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Original Paper

Adapting methods of key population programmatic mapping and enumeration to inform HIV prevention programs for adolescent girls and young women

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Abstract

Background: Standard programmatic mapping involves identifying locations where key populations meet, profiling of these locations (hotspots) and estimating the key population size. Information gained from this method has been used for HIV programming – resource allocation, program planning, service delivery, and monitoring and evaluation – for people who inject drugs, men who has sex with men, and female sex workers (FSW). With an increasing focus on adolescent girls and young women (AGYW) as a priority population for HIV prevention, programs need to know where and how to effectively reach individuals that are at increased risk for HIV but were conventionally considered part of the general population. We hypothesize that AGYW who engage in transactional and casual sex also congregate at sex work hotspots to meet sex partners. Therefore, we adapted the standard programmatic mapping approach to understand the geographic distribution and population size of AGYW in Mombasa County, Kenya.

Objectives: The objectives are several-fold: (1) to detail and compare the modified programmatic mapping approach used in this study to the standard approach; (2) to estimate the number of young FSW; (3) to estimate the number of AGYW who congregate in sex work hotspots to meet sex partners other than clients; (4) to estimate the overlap in sexual network in hotspots; (5) to describe the distribution of sex work hotspots across Mombasa and its four sub-counties; and (6) to compare the distribution of hotspots that were known to the local HIV prevention program prior to this study and those newly identified.

Methods: The standard programmatic mapping approach was modified to estimate the population of young women aged 14-24 years who visit sex work hotspots in Mombasa to meet partners for commercial, transactional and casual sex.

Results: We estimated that there were 11,777 FSW (range 9,265-14,290) in Mombasa in 2014; among whom, 6,127 (52.0%) were 14-24 years old. The population estimate for women aged 14-24 years who engaged in transactional and casual sex and congregated at the hotspots were 5,348 (range 4,185-6,510) and 4,160 (range 3,194-5,125), respectively. Of the 1,025 validated sex work hotspots, 856 (83.5%) were locations also visited by women engaged in both transactional and casual sex. Only 48 (4.7%) hotspots were exclusive sex work locations. The geographic and typological distribution of hotspots were significantly different between the four sub-counties ($P < .001$). Of the 1,025 hotspots, 419 (40.9%) were already known to the local HIV prevention program and 606 (59.1%) were newly identified.

Conclusions: Using the adapted programmatic mapping approach detailed in this study, our results show that HIV prevention programs tailored to AGYW can focus delivery of their interventions to traditional sex work hotspots to reach subgroups that may be at increased risk for HIV.

Keywords: programmatic mapping; key population size estimation; female sex workers; adolescent girls and young women; sex work; transactional sex; casual sex; HIV prevention

Introduction

Key populations are groups of individuals who are at increased risk for, or who are disproportionately burdened by, a particular disease. Therefore, it is important for individuals of a key population to have access to the necessary prevention resources, care and support. In the context of HIV, key populations include people living with HIV, people who inject drugs, men who have sex with men, transgender people and sex workers [1]. One of the earliest steps in designing a focused HIV program for a key population is knowing who and how many within a key population are at risk, where they are at risk, and what puts them at risk (i.e., condomless sex, experience of violence, needle sharing, etc.). Various methods exist for estimating key population size – such as capture-recapture, multiplier, population survey and network scale-up [2, 3]. However, these approaches only provide an estimate for the size of a key population, which in itself may not be sufficient for comprehensive program design, planning and delivery. Recognizing the importance of how place, environment and sexual network formation contribute to the epidemiology of HIV [4-6], programmatic mapping was developed to shed light on the types (or "typology"), and distribution, of locations where key populations congregate. Programmatic mapping involves locating and profiling geographically defined locations (or "hotspots") where key populations meet and where risk behaviours take place and estimating the size of key populations in each hotspot. Individual hotspot-level estimates can be aggregated to generate population size estimates for a district, region and entire country. Many cities and countries, including Kenya, have used programmatic mapping to determine the geographic distribution and population size for people who use injection drugs, men who have sex with men, and male, female and transgender sex workers [5, 7, 8].

