HIV testing and the care continuum among transgender women: population estimates from Rio de Janeiro, Brazil

Emilia M. Jalil1, Erin C. Wilson2, Paula M. Luz2, Luciane Velasque1,3, Ronaldo I. Moreira3, Cristiane V. Castro3, Laylla Monteiro3, Ana Cristina F. Garcia1, Sandra W. Cardoso1, Lara E. Coelho3, Willi McFarland4, Albert Y. Liu2, Valdilea G. Veloso3, Susan Buchbinder2,4 and Beatriz Grinsztejn §1

§Corresponding author: Beatriz Grinsztejn Instituto Nacional de Infectologia Evandro Chagas, Fundação Oswaldo Cruz, Av. Brasil, 4365, Manguinhos, Rio de Janeiro, RJ 21045-900, Brazil. Tel: 55 (21) 2270-7064. (gbeatriz@ini.fiocruz.br)

Abstract

Introduction: Evidence suggests that, of all affected populations, transgender women (transwomen) may have the heaviest HIV burden worldwide. Little is known about HIV linkage and care outcomes for transwomen. We aimed to estimate population-level indicators of the HIV cascade of care continuum, and to evaluate factors associated with viral suppression among transwomen in Rio de Janeiro, Brazil.

Methods: We conducted a respondent-driven sampling (RDS) study of transwomen from August 2015 to January 2016 in Rio de Janeiro, Brazil and collected data on linkage and access to care, antiretroviral treatment and performed HIV viral load testing. We derived population-based estimates of cascade indicators using sampling weights and conducted RDS-weighted logistic regression analyses to evaluate correlates of viral suppression (viral load ≤50 copies/mL).

Results: Of the 345 transwomen included in the study, 89.2% (95% CI 55–100%) had been previously tested for HIV, 77.5% (95% CI 48.7–100%) had been previously diagnosed with HIV, 67.2% (95% CI 39.2–95.2) reported linkage to care, 62.2% (95% CI 35.4–88.9) were currently on ART and 35.4% (95% CI 9.5–61.4%) had an undetectable viral load. The final adjusted RDS-weighted logistic regression model for viral suppression indicated that those who self-identified as black (adjusted odds ratio [aOR] 0.06, 95% CI 0.01–0.53, p < 0.01), reported earning ≤US$160/month (aOR 0.11, 95% CI 0.16–0.87, p = 0.04) or reported unstable housing (aOR 0.08, 95% CI 0.01–0.43, p < 0.01) had significantly lower odds of viral suppression.

Conclusions: Our cascade indicators for transwomen showed modest ART use and low viral suppression rates. Multi-level efforts including gender affirming care provision are urgently needed to decrease disparities in HIV clinical outcomes among transwomen and reduce secondary HIV transmission to their partners.

Keywords: HIV; antiretroviral therapy; care continuum; transgender women; HIV testing; Brazil

Received 1 February 2017; Accepted 22 July 2017; Published 19 September 2017

Copyright: © 2017 Jalil EM et al; licensee International AIDS Society. This is an Open Access article distributed under the terms of the Creative Commons Attribution 3.0 Unported (CC BY 3.0) License (http://creativecommons.org/licenses/by/3.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Introduction

Of all populations affected by HIV, evidence suggests that transgender women (transwomen) may have the heaviest HIV burden worldwide [1]. The rate of HIV infection among transwomen is higher than other at high risk groups, yet most tracking systems do not record data on trans people systematically [2,3]. Measurement of the HIV care cascade has played an important role in monitoring progress in test and treat strategies to curb the HIV epidemic and achieve the 90–90–90 goals [4]. The HIV cascade (or continuum) was developed by Gardner et al. to measure HIV testing, linkage and retention in HIV care and viral suppression [5]. However, little is known about HIV linkage and care outcomes for transwomen, in part, because data about transwomen are usually grouped together with men who have sex with men (MSM). For example, a recently published study from Peru found low HIV status awareness, retention in care, uptake of ART and virologic suppression among transwomen and MSM [6].

