Integrase Inhibitor Prescribing Disparities in the DC and Johns Hopkins HIV Cohorts

Anne K. Monroe¹, Matthew E. Levy¹,², Alan E. Greenberg¹, Jeanne C. Keruly³, Richard D. Moore³, Michael A. Horberg⁴, Paige Kulie¹, Bernadine S. Mohanraj⁵, Princy N. Kumar⁵, Amanda D. Castel AD¹ on behalf of the DC Cohort Executive Committee

¹ The George Washington University, Washington, DC, USA; ² Westat, Rockville, MD; ³ The Johns Hopkins University School of Medicine, Baltimore, MD, USA; ⁴ Kaiser Permanente Mid-Atlantic States, Rockville, MD, USA; ⁵ Georgetown University School of Medicine, Washington, DC, USA

Corresponding Author:

Anne K. Monroe, MD, MSPH
Associate Professor, Department of Epidemiology
Milken Institute School of Public Health, George Washington University
950 New Hampshire Avenue, NW
Washington, DC 20052, USA
202-994-0251 (tel); 202-994-0082 (fax)
amonroe@gwu.edu

Alternate Corresponding Author:

Amanda D. Castel, MD, MPH
Professor, Department of Epidemiology
Milken Institute School of Public Health, George Washington University
950 New Hampshire Avenue, NW
Washington, DC 20052, USA
202-994-0082 (tel); 202-994-0082 (fax)
acastel@gwu.edu

© The Author(s) 2021. Published by Oxford University Press on behalf of Infectious Diseases Society of America.
This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs licence (https://creativecommons.org/licenses/by-nc-nd/4.0/), which permits non-commercial reproduction and distribution of the work, in any medium, provided the original work is not altered or transformed in any way, and that the work is properly cited. For commercial re-use, please contact journals.permissions@oup.com
Abstract

Integrase inhibitors (INSTIs) are recommended by expert panels as initial therapy for people with HIV. Because there can be disparities in prescribing and uptake of novel and/or recommended therapies, this analysis assessed potential INSTI prescribing disparities using a combined dataset from the Johns Hopkins HIV Clinical Cohort and the DC Cohort. We performed multivariable logistic regression to identify factors associated with ever being prescribed an INSTI. Disparities were noted, including clinic location, age, and being transgender. Identifying disparities may allow clinicians to focus their attention on these individuals and ensure that therapy decisions are grounded in valid clinical reasons.

Keywords: disparities; integrase strand transfer inhibitors (INSTIs); transgender; HIV; cohort
Background

U.S. Department of Health and Human Services (DHHS) guidelines for first-line antiretroviral therapy (ART) are regularly updated. Currently, the guidelines only recommend integrase strand transfer inhibitors (INSTIs) for initial ART for most patients [1]. INSTIs are efficacious in ART-naïve [2][3][4] and ART-experienced patients [3][5], generally well-tolerated, with a high barrier to resistance [6]. Greater regimen persistence with INSTI-based compared with non-INSTI-based regimens has been demonstrated [7]. However, there have been concerns regarding adverse metabolic effects, including weight gain, [8,9] and neural tube defects with in utero INSTI exposure [10].

Many factors potentially influence INSTI prescribing: patient or provider preference, insurance and copays, comorbidities, childbearing potential and/or pregnancy, tolerability and ART resistance [11]. It is unknown what effect, if any, the DHHS guidelines for INSTI use in treatment-naïve patients have had on INSTI prescription in treatment-experienced patients. It is possible that providers might extrapolate the recommendation that ART-naïve patients use an INSTI for ART-experienced patients, including recommending a change to INSTI for patients who are tolerating a non-INSTI regimen and are virally suppressed. Whether that change would be recommended and/or accepted uniformly across all demographic groups is unknown. Prescribing disparities have been observed for other medical conditions [12,13]. If disparities exist, they may be detrimental in terms of overall HIV outcomes because INSTIs are favored due to their potency and tolerability. Our objective was to describe INSTI prescribing prevalence and examine disparities in INSTI prescribing in two different locations in the Mid-Atlantic States area.

