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The effect of mobility on HIV-related healthcare access and use for female sex workers: a systematic review

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The effect of mobility on HIV-related healthcare access and use for female sex workers: a systematic review

Female sex workers (FSW) experience a high HIV burden and are often mobile. FSW access to HIV-related healthcare is essential for equitable welfare and to reduce new HIV infections. We systematically reviewed the literature on mobility and HIV-related healthcare access and use among FSW. Outcome measures included: HIV/STI testing, STI treatment, PrEP (initiation or adherence), and ART (initiation or adherence). We summarised the results with a narrative synthesis. From 7,417 non-duplicated citations, nine studies from Canada (3), Guatamala, Honduras (2), India, South Africa, and Vietnam were included. Only one of the studies was designed to address mobility and healthcare access, and only six reported adjusted effect estimates. Mobility was measured over four time-frames (from 'current' to 'ever'), as having lived or worked elsewhere or in another town/province/country. Three studies from Canada, Guatemala, and India found mobility associated with increased odds of poor initial access to healthcare (adjusted odds ratios (AOR) from 1.33, 95% CI 1.02, 1.75, to 2.27, 95% CI 1.09, 4.76), and one from Vietnam found no association (odds ratio (OR): 0.92, 95% CI 0.65, 1.28). The study from South Africa found no association with initiating ART (risk ratio: 0.86, 95% CI 0.65, 1.14). Two studies from Canada and Honduras found increased odds of ART interruption (AOR 2.74, 95% CI 0.89, 8.42; 5.19, 95% CI 1.38, 19.56), while two other studies from Canada and Honduras found no association with detectable viral load (OR 0.84, 95% CI 0.08, 8.33; AOR 0.79, 95% CI 0.41, 1.69). We found that mobility is associated with reduced initial healthcare access and interruption of ART, consistent with literature from the general population. Discordance between effects on adherence and viral load may be due to measurement of mobility. Future research should carefully construct measures of mobility and consider a range of HIV-related healthcare outcomes.

Key words: *Sex work, migration, mobility, healthcare, HIV*

Background

Female sex workers have a high burden of HIV, including in countries with generalised epidemics (Baral et al., 2012). Achieving UNAIDS' 90:90:90 goal to 'end the AIDS epidemic by 2030' will require treatment programmes that include sex workers. Since a substantial proportion of the overall burden of HIV is sustained by sex-work networks (Alary and Lowndes, 2004), reaching female sex workers with effective antiretroviral therapy (ART) could also reduce prevalence in the general population (Grinsztejn et al., 2014). Mobility has been described as a "crucial aspect" of sex work (Siegel, 2011) (see for examples Ferguson and Morris (2007); Duncan et al., (2010); Patel et al., (2016); and Weir et al., (2012)), but many programmes do not adequately address the needs of mobile sex workers (Wilson, 2015).

Controlling HIV in sex-work networks using prevention and treatment technologies requires regular contact with health services and social support (Gupta et al., 2008). In an era where highly-effective ART is available, access to quality healthcare may be as important for overall health of female sex workers as HIV prevalence, which has been the focus of most prior research. Equality of access to healthcare free from discrimination is a human right (Susser, 1993); however, sex workers are often denied care because of stigma, prosecution, and harassment (Wolffers and Beelen, 2003). Factors that negatively affect use of healthcare and allied services limit the ability to address health needs and reduce the transmission of HIV (Beyrer et al., 2015). Engagement with HIV-related healthcare has been conceptualized using care and prevention 'cascades'. The HIV care cascade is a model for the steps that people living with HIV should take to control the virus (Mountain, Pickles, et al., 2014), which are: HIV testing and counselling, linkage to care, immediate ART provision, and adherence to treatment to achieve viral suppression (Giordano et al., 2005) – all of which can require social and psychological support (Chakrapani et al., 2009). The HIV 'prevention cascade' describes conditions needed to reduce the risk of HIV infection (Garnett et al., 2016). For female sex workers, who make a living by having many sexual partners, controlling risk means knowing their status and being sufficiently informed, motivated, and supported to access and use

technologies such as condoms or pre-exposure prophylaxis (PrEP) in a way that is non-stigmatising, non-discriminatory, convenient, and affordable (Hargreaves et al., 2016). Although primarily about access to and use of condoms, prevention can require access to healthcare for HIV testing, STI testing and treatment, and, increasingly, access to PrEP. Interventions can help create enabling conditions to support STI treatment (Saggurti et al., 2013), PrEP (Bekker et al., 2015) and interventions to reduce violence and increase self-efficacy in condom negotiation with clients (Kerrigan et al., 2015; Reza-Paul et al., 2012).

Mobile temporary migrants have been conceived of since the beginning of formal research on population movement. In 1885, Ravenstein wrote that "temporary migrants are an important class [who] constitute the floating element of the population" (Ravenstein, 1885). UNAIDS distinguishes between mobile and migrant populations (Joint United Nations Programme on HIV/AIDS, 2001): *mobile* populations move from one place to another, while *migrant* populations "take up residence or remain for an extended stay" (Joint United Nations Programme on HIV/AIDS, 2001). Put simply: being 'mobile' means to move; migrants and non-migrants can be mobile. While migrants must have once moved, the movement may have been long in the past. The distinction between mobility and migration has also been made based on the intention to stay (Odimegwu and Kekovole, 2015), or as "the complement of permanent migration", mobility being any form of movement that is not permanent (Bell and Ward, 2000). Mobility has many dimensions, including the frequency, distance, transit mode, reason, seasonality, and duration of journeys (Brown and Bell, 2004). By these definitions, mobility includes "circulatory migration" (Zelinsky, 1971) as well as higher frequency movement for work (Cresswell et al., 2016; Haan et al., 2014; Williams et al., 2012), and unstable housing. To distinguish mobility from other non-permanent movement, such as commuting, mobility is often conceived of as involving at least one overnight stay (Smith, 1989). Thus defined, mobility is common: according to one estimate in India, for example, mobility is seven times larger than permanent migration nationally (Keshri and Bhagat, 2013). The distinction between mobility and migration has also been made in the study of sex workers (Reed et al., 2012). While a substantial literature has focused on trafficking, for the purposes of this review, we do not included trafficking in the

definition of mobility although we recognize that there can be difficulties making a clear distinction (Butcher, 2003; Loff and Sanghera, 2004). For deprived populations, neither mobility or stasis deserve an "unwarranted veneer of free choice" (Wood, 1982) from failure to recognize the importance of inequities that dictate degrees of mobility in, among other things, incomes, political freedoms, gender relations, and social capital (Hagen-Zanker, 2008; Massey et al., 1993).

Previous work on structural determinants of health for sex work has identified mobility and migrant status as determinants of HIV risk (Shannon et al., 2015). However, the association between mobility and HIV has been shown to be dependent on context (Deane et al., 2010). For example, a review of the sexual health and health related harms of migrant sex workers relative to non-migrant sex workers found that in low-income settings migrant status was associated with poorer health outcomes, but not in high-income settings (Platt et al., 2013). It is unclear how much migrant's mobility affected health risks, relative to the effects of migrant status, or how risks associated with HIV acquisition relate to risk associated with sex-worker access to healthcare. A recent review of sex-worker access to healthcare (ART use and adherence) did not identify migrant status or mobility as important co-factors (Mountain, Mishra, et al., 2014). However, there is evidence that migrant status can influence use of healthcare by female sex workers; for example, Richter et al. found that cross-border-migrant sex workers in South Africa were approximately 40% less likely to have accessed services while being otherwise better educated and earning more money per client than local women (Richter, 2013; Richter et al., 2014). Migrant status is not equivalent to mobility, and the relationship between migrant status and mobility can be complex; for example, migrants may travel long distances to their country of origin while moving relatively infrequently over short distances within the destination country (Bartel and Koch, 1991; Jones and Murray, 1986). In contrast, migrants may experience higher levels of mobility than local populations because of weaker ties to specific places, higher job insecurity, and demographic differences such as younger age (Trevena et al., 2013). Migrant status and mobility cannot be used interchangeably for exploring effects on health and healthcare access.