Disaggregated data from San Francisco show that transwomen have the lowest survival rates compared to men, the lowest insurance rates and have lower rates of linkage to care [3]. Viral suppression is also considerably lower for transwomen living with HIV compared to all other demographic groups except for people who inject drugs [3]. An analysis of HIV surveillance data from New York during 2011–2016 found that compared to MSM, transwomen had increased odds of not achieving viral suppression [7].
In low- and middle-income countries (LMIC) with HIV epidemics concentrated among key populations very little is known about transwomen’s HIV treatment outcomes. As a result, transwomen remain underserved, and services for this population remain under-resourced. The aims of this study were to estimate population-level indicators of the HIV cascade of care continuum, from testing to linkage to care, treatment and viral suppression, and to evaluate factors associated with viral suppression among transwomen in Rio de Janeiro, Brazil.

Methods
To determine estimates of the HIV cascade of care continuum among transwomen in Brazil, we conducted a secondary analysis of data from Transcender, a respondent-driven sampling (RDS) study of 345 transwomen conducted from August 2015 to January 2016 at the Oswaldo Cruz Foundation, in Rio de Janeiro, Brazil. To participate, individuals had to self-identify as a transwoman, living in Rio de Janeiro or the metropolitan area, and be age 18 years or older. Details of the study methodology have been described elsewhere [8]. In brief, based on formative focus group findings, twelve seeds were selected to ensure that the sample was not over-represented by key variables, e.g. age, race/skin colour, trans identities, education, geography, HIV status, history of sex work, and risk behaviours. Participants received up to five coupons that were used to refer peers to the study until the sample size was reached, and equilibrium was achieved on key variables. Equilibrium was reached when the sample composition from one wave to the next differed by less than 2% in the variables education, geography, HIV status, history of sex work, and risk behaviours.

Participants received up to five coupons that were used to refer peers to the study until the sample size was reached, and equilibrium was achieved on key variables. Equilibrium was reached when the sample composition from one wave to the next differed by less than 2% in the variables education, geography, HIV status, history of sex work, and risk behaviours. Participants received up to five coupons that were used to refer peers to the study until the sample size was reached, and equilibrium was achieved on key variables. Equilibrium was reached when the sample composition from one wave to the next differed by less than 2% in the variables education, geography, HIV status, history of sex work, and risk behaviours.

Recruitment was completed in 26 weeks with a mean of 3.6 recruitment waves for active seeds (standard deviation [SD] 1.6). Incentives for study participation included snacks, sexual health materials, make up, and a medical visit scheduled for after study enrolment. The coupon return rate was 37%. Socio-demographic data included age, race/ethnicity, schooling, income, drug use and other information related to health and access to care. Self-report of HIV serostatus awareness, access to and linkage to care (defined as attending at least one HIV-medical appointment) and current use of antiretroviral treatment (ART) were also collected. HIV viral load and CD4 lymphocyte cell count assessments were performed. All 345 participants, regardless of self-reported HIV serostatus, were offered an HIV test that 99% accepted; HIV testing was performed following the Brazilian Ministry of Health algorithm [10]. All participants with a positive HIV test had their HIV viral load (VL) (Real Time PCR) and CD4+ cell count assessed. Participants who tested positive for HIV and were unaware of their serostatus or were not linked to care were immediately offered linkage to specialized HIV care and ART.

We calculated population-based estimates of the HIV care cascade using the RDSII estimator to weight and adjust population estimates according to the recruitment design. In addition, RDS-weighted logistic regression models were used to quantify the association of independent variables with viral suppression (VL <50 copies/ml) among those with known HIV infection. For the regression model, we excluded participants who were unaware of their HIV infection (n = 40), leaving us with data from 101 transwomen living with HIV. All the remaining analyses were done for all 141 transwomen. Variables significantly associated with the outcome using a 0.2 significance threshold were included in the initial adjusted model except for linkage to care, which was forced in the model; the final adjusted model retained only the significant variables. All analysis considered statistical significance of 5% and were performed with the RDS Analyst Software version 0.57 [11].

Ethical aspects
The Evandro Chagas National Institute of Infectious Diseases-FIOCRUZ Institutional Review Board provided ethical approval for this project. All participants signed informed consent forms before study procedures began. This study was sponsored by the Brazilian Research Council (CNPq) and the National Institute of Allergy and Infectious Diseases (NIAID-NIH).

Results
Table 1 summarizes the characteristics of transwomen living with HIV. Most participants were 35 years of age or younger, self-identified as mixed race or black (80.5%) and had a very low monthly income (54.9%). Roughly 12% had less than 4 years of formal education and only 1.6% had more than a high school education. Very few had access to trans-specific health care (12.4%) or had a transgender surgery (1.7%). The majority of transwomen living with HIV had exchanged sex for money over their lifetime (85.8%), and almost 70% were currently doing sex work. Unstable housing was reported by 56.4%. High frequency of illicit drug use in the prior 12 months was also reported (75%).

