in each region typically began with secondary key informants who were knowledgeable about drug users or hot spots; most of them provided services to or interacted regularly with drug users. They were selected through purposive sampling based on conversations with leaders of community organizations and law enforcement in each region, including nongovernmental organization staff, police officers, and community service providers. All secondary key informants who were identified were interviewed.

Primary key informants were those who reported having used illicit drugs in the past 30 days (PWUD) or who reported having injected illicit drugs in the past 30 days (PWID). Initially, they were identified by secondary key informants; more were identified at hot spots by the field team. Primary key informants were recruited using purposive sampling to include participants with diverse sociodemographic characteristics, including age, sex, level of education, and occupation. Screening questionnaires were used to determine eligibility, and all but 1 eligible key informant consented to participate in the study.

### Data collection

Key-informant interview topics covered the locations of hot spots where illicit drug use occurs, the scope of drug use within the region, and estimates of the number of people who use non-injection or injection drugs and frequent each hot spot, by sex. Possible hot spots where PWUD congregate were first identified by secondary key informants, and additional hot spots were identified by primary key informants found at those hot spots. Interviews were conducted in an iterative process until saturation was reached (ie, no new hot spots were named in the region).

Mapping and enumeration were carried out by the field team that visited identified hot spots. Hot spots were fluid (eg, near bus stops, in alleys, public spaces, and abandoned buildings) and included areas for using, dealing, and sheltering. Particularly in urban areas, a discrete count of hot spots proved imprecise, as it was unclear where 1 began and another ended; hot spots in isolated locations could be more clearly defined. Therefore, where necessary, key informants made estimates with respect to the broad areas, neighborhoods, and towns that surrounded hot spots. During data collection, the field team systematically walked through each hot spot, usually with a primary key informant. The presence of PWUD and PWID was verified by observation of drug use and dealing, by discarded drug paraphernalia (eg, syringes), and by brief intercept of persons present.

## Data synthesis

Population size for each hot spot was estimated using data collected during mapping and enumeration as well as counts provided by multiple primary and secondary key informants. Estimates therefore were created using the local knowledge of key informants and cross-validated by other primary and secondary informants and field observers. Neighboring or overlapping hot spots were combined when appropriate. To arrive at a central or “best” estimate for each hot spot, the field team triangulated estimates from informants (considering medians to address outliers and contextual information used by participants to produce their estimates, such as the extent of the hot spot, its users’ mobility, and its peak or low periods) and counts from the mapping and enumeration. We created final consensus estimates for the hot spots by reviewing these estimates and contextual data in order to offer interpretations for possible over- or underestimation. The field team proposed extrapolations for the wider regions through iterative rounds of discussion and reported the high and low estimates to create a plausible range. We conducted this process at the close of data collection for each region, with participation from all members of the field team. The present report excludes data on persons for whom cannabis was the only illicit drug used.

## Results

A total of 436 key informants were interviewed, of whom 329 (75%) were primary (ie, current and former PWUD and PWID) and 107 (25%) were secondary. The majority (89%) of the primary key informants were male. The minimum age for primary key informants was 18 years, and the maximum was 54 years (median age 29). The 107 secondary key informants included 40 health care workers and 39 police officers, with the remainder being other community service providers, nongovernmental organization staff, peer educators, sober-house managers, local political leaders, hotel workers, merchants, and academicians.

Interviews with primary and secondary key informants indicated that drug-use hot spots were present in all 12 regions in the study. The number of hot spots reported by a primary key informant ranged from 1.0 to 14.0. Across the regions, the average number of hot spots reported by primary key informants ranged from 1.0 to 4.4. Key informants in all regions expressed an opinion that the number of people who use heroin and cocaine was increasing.

The estimated number of PWUD, as the median of the counts and key-informant opinions, showed regional variation. Tanga had the highest estimated number of male PWUD (5000, range 3000–7000), followed by Mwanza (2800, range 1500–4000) and Arusha (2500, range 1000–5000) (Table 1). Mtwara had the fewest estimated male PWUD (65, range 35–150). For female PWUD, the largest numbers were estimated for Mwanza (500, range 300–800), Morogoro (250, range 150–360), and Arusha (200, range 70–300). Key informants did not know any female PWUD in Kigoma and Mtwara, and none were encountered at the hot spots in these regions.