For understanding healthcare access, various conceptual frameworks have been proposed (Ricketts and Goldsmith, 2005). The behavioural model conceptualises access to be determined by predisposing characteristics, enabling resources, and need at the contextual and individual level (Andersen, 1995). The model has been adapted for vulnerable populations and identifies mobility as a predisposing characteristic among the homeless (Gelberg et al., 2000). Mobility was not included in models of access to social safety net or ART among vulnerable groups in the US (Andersen et al., 2000; Davidson et al., 2004). Applications of the behavioural model have under-explored the role of context and the environment (Babitsch et al., 2012; Phillips et al., 1998), although the model has been updated to emphasize these factors (Andersen et al., 2013). An ecological perspective may be conceptually more consistent with the structural determinants of health frameworks developed for sex-worker health (Bronfenbrenner, 1979; McLeroy et al., 1988) (see for example Baral et al. (2013) for an application of the ecological model to HIV risk), and attempts have been made to combine this conceptually with the behavioural model (Ryvicker, 2017). A useful insight from the ecological perspective is that systems are operating a number of scales, and dynamically interact to define and change each other over time. This dynamism is helpful when considering mobility, which is dynamic by definition, in how it relates to and constructs other aspects of the system (e.g. risk environments in urban centres). Finally, another model of access can be helpful for thinking about how healthcare can respond to the mobility of the sex work population and the degree to which sex workers are able to accommodate the restrictions of the system (Penchansky and Thomas, 1981). The model proposes that access is the extent of the 'fit' between features of the healthcare system and the population of potential patients along five dimensions: availability, accessibility, accommodation of patients to the requirements of the services, affordability, and acceptability of both the services offered to the clients and also the client demographics to the service providers.

There are a number of ways that mobility could affect healthcare access and use among female sex workers that have been observed in other populations. The often-observed association between mobility

and acquiring HIV (Brockerhoff and Biddlecom, 1999; Deane et al., 2010; Decosas et al., 1995; Parker et al., 2000) has been explained by "the situations encountered and the behaviours possibly engaged in during mobility" (Joint United Nations Programme on HIV/AIDS, 2001); likewise, the effects of mobility on healthcare use can be differentiated into those that occur before, during, and after moving (Gushulak and MacPherson, 2004). As recognised in the behavioural model, health status prior to moving will determine healthcare need. Healthcare use before moving may also affect how mobility influences on-going access. Structural, socioeconomic, conditions may affect resilience to the effects of moving, through the availability of savings, chronic mental health conditions, substance use, self-stigma associated with sex work, and social capital (Buttram et al., 2014). The reasons for moving and the ability to plan ahead may also be important, reflecting different individuals' predisposing factors and also the wider structural determinants of mobility. During the journey itself, treatment routines can be disrupted and safe spaces unavailable (Taylor et al., 2014), affecting the enabling environment for healthcare use by increasing the risk of disclosure and stigma. On arrival, the social context, such as the degree of cohesion, social isolation, language barriers, legal status, and the attitudes of the police may influence healthcare access (Fonner et al., 2014; Shannon et al., 2015). Mobility can affect healthcare use by dislocating women from support networks (both formal and informal), disrupting routine, and detaching women from an accessible point of care (Babitsch et al., 2012; Gushulak and MacPherson, 2004; Taylor et al., 2011, 2014).

Disparities in the availability and accessibility of healthcare services at different places may influence the effect of mobility on healthcare access. For example, travel to a city or a colliery might have different effects. Rather than reduce healthcare access, women who travel to sites with a female-sex-worker-friendly clinic from a site with limited accessible healthcare may have better overall access than their peers. It has been noted that people living with HIV may travel towards HIV care to improve access to ART (Lima et al., 2010; Taylor et al., 2014), or social support and care when unwell (Knodel and VanLandingham, 2003). These effects may depend on the length of time at each place, frequency of

visits, how these relate to the schedule of access necessary to meet a particular health need, and the capacity to accommodate disparities between these. Mobility may reduce ART adherence by interfering with routine clinic appointments (and the effects may be modified by personal (e.g. knowledge), social (e.g. family support), or organisational (e.g. text-message reminder systems and active follow-up) factors) but increase access to HIV-testing and to STI treatment requiring a single course of medication (World Health Organization, 2016a, 2016b, 2016c). Nationally-scaled services for female sex workers, such as the *Sisters with a Voice* programme in Zimbabwe (Cowan et al., 2017), may reduce negative effects of mobility by equalizing healthcare access between places, allowing medical records to be shared confidentially, and providing peer-support to reach women as they arrive in new places.

Mobility can also be viewed as capacity for coping with the forces that drive it, as an active response to market conditions that allows women to move away from stigmatising or violent contexts. Mobility has been broadly defined as a "means to combine goals in space" (Hooimeijer and Van der Knaap, 1994), and conceptualised as a form of capital (Hall, 2005) for achieving higher incomes but also, among sex workers, for self realisation and adventure (Busza et al., 2014; Siegel, 2011). In response to the structural environment, restricted mobility may be more problematic for sex workers than mobility; for example, in interviews with female sex workers in Ethiopia, women reported choosing to move to avoid having regular clients who start to demand sex for free, and that being restricted by bar owners limits access to HIV treatment (Van Blerk). Mobility may help reduce debt or experiences of stigma from healthcare professionals, both of which have been shown to affect health and healthcare access (Lazarus et al., 2011; Reed et al., 2010; Scorgie et al., 2013). In this respect, studies of mobility face some of the issues regarding agency that have been identified in literature on violence against women, contrasting practical interests (which work within a system of oppression) and strategic interests (which work to undermine the systems of oppression) (Cornish, 2016). This issue is additionally apparent when mobility itself can simultaneously have both a practical interest regarding one oppressive factor, such as poverty, and a

strategic interest in undermining other oppressive concepts, such as those relating to gender and the 'home' (Agustín, 2002).

Despite the high levels of perceived mobility and the burden of HIV, there has not been a systematic review of the literature on mobility and HIV-related healthcare access of female sex workers. We systematically reviewed literature that has investigated the association between mobility of female sex workers and their access to and use of healthcare. Our initial hypotheses were that mobility would be associated with poorer access to healthcare, and that the association would be weakest for the initial stages of the HIV-treatment cascade (testing) and strongest for the late stages (adherence) because of the increasing reliance on access to specialist services, community and social support, and the importance of daily routine. We hypothesized that frequent short-term mobility to multiple places would be particularly disruptive, although speculated that travel to urban centres from rural sites could increase exposure to HIV services. This review builds on work on structural determinants of health for sex workers by focusing on use of healthcare as the outcome and addressing the effects of mobility. Understanding the association between mobility and healthcare access would allow better design of interventions for sex workers.

Methods

Search

The following PICO(ST) criteria were applied (Richardson et al., 1995): the population was women who identify as sex workers; the intervention was mobility, measured as movement between places, in comparison with not being mobile or have not been mobile during the period assessed; the outcome was HIV-related healthcare access and use: access to and/or use of HIV testing, STI treatment, PrEP, ART treatment, viral load for HIV-positive female sex workers on ART; the context was high-, medium-, and low- income settings; rural and urban locations; and the type of study was quantitative papers using cross sectional, case-control, or cohort designs.

We searched MEDLINE, Global Health, Scopus, Popline, and Web of Science (see Appendix 1 for search text). We combined terms for 'healthcare' or 'mobility', with terms for 'sex-work' and 'quantitative analysis' (recommended filters from the University of Texas (University of Texas School of Public Health, n.d.), from the InterTASC Information Specialists' Sub-Group ("InterTASC information specialists sub-group search filter resource," 2012)) (see Figure 1). We conceptualised mobility using the UNAIDS definitions, differentiating the behaviour of moving from the social status that defines migrant populations (Joint United Nations Programme on HIV/AIDS, 2001). However, to be comprehensive, we included terms of migrants and migration in the search.