As for the cascade indicators (Figure 1), 89.2% (95% confidence interval [95%CI] 55–100%) had been previously tested for HIV, 77.5% (95% CI 48.7–100%) had been previously diagnosed with HIV and 67.2% (95% CI 39.2–95.2) reported linkage to care. In addition, 62.2% (95% CI 35.4–88.9) were currently on ART and 35.4% (95% CI 9.5–61.4%) had an undetectable viral load.

Among those aware of their HIV infection (N = 101), 80.0% (95% CI 55–100%) were on ART. 45.0% (95% CI 20–70%) had an undetectable viral load and the median CD4 was 695 cells/mm3 (IQR: 467–946 cells/mm3). Among those aware of their HIV infection but who were not on ART (N = 22), the median CD4 was 398 cells/mm3; nine (41%) were not linked to care. Median RDS-weighted duration of ART use was 2.1 years (interquartile range 0.6–8.7 years) with 41 (52%) reporting use of non-nucleoside reverse transcriptase inhibitor-based regimens (most frequent was tenofovir, lamivudine and efavirenz) and 26 (33%) reporting...
use of protease inhibitor-based regimens (most frequent was tenofovir, lamivudine and boosted atazanavir).

The final adjusted RDS-weighted logistic regression model for viral suppression indicated that race/skin colour, income, housing instability and linkage to care were associated with viral suppression. Participants who self-identified as black (adjusted odds ratio [aOR] 0.06, 95% CI 0.01–0.35; \( p < 0.01 \)) compared to white, reported earning ≤$160/month (aOR 0.11, 95% CI 0.16–0.87; \( p = 0.04 \)) compared to >$160/month, or reported unstable housing (aOR 0.08, 95% CI 0.01–0.43, \( p < 0.01 \)) had significantly lower odds of viral suppression. In contrast, transwomen reporting linkage to care (i.e., defined as ever attending an HIV medical appointment) had a borderline significant higher odds of viral suppression (aOR 3.56, 95% CI 0.74–17.2, \( p = 0.11 \)).

### Discussion

This analysis points to suboptimal HIV care linkage, ART use and viral suppression among transwomen living with HIV in Brazil. Our findings show that just over a third of transwomen living with HIV were virally suppressed. When comparing our results to the Brazilian national estimates of the HIV care continuum, ART coverage was quite similar to all Brazilians living with HIV (62.2% among transwomen vs. 52% among Brazilians overall) [12], but viral suppression among transwomen was lower (35.4% for transwomen vs. 46% for Brazilians overall). Lower viral suppression among transwomen compared to other gender groups or risk categories was also reported in a RDS study of transwomen in San Francisco [13], but contrasts with findings from a retrospective cohort study that showed similar treatment outcomes between transgender and non-transgender persons living with HIV [14]. However, the latter study recruited a convenience sample of participants from 13 HIV clinics that were part of an HIV research network and likely had strong retention and adherence strategies in place.

Our findings highlight the relationship between social determinants and health and are consistent with the literature. We found that black racial identity, low income and unstable housing were associated with significantly lower odds of viral suppression. In the study overall (i.e., Transcender) and a recent study of MSM in Rio de Janeiro, newly diagnosed HIV infection was associated with non-white race [8,15]. And research from San Francisco has shown that housing instability [13] and low income [16] is associated with poor viral suppression. Socio-economic inequalities, including housing instability, will need to be addressed to improve HIV care linkage, ART use and adherence and rates of viral suppression among transwomen living with HIV in Brazil.