Table 1 also shows the estimated number of PWID by region, sex, and per 100,000 inhabitants over the age of 15. Tanga had the highest estimated number of PWID (475 males, 65 females). Key informants in all regions except for Kigoma knew male PWID. No key informants knew female PWID in Shinyanga, Kigoma, Geita, and Mtwara. Per capita

numbers of PWID ranged from 0 in Kigoma to 47 per 100,000 in Tanga. Figure 1 provides a map of regions in the study, with estimated numbers of PWID for each.

## Discussion

Our key informant–driven mapping and population size estimation indicates that illicit drug use is present in all 12 coastal and interior regions of Tanzania included in this exercise. Total estimates of PWUD ranged from several score to several thousand per region, which includes both males and females in most regions. The vast majority of key informants across all regions were of the opinion that drug use was rising in their areas. The investigation also confirmed injection drug use among men in 11 of 12 regions, and among women in 8 of 12 regions. On a per capita basis, the prevalence of injection drug use appears to be low in these Tanzanian regions compared with other parts of sub-Saharan Africa. The highest prevalence was 0.047% of the population aged 15 years and older, more than an order of magnitude lower than the estimate for the island of Unguja (Zanzibar) in 2011/2012 (0.6%), [8] areas of Kenya (0.7%), South Africa (0.9%), and Mauritius (2.1%). [10] Estimates of the prevalence of injection drug use in populations of the Middle East and North Africa have ranged from 0.0003% to 0.35%, which overlaps with our estimates even though the data were collected more than 10 years ago. [11] Of note, different methods for size estimations were used in these other countries and regions and did not depend solely on mapping in the context of a rapid assessment.

Areas with higher numbers of PWID per capita were along the coast and adjacent to Tanzania's largest city, Dar es Salaam (eg, Tanga, Pwani). High prevalence of injection drug use was also found along main highways that pass through major cities (eg, Morogoro and Arusha). In addition, Mwanza region, which is home to a fast-growing city on Lake Victoria, had a high prevalence of injection drug use. Regions with less-developed transport infrastructure (eg, Kigoma) or where transportation corridors are just being established (eg, Geita) had low prevalence of injection drug use.

Our finding of fewer female than male drug users is consistent with the global and sub-Saharan African literature. [10–14] Although female drug users were reported by key informants and interviewed at many hot spots by our field team, males were far more numerous by report and by observation. Male PWUD were found along transport corridors, engaged in economic activities traditionally reserved for men in Tanzanian society (eg, bus touting, fishing). By comparison, women are not as visible in public as men, particularly in regions such as Tanga. Lower visibility of female drug users is a major limitation of the mapping and enumeration methods, which depend on visualizing and interviewing persons at hot spots. Furthermore, men were more likely to be key informants and might have been less aware of female drug users. The above biases may have resulted in an underestimation of the number of female PWUD and PWID, with particular caution needed before concluding that there were no female PWID in 4 of the 12 regions. Other population-size estimation methods, particularly various types of multiplier methods, have been used in Tanzania. However, these are localized to 1 area, resource intensive, and generally tied to biobehavioral surveillance studies. Such studies would not have been feasible to implement throughout the vast area of the 12 regions. Our study aimed to use population-size

estimation techniques that lend themselves efficiently to a rapid assessment, in order to gain an understanding of where future studies might be appropriate.

We recognize other limitations of our methods and data. Our estimates depended highly on key informants to know and reveal all hot spots in a given area. It is likely that some hot spots were new, not known, or concealed to protect the interests of an informant. The methods were also dependent on opinions about or perceptions of the numbers of PWUD and PWID at the known hot spots. Our direct counts verified the presence of drug users but were prone to undercounting (eg, not recognizing the presence of a drug user) or overcounting (eg, counting the same person at different hot spots). In a few cases, in some regions, the field team was not able to visit all of the identified hot spots (due to road closure, time constraint, or weather, for example) and relied only on information provided by informants. Considering that the net direction of these biases is not known, caution is needed in interpreting and extrapolating from the data presented here.