Given the disproportionately high burden of HIV shouldered by female sex workers (FSW) [9], many HIV prevention programs have been implemented to provide focused services to this key population and there have been successes in reducing new HIV infections among FSW in some regions of the world [10-12]. Nonetheless, in a clinic-based survey of Kenyan FSW between 18 and 57 years, HIV prevalence was highest among women who had been in sex work for less than two years [13], thus highlighting a program gap in addressing HIV risk early. In fact, this high HIV prevalence may indeed signal unmitigated HIV risk prior to and in the early stages of a sex work career.

Conventional FSW programs are not designed to reach women who engage in other types of sexual partnerships which may also be associated with increased risk of HIV acquisition – namely, condomless sex in the context of transactional sex and casual sex [14]. Young women and adolescent girls (AGYW) aged 15-24 years are particularly burdened by HIV. Globally, in 2016 there were an estimated 790,000 (range 680,000 – 910,000) new HIV infections among adult women, among whom 46% were AGYW. AGYW also represented 60% and 59.0% globally of all young people living with HIV and newly infected young people, respectively [15]. In Kenya, 32.8% of all new adult HIV infection in 2015 occurred among AGYW [16].

The shared vulnerabilities among AGYW associated with sexual debut and their early sexual experiences, and among young FSW who have newly entered sex work, have led to a global call to refocus and *Fast-Track* HIV prevention among AGYW [17]. But how does one expand

coverage of targeted HIV prevention programs to a sub-population that has long been traditionally regarded as part of the general population?

We hypothesize that AGYW who engage in transactional and casual sex also congregate at sex work hotspots to meet sex partners, and understanding whether and to what extent this potential overlap in sexual networks exists, could provide valuable information for prevention programs on the locations to reach and provide services for AGYW subgroups in high-risk settings. Therefore, in this paper, we describe how we modified the current approach to FSW programmatic mapping [5, 7, 8] to gather information on the geographic distribution and to estimate the population size of AGYW congregating at established sex work hotspots by the spectrum of sexual partnerships, including sex work, transactional and casual sex. The objectives of this paper are several-fold: (1) to detail and compare the modified programmatic mapping approach used in this study to the standard approach; (2) to estimate the number of young FSW; (3) to estimate the number of AGYW who congregate in sex work hotspots to meet sex partners other than clients; (4) to estimate the overlap in sexual network in hotspots; (5) to describe the distribution of sex work hotspots across Mombasa and its four sub-counties; and (6) to compare the distribution of hotspots that were known to the local HIV prevention program prior to this study and those newly identified. Finally, we will also review how this modified approach to programmatic mapping and population size estimation can provide strategic guidance for HIV/STI prevention programs looking to adapt and expand their services to address a wider spectrum of risk among AGYW within sex work hotspots.

Methods

Study setting

Mombasa County is the smallest of 47 counties in Kenya, covering a territory of 294.9 km^2, situated along the coast of the Indian Ocean [18]. In 2014, Mombasa had a population of 1,106,444 (female population of reproductive age [14-44 years] = 319,032; population of adolescent girls and young women [14-24 years] = 134,885) [18]. Mombasa city is an important regional economic hub with a robust tourism sector and a port which handles millions of tons of cargo annually [19]. Kenya has a mixed HIV epidemic and in 2015, the HIV prevalence in Mombasa County was 7.9% [20], 1.3 times higher than the national average of 5.9% [16]. The HIV prevalence among FSW in Kenya was 29.3% in 2015 compared to 6.3% among women in the general population [16]. The HIV prevalence among FSW in Mombasa is currently unknown. Although not representative of the FSW population in Mombasa, the HIV prevalence among FSW registered with our local program partner, the International Centre for Reproductive Health Kenya (ICRH), was 5.9% in 2013 [21].

Definitions

We defined "sex work", "transactional sex" and "casual sex" as follows. *Sex work* is defined as the exchange of money (or gifts or other resources) between individuals for sex. *Transactional sex* is when individuals engage in sex with the expectation of receiving money, gifts or other resources in return. *Casual sex* occurs when individuals engage in sex but neither party expects to receive money, gifts or other resources in return.

A *hotspot* is defined as an indoor or outdoor venue or location where FSW congregate to solicit clients and/or where sex work-related sexual activities take place.

