Opportunities and considerations for the design of decentralized delivery of antiretroviral therapy for female sex workers living with HIV in South Africa

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Abstract

Background: In South Africa, 60% of female sex workers (FSW) are living with HIV, many of whom experience structural and individual barriers to antiretroviral therapy (ART) initiation and adherence. Community-based decentralized treatment provision (DTP) may mitigate these barriers. To characterize optimal implementation strategies, we explored preferences for DTP among FSW living with HIV in Durban, South Africa.

Methods: Thirty-nine semi-structured in-depth interviews were conducted with FSW living with HIV (n = 24), and key informants (n = 15) including HIV program implementers, security personnel, and brothel managers. Participants were recruited using maximum variation and snowball sampling. Interviews were conducted in English or isiZulu between September–November 2017 and analyzed using grounded theory in Atlas.ti 8.

Results: DTP was described as an intervention that could address barriers to ART adherence and retention, minimizing transport costs, time and wage loss from clinic visits, and act as a safety net to address FSW mobility and clinic access challenges. Respondents highlighted contextual considerations for DTP and suggested that DTP should be venue-based, scheduled during less busy times and days, and integrate comprehensive health services including psychological, reproductive, and non-communicable disease services. ART packaging and storage were important for community-based delivery, and participants suggested DTP should be implemented by sex work sensitized staff with discrete uniform and vehicle branding.

Conclusions: Incorporating FSW preferences may support implementation optimization and requires balancing of tensions between preferences and feasibility. These data suggest the potential utility of DTP for FSW as a strategy to address those most marginalized from current ART programs in South Africa.
Background
As antiretroviral therapy (ART) programs expand, global funding for the HIV response is plateauing or even decreasing [1, 2], and donors and national health systems are re-evaluating how ART care is delivered. The World Health Organization (WHO) recommends adaptive or differentiated approaches to HIV care to maximize reach and effectiveness [3]. Differentiated service delivery (DSD), a patient-centered approach to HIV care, aims to more effectively target care and reduce the burden on the health system [4, 5], and can be facility- or community-based [6–8]. Globally, the focus of DSD to-date has largely been ART provision for clinically stable (viraîly suppressed) adult chronic care patients [4, 5]. Through recommendations from key stakeholders [3, 9–11], DSD has increasingly expanded to more vulnerable, but still clinically stable populations including children, adolescents, pregnant and breastfeeding women, and key populations (KPs) including female sex workers (FSW) [9–11].

DSD builds on existing global standards of HIV care [12–15], and can aid in addressing structural barriers to ART access, adherence, and retention through population-specific provision of tailored care [16, 17]. However, scalable DSD strategies must be adaptable, acceptable, and cost-effective to specific populations [10, 18].

In 2021, there were an estimated 7.8 million people living with HIV in South Africa, of which 7.26 million knew their HIV status, 5.6 million were on ART, and 5.1 million had suppressed viral loads [19]. Despite progress in ART scale-up, treatment roll-out remains below UNAIDS 90–90–90 targets [18, 19] and HIV risk and burden are not evenly distributed. HIV prevalence and treatment coverage among FSW in South Africa are estimated to be 62% and 39%, respectively [2, 19, 20], and the prevalence of viral load suppression, where available, are generally suboptimal [21, 22].

Decentralized treatment provision (DTP), a DSD strategy that includes community-based provision of ART, may address barriers to ART linkage, uptake, and retention among FSW [23–27] and leverages priorities for community-based, nurse-led ART care and treatment distribution [28]. DTP at select pick-up points (i.e., designated pharmacy queues, churches, and schools) has been implemented as part of the South African National Department of Health response since 2014 through the Central Chronic Medicine Dispensing and Distribution (CCMDD) program, but it has been limited to virologically suppressed adults living with HIV and on treatment for a sustained period; the CCMDD does not address the unique needs of marginalized populations or those not virally suppressed [29, 30]. This is despite evidence across sub-Saharan Africa that community-based ART distribution for key populations (including but not limited to FSW) has been found to be as effective as facility-based care and resulted in similar HIV clinical outcomes [31].

In sum, most research on DSD predominately compares differentiated models to traditional treatment models, often failing to incorporate user preferences [32, 33]. Understanding and embedding preferences for FSW in the implementation of DTP will support the appropriateness, adoption, and acceptability of the intervention’s implementation [34, 35]. Further, assessing user preferences allows for DSD packages to be tailored to populations and aware of heterogeneity within populations [32]. This formative qualitative research aimed to characterize the opportunities and considerations for DTP implementation for FSW living with HIV in Durban, South Africa.

Methods
Data were collected in Durban, South Africa in collaboration with TB HIV Care (THC), as part of the formative research for the Siyaphambili Study [36], from September–November 2017. The THC FSW program has been active in Durban since 2012, and includes mobile van-based HIV testing and prevention services for FSW, and a facility-based drop-in center staffed by nurses, peer educators, and counselors where ART is provided for free in line with national treatment guidelines [28, 37].