Methods

This secondary data analysis used DC Cohort and Johns Hopkins HIV Clinical Cohort (JHHCC) data. Since 2011, the DC Cohort has enrolled participants receiving care at 15 HIV clinics in Washington, DC. Participants’ socio-demographic, HIV/AIDS-related, encounter, diagnosis, treatment (antiretroviral therapy and others), and laboratory test information are collected from electronic health records (EHRs) supplemented with manual abstraction [14,15]. The JHHCC is an observational cohort of individuals receiving HIV care at the John G. Bartlett Specialty Practice at Johns Hopkins Medicine (Baltimore, Maryland) which started in 1989. Laboratory, diagnostic, clinical, pharmaceutical, behavioral, and social data is collected at enrollment. Subsequent information is collected over time through medical records, the Johns Hopkins Health System databases, medical records from other facilities, vital records, and automated computer-assisted self-interviews [16].

Patient Consent Statement

The DC Cohort is approved by the Institutional Review Board at The George Washington University and all participants sign written informed consent. The Johns Hopkins HIV Clinical Cohort is approved by the Institutional Review Board at The Johns Hopkins University and all participants sign written informed consent.

Inclusion Criteria

Included participants were >18 years old, had at least 1 encounter between 4/1/17-3/31/19 and had been prescribed ART prior to their last encounter.

Outcome of interest

All variables for this analysis were defined using an index visit of each participants’ last encounter between 4/1/17-3/31/19. Prescription data from the EHRs were used to determine INSTI prescription status: current, previous, or never prescribed an INSTI. “Ever prescribed an INSTI” was comprised of participants with current and prior INSTI prescription. Additional characteristics the current regimen were determined, i.e., whether the patient was additionally prescribed a PI or NNRTI. Nucleoside reverse transcriptase inhibitors (NRTIs) serving as backbone agents were not examined in this analysis.
Additional covariates
Variable determination differed slightly between DC Cohort and JHHCC (Supplemental Table 1). Demographic covariates included age, gender and sexual risk behavior, race/ethnicity, insurance status, and time since first HIV care visit at the clinic. HIV-related covariates included presence/absence of drug resistance mutations (IAS 2019 update [17]), and CD4 (last recorded and nadir) and last recorded HIV RNA values. Additional clinical covariates included history of intravenous drug use, current alcohol or tobacco use, and presence of chronic Hepatitis B, chronic Hepatitis C and metabolic comorbidities (chronic kidney disease (CKD), diabetes mellitus (DM)).

Statistical analysis
We compared the demographic and clinical characteristics of individuals by INSTI prescription status using descriptive statistics, including frequencies and percentages for categorical variables and medians and interquartile ranges for continuous variables.

Adjusted multivariable logistic regression (See Table 2) was used to evaluate associations of demographic and clinical factors with the outcome (P-values <0.05 considered statistically significant). Analyses were conducted using SAS Version 9.4 (Cary, NC).

Results
Of the 9,558 participants, 6,839 (71.5%) were currently prescribed an INSTI and 754 (7.9%) were previously prescribed an INSTI, for a total of 79.4% ever prescribed an INSTI. A sizeable minority of 1,965 (20.6%) were never prescribed an INSTI. Of those currently prescribed an INSTI, 47.9% were prescribed dolutegravir, 27.7% prescribed elvitegravir, 16.8% prescribed bictegravir, and 7.5% prescribed raltegravir.

The highest proportion of current INSTI prescriptions (81.1%) was in the youngest age group (ages 18-24 years), while the lowest (68.2%) was in the 40–49-year-old age group (p<0.0001 across age groups) (Table 1). Transgender females had the lowest proportion of current prescriptions when comparing by gender (57.6%, p=0.0017). There were no differences by race. Supplemental Table 2 displays JHHCC/DC Cohort differences. Overall, 87.5% of Johns Hopkins participants had ever been prescribed INSTIs compared with 76.9% of DC Cohort participants. Five DC Cohort sites were comparable to Hopkins with the proportion prescribed an INSTI ranging from 83.5-89.7% whereas ten ranged from 66.7%-79.8%.

Demographic factors associated with having ever been prescribed an INSTI included receiving care at Hopkins (aOR 1.97 compared with DC, 95% CI 1.69, 2.29) and being younger (aOR 2.15 for 18-24-year-olds compared to those aged ≥50 years, 95% CI 1.42, 3.26) (Table 2). Transgender females were less likely to have been prescribed an INSTI (aOR 0.62, 95% CI 0.43, 0.89). No differences by race or insurance type were observed. Those with longer HIV care duration were less likely to have been prescribed an INSTI (aOR 0.98 per each 5-year increase, 95% CI 0.97, 0.99). Alcohol abuse was associated with having ever been prescribed an INSTI (aOR 1.29, 95% CI 1.12, 1.47), as was the presence of NRTI (aOR 1.85, 95% CI 1.50, 2.27) and NNRTI (1.50, 95% CI 1.25, 1.82) drug resistance mutations.
Discussion

In this study of individuals on antiretroviral therapy in the Washington DC/Baltimore metropolitan area, most participants had been prescribed INSTIs, with close to three-quarters of all participants currently being prescribed an INSTI. However, disparities were noted, including location, age, and being transgender. This study uniquely adds to the HIV medical literature by examining INSTI prescription prevalence in a contemporary cohort and demonstrating disparities in the use of INSTI.