The standard approach to programmatic mapping and estimation of key population size

The standard mapping method [5, 7, 8] (Figure 1) involves: 1) pre-mapping and planning exercise; 2) level one secondary and tertiary key informant (KI) interviews to generate an exhaustive list of hotspots where members of a key population congregate; 3) level two interviews (or group discussion) with primary KIs on site to validate and profile hotspots; and 4) data analysis. Primary KIs are members of the key population (in this case, FSW); secondary KIs include persons who have close association with, and an intimate knowledge about, sex work (e.g., pimps, brothel owners, etc.); and, tertiary KIs include those who have a professional knowledge and/or interest in sex work (e.g., taxi drivers, club bouncers, police, etc.).

a) Standard Mapping Approach	b) *Modified* Mapping Approach
PRE-MAPPING AND PLANNING • Train local implementation team • Segment target mapping area into data collection zones • Finalize key informant types for Level One interviews • Finalize hotspot typology • Develop data collection tools, interview guide and script • Develop mapping action plan with timelines for completion • Community engagement with peers from the local FSW collectives	Standard approach *plus*: • Discuss with local implementation team and peers about the expanded scope of the modified approach to also estimate the population size of AGYW who engage in sex work, transactional and casual sex • Discuss the study's hypothesis about co-location of AGWY subgroups at sex work hotspots seeking different types of sexual partnerships
LEVEL ONE ACTIVITY • Systematically walk through streets of each data collection zone • Conduct interviews with secondary and tertiary KIs (and primary KIs If possible) on streets – ensure KI types are evenly represented • Collect data on hotspot name, address, typology, hours of operation, min. and max. # of FSW visiting these hotspots • Collate data and consolidate with data from program listing and previous mapping, if available, to develop a final unique list of hotspots • Select hotspots for Level Two activity	• No change
LEVEL TWO ACTIVITY • Validate and profile hotspots • Conduct interviews or group discussions with FSW (i.e., primary KIs) at hotspot • Collect data on hotspot typology, peak day/time when most FSW visit, min. and max. # of all women and FSW who visit on a normal and peak day, other hotspots in the area, and specific locations where respondents connect with clients • Collate data for triangulation, compilation and analysis	Standard approach *plus*: • Collect additional data on the min. and max. # of women and FSW aged 14-24 years, min. and max. # of women aged 14-24 years who seek casual and transactional sex partners, min. and max. # of men who visit and the proportion of whom came to seek sex partners/FSW, and other places where women visit to meet partners for transactional and casual sex
DATA ANALYSIS • Calculate regional key population size estimate based on hotspot-level population numbers	• No change

Figure 1. Comparison of the standard programmatic mapping approach with the modified approach used in this study.

Pre-mapping and planning exercise

In the *first* stage of the mapping exercise, the local team of program implementers and peers – former or current members of a key population who are familiar with the community – are trained and prepared for data collection. The local team discusses and finalizes a list of potential types of KIs for the level one interviews and the most common typologies of hotspots where members of the key population congregate (see below). The team then segments the city into divisions within which smaller data collection zones are delineated, often based on existing administrative units, and develops an action plan with timelines. Community engagement with peers from local FSW collectives and non-governmental organizations (NGOs) serving FSW is a pivotal part of the pre-mapping exercise. The study team needs to work with peers and NGOs because they hold invaluable knowledge about the sex work context and surroundings that an outsider does not have. More importantly, their involvement will ensure development of a mapping process that is well-informed, socially and ethically responsible, and acceptable to members of the key population.

Level one mapping activity

The *second* stage of the mapping exercise involves systematically walking through the streets and open public areas (e.g., parks, market etc.) of each data collection zone and interviewing secondary and tertiary KIs (and primary KIs as well if possible) with the aim to identify and generate an exhaustive list of hotspots by names and address. Through this process, KIs also provide information about the typology of the hotspots and seasons and hours of operation. The number of interviews with different types of KIs is tracked to ensure a broad range of perspectives is captured. All mentioned locations are collated and de-duplicated daily, and checked against the program listing to determine if they are already known to the local program. A final unique hotspot list is created by consolidating data from program listing and previous mapping findings, if available.

Level two mapping activity

In the *third* stage of the mapping exercise, the implementation team visits each hotspot on the list generated from the level one activity, and validates the hotspot as active if it is currently operational and if it is a location where FSW congregate. The team also conducts group discussions with FSW (i.e., primary KIs) on site if more than one FSW can be mobilized. If only one FSW is available and willing to participate, a one-on-one interview is conducted instead. Detailed information was gleaned about the typology of the hotspot, the peak day of the week and peak time of the day when the majority of FSW visit the hotspot, and the minimum and maximum number of women and FSW of all ages who come to visit the hotspot on a normal and peak day. FSW are also asked to list other sex work hotspots in the area, whereby any new locations that are missed in the level one activity will be added to the list and followed up. To account for the extent of sex worker mobility, FSW are asked about other specific locations where they connect with clients.