Twenty-four in-depth interviews (IDIs) and 15 key informant interviews were conducted between September and November 2017. IDIs were conducted with cisgender FSW who were 18 years or older, sold sex as their primary source of income in the last 12 months, self-reported living with HIV, and resided in Durban. To address FSW heterogeneity, IDI participants were recruited using maximum variation sampling to ensure variability across age, venue type, time of operation, treatment experience, and proximity from sex work venue to the THC drop-in center [38, 39]. Recruited by peers, FSW participants were identified at sex work venues and the THC drop-in center. Reimbursement of 100 ZAR (~7 USD) was provided to FSW participants.

Key informants (KIs) were recruited purposively and through snowball sampling [40] and included FSW program staff (manager, nurses, counselors, peers, and drivers) from government and non-governmental organizations, security (police and neighborhood watch personnel), and brothel managers. Eligibility criteria for KIs
included stakeholders who were 18 years or older and had experience in HIV programming or policy for FSW or could speak to the needs of FSW.

Prior to data collection, written informed consent was obtained from participants. All interviews were conducted in a private location (i.e., THC drop-in center, THC mobile van, sex work venue, or other prespecified community location) by one qualitative interviewer trained and experienced in qualitative methods and human subjects’ research. Semi-structured interview guides focused on potential barriers and facilitators of DTP intervention through the mobile van to promote ART access and adherence for FSW living with HIV. Interviews lasted between 60–80 min, were conducted in isiZulu or English, and were audio-recorded. Participation was limited to one interview per person. Recordings were transcribed verbatim and translated into English by an external individual trained and experienced in transcription and translation of qualitative interviews.

Analysis occurred in a two-phased, cyclical process. After each interview, a memo was drafted by the interviewer to capture key themes and field notes [41]. Memos and emerging themes were discussed on a weekly basis by the study team; data collection and interpretation were iterative. A codebook was developed based on emergent themes and DSD strategies. Each transcript was coded by co-authors CAC and LP, discussed, and coding discrepancies resolved. Data were managed using Atlatl 8 and analyzed using a grounded theory approach [42]. Themes have been summarized in the text and illustrative quotes presented within the text and tables. Names included are pseudonyms provided by participant.

This study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board (IRB No. 00007847), the University of Western Cape Biomedical Research Ethics Committee, and the KwaZulu-Natal Department of Health.

**Results**

Among the 24 FSW participants, half reported current ART use (Table 1). More than half of FSW met or solicited clients at outdoor sex work venues (e.g. streets, parks) and 63% operated during the day. KIs were primarily female and over half were older than the age of 40 (Table 2).

**Opportunities for community-based decentralized treatment provision of ART**

Most FSW expressed interest in receiving ART at sex work venues. Primary opportunities for DTP included saving time and money, creating a safety net to address barriers caused by FSW mobility and challenges accessing the clinic, and protecting confidentiality, as described in detail below. Illustrative quotes highlighting subthemes are presented in Table 3.

**Time is money**

All FSW participants expressed that DTP could address structural barriers to ART access and retention, specifically noting DTP would save FSW time and money. FSW emphasized that taking ART was not difficult, however, leaving sex work venues to collect treatment at the clinic posed challenges as it required time, money, and resulted in potential income loss (i.e. from clients, daily rent, or money paid to manager/pimp). FSW noted that DTP at sex work venues would address these challenges, enabling women to obtain treatment onsite, return to work quickly, and reduce time spent away from clients.

DTP was suggested to reduce time spent traveling to and at the clinic as well as reduce transportation costs. While a few FSW reported having to ‘hustle’ harder or

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**Table 1** Demographic characteristics of female sex workers participating in in-depth interviews, Durban, South Africa (n = 24)

| Characteristic                          | n (%)   |
|----------------------------------------|---------|
| **Age**                                |         |
| 18–25                                  | 4 (16.7%) |
| 26–30                                  | 5 (20.8%) |
| 31–35                                  | 9 (37.5%) |
| 36–40                                  | 4 (16.7%) |
| 41–50                                  | 2 (8.3%)  |
| **ART-naïve**                          |         |
| No                                     | 20 (83.3%) |
| Yes                                    | 4 (16.7%)  |
| **Currently on ART**                   |         |
| No                                     | 12 (50.0%)  |
| Yes                                    | 12 (50.0%) |
| **Venue Type**                         |         |
| Indoor                                 | 9 (37.5%)   |
| Outdoor                                | 15 (62.5%)  |
| **Primary time of work**               |         |
| Daytime                                | 15 (62.5%) |
| Nighttime                              | 6 (25.0%)  |
| Both                                   | 3 (12.5%)  |
| **Distance from sex work venue to drop in center** | |
| Near                                   | 18 (75.0%) |
| Far                                     | 6 (25.0%)  |