Our results are consistent with prior studies that INSTI prescription is common among individuals initiating therapy [18][19] and changing therapy [20]. Prior work in the Medical Monitoring Project showed that prescription of INSTI increased from 43.4% to 50.7% from 2015-2016 to 2016-2017 [19]; we found 71.6% in 2019.

In our sample, younger individuals were more likely to have been prescribed an INSTI. Younger individuals with newer HIV diagnoses may have started therapy after the DHHS guidelines recommending INSTIs as first line therapy were released, making them more likely to have started and persisted on INSTI therapy. We found that individuals who had NRTI and NNRTI drug resistance mutations were more likely to have been prescribed an INSTI. This may represent prior virologic failure necessitating a switch to INSTI. Individuals who were never prescribed an INSTI may be more likely to have more stability in their HIV regimen history overall, possibly having not experienced virologic failure and/or having had a longer duration of HIV.

We also found that being a transgender female was associated with not being prescribed an INSTI. Although INSTIs are considered least likely to interfere with gender affirming hormone therapy [1], transgender women may be hesitant to use newer ART agents and/or prescribers may be more hesitant to prescribe because of concerns about ART-hormone interactions [21]. Transgender women experience discrimination within the healthcare system and are less likely to be retained in care and achieve viral suppression, and our findings may reflect less engagement by providers of transgender women [22,23].

We noted geographic disparities in INSTI prescribing, with more individuals at Hopkins having ever been prescribed an INSTI. This raises the question of how geographic areas influence prescribing patterns. Prior work has not focused specifically on regional patterns of ART prescribing by ART class. However, other ART-related outcomes, like time to ART initiation, have been shown to vary along regional lines [24]. It is unclear what is driving the difference in prescribing between DC and at Hopkins. The DC Cohort practices represent a mix of hospital- and community-based clinics. Within DC, there were no unifying characteristics of the lower-prescribing clinics, such as size or hospital- vs community-based practice.

The strengths of our study are that we had a large sample size covering a large metropolitan area. We were able to use our dataset to identify differences between PWH prescribed and not prescribed INSTIs, illuminating disparities in INSTI prescribing. Our main limitation is that we have no detailed information about reasons for stopping/switching therapy available.

In summary, we found differences by clinic location, age and gender in INSTI usage. Further research, including both qualitative research and quantitative research incorporating individuals receiving HIV care in additional geographic areas, may provide additional insights.
Acknowledgments

Financial support. The DC Cohort is funded by the National Institutes of Health grants UM1 AI069503 and 1R24AI152598-01. The Johns Hopkins HIV Clinical Cohort is funded by National Institutes of Health Grant U01DA036935

Potential Conflicts of Interest
None of the authors have relevant conflicts of interest to disclose

Acknowledgments/Collaborators

Data in this manuscript were collected by the DC Cohort Study Group with investigators and research staff located at: Children's National Medical Center Adolescent (Lawrence D'Angelo) and Pediatric (Natella Rakhmanina) clinics; The Senior Deputy Director of the DC Department of Health HAHSTA (Michael Kharfen); Family and Medical Counseling Service (Michael Serlin); Georgetown University (Princy Kumar); The George Washington University Biostatistics Center (Aria Bamdad, Tsedenia Bezabeh, Susan Reamer, Alla Sapozhnikova, Marinella Temprosa, Naji Younes, Jinxi Liu and Kevin Xiao); The George Washington University Department of Epidemiology (Morgan Byrne, Amanda Castel, Alan Greenberg, Maria Jaurretche, Matthew Levy, Anne Monroe, James Peterson, Lindsey Powers Happ, Brittany Wilbourn) and Department of Biostatistics and Bioinformatics (Yan Ma); The George Washington University Medical Faculty Associates (Hana Akselrod); Howard University Adult Infectious Disease Clinic (Ronald Wilcox) and Pediatric Clinic (Sohail Rana); Kaiser Permanente Mid-Atlantic States (Michael Horberg); La Clinica Del Pueblo (Ricardo Fernandez); MetroHealth (Annick Hebou); National Institutes of Health (Carl Dieffenbach, Henry Masur); Washington Health Institute, formerly Providence Hospital (Jose Bordon); Unity Health Care (Gebeyehu Teferi); Veterans Affairs Medical Center (Debra Benator); Washington Hospital Center (Maria Elena Ruiz); and Whitman-Walker Health (Stephen Abbott).
Table 1. Demographic and clinical characteristics of participants with current, previous, and never INSTI use, DC Cohort and Johns Hopkins HIV Clinical Cohort, 2017-2019.