Data analysis

Since all the identified sex work hotspots were validated during the level two activity, we used only level 2 data for analysis. To obtain a crude population estimate for FSW in the entire county, the minimum and maximum estimates of all hotpots were summed and the mean was calculated.

$$Cr = \sum_{i=1}^{n} Ei$$

where   Cr is the crude estimate of FSW in the county;
       Ei is the estimated number of FSW in hotspot i;
       i = 1, 2, 3,…n is the number of hotspots in the county.

To account for the extent of duplication due to mobility of FSW visiting multiple hotspots looking for clients, the following mathematical function was used:

$$Ni = Cr(1-pi) + (Cr*pi/mi)$$

where the adjusted estimate (Ni) is a function of the crude estimate (Cr), the proportion of FSW who visited other hotspots (pi) and the mean number of hotspots FSW visited (mi). Mobility was adjusted at the sub-county level; adjusted estimates for all sub-counties were then summed to generate a county-wide estimate.

Modifying the standard approach to estimate the population size of young women engaged in transactional and casual sex

We modified the pre-mapping and planning exercise and level two interviews of the standard programmatic mapping approach but adhered to the standard practice for all other phases (Figure 1). In pre-mapping and planning, the expanded scope of the modified method to also estimate the population size of AGYW engaging in sex work, transactional and casual sex was raised with the implementation team, and peers during community engagement, to prepare the team for the later phases of the mapping exercise. The study's hypothesis about co-location of AGYW subgroups at sex work hotspots seeking different types of sexual partnership was specifically discussed. In level two interviews, the team asked primary KIs at each hotspot about the number of young women aged 14-24 years engaging in sex work, transactional and casual sex, the number of men who frequent the hotspot seeking FSW and other sex partners, and other places where women visit to meet partners for transactional or casual sex.

In contrast to FSW, mobility of women engaging in transactional and casual sex was assumed to be limited. As such, the mean peak day population estimate for women engaging in transactional and casual sex at each hotspot was taken as the best estimate for that hotspot. All hotspot-level estimates were summed to generate an estimate for the entire county.

Implementation of the Modified Programmatic Mapping Approach in Mombasa, Kenya

The modified mapping approach was implemented between May 15, 2014 and June 20, 2014 by a 30-member team comprised of ICRH research staff and peer educators with experience linking FSW within their community to ICRH and other local HIV prevention and support programs. Based on existing administrative divisions, Mombasa County was segmented into four sub-counties encompassing nine data collection zones. The types of KIs approached for level one interviews included FSW, men who have sex with men (including male sex workers), drug

peddlers, beach boys/girls, public transport drivers (e.g., taxi, taxi motorcycles, auto rickshaws and mini-buses), owners/staff/patrons of Internet shops/video dens, security guards/watchmen/community policing groups, bouncers, bar owners/staff/patrons, massage parlor owners/staff, brothel/sex den owners/staff, hotel/lodge owners/staff/patrons, khat vendors, local brew sellers/patrons, staff of the Government of Kenya and NGOs, community health workers/health facility service providers, police/law enforcement agents, pharmacists, and village chiefs/assistant chiefs/elders.

Sex work hotspots in Mombasa can be categorized into eight general typologies: (1) public place (beach, park etc.); (2) street; (3) bar/nightclub/casino/hotel (i.e., venues with rooms); (4) bar/restaurant/café (i.e., venues without rooms); (5) guesthouse/lodge (i.e., venues without bars); 6) sex den/brothel; (7) local brew den (i.e., street kiosks selling *mnazi* - palm wine made from naturally fermented coconut tree sap); and (8) other (e.g., home, massage parlours/saunas, video dens, and truck stops). These typology categories were developed in partnership with ICRH.

Statistical Analysis

Chi-square test was used to compare the distribution of sex work hotspots by sub-counties, and the distribution of previously-known and newly-identified hotspots by typology. A difference is considered significant if $P < .05$.