*Indoor venues: hotels, home-based brothels, strip clubs with accommodations
Outdoor venues: corners/streets/street corners, taxi rank, truck stops
Far venues: defined as needing to take more than one taxi or bus to get to the THC drop-in center

Abbreviations: ART Antiretroviral therapy
budget appropriately to ensure they had money to visit the clinic during work hours, many reported not visiting clinics due to cost including opportunity cost. DTP at venues was also seen as an opportunity to replace long clinic queues and wait times, but also duration of time spent at the clinic, as FSW could obtain treatment, conduct necessary bloodwork, and receive routine services on the spot and near their place of work. A few women stated that DTP would benefit their overall health and wellbeing, noting that it would prevent treatment defaulting and enable women to save money (e.g. to buy food).

Confidentiality
Protecting FSW’s confidentiality and HIV-positive status emerged as another major opportunity of DTP. Most participants identified fear of unintended HIV disclosure to boyfriends or known community members as a key barrier to accessing HIV treatment from government clinics. Participants feared community members learning their HIV statuses as a result of seeing them at the clinic and explained that receiving ART from the THC mobile van would be discrete and confidential as it offers a wide range of health services. KIs reiterated that the offering of additional services on the mobile van and at the point of distribution reduces the likelihood of inadvertent disclosure to other FSW or clients.

Considerations for community-based DTP of ART
The importance of co-designing DTP strategies with FSW and tailoring strategies to focus specifically on FSW strongly emerged. FSW and KI considerations are summarized against the building blocks of differentiated ART delivery for KPs put forth by the International AIDS Society [10]. Specifically, the Building Blocks “who,” “what,” “where,” and “when” of DTP implementation for FSW living with HIV who are not virally suppressed in the Siyaphambili study are described (Fig. 1).

When to implement DTP
When to implement DTP for FSW in Durban emerged as a relevant consideration as it determined whether women were at the venues and able to visit the van when it arrived. To optimize DTP uptake among FSW at greatest need, participants emphasized that DTP should be delivered during less busy work days as well as less busy work times; FSW recommended DTP during midweek, as Thursday through Sunday were busy days and Mondays were days of rest. Avoiding delivery on weekends and during pay periods or holidays due to high client demands was also emphasized by participants. FSW explained that a lack of consideration of when DTP strategies were delivered would result in hostility from some FSW (e.g. for interrupting work). Many participants suggested ART should be delivered in the morning, albeit

| Characteristics                        | n (%)|
|----------------------------------------|-----|
| Sex                                    |     |
| Male                                   | 6 (40.0%) |
| Female                                 | 9 (60.0%) |
| Racea                                 |     |
| Black African                          | 7 (46.7%) |
| Coloured                               | 4 (26.7%) |
| Indian                                 | 2 (13.3%) |
| White                                  | 2 (13.3%) |
| Age (years)                            |     |
| 26—30                                  | 3 (20.0%) |
| 31—35                                  | 3 (20.0%) |
| 36—40                                  | 1 (6.6%) |
| 41—45                                  | 4 (26.7%) |
| 46+                                    | 4 (26.7%) |
| Role                                   |     |
| FSW program staffb                     | 8 (53.4%) |
| Security (police/neighborhood watch)   | 2 (13.3%) |
| Professional nurse                     | 4 (26.6%) |
| Brothel owner                          | 1 (6.7%) |

*a Based on official race categories in South Africa  
b Program staff included program manager, peer educators, counselor, driver from Department of Health and non-governmental organizations

### Table 2: Demographic characteristics of key informants, Durban, South Africa (n = 15)
not too early as some FSW work during the night. A few participants and many KIs expressed safety considerations for FSW and staff around delivery of DTP in the community late at night. A couple of home-based brothels were noted as having curfew for FSW and all services would need to be provided before then. Participants reported that considerations of when DTP is implemented would maximize uptake and acceptability.

**Where to implement DTP**

FSW noted that DTP should be delivered close to sex work venues, but away from public areas, shops, homes, and informal settlements. FSW expressed wanting to avoid being seen entering the mobile van by clients, boyfriends, or others who many assume they are sick or gossip about them for attending the mobile clinic.

FSW recommended side streets and open spaces with minimal foot traffic as preferred DTP locations. A couple of women expressed disregard for others’ opinions, specifically noting that they would visit the mobile van wherever it parked as their health took priority. A few indoor-based FSW suggested parking the mobile van outside sex work venues and having staff deliver ART directly to the women’s rooms.

Safety around delivery locations also emerged, both in relation to staff safety on the mobile van as well as safe
storage of ART once obtained by FSW. Record keeping of ART, operating during daylight hours, ensuring appropriate security measures of the mobile van (i.e. security personnel, male program staff), and having awareness and contingency plans while in the community were suggestions reported for ensuring staff and clinic safety. Participants also reported that the safety of receiving ART at sex work venues and appropriately storing ART would be dependent on where the woman stayed (i.e. in a shared vs. individual room), location of the place of residence (i.e. whether she sleeps at the venue where she works), and whether she had disclosed to peer or boyfriend cohabitants.