We added a second combination of the terms for 'mobility' and 'healthcare' and 'trials' and 'women' (see Figure 1 and Appendix 1) because trials of sexual health preventive interventions may recruit sex workers to increase the incidence of the outcome in the cohort, for example the incidence of herpes simplex virus (Watson-Jones et al., 2009), but not explicitly identify the women in the study as being sex workers. Including terms for 'trials' in this part of the search excluded observational studies; without these terms

the search returned an unmanageable number of citations. The main search, with terms for sex work, was not restricted to citations relating to trials.

Included studies were quantitative; clearly stated that the study population was women who identify as sex workers; measured mobility in terms of movement between places (studies that compared healthcare access between migrants and non-migrants only were excluded); clearly defined HIV-related healthcare access and use that includes one of: HIV testing, STI treatment or clinic attendance, PrEP (initiation or adherence), or ART (initiation or adherence); reported crude or appropriately adjusted associations between mobility and HIV-related healthcare use (regardless of whether as primary analysis), and published in English. We included studies published during or after 1998 so that the HIV care model would be broadly similar across studies and relevant to current conditions.

The search was conducted in April 2018, and we hand-searched the references of nine recent systematic reviews (Aldridge et al., 2017; Awungafac et al., 2017; Chaiyachati et al., 2014; Govindasamy et al., 2014; Lancaster et al., 2016; Ma et al., 2017; Mountain, S. Mishra, et al., 2014; Platt et al., 2013; Shannon et al., 2015). We used a standardised data extraction form adapted from the Cochrane Effective Practice and Organisation of Care group (Cochrane Effective Practice and Organisation of Care (EPOC), n.d.) and appraised the quality of the results using the National Institute for Health (NIH) *Quality Assessment Tool for Observational Cohort and Cross-sectional Studies* (National Heart and Institute, 2014).

We were interested in analyses that appropriately controlled for confounding factors; however, we anticipated that many analyses would not have mobility as the primary exposure and that some may be "over adjusted". Over adjustment occurs when factors adjusted for in a model lie on the causal pathway between the exposure and outcome under investigation (Schisterman et al., 2009). For example, a study that adjusted for ART adherence in the association between mobility and viral load would be considered over adjusted because the effect of mobility on viral load may be partly due to an effect on ART adherence. We extracted and reported crude and adjusted estimates where possible, as well as the adjustment variables. We anticipated that some measures of mobility could be indicators of migration, for

example, answering affirmative to 'have you worked in other country in the previous year?' could indicate that the individual is mobile and traveled away from the location of the interview, or that they are a recently-arrived migrant. Migrant status can have effects on healthcare access for sex workers, therefore we identified whether migrant-status was separately measured and adjusted for in the analyses.

We conducted a narrative synthesis of the results, describing the studies in a table, and the associations in a figure on the log scale. We anticipated that the exposure and outcome measures would differ substantially and be too heterogeneous to combine, and therefore did not synthesize the results quantitatively.

Results

Description of the studies

The search process is shown in Figure 2.

A small proportion of the citations found, 164 from 7,417 (2%), were eligible for full-text review. Of these, 110 did not investigate the effect of mobility (67%), 33 did not investigate healthcare use, 19 did not specifically describe female sex workers, and 16 were descriptive only (reasons for exclusion are not exclusive). Nine papers were included, and are described in Table I. From these, seven research projects were represented.

There were three papers that used data from the *An Evaluation of Sex Workers Health Access* (AESHA) open cohort in Vancouver, Canada: one from 2014 (Goldenberg et al., 2014) and two from 2016 (Duff et al., 2016; Goldenberg et al., 2016). Women were recruited into the cohort using time-location sampling and contacted semi-annually from 2010. The first paper included 646 sex workers followed from 2010-2012 (Goldenberg et al., 2014). The second analysed data from the 74 HIV-positive women in the same period (Goldenberg et al., 2016). The third analysed data from the 72 HIV-positive women also taking ART in the cohort of 744 women from 2010-2014 (Duff et al., 2016).

In the Dominican Republic, two papers analysed data from HIV-positive women recruited in cross-section through informal referrals for the *Abriendo Puertas* study: one included 268 women (from 318 women approached to participate) (Donastorg et al., 2014) and the other analysed data from the 205 women who had ever initiated ART (Zulliger et al., 2015).

A study from north-eastern India used respondent-driven-sampling (RDS) to survey 417 women in Dimapur (Armstrong et al., 2013). A study in Guatemala analysed data from 4,449 women recruited as they attended any one of four clinics (of 5,682 women who attended the clinics for the first time between

2007 and 2011) (Morales-Miranda et al., 2014). A study in South Africa used RDS to survey 410 women in Port Elizabeth (Schwartz et al., 2017). In Vietnam, 1,998 women were recruited using a snowball sampling and informal referral (Bach Xuan et al., 2013).

Quality appraisal

The Vancouver cohort papers were graded 'Good' based on their high score on the NIH appraisal tool, and a subjective judgment on the quality of the overall design to address the question. The remaining six studies were graded 'Fair' quality.

Only one study reported a participation rate, which was 84% (Donastorg et al., 2014). The Vancouver-cohort papers did not report loss-to-follow-up directly or investigate reasons for loss to follow-up such as moving away or no-longer working in sex work. They reported the number of follow-up visits differently. One reported the median follow-up time (18 months; inter-quartile range [IQR] 12–24) (Goldenberg et al., 2014); one reported the median study visits (5 visits; IQR: 3–7) (Duff et al., 2016), and one reported both (18 months; IQR: 12–25 and 3.5 visits; IQR: 2–5) (Goldenberg et al., 2016). The cohort study in Guatemala reported a high loss-to-follow-up rate from the clinics, which was treated as the measure of healthcare access (Morales-Miranda et al., 2014). The proportion who did not return to the clinic after 12 months was shown for each site, ranging from 8% to 43% in 2011 (the last year of the study).

Only one of the studies explored the association between mobility and healthcare access as the primary analysis (Goldenberg et al., 2014). In none of the studies were the variables used in adjusted analysis selected with reference to a conceptual hierarchy or directed acyclical graph ('DAG') to avoid over-adjustment. In one of the studies from Honduras there was possible over-adjustment of the association between mobility and detectable viral load for 'all female sex workers' by adjusting for having received HIV care in last 6 months, and among 'female sex workers who ever took ART' by adjusting for ever having interrupted ART, since mobility could affect viral load through these factors (Donastorg et al., 2014). Without a causal diagram, other cases were more ambiguous: place of solicitation, discrimination

at the clinic, and condom refusal by clients (Armstrong et al., 2013; Goldenberg et al., 2014; Zulliger et al., 2015) may lie on the causal pathway between mobility and healthcare access, as well as physical violence by clients (Goldenberg et al., 2014). Unadjusted and adjusted estimates were similar in sign and magnitude for the six studies that reported both.

Definitions of mobility and HIV-related healthcare access and use

All of the studies operationalized mobility as a binary exposure. In all but one of the studies mobility was defined as having lived or worked in a town/province or country other than were being interviewed. One defined mobility as living elsewhere than where currently working (Donastorg et al., 2014). Mobility was measured for four time-frames: ever (Armstrong et al., 2013; Bach Xuan et al., 2013; Morales-Miranda et al., 2014), last 12 months (Schwartz et al., 2017; Zulliger et al., 2015), last 6 months (Duff et al., 2016; Goldenberg et al., 2014, 2016), and current (Donastorg et al., 2014). The prevalence of mobility ranged from just 3% in the past 6 months (2 of 72 female sex workers when interviewed at baseline) (Duff et al., 2016), to 25% ever having worked in another province in Vietnam (Bach Xuan et al., 2013).