Ethical Approval

This study was approved in Kenya by the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee, and the Research Permit Committee of the National Commission for Science, Technology and Innovation; and in Canada by the Human Research Ethics Board at the University of Manitoba.

Results

Population Size Estimates

We estimated that there were 11,777 FSW (range 9,265-14,290) in Mombasa in 2014; among whom, 6,127 (range 4,793-7,462) (52.0%) were between 14 and 24 years and represented about 4.5% of the general female population of the same age group. The population estimate for women aged 14-24 years who engaged in transactional and casual sex and congregated at the hotspots were 5,348 (range 4,185-6,510) and 4,160 (range 3,194-5,125), respectively. Combined, young women who engaged in transactional and casual sex represented about 7.1% of the female population of the same age group (Table 1).

Table 1

Estimated population size of women engaging in sex work, transactional sex and casual sex in Mombasa County, Kenya.

Study population	Age group	Point estimate	Range	% general female population of the same age group [18]
Women engaging in:				
Sex work	All ages	11,777	9,265-14,290	3.7%[a]
	14-24 years	6,127	4,793-7,462	4.5%
Transactional sex	14-24 years	5,348	4,185-6,510	4.0%
Casual sex	14-24 years	4,160	3,194-5,125	3.1%

[a] % general female population of reproductive age (14-44 years)

Sexual Network Overlap

1,183 sex work hotspots were named during level one interviews, of which 1,025 (86.6%) were validated to be active. Among these validated hotspots, 107 (10.4%), 14 (1.4%) and 856 (83.5%) were also locations visited by women engaged in transactional sex, casual sex or both, respectively. Only 48 (4.7%) hotspots were exclusive sex work locations (Figure 2).
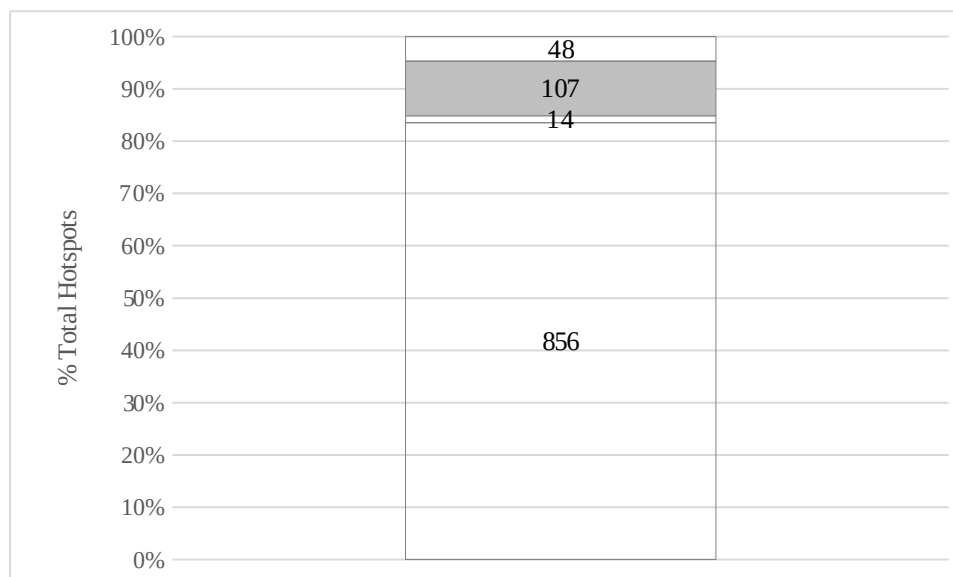

Figure 2. Overlap in the 1,025 sex work hotspots in Mombasa County, Kenya that were also visited by women engaging in transactional and/or casual sex.

