

Repeat Use of Post-exposure Prophylaxis for HIV Among Nairobi-Based Female Sex Workers Following Sexual Exposure

Preston Izulla¹ · Lyle R. McKinnon^{1,2,3} · Julius Munyao¹ · Naomi Ireri¹ · Nico Nagelkerke^{4,5} · Gloria Gakii¹ · Lawrence Gelmon¹ · Mabel Nangami⁶ · Rupert Kaul^{1,2} · Joshua Kimani^{1,5}

© Springer Science+Business Media New York 2015

Abstract As ART-based prevention becomes available, effectively targeting these interventions to key populations such as female sex workers (FSW) will be critical. In this study we analyze patterns of repeated post-exposure prophylaxis (PEP) access in the context of a large FSW program in Nairobi. During close to 6000 person-years of follow-up, 20 % of participants (n = 1119) requested PEP at least once and 3.7 % requested PEP more than once. Repeat PEP users were younger, had a higher casual partner volume, and were more likely to use condoms with casual and regular partners, have a regular partner, and test for HIV prior to enrolment. Barriers to PEP included stigma, side effects, and lack of knowledge, suggesting repeated promotion may be required for higher rates of uptake. A small subset of FSW, potentially those with heightened risk perception, showed a higher frequency of PEP use; these individuals may be most amenable to roll-out of pre-exposure prophylaxis.

Keywords FSW · HIV prevention · PEP · PrEP · Risk perception

Introduction

HIV/AIDS continues to cause significant morbidity and mortality, with the greatest impact experienced in sub-Saharan Africa [1]. Kenya has a generalized epidemic with an estimated HIV prevalence of 5.6 % and approximately 106,000 new HIV infections per annum [2]. A growing body of literature suggests that targeted interventions in key populations can have major impact on HIV transmission, even when epidemics are advanced [3]. Female sex workers (FSW) are a key population that experiences higher rates of HIV acquisition, disease, and transmission, with pooled odds of HIV infection that in the global context are on average 13-times higher than the general population [4]. Recent mapping estimates suggest there are >100,000 FSW in Kenya [5], out of a total population of over 40 million [6] with a HIV prevalence estimated at approximately 10.7 %, or twice that of the general population [2]. Other estimates have placed this prevalence even higher, suggesting HIV prevalence rates of 29–47 % in Kenyan FSW [3]. Modes of transmission analyses have conservatively estimated that sex work is involved in 14 % of all new HIV infections in Kenya [7]. Together these statistics highlight the need for better interventions to prevent HIV transmission in FSW.

Higher rates of HIV exposure in FSW are multi-factorial with some of the contributing factors being inherent to their work and thus difficult to avoid. Some of the bio-behavioral factors include high partner turnover, incorrect and/or inconsistent condom use, substance abuse, engaging in sex during menses, and douching [8]. Factors like poor health

✉ Preston Izulla
PIzulla@gmail.com

¹ Kenya AIDS Control Project, Department of Medical Microbiology, University of Nairobi, PO Box 69555-00400, Nairobi, Kenya

² Department of Medicine, University of Toronto, Toronto, Canada

³ Centre for the AIDS Program of Research in South Africa (CAPRISA), University of KwaZulu-Natal, Durban, South Africa

⁴ Department of Community Medicine, United Arab Emirates University, Al Ain, United Arab Emirates

⁵ Department of Medical Microbiology, University of Manitoba, Winnipeg, Canada

⁶ School of Public Health, Moi University, Eldoret, Kenya

seeking behavior can amplify HIV risk due to presence of untreated STIs, having inaccurate information on HIV transmission dynamics, and limited condom access [9]. Moreover, in younger FSWs, an immature cervical epithelium may heighten risk of HIV transmission [10]. Other structural factors include male domination during negotiation, forced sex, discriminatory laws, unemployment, low literacy levels and stigma from both the general population and health care providers [11, 12]. Significantly, FSW are more likely to have sex with acutely infected individuals, where the risk of HIV transmission is much higher [13].