Healthcare access was measured over four time-frames: ever in the past (Armstrong et al., 2013; Bach Xuan et al., 2013; Schwartz et al., 2017; Zulliger et al., 2015), in the past 6-months (Duff et al., 2016; Goldenberg et al., 2014, 2016), currently (Donastorg et al., 2014), or over 12 months of prospective follow-up time (Morales-Miranda et al., 2014). Most of the measures related to steps in the HIV care cascade, and no HIV-negative-specific outcomes were identified. Self-report was used for ART initiation (Schwartz et al., 2017), ART interruption (Zulliger et al., 2015), not collecting HIV test result (Bach Xuan et al., 2013), experiencing barriers to healthcare (Goldenberg et al., 2014), and not being contacted by a peer educator or visiting a clinic (Armstrong et al., 2013). The latter was included in the review because of the clinic visit component of the outcome measure although contact with peer-educators was not considered part of HIV-related healthcare (it would be considered an important part of HIV-prevention); this measure of HIV-related healthcare access was not ideal. Data from dispensaries was used to measure

delayed ART initiation or interruption (Goldenberg et al., 2016). Detectable viral load was used as an indicator of sub-optimal adherence among female sex workers living with HIV and taking ART in two studies, one cross-sectionally (Donastorg et al., 2014) and one with a cohort using drug-treatment programme data to measure viral suppression over 6-monthly intervals (Duff et al., 2016). In one study, loss-to-follow-up within 12 months of the initial visit was used as the measure of barriers to healthcare (Morales-Miranda et al., 2014). The prevalence of the outcomes also varied considerably (see Table I).

There were many temporal configurations between the period during which mobility was measured and the period during which healthcare access and use was measured. This led to varying degrees of plausibility and length of the causal chains linking the two. In Vancouver, mobility and healthcare access and use were both measured from the previous 6 months. In Honduras, one study explored the association between *currently* working away from home and *current* viral load (Donastorg et al., 2014), while the other compared having moved city in the past *12 months* and reported ART interruption *ever* (Zulliger et al., 2015). Similarly, in the South African study, mobility was measured over 12 months but compared with ever having initiated ART (Schwartz et al., 2017). In the study from Guatemala, the measure of mobility was at baseline and retrospective, while the measure of healthcare access was prospective (Morales-Miranda et al., 2014). In India and in Vietnam, both exposure and outcome were measured *ever* in the past (Armstrong et al., 2013; Bach Xuan et al., 2013).

Association between mobility and healthcare access and use

The study from South Africa reported the results using risk ratios, the others as odds-ratios. The effect estimates from the nine studies are shown in Table I and Figure 3. Six ratios were inverted so that the effects would be comparable (Armstrong et al., 2013; Bach Xuan et al., 2013; Donastorg et al., 2014; Duff et al., 2016; Morales-Miranda et al., 2014; Schwartz et al., 2017) and the outcomes described correspondingly: for example, in Duff *et al.*, the outcome was undetectable viral load, which was inverted to *detectable* viral load for reporting in this review. For Donastorg *et al.*, the effect estimate was inverted

because living and working in different places (the indicator of mobility) was the baseline for the effect of living where female sex workers were sampled. The estimates are shown on the log scale in Figure 3. The log scale was used to restore linearity and symmetry of the confidence intervals (Anzures-Cabrera and Higgins, 2010).

Organising the results by context

In Vancouver, mobile female sex workers (engaged in sex work outside Vancouver or lived outside Vancouver in the past 6 months) had higher odds of self-reported experience of barriers to healthcare in the past 6 months (AOR 1.77; 95% CI 1.08, 2.89), where the combined HIV and STI prevalence was 21% (HIV prevalence alone was not reported) (Goldenberg et al., 2014). The OR for mobility (measured in the same way) and detectable viral load among female sex workers who had initiated ART was close to 1.0, and had very wide confidence intervals (OR 0.84, 95% CI 0.08, 8.33) (Duff et al., 2016). Mobile female sex workers – where 'mobility' included moving to Vancouver in the last 6 months – had much higher odds of delayed ART initiation or interruption measured using dispensary records (AOR 5.19; 95% CI 1.38, 19.56) (Goldenberg et al., 2016).

Similarly, heterogeneous results were observed in Honduras. Using a measure of 'current' mobility, mobile female sex workers were found to have similar odds of having a detectable viral load (all: AOR 0.79; 95% CI 0.41, 1.69; women initiated onto ART: AOR 0.63; 95% CI 0.28, 1.41) (Donastorg et al., 2014). Among female sex workers who had initiated ART, women who had moved cities in the past 12 months had higher odds of reporting ever interrupting ART, but with wide confidence intervals (AOR 2.74; 95% CI 0.89, 8.42) (Zulliger et al., 2015). This analysis may have been over-adjusted by controlling for variables on the causal pathway ('perception of HIV services' and 'sex-work-related discrimination at clinic'), and in the crude analysis the association was stronger (OR 3.74; 95% CI 1.42, 9.85).

In India, female sex workers who had ever worked outside of the survey city had higher odds of never being contacted by a peer educator or attending a clinic (AOR 2.27; 95% CI 1.09, 4.76) (Armstrong et al.,

2013). In Guatemala, female sex workers who had ever worked abroad had higher odds of not being seen at the clinic within 12 months of first visiting (AOR 1.33; 95% CI 1.02, 1.75) (Morales-Miranda et al., 2014). In South Africa, women who had moved cities in the past 12 months had similar risk of never initiating ART as those who had not moved (risk ratio 0.86; 95% CI 0.65, 1.14) (Schwartz et al., 2017). In Vietnam, female sex workers who had ever worked abroad or in another province had similar odds of ever collecting an HIV test result as those who had not (OR 0.92; 95% CI 0.65, 1.28) (Bach Xuan et al., 2013).

Organisation of the results around the HIV care cascade

The results can be organised around the stages of the HIV care and prevention cascades, as shown in Figure 3. Four studies investigated the effect of mobility on access to healthcare facilities, or HIV testing, for female sex workers living with, or not living with, HIV. Three studies found that mobility was associated with reduced access (Armstrong et al., 2013; Goldenberg et al., 2014; Morales-Miranda et al., 2014), and one found no association with collecting HIV test results (Bach Xuan et al., 2013). No studies investigated access to, initiation of, or continuation of PrEP. One study found no association with ART initiation (Schwartz et al., 2017). Two studies explored the effect of mobility on ART interruption, from dispensary records and self-reported adherence, both finding strong associations with mobility (AOR 5.19 (Goldenberg et al., 2016) and 2.74 (Zulliger et al., 2015)). Two studies of women on ART found associations between mobility and detectable viral load that were close to the null, with wide confidence intervals (Donastorg et al., 2014; Duff et al., 2016).

Disassociating migration and mobility, and types of mobility

Three studies reported the proportion of participants born abroad, which were 1.4% (Duff et al., 2016), 2.7% (Goldenberg et al., 2016), and 24.1% (Morales-Miranda et al., 2014), although only one controlled for migrant status (Morales-Miranda et al., 2014). In three studies, the measures of mobility were distinct from migration: travel within the past 6 months (Duff et al., 2016; Goldenberg et al., 2014) and currently

working away from home (Donastorg et al., 2014). Of these, only one found that healthcare access was lower among mobile sex workers, in a cohort of both HIV-negative and HIV-positive sex workers (Goldenberg et al., 2014). Others used measures of mobility that could reflect migrant status: three measured 'ever' working elsewhere (Armstrong et al., 2013; Bach Xuan et al., 2013; Morales-Miranda et al., 2014); two measured having moved city, including (potentially) to the study city, in the past year (Schwartz et al., 2017; Zulliger et al., 2015); one measured having moved to the study city in the past 6 months (Goldenberg et al., 2016). Of these, all but one study (Bach Xuan et al., 2013) found poorer healthcare access and use among mobile female sex workers.