Hotspot Typology and Distribution

Of the 1,025 sex work hotspots, local brew dens were the most numerous overall, followed by bars/restaurants/cafés (Figure 3).
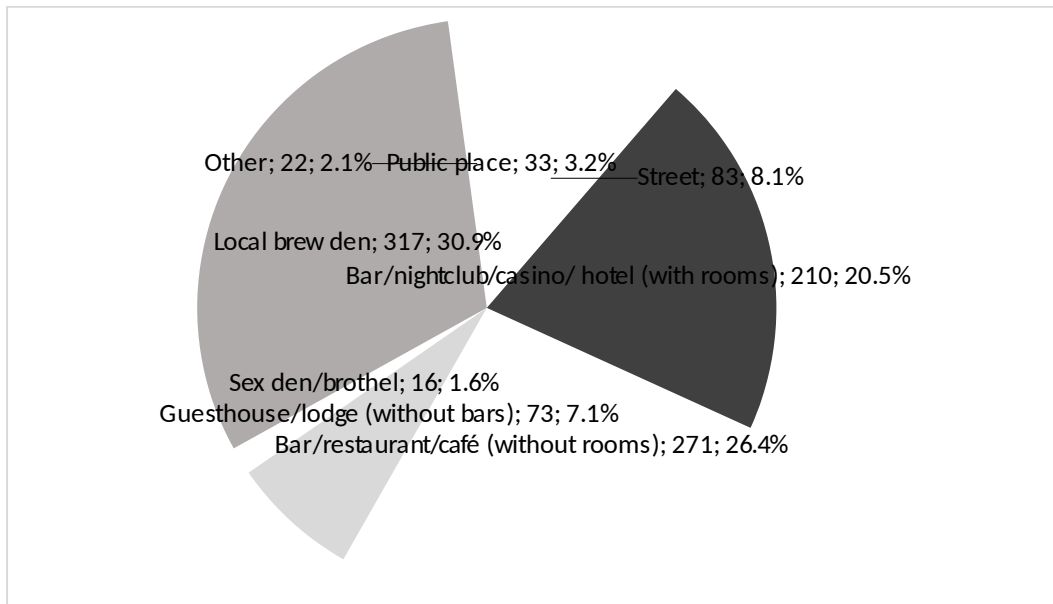

Figure 3. Distribution of sex work hotspots by typology in Mombasa County, Kenya. The "Other" category includes hotspot types such as home, massage parlours/saunas, video dens, and truck stops.

Of these 1,025 hotspots, 280 were located in sub-county A, 164 in sub-county B, 466 in sub-county C and 115 in sub-county D (Figure 4). The distribution of the different types of hotspots were significantly different between the four sub-counties (Table 2, $P < .001$).
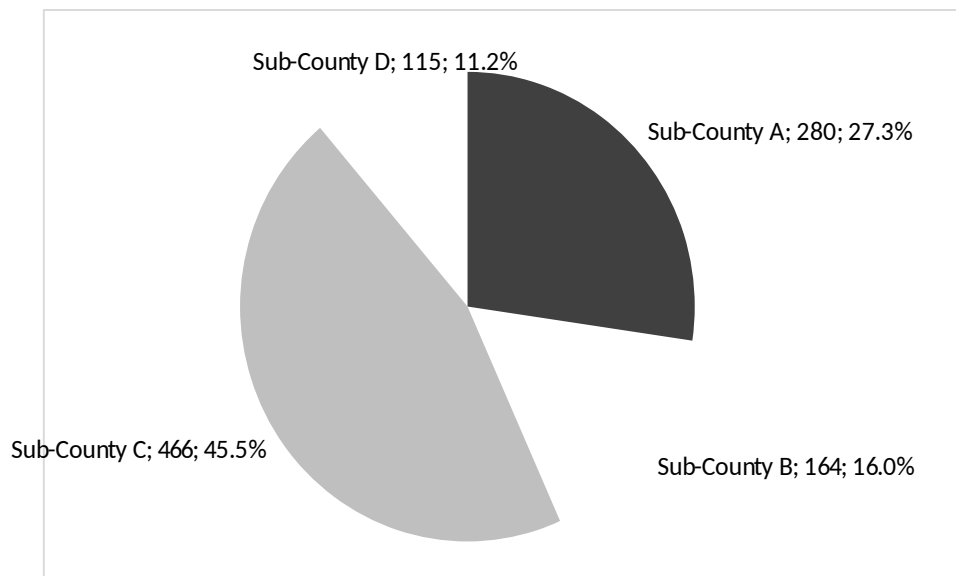

Figure 4. Distribution of sex work hotspots by sub-county in Mombasa County, Kenya.