Traditional interventions to prevent HIV in FSW revolve around risk-reduction, with a particular focus on consistent condom use [14, 15]. However, ART-based HIV prevention is growing in scope, particularly in light of efficacy results from interventions tested in both men and women [16]. These include treating HIV-infected individuals earlier, which in the HPTN 052 study of discordant couples led to a 96 % reduction in HIV transmission [17]. More recently, several clinical trials have been undertaken to assess efficacy of ART in preventing HIV transmission when used before risky sexual encounters (pre-exposure prophylaxis, or PrEP), with mixed results [18]. In females, several trials including CAPRISA-004 (vaginal TFV gel), Partners PrEP, and CDC-Botswana all showed partial efficacy [19–21]. A number of parallel trials in women have been unsuccessful, presumably due to adherence (FEM PrEP, VOICE), highlighting the need for more operational research to better optimize these interventions [22, 23]. In addition, understanding who is likely to more rapidly use PrEP, and the impact of social and behavioral factors, will be critical in its implementation [24].

Of the interventions tested to date in women (including PrEP), only a small proportion of participants in these studies have been FSW [14]. Despite this, acceptability data suggests FSW in Kenya are interested in ART based interventions specifically PrEP, with adherence challenges acknowledged [25]. Therefore, a gap continues to exist in HIV prevention options for HIV uninfected FSW who become exposed during sex work.

Post-exposure prophylaxis (PEP) following sexual exposure is a HIV prevention intervention that could help to mitigate this gap in the short-term. The World Health Organization (WHO) and United States Centre for Disease Control (CDC) guidelines recommend that non-occupational PEP should be given for risky exposures including unprotected vaginal or anal intercourse, for instance, cases of forced sex [26, 27]. Similarly, current Kenyan Ministry of Health (MOH)/National AIDS and STI Control Program (NASCO) guidelines on HIV/STI services targeting sex workers also recommend use of PEP in FSW for similar exposures [28]. We have recently published one of the first

large analyses of PEP provision for sexual exposure in FSW [29]. Numerous additional questions arose from this initial work, including the continued uptake of PEP repeatedly during program expansion, in which the line between PEP and PrEP becomes blurred. Here we characterize variables associated with FSW seeking repeat doses of PEP, and briefly describe some barriers to PEP access and use.

Methods

Description of the Study Population and Routine Clinic Operation

The Sex Worker Outreach Program (SWOP) Clinic is a HIV/STI prevention, care, treatment and research program operated by Kenya AIDS Control Project (Universities of Nairobi and Manitoba) and funded by the United States President's Emergency Plan for AIDS Relief (PEPFAR). The clinic is located in central Nairobi and provides services to key populations focusing on FSW and men who have sex with men (MSM). For these analyses, we included all HIV uninfected, active FSW who were enrolled to receive HIV prevention services at SWOP. At the time of analysis, 5814 HIV uninfected FSW were enrolled into the program over a 4-year period (2009–2013), through a combination of hot spot based mobilization and snowball recruitment techniques. This number is similar to the total population estimate for FSW working in Nairobi's central business district [30] and close to 20 % of all FSW in Nairobi [5].

HIV/STI prevention services included field- and facility-based health education sessions focusing on risk reduction through correct and consistent condom use, reducing number of sexual partners, reducing substance abuse and condom negotiation skills. These sessions were co-facilitated by peers and program staff. Condoms and lubricants were routinely distributed with the FSW encouraged to come to the clinic for quarterly HIV/STI screening and treatment. At the baseline visit, trained nurses and counselors administered a semi-structured enrolment questionnaire capturing bio-behavioral and reproductive health data. This questionnaire captured a wide range of variables around demographics, details of sex work, sexual risk taking behavior, and reproductive health.