Discussion

We found mixed results in the nine studies addressing the relationship between the mobility of female sex workers and their access and use of HIV-related healthcare. The measures of mobility were simple; only one study investigated the effect of mobility on healthcare access and use as the primary aim of the paper. This may have led to under-powered analyses and less well-thought-out definitions of mobility. None of the studies were conducted in Europe or South America. These results support our overall hypothesis that mobility is associated with poorer access to healthcare for female sex workers. However, the weak association with viral load contradicts our hypothesis that mobility would be more strongly associated with treatment regimens than regular testing. Our hypothesis that the frequency of trips and the types of destinations would affect the association was not testable with the available data. Differentiating the effects at different stages of the care cascade is made more difficult by the possible confounding by migrant status.

The review took an inclusive approach to the literature search. In all cases, the association between mobility and HIV-related healthcare was not the primary question in the paper, but by screening abstracts with healthcare terms *or* mobility terms plus terms for sex-work and quantitative analysis, the search strategy aimed to capture papers that did not mention one or other in the title, abstract, or key-words, but nonetheless provided estimates of the effect in the body of the paper. The search explicitly attempted to access studies of women who exchanged money for sex but were not described as sex workers in the paper.

This review has limitations. There are various ways of operationalising mobility and some studies may have been excluded because the measure did not meet the inclusion criteria during the screening. For example, measures of unstable housing did not meet the inclusion criteria, but in some cases this measure may be a proxy for local mobility. In some contexts, especially in Sub-Saharan Africa, the strict identification of women as ‘sex workers’ is, or has been, considered unhelpful or even invalid (Hunter,

2002; Wojcicki, 2002). The search strategy addressed this with a second combination of mobility terms including terms for 'women' and 'trials' to capture studies describing cohorts of high-risk women in trials of HIV prevention or treatment technologies. A wider search was not feasible and other studies, including observational studies, may have been missed. No meta-analysis was undertaken to combine the results of these studies; this decision was taken in advance, anticipating that the exposures would be heterogeneous. All reviews are susceptible to publication bias, especially exploratory and observational research, with weak associations less likely to be reported (Easterbrook et al., 1991). However, since the effect of mobility on healthcare access was often incidental to the main analysis, the extent of selection for publication on the basis of the mobility associations may be lessened. We assumed that the way that female sex workers were identified would not influence the association between mobility and healthcare access; the included studies all used similar definitions for sex work and therefore this assumption could not be tested. Qualitative studies were not included in this review, and the search included English-language papers only. We did not include access to condoms in the measure of HIV-related healthcare access; although mobility may affect condom access, we did not include this measure because condoms are widely distributed by non-healthcare services.

Elements of the design and reporting of the included studies limited our analysis. Five of the studies used self-report for the outcome, three related to attending clinics (Armstrong et al., 2013; Bach Xuan et al., 2013; Goldenberg et al., 2014), one to initiating (Schwartz et al., 2017) and one to interrupting ART (Zulliger et al., 2015). Although it is unlikely that mobile and non-mobile sex workers would have differential reporting bias unless an additional factor was associated, non-differential bias or imprecision in the measures may have biased the associations towards the null. The Vancouver cohort studies did not adequately report or explore loss to follow-up, which is very likely to be affected by mobility and may be correlated with the outcome (in one study it was used as the outcome (Morales-Miranda et al., 2014)): this may have led to bias. Female sex workers cannot be randomly selected from a sampling frame, and mobility and not accessing healthcare may both have affected entry into the samples, many of which used

clinics or social networks to recruit, creating a selection bias that would underestimate the effects. Three of the nine studies only reported unadjusted effects, which may have been confounded; however, in the six studies that did adjust for confounding, the estimates of the effect did not change substantially after adjustment. The causal relationship between mobility and healthcare access and use is complex, and it is unlikely that the adjusted models will have completely avoided omitting important confounders or generating 'colliders', especially for the cross-sectional studies (Hernan et al., 2002).

Construct validity

The included studies treated mobility as binary – mobile or not mobile – but mobility is not well characterized in this way because 'mobility' encompasses the recency, frequency, distance, and destination of movement *events* (Brown and Bell, 2004; Taylor et al., 2011). None of these studies operationalised any measure of distance, the time spent at a destination, the frequency of travel, proportion of time spent away from home, or seasonality of mobility. None of the studies investigated the potential causal pathways between mobility and healthcare access. Investigating the causal pathways and the importance of context may help to explain the heterogeneity of effects of mobility and inform programmes.

The causal relationship between mobility and healthcare access is complex because mobility can affect healthcare access both when (1) making a journey, and (2) arriving in a new place. Estimates of the effect of (1) are plausible when there is overlap in the time during which both movement and healthcare access are measured. Since many of the overlapping periods were long (in India, for example, healthcare access and mobility were measured *ever* in the past in Armstrong et al. (2013)), much of the period where healthcare access was measured included time after arriving, and hence the effect of (2) would be part of what was estimated. In the one study with no overlap in the time-periods, mobility was measured as having worked in another country and healthcare access was measured as clinic re-attendance over 12 months of follow-up; therefore, without assuming that past mobility was associated with future mobility,

only (2), the effect of arriving, could be estimated (Morales-Miranda et al., 2014). While this definition of mobility is weak for the purposes of this review, the authors did control for country of origin in their analysis to address confounding from migrant status.

Reverse causality between healthcare access and mobility is plausible, and a particular problem for the cross-sectional studies. Only the study from Guatemala measured mobility from a period before the measure of healthcare access (Morales-Miranda et al., 2014). At least one study, a cross-sectional study of 5,498 female sex workers in southern India, concluded that using healthcare can affect mobility. The study found that women planning to move were less likely to have collected an HIV test result than women not planning to move, and the authors concluded that it was receipt of a positive test result that encouraged women to move because of HIV-related stigma (Suryawanshi et al., 2015). However, the authors did not explore this association by HIV-status to confirm that this association was only present for the HIV-positive women. It is also possible that there is a 'healthy worker effect', or in this case characteristics that may predispose women to mobility that helps them access healthcare, such that the effect of mobility would be different for other women if, for social or economic reasons, mobility levels where to substantially increase.

Differences in effects for HIV-negative and HIV-positive women and confounding by migrant status may explain the pattern of effects in the studies included in the review. The studies that found evidence for associations between mobility and the outcomes they measured either included HIV negative women in the analysis (Armstrong et al., 2013; Goldenberg et al., 2014; Morales-Miranda et al., 2014) and/or used measures of mobility that could indicate migrant status (Goldenberg et al., 2016; Morales-Miranda et al., 2014; Zulliger et al., 2015). There was just one study with both that did not find an association (Bach Xuan et al., 2013). The two studies with HIV-positive women and distinct measures of mobility found no effect (Donastorg et al., 2014; Duff et al., 2016). The disparity between the null effects in these studies, which both measured viral load, and the strong effects found on ART interruption (Goldenberg et al., 2016; Zulliger et al., 2015) was unexpected, but may be because the measures of mobility in the latter

could reflect migrant status. The greater consistency in the effects when including HIV-negative women (effect on healthcare access and HIV testing) than for HIV-positive women (effects on ART interruption and viral load) may be due to interaction between mobility and factors that support initiation onto ART, such as self-efficacy or social support – further research, perhaps using a cohort or a life-course perspective, will be needed.

Context of other literature

A review of literature on mobility and HIV-related healthcare access and use among the general population found similar results and called for better measures of mobility (Taylor et al., 2011). The review did not include any studies of female sex workers. Mobility was described as having a 'churn' effect on patients in HIV care programmes in Vancouver, that "can disrupt the continuity of patient care" (Gill and Krentz, 2009). Stigma experienced while traveling was found to reduce ART adherence in the USA (Taylor et al., 2014), Australia (Woolley and Bailey, 2012), and France (Abgrall et al., 2014). Mobility was the strongest predictor of low adherence to PrEP in a cohort of men-who-have-sex-with-men (MSM) in Kenya (Mugo et al., 2015) and associated with non-adherence to ART in a cohort of 1,185 migrant workers in Lesotho (Bygrave et al., 2010). In a cohort of 685 injecting drug users (IDU) in Canada, moving address during ART treatment was associated with three times the odds of non-adherence, more than for the general population (Lima et al., 2009). While mobility may affect healthcare access for key populations for HIV – such as MSM, migrant workers, or IDU – the reasons for moving and structural contexts are very different from those of sex workers.