**Whom to implement DTP**

The provider of ART emerged as another important consideration to DTP implementation. FSW explained that staff who were not sensitized around sex work and operated at HIV clinics were barriers to ART access and adherence, and the implementation of DTP by sensitized staff could aid in overcoming these challenges. Participants also reported that the safety of receiving ART at sex work venues and appropriately storing ART would be dependent on where the woman stayed (i.e. in a shared vs. individual room), location of the place of residence (i.e. whether she sleeps at the venue where she works), and whether she had disclosed to peer or boyfriend cohabitants.

**Where to implement DTP**

The time that I will encourage you to come when most of the girls (FSW) are not busy. Because if you, when these girls are busy, you come, they will ignore you. They will not even see you’re there. - Lindwe, hotel-based FSW.

Don’t go and recruit during busy… peak times that’s how they (FSW) call it. Don’t go at the beginning of the month. Check month ends. Because others are getting paid. So avoid these times. And it mustn’t be during the night. It must be during the day. (Peak times) is when they are busy. You won’t find them. They are really busy. It is like when you go there just to give them a treatment or if you want to go and give health services you won’t find them. You’ll find a few. - Female, professional nurse.

I think first of all our fellow sisters shouldn’t be seen at night or be given treatment at night. I think maybe it would be better during the day and while our fellow sisters are still indoors in where they do stay. You understand?... some of the sites that we do go to they are dangerous because we are coming from that life. So some of the places they know us by luck we are safe because of that. - Female, FSW program staff.

Branding on the mobile van and staff uniforms were expressed as an important consideration for DTP implementation as it had the potential for HIV and/or sex work disclosure. Several participants reported that branding the mobile van with ‘HIV,’ ‘sex workers,’ or ‘clinic’ would lead to stigma and discrimination from their pimps, boyfriends, or community. However, other FSW recommended maintaining existing mobile van branding, which includes ‘HIV’ and ‘clinic,’ to ensure recognition, authenticity, and security. Regarding nurse and peer uniforms, participants expressed professionalism, with an emphasis on non-descript civilian attire and name tags, but no organizational branding. While some FSW noted that visiting a provider wearing a uniform identified them as sex workers, some KIs found uniforms to build trust and facilitate community-based activities.

**What to implement with DTP**

FSW recommended that ART packaging should be unidentifiable and dispensed with material to put in containers (e.g. cotton wool, sponge) to reduce recognizable sounds of pill movement. Participants reported considerations for ART storage, noting the need to ensure temperature control inside the mobile van. Most FSW expressed that the mobile van should offer HIV testing and treatment, but also sexually transmitted infections and tuberculosis screening, yeast infection medication,

![Fig. 1 Participant preferences surrounding DTP implementation for FSW living with HIV at greatest need](image-url)
pap smears, and family planning. Additionally, almost all FSW expressed interest in psychosocial support as part of their HIV management. Psychological support was noted to relieve and manage stress and aid with disclosure, encouragement, parenting skills, and ART adherence support. Participants who expressed a desire for psychosocial support had histories of physical or sexual abuse and reported lacking adequate support systems.

Discussion
Concerted efforts are needed to reach and sustain the most marginalized FSW living with HIV in South Africa with ART, to increase their quality and quantity of life and minimize onward transmission risks. These qualitative data highlight FSW-centered perspectives surrounding the opportunities and considerations for DTP implementation to support the appropriateness, adoption, and acceptability of the intervention. Additionally, these analyses aid in the understanding of for whom and in what context DTP implementation may be most cost-effective to retain and promote viral suppression among FSW in Durban, South Africa.

Several of the opportunities and considerations for DTP among FSW that emerged, including occupational influences, substance use, and mobility, were facilitators and barriers to ART care more generally and important considerations for the implementation of decentralized care. DTP was seen as an acceptable way to address these facilitators and barriers and determining strategies to optimally initiate and dispense DTP requires extensive consideration. Working within formal establishments (e.g., hotels, bars), HIV non-disclosure to non-paying partners, substance use, and mobility have been found to be associated with ART interruptions and barriers to retention in care and viral suppression among FSW [27, 44–49]. Safe venue-based ART delivery and storage while at work would depend on work location, housing conditions, and HIV disclosure, and recognizing venue typology becomes important for successful DTP uptake and implementation. Persons are more likely to miss a treatment dose or have suboptimal adherence if they have not disclosed their HIV status to their partners, co-workers or other peers [50, 51]. However, research among virally suppressed ART patients also shows that community ART distribution groups may be self-protective, normalizing and hiding their HIV status and reducing exposure to discrimination through fewer clinic visits [52]. The ability of DTP to serve as a safety net for women who are mentally incapacitated emerged but may pose challenges to DTP implementation due to FSW sobriety to engage in care, including bloodwork and counseling/treatment of other health ailments when found on site. Moreover, utility of DTP to provide onsite ART distribution may be an opportunity to retain FSW in care as women may move between clinic catchment areas, although potential implementation challenges may arise around scheduling DTP visits and meeting delivery targets given frequent mobility across venues.