Initial HIV/STI testing was offered at baseline, including blood tests for HIV and syphilis, and cervical swabs for gonorrhea, trichomoniasis, bacterial vaginosis and candidiasis. *Chlamydia trachomatis* and *Neisseria gonorrhoea* were diagnosed in first void urine using Roche Amplicor kits. *Trichomonas vaginalis* was diagnosed from vaginal swabs using the In-PouchTM TV test kit (Biomed

Diagnostics, Inc.). Syphilis was diagnosed serologically using RPR Syphilis Test Kits (Diagnostics Worldwide). HIV testing throughout the study period was performed according to Kenyan national guidelines, with initial screening by antibody based rapid test Determine HIV 1/2 (Inverness Medical, Japan) and confirmation of positive tests using SD Bioline HIV 1/2 (Standard Diagnostics Inc., South Korea) as per national protocols. In the first year of the program, a further confirmatory test, over and above Bioline test, was done using ELISA (Vironstika, Biomerieux) in the program laboratories but this was stopped due to its limited value after the two rapid tests done at the clinic. A registered nurse performed blood draws, while laboratory tests were carried out at University of Nairobi (KACP) laboratories. FSW with signs and symptoms of STIs were given syndromic management that included norfloxacin 800 mg as a single dose, doxycycline 100 mg twice a day for 10 days and metronidazole 400 mg twice a day for 7 days (or Tinidazole 2 g single dose) in accordance with the MOH guidelines [31], and results provided within 1 week of testing. HIV-infected FSWs were initiated into HIV care and treatment as per Kenya National guidelines [32]. FSWs were encouraged to utilize the clinic for unscheduled visits for outpatient illnesses and were referred to a higher-level facility for any health issues that were beyond the scope of the program. All FSWs were encouraged to return to the clinic for quarterly follow up including HIV/STI screening as appropriate.

IRB approval for both the retrospective programmatic analyses of clinical care databases and focus group discussions (FGDs) in this study was obtained from both MOI University Institutional Research and Ethics Committee in Eldoret and the Kenyatta National Hospital Ethical Review Committee. All women gave informed written consent for the FGDs. A study number used for identification purposes was recorded in a file and kept in a locked cabinet at the clinic for all participants; no identifying information was entered into any database that was accessible by the analysis team.

Post-exposure Prophylaxis

PEP was provided at the clinic in accordance with the 2007 WHO/International Labour Organization (ILO) guidelines for the general population following sexual exposure, and as per Kenya MOH guidelines, as previously described [26, 28]. The availability and appropriate use of PEP was funded by PEPFAR and the concept introduced to all HIV uninfected women during their baseline visit. Any HIV uninfected FSW who perceived a risky exposure—typically unprotected sexual intercourse (accidental or intentional) with a client of unknown HIV status—was given a 28-day course of therapy with Zidovudine (300 mg) and Lamivudine (150 mg) twice a day. FSWs were given PEP

dosages for 10 days and a re-fill at a day 10 follow up visit; this visit was also used to review results of liver and kidney function tests done at initial visit for PEP and report any side effects. In addition, prophylactic medication against common STIs that included Norfloxacin 800 mg as a single dose, Doxycycline 100 mg twice daily for 10 days and Metronidazole 400 mg twice daily for 7 days (or Tinidazole 2 g as single dose); and emergency contraception using Postinor 2 (Levonorgestrol 1.5 mg) as a single dose were administered as necessary. Participants were advised to come for follow up HIV testing at 6 weeks, 3 months and 6 months and to use protection with all sexual partners until their HIV status could be confirmed.

Statistical Analyses

We undertook a cross-sectional analysis of baseline variables associated with repeat PEP use. All HIV uninfected participants with complete data were included in the analysis with 4 PEP users and 41 non-users excluded due to incomplete data. ‘Repeat PEP users’ were defined as HIV uninfected FSW who sought PEP more than once at the SWOP clinic during the study period. This group was compared to FSWs who did not request PEP during the same time period, from the same predefined strata, with a negative HIV test at enrolment. Unique strata were created on the basis of year of enrolment, duration of follow-up (truncated into 6-monthly categories), and duration of sex work (truncated into annual categories). Participant groups were compared using conditional logistic regression analyses, with backward selection and likelihood ratios. The final model included all variables significant at a p value of less than 0.05. No variables were forced into the model; variables were included in multivariate analyses if significant at $p < 0.2$ in univariate analyses [33]. Both SPSS version 21 and STATA version 10 were used to carry out the described analyses.