Studies have compared healthcare access for migrants and non-migrants. These were excluded because non-migrant sex workers can be mobile, however they may be informative about some of the barriers that mobile women can face. In line with the results from Richter et al. (2014), recent studies have found that migrant status was associated with poor healthcare access. In Shanghai, Pan et al. (2015) found that the 250 of 400 female sex workers sampled with time location sampling who had been living in the city for 6

months or longer had 2.55 times the odds of having accessed free health services (adjusted for other 'significant' covariates, $p < 0.01$). Using data from 742 women in the Vancouver cohort described above, Sou et al. (2017) found that migration to Canada within the last five years was the strongest predictor of unmet health need (adjusted OR 3.23, 95% CI 1.93,5.40), stronger than the effect of longer-term migration (adjusted OR 1.90, 95% CI 1.22, 2.96). Using data on 435 seronegative sex workers from the same cohort, Deering et al. (2014) found that new immigrants to Canada had 0.33 times the odds of having tested for HIV within the last year, after adjusting for other factors ($p<0.001$). These results indicate that migrant women may be particularly at risk of exclusion from equitable healthcare access.

Our results are consistent with studies that have investigated the viability of following high-risk women for the purposes of conducting controlled trials of prevention interventions. One of the key challenges for conducting research with high risk women is that mobility itself makes follow-up more difficult (Hoffmann et al., 2004). In a trial of microbicides, women who were more mobile were more difficult to follow over just three months (Vallely et al., 2010). These studies have been able to explore the effects of mobility in more detail than in cross-sectional studies. In a study of adherence to HSV suppressive therapy in Tanzania, moving longer distances, and between communities rather than just between homes, had a greater effect on use of healthcare: women who had not moved house had 1.49 times the odds of having >90% adherence (adjusted for co-factors, 95% CI 1.23, 1.80) and 2.21 times the odds of adhering (95% CI 1.83, 2.67) if they stayed in the same site (Watson-Jones et al., 2009). Analysis exploring the effect of mobility in detail could better inform how different dimensions interact with healthcare access.

One study has assessed the association between mobility and HIV-related death among female sex workers in a cohort of 1,559 in India followed for 15 months using verbal-autopsy to determine cause of death (Becker et al., 2012). Forty deaths were attributed to HIV – an HIV-attributable mortality rate of 2 deaths per 100 person years. Of the 35 known to be living with HIV, only 17 (49%) were on ART. Having ever travelled to another district for sex work was associated with a 1.86 higher mortality rate (95% CI 0.91,3.81), although having moved outside or within the district within the follow-up period

were not associated with mortality risk. Although 39 of the 40 women were actively involved in sex work within three months of their death, mobility during the 15 month follow-up may have been hindered by failing health. These analyses did not adjust for or explore the mediating effect of being on ART, however the findings are in line with the interpretation that mobility reduces adequate treatment for HIV and emphasize the need for accessible treatment for female sex workers living with HIV.

Interpretation

The mobility of female sex workers has the potential to disrupt access to HIV-related healthcare. Equitable access to effective healthcare is a human right and a key determinant of overall health. Secondarily, adherence to ART can reduce onward transmission of HIV and also protect uninfected individuals – therefore, reaching global targets for treatment coverage and reduction in new infections requires that sex workers have access to appropriate services. Despite this, our review has found that research on mobility and sex work is sparse and offers limited guidance on ways that mobility can influence different elements of the HIV care and prevention cascades, and hence how its effects might be mitigated. Given the importance of sex work, ART use, and mobility in understanding the dynamics of HIV with mathematical modeling, it is also important that we have information how these interact. Future research should explore the features of sex worker mobility and try to identify what types of journeys women are undertaking before investigating the effects of mobility on the stages of the HIV care and prevention cascades. Better information about the importance of mobility, strategies that women may use to overcome its potential effects and differentiating more clearly between mobility and being a migrant will inform programming for sex workers who remain under-served by healthcare services in many contexts.

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Figure captions

Figure 1

Diagram of systematic search logic. The logic gates show how different catagories of search terms were combined, as entered in the Medline database. Leading into the left of the final OR gate, is a combination of terms of sex work, quantitative research, and healthcare or mobility terms. This was the main search strategy. To expand the search, a second strand was added that did not include terms for sex work, a combination of terms for trials with women, mobility and healthcare. This is shown leading into the right-side of the final OR gate.

Figure 2

Flow diagram of the systematic search and assessment for inclusion. Reasons for exclusion after full-text review are not exclusive.

Figure 3

The association between mobility and healthcare access and use. Effect estimates for the nine included studies, with 95% confidence intervals, organised according to the HIV care cascade. All of the outcomes represent barriers to access along the cascade; effects to the left of the dotted vertical line show positive associations between mobility and barriers to access. Adjusted estimates were not reported in Duff et al. or Bach et al. and the log-odds ratios are plotted; the risk-ratio was reported unadjusted in Schwartz et al. and is plotted on the log-risk-ratio scale; for the other studies the adjusted-log-odds ratios are shown. Two studies, Goldenberg et al. 2016 and Donastorg et al., each reported effects for two groups. The measure of the mobility measure is shown in non-italicised text, the outcome measures are italicised.

Table I: Characteristics of studies investigating mobility and healthcare access and use among female sex workers

Table I: Rat were inverted for Duff et al., Donastorg et al., Morales-Miranda et al., Armstrong et al., Schwartz et al., and Bach et al. ‘Worked’ in this table refers to sex-work. The adjustment variables for Morales-Miranda et al. are shown without brackets when used for both the ‘all women’ and ‘women who took ART’ models, in rounded brackets for the former model only, and square brackets for the latter model only.

	First Author	Date	Sample definition	Recruit-ment	N Analysed	HIV prevalence	Design	Mobility time-period	Measure of mobility	Outcome time-period	Outcome	Mobility prevalence	Outcome prevalence	Analysis method	Unadjusted effect OR (95% CI)	Adjusted effect AOR (95% CI)	Adjustment variables
Canada	**Goldenberg**	2014	Women ≥14 exchanged sex for cash in last month		646; no. obs. not reported; median follow-up 18 months, IQR 12– 24	HIV or STI, 136 (21.1 %)			Worked or lived outside survey city		Any barrier to healthcare access	Baseline: 42 (7%). Longitudinal: 70 (11%), 567 (89%) did not	Baseline: 412 (64 %)	Generalised estimating equation (GEE) with exchangeable correlation structure	Any mobility: 1.79 (1.12, 2.86); Mobility for work: 2.36 (1.31, 4.27)	Any mobility: 1.77 (1.08, 2.89) Mobility for work: 2.18 (1.17, 4.08)	Age, condom refusal by intimate partner, primary place of solicitation, physical violence by clients
	Goldenberg	2016	HIV positive women ≥14, exchanged sex for cash in last month	Time-location sampling from venues; semi-annual follow-up.	74; 242 obs; median 3.5 study visits, IQR 2–5; median follow-up 18 months, IQR 12–25	All	Cohort, bi-annual follow-up	Past 6 months	Migrated (moved to survey city) or moved (worked or lived outside survey city)	Past 6 months	Gap in ART use: not having ART dispensed (interruption and delays in starting)	Baseline: 8 (11%)	Baseline: 27 (36%); Longitudinal: 63 / 242 (26%).	GEE with exchangeable correlation structure	5.65 (1.61, 19.82)	5.19 (1.38, 19.56)	Age, non-injecting drug use, incarceration.
	Duff	2016	Women ≥14, exchanged sex for cash in last month, HIV positive, and on ART.		72; 388 observations; median study visits 5, inter-quartile range (IQR) 3–7	All			Worked outside survey city		Viral load ≥50 copies/ml	Baseline: 2 (3%)	Baseline: 26 (36%); Longitudinal: 204 (53%); 82% had outcome at least once	Generalised linear mixed-effects model with logit link and subject-specific random effects	0.84 (0.08, 8.33)	-	NA