|                                | Currently on INSTI | Previously on INSTI | Never on INSTI | p     |
|--------------------------------|--------------------|---------------------|----------------|-------|
| Overall (n=9,558)              | 6,839 (71.5)       | 754 (7.9)           | 1,965 (20.6)   | ---   |
| Clinic Location                |                    |                     |                | <0.0001|
| Baltimore - Hopkins (n=2,302)  | 1,796 (78.0)       | 219 (9.5)           | 287 (12.5)     |       |
| DC (n=7,256)                   | 5,043 (69.5)       | 535 (7.4)           | 1,678 (23.1)   |       |
| Age (years)                    |                    |                     |                | <0.0001|
| 18-24 (n=206)                  | 167 (81.1)         | 11 (5.3)            | 28 (13.6)      |       |
| 25-39 (n=1,713)                | 1,222 (71.3)       | 115 (6.7)           | 376 (21.9)     |       |
| 40-49 (n=1,860)                | 1,269 (68.2)       | 151 (8.1)           | 440 (23.7)     |       |
| 50+ (n=5,779)                  | 4,181 (72.3)       | 477 (8.3)           | 1,121 (19.4)   |       |
| Gender and sexual risk behavior*|                    |                     |                | 0.0017 |
| Cisgender male – MSM (n=3,376) | 2,390 (70.8)       | 269 (8.0)           | 717 (21.2)     |       |
| Cisgender male – heterosexual  | 2,297 (72.6)       | 229 (7.2)           | 639 (20.2)     |       |
| (n=3,165)                      |                    |                     |                |       |
| Cisgender female (n=2,856)     | 2,059 (72.1)       | 239 (8.4)           | 558 (19.5)     |       |
| Transgender female (n=151)     | 87 (57.6)          | 16 (10.6)           | 48 (31.8)      |       |
| Transgender male (n=10)        | 6 (60)             | 1 (10)              | 3 (30)         |       |
| Race/ethnicity                 |                    |                     |                | 0.29  |
| Non-Hispanic Black (n=7,386)   | 5,294 (71.7)       | 589 (8.0)           | 1,503 (20.3)   |       |
| Non-Hispanic white (n=1,332)   | 952 (71.5)         | 104 (7.8)           | 276 (20.7)     |       |
| Hispanic (n=514)               | 377 (73.3)         | 36 (7.0)            | 101 (19.7)     |       |
| Other/unknown (n=326)          | 216 (66.2)         | 25 (7.7)            | 85 (26.1)      |       |
| Insurance status*              |                    |                     |                | <0.0001|
| Public (n=5,956)               | 4,374 (73.4)       | 428 (7.2)           | 1,154 (19.4)   |       |
| Private (n=3,175)              | 2,151 (67.7)       | 301 (9.5)           | 723 (22.8)     |       |
| No insurance (n=147)           | 111 (75.5)         | 2 (1.4)             | 34 (23.1)      |       |
| Insurance type unknown (n=280) | 203 (72.5)         | 23 (8.2)            | 54 (19.3)      |       |
| Last recorded HIV viral load   |                    |                     |                | 0.030 |
| (copies/mL)                    |                    |                     |                |       |
| <200                           | 5,383 (78.7)       | 565 (74.9)          | 1,537 (78.2)   |       |
| 200+                           | 606 (8.9)          | 92 (12.2)           | 170 (8.7)      |       |
| Unknown                        | 850 (12.4)         | 97 (12.9)           | 258 (13.1)     |       |
| Current Alcohol abuse          |                    |                     |                | 0.017 |
| Currently on INSTI (n=6,839)   | 1,614 (23.6)       | 156 (20.7)          | 412 (21.0)     |       |
| Previously on INSTI (n=754)    | 1,582 (20.9)       | 152 (20.1)          | 412 (21.0)     |       |
| Never on INSTI (n=1,965)       | 1,478 (23.9)       | 139 (20.4)          | 412 (21.0)     |       |
|                                     | Number | Percentage | Number | Percentage | Number | Percentage | p-value |
|-------------------------------------|--------|------------|--------|------------|--------|------------|---------|
| Current Smoking                     | 2,658  | 38.9       | 263    | 34.9       | 738    | 37.6       | 0.078   |
| History of injection drug use       | 970    | 14.2       | 119    | 15.8       | 207    | 10.5       | <0.0001 |
| Years since first HIV care visit at clinic, median (IQR)** | 9.4 (5.3-14.3) | 9.6 (5.6-15.4) | 9.4 (6.3-13.3) | 0.19 |
| HIV Drug Resistance Mutations*      |        |            |        |            |        |            |         |
| Major NRTI mutation present         | 1,303  | 19.1       | 156    | 20.7       | 165    | 8.4        | <0.0001 |
| Major NNRTI mutation present        | 1,258  | 18.4       | 124    | 16.4       | 183    | 9.3        | <0.0001 |
| Major PI mutation present           | 569    | 8.3        | 53     | 7.0        | 80     | 4.1        | <0.0001 |
| Major INSTI mutation present        | 101    | 1.5        | 28     | 3.7        | 22     | 1.1        | <0.0001 |