Qualitative Component

To triangulate findings from the quantitative analyses, three FGDs with HIV uninfected FSWs were conducted. The aims of these were to compare the nature of sex work, risk-taking behavior, knowledge of PEP, and potential barriers to PEP access and use between repeat PEP and non-PEP users. Two lists were developed from the database of >5800 HIV uninfected women; one with HIV uninfected FSWs who had never used PEP and a second one with HIV uninfected FSWs who had accessed PEP more than once over the 4 year period. No further inclusion criteria were used. From the first list of non-PEP users, sixteen FSWs randomly selected using a table of random numbers, were invited based on cell phone availability and willingness to participate in the focus group discussion. Two separate FGDs of eight participants each

were planned from this initial list. From the second list of repeat PEP users, eleven FSWs were randomly selected as above to participate in a separate FGD. Informed consent was obtained from the participants and interviews conducted using an FGD guide. The FGD were audio-recorded and later transcribed and translated into English. Data were manually coded in line with the discussion guide and emerging themes. During analysis, we looked for patterns and associations focusing on the earlier alluded to thematic areas.

Results

Participant Characteristics

A total of 5814 HIV uninfected FSW were included in the study. The median age was 31 (IQR 27, 37). Very few participants (1.1 %) were married at the time of enrolment. The median number of years in sex work prior to enrolment was 2 (IQR 1, 5). Nearly half of participants (47.4 %) attained primary level education, 43.8 % attained at least secondary education, and 6.8 % had tertiary level of education. Descriptive statistics for selected variables representing behavioral, risk taking, and health seeking behaviors are outlined in Table 1, with p values indicated where significant differences were observed.

More than two-thirds (69.9 %) of FSWs reported always using condoms with casual partners during vaginal sex. Condom use was infrequent with regular partners, with only 13.1 % reported 'always' using condoms with this type of client. Nearly half (42.3 %) of FSW reported using lubricants with male condoms. Of these, only 19.8 % used water based lubricants (i.e. KY Jelly), with the rest using a variety of oil based lotions and creams. The median number of reported casual partners per week was 10 (IQR 5, 15). Approximately one quarter of FSW engaged in sex during menses with both casual partners and regular partners. Many FSW (27 %) reported having had sex with a person known or suspected to be HIV-infected in the preceding 6 months, and 48.6 % did not use a condom during this act. A majority (84.3 %) of FSW had tested for HIV prior to enrolling in the clinic. Additionally, 61.3 % of the sex workers reported using at least one method of contraception that was either hormonal oral pill, hormonal implant, injectable Depo-Provera or intra-uterine device. At enrolment, approximately one-quarter of participants (25.7 %) reported a prior history of genital ulcers, 62.2 % abnormal vaginal discharge, and 26 % a painless genital growth.

Comparison of Characteristics Between Repeat and None PEP Users

Of the 5814 HIV uninfected FSWs in the cohort, 4695 (80.7 %) did not request PEP, while 1119 (19.2 %) requested

PEP, including a total of 1421 PEP episodes. Of 1119 PEP users, 214 (3.7 %) sought PEP more than once (repeat PEP users). We excluded 4 PEP users and 41 non-users from the analysis due to incomplete data. In univariate analysis, repeat PEP users were more likely to be younger (OR 0.97, 95 % CI 0.94–0.99). These participants were half as likely to have regular partner (OR 0.54, 95 % CI 0.40–0.72), but were also twice as likely to use condoms with the regular partner (OR 1.98, 95 % CI 1.29–3.06). Repeat PEP users were 1.5 times more likely to have sex during menses with casual partners (OR 1.58, 95 % CI 1.16–2.16), had almost 20 % more casual partners on day prior to enrolment (OR 1.16, 95 % CI 1.08–1.24), and were more than twice as likely to report always using condoms with casual partners (OR 2.32, 95 % CI 1.53–3.52). Lastly, repeat PEP users showed a statistical trend to be 1.7 times more likely to have had a HIV test prior to enrolment (OR 1.70, 95 % CI 1.00–2.88).