The data support the understanding of for whom and in what context to implement DTP. FSW with economic barriers to clinic attendance and those that are highly mobile or recently relocated may benefit substantially from community-based DTP. Recognizing the heterogeneity in treatment needs among FSW, and tailoring DTP programs to those in greatest need may prove to be most cost-effective [35]. With financial limitations, including transportation costs and wages lost while at work, have been noted as drivers of treatment interruption [51, 53], the opportunity for FSW to save time and money with DTP at sex work venues emerged from the perspective of the user. Moreover, community-based DTP must balance preferences of FSW with implementation feasibility while maximizing reach and targeting those at highest need. FSW and KIs emphasized DTP should occur on less busy days and avoid peak hours, yet ART deliveries will only be effective when women are on site, which may not be the slowest times of the day or week. Implementation teams may frequent a sex work venue while unable to find patients, and implementation costs incurred with non-deliveries must be considered. Similarly, while night deliveries were not recommended, alternative strategies for how to reach nighttime workers are required.

Decentralized services are often implemented as “lighter touch” models, and the utilization of community and peers in DSD strategies engages FSW and removes the burden on the healthcare system through these lay providers [17]. However, from the FSW perspective, integrating other health services (e.g., reproductive health and non-communicable disease services) and psychosocial services into DTP emerged as important as it would allow for the dynamic needs and comorbidities of FSW to be addressed. Moreover, in consideration for whom and in what context to implement DTP, this more comprehensive approach may be particularly warranted for those who are not virally suppressed or most marginalized. Yet, the necessary intensity and feasibility of comprehensive service provision remains unclear. The current standard of care for most ART DSD programs in South Africa is to exclude patients with non-communicable diseases, such as hypertension and diabetes, or women who are currently pregnant [54]. DSD among key populations in other settings has been found as effective as facility-based care [31]. Recent implementation evaluation research surrounding the CCMDD program for stable adults living with HIV in South Africa found it to reduce stigma, but cited patient-level and organizational-level barriers (i.e.
inadequate education about CCMDD, inability to access treatment on designated dates, challenges with communication and transportation, treatment packaging, rigidity of CCMDD rules, and insufficient infrastructure) [30]. Additional research is needed to assess whether these barriers and challenges exist in DSD implementation strategies aimed to support the unique needs of FSW living with HIV and what mechanisms and contextual considerations are needed to overcome DSD implementation among populations at increased risk for suboptimal HIV treatment outcomes. Furthermore, though there are indications that more comprehensive services are needed [55], FSW programs like THC in Durban, may have limited scope to offer integrated health services as outlined in national guidelines [56].

This study has several limitations. FSW participants were recruited from sex work venues served by THC in Durban, as well as THC peers. Though many of the themes raised are likely applicable in other regional settings, acceptability, and preferences may differ, particularly in areas in which programmatic services and trusting relationships have not already been developed. Through the community-based, peer-led recruitment process, FSW operating on virtual platforms (i.e. the websites or mobile applications) were not represented. However, FSW operating exclusively online are also unlikely to benefit or be reached by DTP in a sustainable manner. Maximum variation sampling ensured representation of FSW engaged and not engaged in care and operating across various sex work venues. Finally, themes that could have been explored further included contingency planning for DTP implementation, specifically focusing on what to do when FSW are not at the venue.

Conclusions
This formative, qualitative analysis explored patient-centered opportunities and consideration for DTP implementation for FSW operating in Durban, South Africa. Considering FSW and KI perspectives is important when considering for whom and in what context to implement DTP as well as when identifying appropriate, acceptable, and feasible implementation strategies. Recognizing the heterogeneity in risks and needs among FSW is critical for cost-effective implementation, and these data suggest that tailoring DTP to preferences may promote ART adherence as well as address structural barriers to engagement and retention in care. Tensions between preferences and implementation considerations including feasibility and sustainability exist, and data are needed to determine the impact and cost-effectiveness of DTP in isolation or as part of a larger DSD package. Ultimately differentiated service delivery models, including DTP, may offer solutions to better addressing the treatment needs among FSW in South Africa, but effectiveness cannot be assumed, and evidence is urgently needed.

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Authors’ contributions
H.H., K.Y, M.M, N.M, V.G. implemented the research with support from other co-authors. S.B., H.H., S.S, S.M, D.R.P., and K.Y designed the research study. C.A.C and L.E.P. analyzed the data. C.A.C wrote the paper with input from all other co-authors. All co-authors have read and approved the final manuscript.