	First Author	Date	Sample definition	Recruit-ment	N Analysed	HIV prevalence	Design	Mobility time-period	Measure of mobility	Outcome time-period	Outcome	Mobility prevalence	Outcome prevalence	Analysis method	Unadjusted effect OR (95% CI)	Adjusted effect AOR (95% CI)	Adjustment variables
Guatamala	**Morales-Miranda**	2014	Women ≥18 exchanged sex for cash in last month	Recruitment at clinic attendance.	4,449	58 / 4076 (1.4%)	Open cohort	Ever	Worked in another country	12 months from first visit	Lost from clinic follow-up	339 / 5,623 (7%)	532 / 5,682 (9.4%)	Logistic regression	1.30 (1.01, 1.67)	1.33 (1.02, 1.75)	Facility, year of first visit, age, education, nationality, current HIV diagnosis
Honduras	**Donastorg**	2014	HIV-positive women ≥18, exchanged sex for cash or in-kind payment in last month, spoke Spanish	Convenience recruitment by peer navigators and clinic staff; subsequent referrals were made by women who were participating in the study.	All: 266; Ever initiated ART: 207	All (self report)	Cross-sectional	Current	Lives in city/town/ area other than survey city	Current	Viral load ≥50 copies/ml	58 / 268 (22%)	138 / 268 (52%)	Logistic regression	All women: 0.79 (0.44, 1.43) Women who ever took ART: 0.68 (0.34, 1.32)	All women: 0.83 (0.41, 1.69) Women who ever took ART: 0.63 (0.28, 1.41)	Age, cohabitation, education, number of children, time in sex work, (alcohol consumption) , drug use, recent HIV diagnosis, (HIV care in last 6 months), currently taking ART, interrupted ART in last four days, ever]

	First Author	Date	Sample definition	Recruit-ment	N Analysed	HIV prevalence	Design	Mobility time-period	Measure of mobility	Outcome time-period	Outcome	Mobility prevalence	Outcome prevalence	Analysis method	Unadjusted effect OR (95% CI)	Adjusted effect AOR (95% CI)	Adjustment variables
	Zulliger	2015	HIV-positive women ≥18, exchanged sex for cash or in-kind payment in last month, spoke Spanish, initiated onto ART		205	All (self report)		Past 12 months	Moved cities	Ever	Reported interrupting or suspending ART	Not reported	76 / 205 (36%)	Logistic regression	3.74 (1.42, 9.85)	2.74 (0.89, 8.42)	Perception of HIV services, discriminatio n at clinic, years in SW, lifetime use of any drug, establishmen t-based, self-stigma
India	**Armstrong**	2013	Women ≥18 exchanged sex for cash or in-kind payment in last month	Respondent-driven sampling	417	Not reported	Cross-sectional	Ever	Worked outside of survey city	Ever	None of: contacted by peer educator; received condoms; visited clinic	20% sold sex outside of Dimapur (no raw figures)	Not reported	Logistic regression (individual weights from RDSAT)	1.89 (0.93, 3.85)	2.27 (1.09, 4.76)	Literacy, place of solicitation
South Africa	**Schwarz**	2017	Cis-women ≥18, living in study site, sex work as principal form of income in past year, conversant in English or Xhosa.	Respondent-driven sampling	163	All	Cross-sectional	Past 12 months	Moved cities	Ever	Not initiated ART	17% in total sample (410), not reported for analysed sub-group	28%	Modified Poisson regression, robust standard errors	0.86 (0.65, 1.14)	-	NA

	First Author	Date	Sample definition	Recruit-ment	N Analysed	HIV prevalence	Design	Mobility time-period	Measure of mobility	Outcome time-period	Outcome	Mobility prevalence	Outcome prevalence	Analysis method	Unadjusted effect OR (95% CI)	Adjusted effect AOR (95% CI)	Adjustment variables
Vietnam	**Bach Xuan**	2013	Women referred to clinic by peer educators or outreach program officers	Mapping of hotspots with primary informants, and referral by peers and outreach workers	1,998	Not reported	Cross-sectional	Ever	Worked overseas or in other provinces	Ever	Involuntary HIV test or not collected result	489 / 1998 (25%) in other provinces, 21 / 1998 (4%) overseas	In-voluntary tested of tested, 296 / 641 (46%) Not know result of tested, 84 / 641 (13%)	Logistic regression	0.92 (0.65, 1.28)	-	NA