Multivariate Analysis

In light of several univariate associations of repeat PEP use, we next carried out multivariate analyses (Table 2). Because non-PEP users greatly outnumber repeat PEP users, and also to minimize the influence of time trends and program exposure, this analysis was stratified based on variables including year of enrollment, duration of follow-up, and duration of sex work. Age remained associated with repeat PEP; older FSW were less likely to be repeat PEP users (aOR 0.94, 95 % CI 0.90–0.98). Repeat PEP users were more than twice as likely to report always using condoms with regular partners (aOR 2.39, 95 % CI 1.44–3.97) and had 30 % more casual partners on the day prior to enrolment in the clinic (aOR 1.29, 95 % CI 1.14–1.45).

Focus Group Discussions

To further understand PEP access, we conducted FGDs with FSW who had accessed PEP repeatedly and those who did not access PEP. These FGDs revealed that repeat PEP users tend to be based in more traditional venues for sex work such as streets and bars, where client volume is higher, risk for forceful unprotected sex was also higher and opportunities for consistent condom use were reportedly less. In contrast, non-PEP users tended to operate in newer venues like massage parlors and strip clubs. The non-PEP users intimated that in these newer venues, the clients paid more per act, were more likely to use condoms and would often engage in non-penetrative sexual encounters. They highlighted that they felt safer and in control in these newer environments and this could imply lesser risks for them.

Knowledge of PEP was a clear difference between FGD groups. Repeat PEP users had a much better understanding

Table 1 Comparison of selected socio-demographic, risk and health seeking characteristics of repeat and none PEP users

Variable	Non PEP users	Single PEP users	Repeat PEP Users
Number	4734	868	210
Age, years	31 (27, 38)	30 (26, 35)	30 (27, 35)**
Median (IQR)			
Number of years in sex work	2.4 (1.0, 5.0)	1.6 (0.6, 3.8)	1.1 (0.6, 3.0)**
Median (IQR) ^a			
Duration of follow up, days	253 (112, 499)	314 (151, 595)	374 (220, 609)**
Median (IQR) ^a			
Completed primary school	48.8 %	58.7 %	57.1 %***
100 % condom use with casual partners	66.9 %	81.9 %	86.6 %***
Casual partners in the prior week	2 (0, 4)	3 (1, 6)	4 (1, 8)**
Have a regular partner	71.7 %	61.7 %	51.4 %***
HIV test prior to enrolment	82.9 %	90.7 %	92.4 %***
Use contraception	59.8 %	56.0 %	59.0 %
History of genital ulcers	26.1 %	23.8 %	27.6 %
History of vaginal discharge	62.4 %	61.4 %	64.8 %

^a Variables used to create strata for conditional logistic regression (in addition to calendar year of enrolment)

** $p < 0.001$, one-way ANOVA

*** $p < 0.001$, χ^2 test

Table 2 Conditional logistic regression to characterize socio-demographic, risk taking and health seeking behaviors associations of repeat PEP use

Variable	Univariate analysis			Multivariate analysis		
	p value	Crude OR	95 % CIs	p value	aOR	95 % CIs
Age (per year)	0.01	0.97	0.94, 0.99	0.005	0.94	0.90, 0.98
100 % condom use with regular partners during vaginal sex	0.002	1.98	1.29, 3.06	0.001	2.39	1.44, 3.97
Number of casual partners the day prior to enrolment	<0.001	1.16	1.08, 1.24	<0.001	1.29	1.14, 1.45
HIV testing prior to enrolment	0.051	1.70	0.997, 2.88	– ^a	–	–
Lubrication of male condoms during sex	0.059	0.76	0.57, 1.01	–	–	–
Sex with casual partners during menses	0.004	1.58	1.16, 2.16	–	–	–
Having a regular partner	<0.001	0.54	0.41, 0.72	–	–	–
100 % condom use during vaginal sex with casual partners.	<0.001	2.32	1.53, 3.52	–	–	–

^a Dashed lines represent variables removed from stepwise multivariate models

of PEP and its uses in comparison to non-PEP users. This knowledge extended to the ability to compare PEP services across multiple clinics across Nairobi. Conversely, many non-PEP users reported hearing about PEP for the first time at the FGD, or having heard of PEP but not clearly understanding and/or unable to describe its use. Some non-PEP users reported high risk exposures where PEP access would have been appropriate, but instead practiced douching and/or 'hoped for the best' due to the limited knowledge on PEP. Thus, limited literacy around PEP in non-users was one of the barriers to their seeking PEP after risky exposures.