We also found that linkage to care was significantly associated with increased odds of viral suppression. However, few (12%) transwomen in our study had access to trans-specific healthcare, and it is known that transwomen have significant challenges to accessing primary and HIV medical care, even where it is available [13,17,18]. Additionally, studies of transwomen living with HIV in the USA and Canada identified fear of disclosure of transgender identity, poor treatment by staff, and providers’ lack of awareness of transgender issues, as important barriers to engagement in care [13,19]. Lack of access or adherence can result in late presentation (or no presentation) to HIV medical care [21], and overall poor health outcomes among transwomen living with HIV. Our findings point to barriers to healthcare access among transwomen. Gender affirming care includes the

### Table 1. Socio-demographic, behavioural and clinical characteristics of transwomen living with HIV, Rio de Janeiro, Brazil

| Variable                                      | RDS weighted, % (95% CI) |
|-----------------------------------------------|--------------------------|
| **Age (years)**                               |                          |
| 18–24                                         | 10.1 (0.0–26.7)          |
| 25–35                                         | 50.8 (27.6–74.0)         |
| 36–45                                         | 22.1 (9.7–34.6)          |
| >45                                           | 17.0 (0.0–42.2)          |
| **Self-declared race/skin colour**            |                          |
| White                                         | 19.5 (4.7–34.2)          |
| Mixed/other                                   | 39.3 (16.5–62.1)         |
| Black                                         | 41.2 (13.8–68.6)         |
| **Monthly income (in RS)**                    |                          |
| ≤500 (160 USD)                                | 54.9 (30.0–79.6)         |
| 501–1000 (160–320 USD)                        | 33.6 (7.6–59.7)          |
| >1000 (320 USD)                               | 11.5 (0.0–24.6)          |
| **Years of formal education**                 |                          |
| <4                                            | 11.6 (0.0–25.8)          |
| 4–8                                           | 27.8 (12.7–42.9)         |
| 9–12                                          | 59.0 (52.7–65.3)         |
| >12                                           | 1.6 (0.0–20.1)           |
| **Gender identity**                           |                          |
| Travesti                                      | 36.8 (21.3–52.4)         |
| Woman                                         | 24.3 (8.2–40.4)          |
| Transgender woman                             | 37.2 (15.3–59.2)         |
| Other definitions                             | 1.6 (0.0–14.1)           |
| **Lack of access to healthcare due to self-identification as trans** | 21.8 (12.1–31.5)        |
| **Access to trans-specific healthcare**        |                          |
| Ever had transgender surgeries                | 1.7 (0.0–7.3)            |
| **Housing instability**                       |                          |
| 56.4 (30.8–81.9)                              |                          |
| **Sex work (ever)**                           |                          |
| 85.8 (69.4–100)                               |                          |
| **Sex work (current)**                        |                          |
| 68.7 (39.5–98.0)                              |                          |
| **Illicit drug use in the prior 12 mos**       |                          |
| 75.0 (56.3–93.8)                              |                          |
| **Binge drinking**                            |                          |
| 69.9 (53.2–86.6)                              |                          |
| **CD4+ cell count (cells/mm³)**               |                          |
| ≥200                                          | 8.4 (0.0–29.4)           |
| 201–350                                       | 4.3 (0.0–15.6)           |
| 351–500                                       | 13.7 (0.0–29.0)          |
| >500                                          | 73.3 (55.9–90.7)         |

RDS: respondent-driven sampling; CI: confidence interval
correct use of pronouns and provision of hormone therapy, among others, and may be offered even in settings without referral centres specialized in transgender healthcare. Such services have been shown to reduce mental health risks [22,23] and improve quality of life for transgender people [24]. In the absence of the ability of the public health system to end systemic discrimination towards transwomen, offering hormones and providing an environment where transwomen’s gender identity is respected may be one way to improve linkage to care and increase HIV viral suppression among transwomen. Interventions to better provide medical care for transwomen may affect HIV disease progression within the population, which also have implications for onward HIV transmission [25] and research to best capture the HIV care continuum among transwomen.

Our study is not without limitations. This is a cross-sectional study, which limits temporal analysis and determination of the directionality of association. RDS-weighted estimates provide population-based data; yet, there is an ongoing debate as to which estimators are the most accurate for use, and should therefore be reviewed with caution. While our findings may not generalize to all transwomen in Brazil, they suggest that transwomen have similar rates of ART coverage as non-transgender men when engaged in care. A major strength of this study is that estimates of the HIV care continuum were biologically confirmed and show low viral suppression among transwomen, pointing to next steps in HIV care interventions.

Conclusions
HIV risk remains very high among transwomen, emphasizing the urgent need for prevention interventions such as pre-exposure prophylaxis and others. Our results emphasize structural vulnerabilities as key factors impeding viral suppression. Better healthcare access is needed in Brazil to address the persistent and growing HIV epidemic among transwomen. Our findings also point to the inequalities in viral suppression for transwomen compared to other key populations, which serve to continue to fuel the HIV epidemic in Brazil. Interventions to improve linkage and engagement to HIV treatment and care for transwomen will help transwomen achieve viral suppression and address inequalities resulting in disparities along the HIV care cascade.