Figures

Figure 1

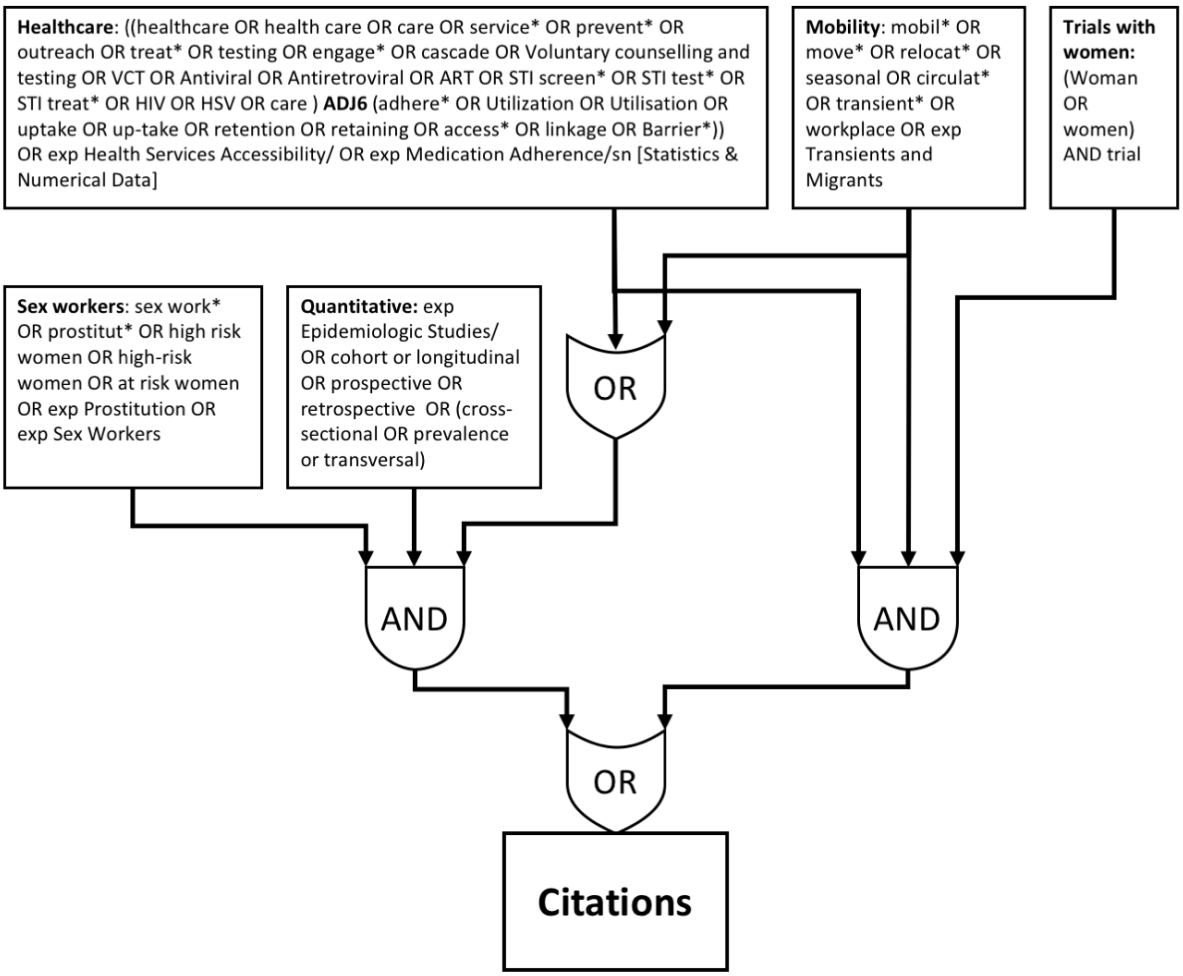


Figure 2

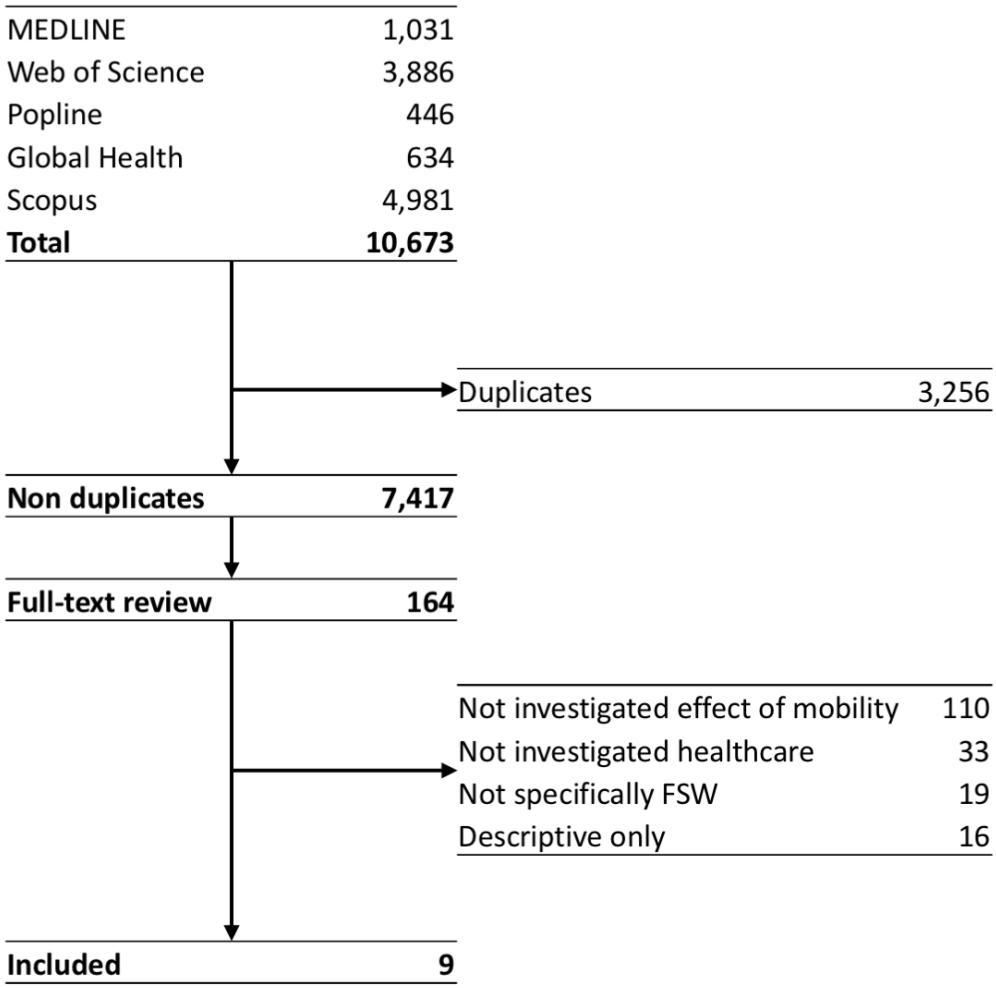
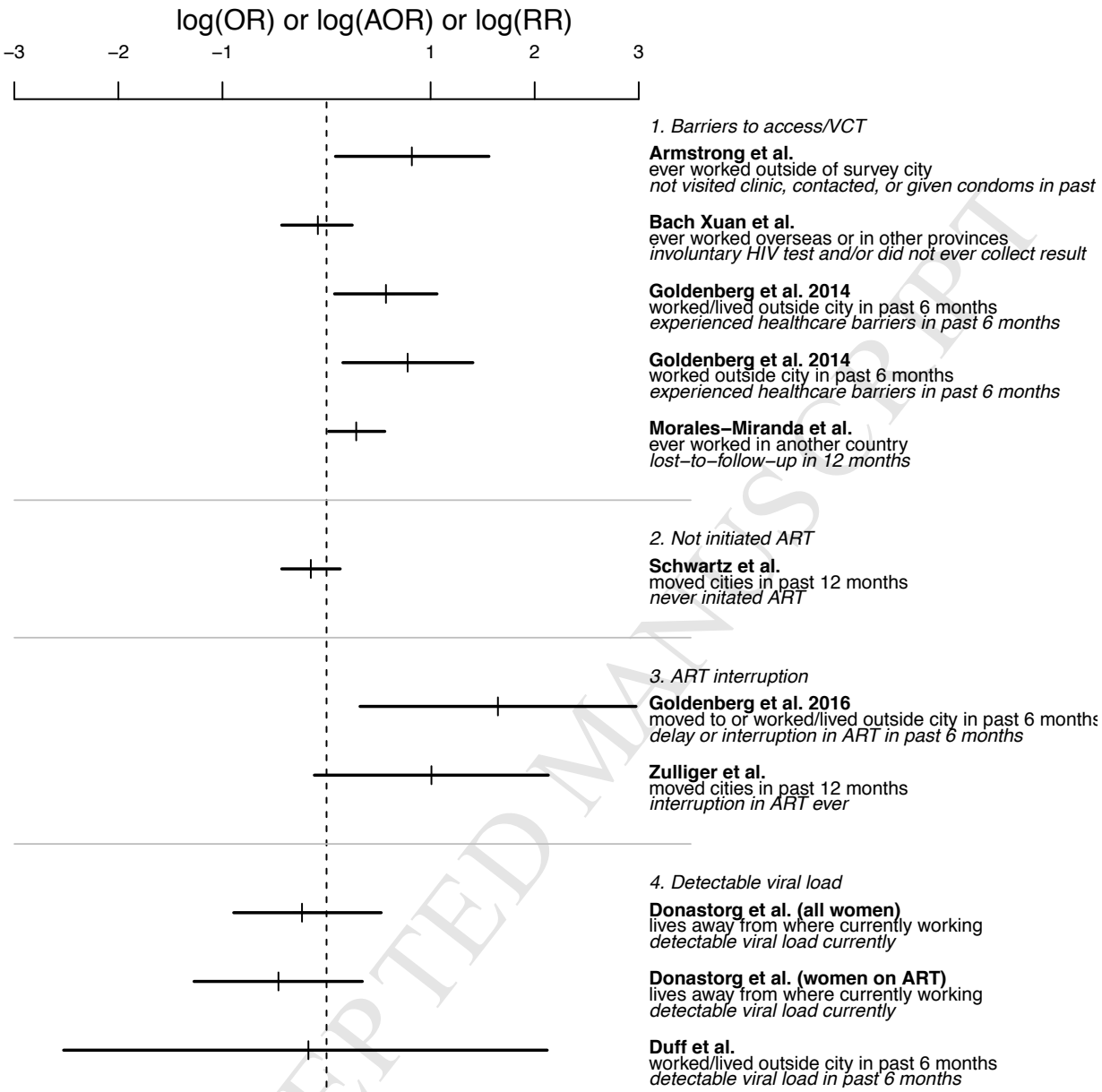


Figure 3



- Nine studied have addressed mobility and healthcare access for sex workers
- Three found associations with poor access to healthcare
- On study found no association with antiretroviral (ART) initiation
- Associations found for antiretroviral interruption were not found with viral load
- Future research should carefully measure mobility