A key limitation to secondary PEP access and adherence that was highlighted by the repeat PEP users was the

perceived or experienced side effects of antiretroviral medications. Furthermore, perceived stigma from other FSWs based on the notion that one using anti-retroviral medication (PEP) is likely to be HIV-positive also emerged as one of the barriers to seeking PEP. Fear of stigmatization from health care providers especially for repeated PEP requests was a pertinent issue, since it would possibly imply the FSW was not taking any measures to avoid the circumstances that led to previous PEP requests.

Apart from the location of sex work, which represented a key structural difference between non-PEP and repeat PEP groups, self-reported risk taking behavior with clients was mostly similar. In both groups, condom use was much lower with regular clients for the reported reasons of emotional

connections and trust. Other factors that might lead to an exposure acknowledged by both groups of FSW included that more money could be obtained by offering sex without a condom and inexperience among new FSWs. However, it is clear that not all potential exposures led to PEP requests, highlighting the important need to better understand this issue.

Discussion

While PEP was accessed in the current study by approximately 20 % of the HIV uninfected FSWs, a much smaller proportion (<4 %) used PEP more than once. Several characteristics distinguished repeat PEP users from the remainder of the study population. There was a likelihood of increased perception of HIV risk among repeat PEP users, as suggested by higher frequency of condom use with regular partners; and a higher likelihood of HIV testing prior to enrolment. However, higher condom use with regular partners may also point toward better condom negotiation skills among repeat PEP users and this particular behavior will need to be the focus of future research.

It is worth noting that the association between frequency of condom use and repeat PEP use may be partly explained by the fact that condom related failure; either through breakage, slipping off during intercourse or deliberate puncturing and/or removal by male client, were previously identified among the main reasons for seeking PEP and would thus be expected to occur more frequently in those with higher condom use [29].

Another strong association of repeat PEP was high client volume, which could imply both a higher chance for a risky exposure as well as a higher frequency of condom use. Both the qualitative and quantitative work suggested that repeat PEP use was associated with younger age and shorter duration of sex work (half the duration as the non-PEP users), possibly indicating higher risk perception among younger sex workers, and/or a reduced ability to avoid risk either due to inexperience or high client volumes (McKinnon et al. submitted). While it is difficult to measure 'inexperience' other than by comparing age and stratifying by time in sex work, we noted that if anything PEP users were slightly more educated than non-users (Table 1). However, formal education and experience as a sex worker are likely two very different concepts.

Furthermore, increased client volume and inexperience could also be related to the observation that repeat PEP users were more likely to operate in streets and brothels that are typically less expensive than massage parlors and newer venues, meaning sex workers need to take more clients to earn enough money. Additionally, streets and brothels are a less predictable environment for sexual

encounters where FSW have limited ability to control high risk situations with clients including forced unprotected intercourse. A deeper understanding of the interaction between the different variables that lead to increased PEP uptake is a critical area for future study.

One of the major strengths of this study is that it was carried out in a large cohort of FSW enrolled in a HIV prevention, care and treatment clinic in Nairobi over a 4-year period. As earlier highlighted, the study enrolled approximately 20 % of estimated FSW in Nairobi with most of them operating within the downtown area [5, 30] and as such, we believe the findings of this study should be fairly representative of self-identified FSW operating in urban Nairobi.

There were few limitations to the study. Firstly, there may be misclassification bias in defining repeat PEP use based on FSW who reported to the SWOP clinic only, as it is clear that some FSW accessed PEP elsewhere. This was countered by asking about prior PEP access at each repeat visit, and encouraging PEP access where convenient for the FSW. Secondly, the bulk of our data relied primarily on self-reported information, which can be inaccurate for a variety of reasons including recall and social desirability biases. Thirdly, our multivariate model utilized step-wise selection, which could result in the inflation of some estimates and exclusion of some significant variables. However, we did not find this to be a major factor in exploratory sensitivity analyses. Lastly, reliance on cell phone contacts for the FGD recruitment represents a potential selection bias, but was difficult to avoid for reasons of feasibility.