Authors’ affiliations
1 Evandro Chagas National Institute of Infectious Diseases, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil; 2 Bridge HIV, San Francisco Department of Public Health, San Francisco, CA, USA; 3 Departamento de Matemática e Estatística, Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro, Brazil; 4 Departments of Medicine, Epidemiology and Biostatistics, University of California, San Francisco, San Francisco, CA, USA

Competing interests
All authors declare no competing interests.

Authors’ contributions
BG, EMJ, WM, ECW, SB, and VGV conceived the study and interpreted the findings. BG, EMJ, ECW, and VGV drafted the manuscript. LV did the statistical analyses with aid from RIM, EMJ, and PML. LM, LV, RIM, ACFG, CVC, LEC, SWC and PML helped with data acquisition, interpretation of the findings, and drafting the manuscript. WM, AYL, and SB were involved in revising the manuscript for important intellectual content.

Acknowledgements
We acknowledge all of the Transcender team and participants.

Funding
This study was funded by the Brazilian Research Council (National Council for Scientific and Technological Development [470056/2014-2]) and National Institute of Allergy and Infectious Diseases (National Institutes of Health [UM1AI069496]). BG and PML have received funding from the Brazilian Research Council (National Council for Scientific and Technological Development) and Carlos Chagas Filho Research Support Foundation of the state of Rio de Janeiro.

ORCID
Beatriz Grinsztejn http://orcid.org/0000-0003-3692-5155

Figure 1. The HIV care continuum among HIV-positive transgender women in Rio de Janeiro, Brazil (N = 141). Crude percentages in dark grey, respondent-driven sampling weighted population estimates in light grey, error bars represent 95% confidence intervals for population estimates.

* N = 138 for denominator with undetectable viral load due to missing data.
References

1. Baral SD, Poteat T, Strüngmann S, Wirtz AL, Guadamuz TE, Beyrer C. Worldwide burden of HIV in transgender women: a systematic review and meta-analysis. Lancet Infect Dis. 2013;13:214–22. doi:10.1016/S1473-3099(12)70315-8

2. Nemoto T, Luke D, Mamo L, Ching A, Patria J. HIV risk behaviours among male-to-female transgenders in comparison with homosexual or bisexual males and heterosexual females. AIDS Care. 1999;11:297–312. doi:10.1080/0954012947938

3. SFDPH. HIV epidemiology annual report [Internet]. San Francisco, CA, 2014. Available from: https://www.sfdph.org/dph/files/reports/RptsHIV/AIDS/HIV-EpidemiologyAnnualReport-2014.pdf

4. Deeks SG, Lewin SR, Havlir DV. The end of AIDS: HIV infection as a chronic disease. The Lancet. 2013;382:1525–33. doi:10.1016/S0140-6736(13)61809-7

5. Gardner EM, McLees MP, Steiner JF, Del Rio C, Burman WJ. The spectrum of engagement in HIV care and its relevance to test-and-treat strategies for prevention of HIV infection. Clin Infect Dis Off Publ Infect Dis Soc Am. 2011;52:793–800. doi:10.1093/cid/ciq243

6. Chow JY, Konda KA, Borquez A, Caballero P, Silva-Santisteban A, Klausner JD, et al. Peru’s HIV care continuum among men who have sex with men and transgender women: opportunities to optimize treatment and prevention. Int J STD AIDS. 2016;27:1039–48. doi:10.1177/0956462416645727

7. Wiewel EW, Torion LV, Merchant P, Brauntstein SL, Shepard CW. HIV diagnoses and care among transgender persons and comparison with men who have sex with men: New York City, 2006-2011. Am J Public Health. 2016;106:497–502. doi:10.2105/AJPH.2015.302974

8. Grinsztejn B, Jalil EM, Monteiro L, Velasque L, Garcia ACF, et al. Unveiling HIV dynamics among transgender women: a respondent-driven sampling study in Rio de Janeiro, Brazil. Lancet HIV. 2017;4(4):e169–e176. doi:10.1016/S2352-3018(17)30015-2