Table 2
Distribution of sex work hotspots by typology and sub-county in Mombasa County, Kenya.[a]

Sex Work Hotspot Typology	Sub-County A, N = 280 n (%)	Sub-County B, N = 164 n (%)	Sub-County C, N = 466 n (%)	Sub-County D, N = 115 n (%)
Public place	12 (4.3%)	6 (3.7%)	13 (2.8%)	2 (1.7%)
Street	21 (7.5%)	29 (17.7%)	31 (6.7%)	2 (1.7%)
Bar/nightclub/casino/ hotel (with rooms)	63 (22.5%)	40 (24.4%)	81 (17.4%)	26 (22.6%)
Bar/restaurant/café (without rooms)	82 (29.3%)	49 (29.9%)	118 (25.3%)	22 (19.1%)
Guesthouse/lodge (without bars)	19 (6.8%)	10 (6.1%)	38 (8.2%)	6 (5.2%)
Sex den/brothel	8 (2.9%)	6 (3.7%)	2 (0.4%)	0 (0.0%)
Local brew den	68 (24.3%)	19 (11.6%)	173 (37.1%)	57 (49.6%)
Other [b]	7 (2.5%)	5 (3.0%)	10 (2.1%)	0 (0.0%)

[a] The distribution of hotspots between the four sub-counties was significantly different ($P < .001$).

[b] The "Other" category includes hotspot types such as home, massage parlours/saunas, video dens, and truck stops.

Figure 5 shows the typological distribution of sex work hotspots that were already known to the local HIV prevention program prior to this study and those that were newly identified. Of the 1,025 validated active hotspots, 419 (40.9%) were already known to program and 606 (59.1%) were newly identified. The typological distribution of previously known hotspots and newly identified hotspots varied significantly ($P < .001$). Bars/nightclubs/casinos/hotels were the most common among previously known hotspots, whereas local brew dens were the most common among newly identified hotspots.
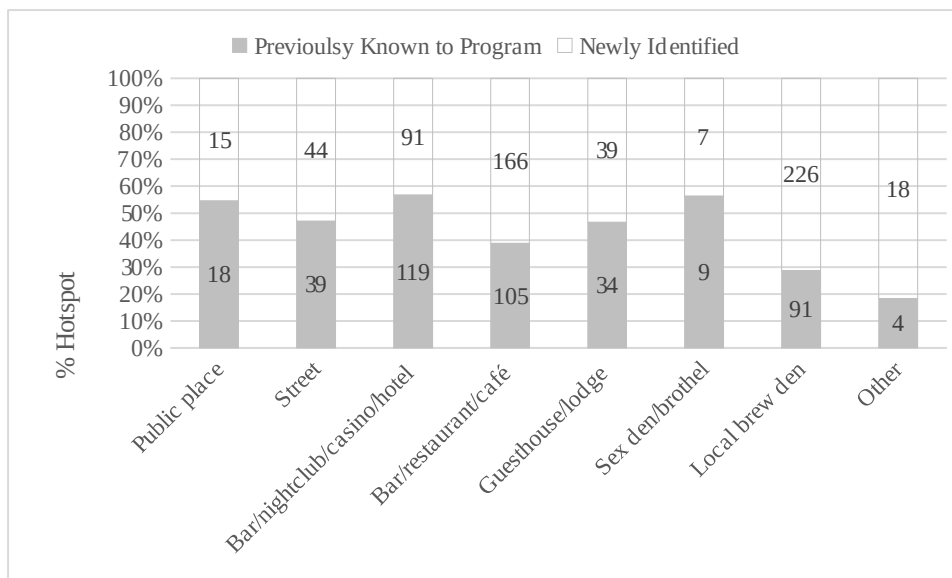
Figure 5. Proportion of sex work hotspots within each typology that were previously known to the local HIV prevention program prior to this study and those that were newly identified in Mombasa County, Kenya. The "Other" category includes hotspot types such as home, massage parlours/saunas, video dens, and truck stops.

Discussion

Principle Results

Using an established mapping method as the foundation, we developed a more nuanced approach to identify the distribution and population size of subgroups at risk of HIV. Our subgroups of interest were AGYW engaged in a spectrum of sexual partnerships and met their sex partners at sex work hotspots. We estimated that the 2014 FSW population size in Mombasa was 11,777 (range 9,265-14,290), and our estimate largely falls within the range of the estimate from a previous standard mapping exercise implemented in 2012 (point estimate 9,288; range 6,917-11,660) [5, 22]. We also estimated that half of the FSW population was between the ages of 14 and 24 years, while a further 9,500 young women in the same age group practiced transactional and casual sex. We found that there was a substantial overlap in spaces where young women meet sex work clients and partners for transactional and casual sex, thereby providing opportunities for women engaging in transactional and casual sex to interact with higher risk social and sexual networks. Using this modified mapping approach, our results show that local HIV programs can utilize a sex work hotspot-based mechanism, as opposed to a general population approach, to reach and deliver services to AGYW subgroups at increased risk of HIV. Moreover, this modified mapping approach provides a deeper layer of strategic information for HIV/STI service design and planning, and for developing representative sampling frames for surveillance and research studies.