In conclusion, FSW seeking PEP repeatedly were likely to be younger, have a higher client volume, and used condoms more frequently than those who did not access PEP repeatedly. This in part may reflect an increase in risk perception and health care system literacy (around PEP especially); however it also could reflect inexperience in sex work, working in an unpredictable environment (i.e. street and brothel-based), and a general decreased ability to control the likelihood of potential HIV exposures. Furthermore, several potential barriers to PEP uptake were identified, including perceived stigma from other FSW and health care workers, decreased knowledge around PEP and its use, and the desire to avoid side effects of the medication. Additional efforts to increase PEP awareness, use and adherence, as well as minimizing other barriers to its access could be a key feature in increasing uptake. In addition, identifying and intervening in unpredictable work environments such as streets and brothels where FSWs are likely to be at higher risk of unprotected and or forceful unprotected intercourse should be an important area of focus for FSW programs.

Finally, more research on PEP use in FSW could help to identify individuals with higher risk (both perceived and

actual) who may be more likely to benefit from PrEP to prevent HIV infection if and when this intervention becomes available in Kenya.

Acknowledgments We would like to acknowledge and thank all the staff and participants of the SWOP clinic in Nairobi for their assistance with the completion of this study. Funding was provided by US-PEPFAR (CDC-PEPFAR U62/CCU024510-01) to L.G. and J.K. and CIHR MOP-89983 to R.K. R.K. is supported by an OHTN Career Scientist Award. L.R.M. was supported by a CIHR fellowship and the International Infectious Diseases and Global Health Training Program.