9. Wejnert C, Heckathorn DD. Web-based network sampling: efficiency and efficacy of respondent-driven sampling for online research. Sociol Methods Res. 2008. Available from: http://smr.sagepub.com/content/early/2008/06/10/0049124108318333.short

10. Ministério da Saúde. Secretaria de Vigilância em Saúde, Departamento de DST, aids e hepatites virais. Brasil: Manual técnico para o diagnóstico da infecção pelo HIV [Internet]; 2013. Available from: http://bvmsb.saude.gov.br/bvs/publicacoes/manual_tecnico_diagnostico_infeccao_hiv.pdf

11. Hancock MS, Fellows IE, Gile KJ. RDS analyst: software for the analysis of respondent-driven sampling data, version 0.42 [Internet]. 2014. Available from: http://hpmerg.org

12. Ministério da Saúde. Boletim Epidemiológico HIV-Aids - 2015 | departamento de IST, aids e hepatites virais [Internet]. 2015. [cited 2017 Jan 16]. Available from: http://www.aids.gov.br/publicacao/2015/boletim-epidemiologico-do-aids-e-dst-2015

13. Santos G-M, Wilson EC, Rupes J, Macias O, Packer T, Raymond HF. HIV treatment cascade among transgender women in a San Francisco respondent-driven sampling study. Sex Transm Infect. 2014;90:430–33. doi:10.1111/sextrans.2013.051342

14. Yehia BR, Fleshman JA, Moore RD, Gebo KA. Retention in care and health outcomes of transgender persons living with HIV. Clin Infect Dis. 2013;57:774–76. doi:10.1093/cid/cit363

15. Castro R, Ribeiro-Alves M, Corrêa RG, Derrico M, Lemos K, Grangeiro JR, et al. The men who have sex with men HIV care cascade in Rio de Janeiro, Brazil. Paraskevis D, editor. Plos One. 2016;11:e0157309. doi:10.1371/journal.pone.0157309

16. Das M, Chu PL, Santos G-M, Scheer S, Vittinghoff E, McFarland W, et al. Decreases in community viral load are accompanied by reductions in new HIV infections in San Francisco. Carr Jr, editor. PLoS ONE. 2010;5:e11068. doi:10.1371/journal.pone.0011068

17. Melender RM, Pinto RM. HIV prevention and primary care for transgender women in a community-based clinic. J Assoc Nurses Aids Care JANAC. 2009;20:387–97. doi:10.1016/j.jana.2009.06.002

18. Wilson EC, Arayasingilk S, Johnson K. Access to HIV care and support services for African American transwomen living with HIV. Int J Transgenderism. 2013;14:182–95. doi:10.1080/15532739.2014.890090

19. Logie CH, James L, Tharao W, Losty MF. “We don’t exist”: a qualitative study of marginalization experienced by HIV-positive lesbian, bisexual, queer and transgender women in Toronto, Canada. J Int AIDS Soc. 2012;15:doi:10.7448/IAS.15.2.17392

20. Houston Area Ryan White Planning Council. Access to HIV care among transgender and gender non-conforming people in Houston. A Special Study of the Houston Area Ryan White Planning Council [cited 2013 Feb 12]. [Internet]. 2016. Available from: http://www.rwpchouston.org

21. Stone VE. Optimizing the care of minority patients with HIV/AIDS. Clin Infect Dis. 2004;38:400–04. doi:10.1086/380969

22. Wilson EC, Chen Y-H, Arayasingilk S, Wenzel C, Raymond HF. Connecting the dots: examining transgender women’s utilization of transition-related medical care and associations with mental health, substance use, and HIV. J Urban Health. 2015;92:182–92. doi:10.1177/1191590314552401

23. Colton Meier SL, Fitzgerald KM, Pardo ST, Babcock J. The effects of hormonal gender affirmation treatment on mental health in female-to-male transsexuals. J Gay Lesbian Ment Health. 2011;15:92–100. doi:10.1080/19359705.2011.581195

24. Murad MH, Elamin MB, Garcia MZ, Mullan RJ, Murad A, Erwin PJ, et al. Hormonal therapy and sex reassignment: a systematic review and meta-analysis of quality of life and psychosocial outcomes. Clin Endocrinol (Oxf). 2010;72:214–31. doi:10.1111/j.1365-2265.2009.03625.x

25. Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, et al. Prevention of HIV-1 infection with early antiretroviral therapy. N Engl J Med. 2011;365:493–505. doi:10.1056/NEJMoa1105243