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Availability of data and materials
The data generated and analyzed are not publicly available as these data are qualitative and within qualitative transcripts there are often ultimately identifiable pieces of information provided by the respondents. Further this is a criminalized population in South Africa. Thus, to protect respondents’ privacy and confidentiality the data are not publicly available. Data can be made available upon reasonable request and approval from both PIs Stefan Baral and Harry Hausler. Requesting individuals will need to be added to the study IRB prior to receiving the data.

Declarations
Ethics approval and consent to participate
This study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board, the University of Western Cape Biomedical Research Ethics Committee, and the KwaZulu-Natal Department of Health. Written informed consent was obtained from all participants. All methods were carried out in accordance with relevant guidelines and regulations of Helsinki declaration.

Consent for publication
N/A – This manuscript does not contain any individual person’s data in any form.

Competing interests
The authors declare no conflict of interests nor other financial or non-financial competing interests.

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References

1. Kates JWA, Lief E. Financing the response to HIV in low- and middle-income countries: international assistance from DonorGovernments in 2015. Menlo Park (CA): Kaiser Family Foundation and Joint United Nations Programme on HIV/AIDS; 2016.

2. Data UNAIDS. New York: NY: UNAIDS; 2018. p. 2018.

3. Organization WH. Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection: recommendations for a public health approach – 2nd edition. Geneva, Switzerland: WHO; 2016.

4. Organization WH. Guideline on when to start antiretroviral therapy and on prevention to suppression. J Int AIDS Soc. 2016;19(1):21484.

5. Prust ML, Banda CK, Nyirenda R, Chimbwandira F, Kalua T, Jahn A, et al. Differentiated Care for HIV: A decision framework for antiretroviral therapy delivery. Durban, South Africa. 2016.

6. (IAS) IAS. Differentiated care for HIV: A decision framework for antiretroviral therapy delivery. Geneva, Switzerland; 2017;20 Suppl 4:21650.

7. Okoboi S, Ding E, Persaud S, Wangisi J, Birungi J, Shurgold S, et al. Community-based ART distribution system can effectively facilitate long-term program retention and low-rates of death and virologic failure in rural Uganda. AIDS Res Ther. 2015;12:37.

8. World Health Organization, United States Agency for International Development, United Nations Population Fund, World Health Organization, United Nations Development Programme, The President’s Emergency Plan For AIDS Relief, International AIDS Society. Key Considerations for differentiated service delivery for specific populations: Children, adolescents, pregnant and breastfeeding women and key populations. Geneva, Switzerland: WHO; 2017.

9. World Health Organization, United States Agency for International Development, New York (NY): United Nations AIDS Society; 2018.

10. Prust ML, Banda CK, Nyirenda R, Chimbwandira F, Kalua T, Jahn A, et al. Multi-month prescriptions, fast-track refills, and community ART groups: results from a process evaluation in Malawi on using differentiated models of care to achieve national HIV treatment goals. J Int AIDS Soc. 2017;20(2 Suppl 4):21650.

11. World Health Organization, United States Agency for International Development, New York (NY): United Nations Population Fund; 2015.

12. United Nations Population Fund, World Health Organization, United States Agency for International Development, New York, France: France: 2017.

13. United Nations Population Fund, World Health Organization, United States Agency for International Development, World Bank. Implementing comprehensive HIV and STI programmes with men who have sex with men: practical guidance for collaborative interventions. New York (NY): United Nations Population Fund; 2015.

14. United Nations Population Fund, World Health Organization, United States Agency for International Development, World Bank. Implementing comprehensive HIV and STI programmes with men who have sex with men: practical guidance for collaborative interventions. Vienna, Austria; 2017.

15. United Nations Population Fund, World Health Organization, United States Agency for International Development, World Bank. Implementing comprehensive HIV and STI programmes with transgender people: practical guidance for collaborative interventions. New York (NY): United Nations Population Fund Programme; 2016.

16. World Health Organization, Global Network of Sex Work Projects, The World Bank. Implementing comprehensive HIV/STI programmes with sex workers: practical approaches from collaborative interventions. Geneva, Switzerland: World Health Organization; 2013.

17. MacDonald V, Verster A, Baggaley R. A call for differentiated approaches to delivering HIV services to key populations. J Int AIDS Soc. 2017;20(2 Suppl 4):21658.

18. Organization WH. Consolidated guidelines on HIV prevention, diagnosis, treatment and care for key populations - 2016 update. Geneva: WHO; 2016.

19. Joint United Nations Programme on HIV/AIDS (UNAIDS). 90-90-90 - An ambitious treatment target to help end the AIDS epidemic. Geneva: 2014. https://www.unaids.org/sites/default/files/media_asset/90-90-90_en.pdf.

20. Johnson LFMM, Dorrington RE, Cornell M, Boule A, Egger M, Davies MA. Estimating the impact of antiretroviral treatment on adult mortality trends in South Africa: a mathematical modelling study. PLoS Med. 2017;14(12):e1002468.