## Conclusions

At a minimum, this study broadly describes the scope of non-injection and injection drug use across 12 regions in Tanzania, and serves as a foundation for understanding the likely extent of drug use over a vast area of the country for which data have previously been absent. The planning of interventions for people who use drugs should be evidence based, and these findings establish a basis for quantifying and characterizing the HIV epidemic in mainland Tanzania outside of Dar es Salaam. These results can inform geographical targeting of HIV prevention and care interventions for PWUD and PWID, identify resources and existing opportunities for rolling out or scaling up interventions, and indicate potential directions for future studies. Additionally, the population size estimates in this study may be triangulated with national estimates to arrive at updated figures for the country and the distribution of drug users among subnational units. We also note that key informants felt that drug use was increasing in all 12 regions in our study, which signals a need to prevent further expansion of drug use to levels seen in other parts of Africa and around the world.

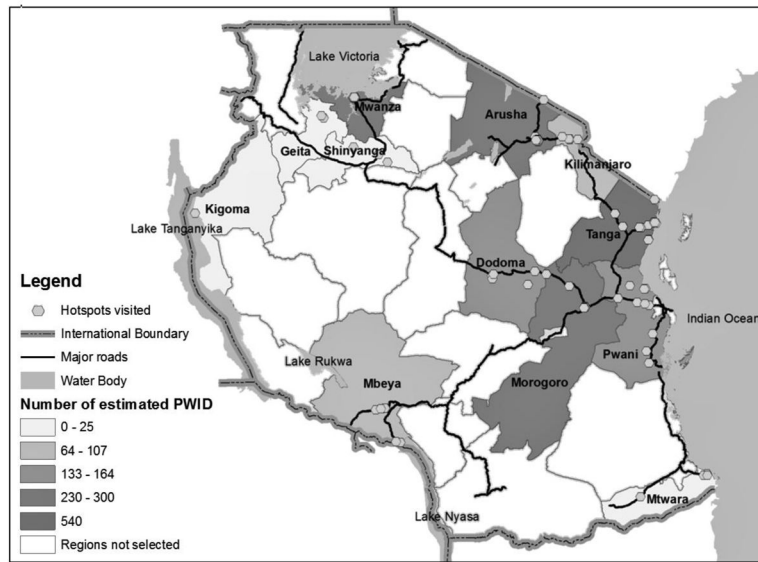
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**Figure 1.** Regions of Tanzania where population size estimation of illicit drug users was done through key informant-driven hot spot mapping, showing numbers of injection drug users estimated, 2013–2014.



**Table 1**

Estimated numbers of people who use drugs and who inject drugs, by region and sex, and per adults aged 15 years and older, Tanzania, 2013–2014.

Region	People who use drugs (PWUD)				People who inject drugs (PWID)				
	# of hot spots	Male estimate (low and high)	Female estimate (low and high)	M:F ratio	PWUD per 100,000 adults 15 years and older	Male estimate (low and high)	Female estimate (low and high)	M:F ratio	PWID per 100,000 adults 15 years and older
Tanga	25	5000 (3000–7000)	190 (120–400)	26:1	452	475 (300–600)	65 (40–100)	7:1	47
Mwanza	14	2800 (1500–4000)	500 (300–800)	6:1	220	250 (180–400)	50 (30–80)	5:1	20
Arusha	16	2500 (1000–5000)	200 (70–300)	13:1	270	175 (80–300)	55 (30–110)	3:1	23
Pwani	10	1475 (1000–2700)	64 (43–117)	23:1	235	150 (50–250)	14 (5–23)	11:1	25
Morogoro	7	1250 (750–1800)	250 (150–360)	5:1	116	260 (180–500)	37 (26–71)	7:1	23
Dodoma	8	913 (460–1600)	183 (92–320)	5:1	99	100 (50–130)	33 (17–43)	3:1	12
Mbeya	7	775 (500–1200)	45 (30–60)	17:1	51	55 (40–70)	9 (5–15)	6:1	4
Kilimanjaro	5	450 (200–650)	113 (50–163)	4:1	53	80 (55–125)	27 (18–42)	3:1	10
Shinyanga	5	308 (140–410)	11 (6–30)	28:1	38	25 (12–35)	0 (0–0)	-	3
Kigoma	1	100 (50–150)	0 (0–0)	-	8	0 (0–0)	0 (0–0)	-	0
Geita	2	95 (50–120)	13 (5–20)	7:1	11	3 (0–10)	0 (0–0)	-	<1
Mtwara	2	65 (35–150)	0 (0–1)	-	6	7 (2–10)	0 (0–0)	-	1