References

- UNAIDS. UNAIDS report on the global AIDS epidemic. 2012. <http://www.unaids.org/en/resources/publications/2012>. Accessed March 2015.
- Kenya AIDS indicator survey 2012-final report. National AIDS Control Council (NACC), Kenya. 2014. <http://www.nacc.or.ke>. Accessed Sept 2014.
- Tanser F, de Oliveira T, Maheu-Giroux M, Bärnighausen T. Concentrated HIV subepidemics in generalized epidemic settings. *Curr Opin HIV AIDS*. 2014;9(2):115–25.
- Baral S, Beyrer C, Muessig K, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. *Lancet Infect Dis*. 2012;12:538–49.
- Odek WO, Githuka GN, Avery L, et al. Estimating the size of the female sex worker population in Kenya to inform HIV prevention programming. *PLoS ONE*. 2014;9:e89180.
- Kenya facts and figures. 2014. <http://www.knbs.or.ke>. Accessed April 2015.
- Gelmon L, Kenya P, Oguya F, et al. Kenya HIV prevention response and modes of transmission analysis. Nairobi: Kenya National AIDS Control Programme, UNAIDS, the World Bank Global AIDS M&E Team (GAMET); 2009.
- Chersich MF, Luchters S, Ntaganira I, et al. Priority interventions to reduce HIV transmission in sex work settings in sub-Saharan Africa and delivery of these services. *J Int AIDS Soc*. 2013;16:17980.
- Dhana A, Luchters S, Moore L, et al. Systematic review of facility-based sexual and reproductive health services for female sex workers in Africa. *Glob Health*. 2014;10:46.
- Yi TJ, Shannon B, Prodger J, et al. Genital immunology and HIV susceptibility in young women, Review Article. *Am J Reprod Immunol*. 2013;69(Suppl 1):74–9.
- Shannon K, Strathdee SA, Goldenberg SM, et al. Global epidemiology of HIV among female sex workers: influence of structural determinants. *Lancet*. 2015;3(385):55–71.
- Wirtz AL, Schwartz S, Ketende S, et al. Sexual violence, condom negotiation, and condom use in the context of sex work: results from two West African countries. *J Acquir Immune Defic Syndr*. 2015;68(Suppl 2):S171–9. doi:10.1097/QAI.0000000000000451.
- Wawer MJ, Gray RH, Sewankambo NK, et al. Rates of HIV-1 transmission per coital act, by stage of HIV-1 infection, in Rakai, Uganda. *J Infect Dis*. 2005;1(191):1403–9.
- Bekker L-G, Johnson L, Cowan F, et al. Combination HIV prevention for female sex workers: what is the evidence? *Lancet*. 2015;385(9962):72–87.
- Ngugi EN, Wilson D, Sebstad J, et al. Focused peer-mediated educational programs among female sex workers to reduce sexually transmitted disease and human immunodeficiency virus transmission in Kenya and Zimbabwe. *J Infect Dis*. 1996;174(Suppl2):8240–7.
- Karim SSA, Karim QA. Antiretroviral prophylaxis: a defining moment in HIV control. *Lancet*. 2011;378:e23–5. <http://eutils.ncbi.nlm.nih.gov/entrez/eutils/elink.fcgi?dbfrom=pubmed&id=21771566&retmode=ref&cmd=prlinks>.
- Cohen MS, Chen YQ, McCauley M, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med*. 2011;11(365):493–505.
- Karim SSA. HIV pre-exposure prophylaxis in injecting drug users. *Lancet*. 2013;15(381):2060–2.
- Karim QA, Karim SSA, Frohlich JA, et al. Effectiveness and safety of tenofovir gel, an antiretroviral microbicide, for the prevention of HIV infection in women. *Science*. 2010;329:1168–74.
- Baeten JM, Celum C. Antiretroviral preexposure prophylaxis for HIV prevention. *N Engl J Med*. 2013;3(368):83–4.
- Thigpen MC, Kebaabetswe PM, Paxton LA, et al. Antiretroviral preexposure prophylaxis for heterosexual HIV transmission in Botswana. *N Engl J Med*. 2012;2(367):423–34.
- Van Damme L, Corneli A, Ahmed K, et al. Preexposure prophylaxis for HIV infection among African women. *N Engl J Med*. 2012;2(367):411–22.
- Baeten JM, Haberer JE, Liu AY, Sista N. Preexposure prophylaxis for HIV prevention: where have we been and where are we going? *J Acquir Immune Defic Syndr*. 2013;63(Suppl 2):S122–9.
- Koblin BA, Andrasik M, Austin J. Preparing for the unexpected: the pivotal role of social and behavioral sciences in trials of biomedical HIV prevention interventions. *J Acquir Immune Defic Syndr*. 2013;63(Suppl 2):S183–6.
- Van der Elst EM, Mbogua J, Operario D, et al. High acceptability of HIV pre-exposure prophylaxis but challenges in adherence and use: qualitative insights from a phase I trial of intermittent and daily PrEP in at-risk populations in Kenya. *AIDS Behav*. 2013;17:2162–72.
- Post-exposure prophylaxis to prevent HIV infection: joint WHO/ILO guidelines on post-exposure prophylaxis (PEP) to prevent HIV infection. World Health Organization, Geneva; 2007. [http://www.who.int/hiv/pub/guidelines/post-exposure prophylaxis/en](http://www.who.int/hiv/pub/guidelines/post-exposure%20prophylaxis/en). Accessed August 2014.
- CDC morbidity and mortality weekly report. 2005;54: RR-2. <http://www.cdc.gov/hiv/prevention/research>. Accessed Sept 2014.
- The National AIDS and STI Control Program. National Guidelines for HIV/STI Programs for sex workers NASCOP. 2010. <http://nascop.or.ke/library/Marps/Sex%20Worker%20Guidelines.pdf> Accessed Sept 2014.
- Izulla P, McKinnon LR, Munyao J, et al. HIV postexposure prophylaxis in an urban population of female sex workers in Nairobi, Kenya. *J Acquir Immune Defic Syndr*. 2013;1(62):220–5.
- Kimani J, McKinnon LR, Wachih C, et al. Enumeration of sex workers in the central business district of Nairobi. Kenya. *PLoS ONE*. 2013;8:e54354.
- Algorithms for managing common STI syndromes. <http://www.nascop.or.ke/stipubs>. Accessed August 2014.
- Guidelines for anti-retroviral therapy in Kenya. <http://www.nascop.or.ke/artpubs.php>. Accessed August 2014.
- Sun GW, Shook TL, Kay GL. Inappropriate use of bivariable analysis to screen risk factors for use in multivariable analysis. *J Clin Epidemiol*. 1996;49:907–16.