21. Mikkelsen E, Hortalon JC, Jansen MPM, Bärnighausen T, Hauck K, Johannson KA, et al. Evidence for scaling up HIV treatment in sub-Saharan Africa: A call for incorporating health system constraints. PLoS Med. 2017;14(2):e1002240.

22. Dutta A, Barker C, Kallarakal A. The HIV Treatment Gap: Estimates of the Financial Resources Needed versus Available for Scale-Up of Antiretroviral Therapy in 97 Countries from 2015 to 2020. PLoS Med. 2015;12(11):e1001907 (discussion e).

23. Baral S, Beyer C, Muesig K, Potest A, Witzt AL, Decker MR, 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(7):538–49.

24. Mishra S, Pickles M, Blanchard JF, Moses S, Boyle MC. Distinguishing sources of HIV transmission from the distribution of newly acquired HIV infections: which is important for HIV prevention planning? Sexually transmitted infections. 2014;90(1):19–25.

25. Shannon K, Stathdhe SA, Goldenberg SM, Duff P, Mwangi P, Rusakova M, et al. A Global epidemiology of HIV among female sex workers: influence of structural determinants. Lancet (London Engl). 2015;385(9962):55–71.

26. Taskforce SWEAT, Consulting, I. Sex workers in South Africa: a rapid population size estimation study. South Africa National AIDS Council: South Africa, 2013.

27. Schwartz S, Lambert A, Phaswana-Mafuya N, Kose Z, Mclnanga M, Holland C, et al. Engagement in the HIV care cascade and barriers to antiretroviral therapy uptake among female sex workers in Port Elizabeth, South Africa. Findings from a respondent-driven sampling study. Sexually transmitted infections. 2017;93(4):290–6.

28. Georgeu D, Colvin CJ, Lewin S, Fairall I, Bachmann MO, Uebel K, et al. Implementing nurse-initiated and managed antiretroviral treatment (NIMART) in South Africa: a qualitative process evaluation of the STRETCH trial. Implementat Sci. 2012;7:66.

29. Steel G. Alternative Chronic Medicine Access Programme for Public Sector Patients [Internet]. Civil Society Stakeholder Meeting, 2014. https://www.differentiatedcare.org/Portals/0/adam/Content/5zdRWskIhUCwZOTtmWnpKg/fiDjOC/CCMD%20v2circles%20society%20representation_2014_012_T0%20MSF.pdf.

30. Boggart LM, Shaari Z, MacCarthy S, Mendoza-Grat A, Waru NJ, Zions D. et al. Implementation of South Africa’s central chronic medicine dispensing and distribution program for HIV treatment: a qualitative evaluation. AIDS Behav. 2022;26(8):2600–12.

31. Ibilooye O, Masquiller C, Jwanje P, Van Belle S, Van Olmen J, Lyen L, et al. Community-based art service delivery for key populations in South-Africa: a scoping review of outcomes along the continuum of HIV care. AIDS Behav. 2022;26(7):2314–37.

32. Eshun-Wilson I, Mukumbwa-Mwenechanya M, Kim H-Y, Zannolini A, Mwamba CP, Dowdy D, et al. Differentiated Care Preferences of Stable Patients on Antiretroviral Therapy in Zambia. A Discrete Choice Experiment. J Acquir Immune Defic Syndr. 2019;89(5):540–6.

33. IAS. Differentiated Service Delivery. 2020.

34. Proctor E, Silmere H, Raghavan R, Havmand P, Aarons G, Bunger A, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Health. 2011;38(2):65–76.

35. Schwartz SR, Baral S. Remembering individual perspectives and needs in differentiated HIV care strategies. BMJ Qual Saf. 2020;29(7):2314–37.

36. Comins CA, Schwartz SR, Phetlhu DR, Guddera V, Young K, Farley JE, et al. Evidence for scaling up HIV treatment in sub-Saharan Africa: A call for incorporating health system constraints. PLoS Med. 2017;14(2):e1002240.

37. Pope DS, Atkins S, Delusca AN, Hausler H, Hoosain E, Celentano DD, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Health. 2011;38(2):65–76.

38. Schwartz SR, Baral S. Remembering individual perspectives and needs in differentiated HIV care strategies. BMJ Qual Saf. 2019;28(4):257–9.

39. Comins CA, Schwartz SR, Phetlhu DR, Gudlera V, Young K, Farley JE, et al. Sivapramibili protocol: An evaluation of randomized, nurse-led adaptive HIV treatment interventions for cisgender female sex workers living with HIV in Durban, South Africa. Res Nurs Health. 2019;42(2):107–18.

40. Pope DS, Atkinson S, Deluca AN, Hauser H, Hoosain E, Celentano DD, et al. South African TB nurses’ experiences of provider-initiated HIV counseling and testing in the Eastern Cape Province: a qualitative study. AIDS Care. 2010;22(2):238–45.