We found that the hotspot typology profile varies significantly geographically between the four sub-counties. When comparing the typologies of sex work hotspots known to the local program prior to this study and those newly identified, we additionally found that hotspot turnover was high (i.e., high rates of hotspot closure and opening of new ones). For example, we identified a

total of 317 local brew dens in 2014, among which 226 (71.3%) were new. This suggests that a significant proportion of active hotspots were not known to program and therefore no outreach was provided to women at these hotspots. Furthermore, we validated 1,025 active sex work hotspot in this study, whereas the previous 2012 mapping exercise identified only 774. Taken together, the geographic heterogeneity in hotspot typology, the high hotspot turnover, and notable increase in the number of hotspots all suggest that mapping should be performed iteratively and updated over time in order for local HIV prevention programs to make the necessary service linkage and delivery adaptations responsive to the changing landscape of sex work.

Programmatic mapping is a population size estimation method that is based on the collective knowledge of individuals associated with a key population, or who are members themselves, on where the key population of interest is located within a defined geographic area. Unlike many other population size estimation methods that generate estimates that can be wildly variable and difficult to validate [2, 3], by tethering populations size estimates to spaces where vulnerability and risk cluster, mapping can provide programs with reasonable estimates that can be refined as a program is rolled out and monitored over time. By overlaying data regarding HIV prevalence, sexual network and risk behavior on top of the key population size data linked to space, this clustering of multiple factors which contribute to HIV transmission risk will help local HIV programs make strategic decisions related to geographic allocation of prevention resources, design the right intervention mix appropriate for the level of risk, and reach key populations for delivery of services to ensure program coverage and efficiency [23].

Limitations
There are limitations to the use of programmatic mapping for identifying hotspots and estimating key population size. Because mapping involves collection of empirical data that are often sensitive, the quality, accuracy and comprehensiveness of the data is highly dependent on connecting with informants who are knowledgeable about the structure and operation of sex work. Therefore, during the pre-mapping phase, it is important to dedicate time, as part of project planning, to engage with the FSW community and NGOs serving FSW in order to understand the context of sex work and to adapt the mapping approach that fits with the situation. For the purposes of this study, we worked with a well-established NGO and engaged a trusted network of peer educators.

Despite a well-planned and well-executed mapping exercise, the population size estimates generated by this method still likely underestimate the true population size due to the method's limitation to account for populations who congregate in private and virtual spaces. With the growing popularity of social networking websites and mobile applications, virtual spaces have opened up new communication channels for people to connect for sexual activities. To begin to address this question, our team has piloted a new mapping method in conjunction with analysis of internet-based networks to generate crude size estimates for online key populations [24].

Pertinent to the modifications introduced in this study to the standard programmatic mapping approach, another limitation is the accuracy in estimating the number and the age of AGYW who might be at hotspots connecting with potential partners for transactional and casual sex. More work, including another round of mapping, will need to be done to validate the current estimates and to refine the modified method. Nevertheless, these populations size estimates for AGYW

provide a starting place for HIV prevention programs focusing on AGYW to assess the coverage of their current services and inform program adjustments as required.

Conclusions

Programmatic mapping is an effective method that can be adapted to understand the size, and geographical organization of diverse priority populations for resource allocation, program planning, service delivery, and monitoring and evaluation. Mapping has been extensively utilized for planning HIV/STI prevention and control programs with key populations. By adapting the standard programmatic mapping approach used traditionally for key populations, our results show that HIV prevention programs tailored to AGYW can focus delivery of interventions to traditional sex work hotspots to reach subgroups that may be at increased risk for HIV. Effective HIV prevention and control programs need to be responsive to the evolutions of an HIV epidemic, and mapping is an integral tool for the iterative process of program planning, adaptation and evaluation.

Acknowledgment

Conflicts of Interest

The authors have no conflicts of interest to declare.

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