41. Patton M. Qualitative evaluation and research methods. Beverly Hills, CA: Sage Publications, inc; 1990.
39. Parmley LE, Comins CA, Young K, McIngana M, Phetlhu DR, Guddera V, et al. Occupational barriers to accessing and adhering to antiretroviral therapy for female sex workers living with HIV in South Africa. Occup Environ Med. 2020;77(2):100–6.
40. Goodman LA. Snowball Sampling. Ann Math Statist. 1961;32(1):148–70.
41. Birks M, Chapman Y, Francis K. Memoing in qualitative research: Probing data and processes. J Res Nurs. 2008;13:68–75.
42. Charmaz K. Constructing Grounded Theory: A Practical Guide through Qualitative Analysis. (College) DSM, editor. London: Sage Publications Ltd; 2006.
43. Saunders B, Sim J, Kingstone T, Baker S, Waterfield J, Bartlam B, et al. Saturation in qualitative research: exploring its conceptualization and operationalization. Qual Quant. 2018;52(4):1893–907.
44. Zulliger R, Barrington C, Donastorg Y, Perez M, Kerrigan D. High Drop-off Along the HIV Care Continuum and ART Interruption Among Female Sex Workers in the Dominican Republic. J Acquir Immune Defic Syndr. 2015;69(2):216–22.
45. Goldenberg SM, Montanari J, Duff P, Nguyen P, Dobrer S, Guillems A, et al. Structural barriers to antiretroviral therapy among sex workers living with HIV: findings of a longitudinal study in Vancouver, Canada. AIDS and behavior. 2016;20(5):977–86.
46. Richter M, Chersich MF, Vegetal J, Sartorius B, Temmerman M, Luchters S. Migration status, work conditions and health utilization of female sex workers in three South African cities. J Immigr Minor Health. 2014;16(1):7–17.
47. Lancaster KE, Go VC, Lungu T, Mmodza P, Hosseinipour MC, Chadwick K, et al. Substance use and HIV infection awareness among HIV-infected female sex workers in Lilongwe, Malawi. Int J Drug Policy. 2016;30:124–31.
48. Lancaster KE, Lungu T, Mmodza P, Hosseinipour MC, Chadwick K, Powers KA, et al. The association between substance use and sub-optimal HIV treatment engagement among HIV-infected female sex workers in Lilongwe. Malawi AIDS care. 2017;29(2):197–203.
49. Lancaster KE, Cernigliaro D, Zulliger R, Fleming PF. HIV care and treatment experiences among female sex workers living with HIV in sub-Saharan Africa: A systematic review. Afr J AIDS Res. 2016;15(4):377–86.
50. Do NT, Phiri K, Bussmann H, Gaolathe T, Marlink RG, Wester CW. Psychosocial factors affecting medication adherence among HIV-1 infected adults receiving combination antiretroviral therapy (cART) in Botswana. AIDS Res Hum Retroviruses. 2010;26(6):685–91.
51. Hardon AP, Akurut D, Comoro C, Ezike C, Irunde HF, Gerrits T, et al. Hunger; waiting time and transport costs: time to confront challenges to ART adherence in Africa. AIDS Care. 2007;19(5):658–65.
52. Pelleccchia U, Baert S, Nundwe S, Bwanali A, Zamadenga B, Metcalf CA, et al. “We are part of a family” Benefits and limitations of community ART groups (CAGs) in Thyolo, Malawi: a qualitative study. J Int AIDS Soc. 2017;20(1):21374.
53. Tabatabai J, Namakhoma I, Tiweya H, Phiri S, Schnitzler P, Neuha et al. Understanding reasons for treatment interruption amongst patients on antiretroviral therapy – A Qualitative study at the Lighthouse Clinic, Lilongwe, Malawi. Glob Health Action. 2014;7:24795. https://doi.org/10.3402/gha.v7.24795.
54. Davey DJ, Hamlyn C, Mitchell C. Uptake of HIV differentiated care models for patients on antiretroviral therapy in South Africa. 2016 Durban: South African AIDS Conference; 2016. https://cquinnicapcolumbia.edu/wp-content/uploads/2017/11/ICAP_CQUIN_Broadreach_Uptake-of-HIV-DC-Models_2016.pdf.
55. Comins CA, Schwartz SR, Young K, Mishra S, Guddera V, McIngana M, et al. Contextualising the lived experience of sex workers living with HIV in South Africa: a call for a human-centred response to sexual and reproductive health and rights. Sexual and Reproductive Health Matters. 2019;27(1):1686200.
56. South African Department of Health. The South African Antiretroviral Treatment Guidelines. South Africa: South African Department of Health; 2013. https://sahivsoc.org/files/2013%20ART%20Treatment%20Guidelines%20Final%2025%20March%202013%20corrected.pdf.

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