* See Supplemental Table 1 for definition

** There were 183 missing values for years since first HIV care visit.
### Table 2. Adjusted* analysis of Demographic and clinical characteristics associated with Ever having been prescribed an INSTI vs Never having been prescribed an INSTI (n=9,558) †.

| Clinic Location          | Adjusted OR (95% CI)                  |
|--------------------------|--------------------------------------|
| Baltimore – Hopkins      | Ref                                  |
| DC                       | 1.97 (1.69, 2.29)*                   |
| **Age (years)**          |                                      |
| 18-24                    | 2.15 (1.42, 3.26)*                   |
| 25-39                    | 1.05 (0.90, 1.22)                    |
| 40-49                    | 0.92 (0.80, 1.06)                    |
| 50+                      | Ref                                  |
| **Gender and sexual risk behavior** |                                      |
| Cisgender male – MSM     | Ref                                  |
| Cisgender male – heterosexual | 0.94 (0.82, 1.07)                |
| Cisgender female         | 1.02 (0.89, 1.18)                    |
| Transgender female       | 0.62 (0.43, 0.89)*                   |
| Transgender male         | 0.63 (0.16, 2.51)                    |
| **Race/ethnicity**       |                                      |
| Non-Hispanic white       | Ref                                  |
| Hispanic                 | 1.22 (0.93, 1.60)                    |
| NH Black                 | 0.95 (0.81, 1.12)                    |
| Other                    | 0.74 (0.49, 1.10)                    |
| Unknown                  | 0.98 (0.67, 1.43)                    |
| **Insurance status**     |                                      |
| Public                   | Ref                                  |
| Private                  | 1.02 (0.90, 1.15)                    |
| Other                    | 0.88 (0.59, 1.31)                    |
| Unknown                  | 0.92 (0.67, 1.27)                    |
| **Current Alcohol abuse**| 1.29 (1.12, 1.47) *                  |
| **HIV Drug Resistance Mutations** |                                      |
| Major NRTI mutation present (vs absent) | 1.85 (1.50, 2.27)* |
| Major NNRTI mutation present (vs absent) | 1.50 (1.24, 1.82) * |
| Major PI mutation present (vs absent) | 1.25 (0.95, 1.63) |
| Major INSTI mutation present (vs absent) | 0.96 (0.60, 1.55) |
| **Years since first HIV care visit at clinic (per 5-year increase)**† | 0.98 (0.97, 0.99) * |

*p<0.05  
** See supplemental Table 1 for definition

† There were 183 participants in the DC Cohort who had missing values for years since first HIV care visit at the clinic and were excluded from the adjusted analysis.  
* Analysis adjusted for all factors shown in Table 2 plus the following defined in Supplental Table 1: chronic Hepatitis B, chronic Hepatitis C, diabetes, chronic kidney disease, the following: last recorded and nadir CD4 count, current smoking, history of IDU, and last recorded HIV RNA level.
1. DHHS Panel on Antiretroviral Guidelines for Adults and Adolescents – A Working Group of the Office of AIDS Research Advisory Council (OARAC). Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the Use of Antiretroviral Agents in Adults and Adolescents with HIV. 2018.

2. Mills AM, Brunet L, Fusco JS, et al. Virologic Outcomes Among ART-Naïve Individuals Initiating Dolutegravir, Elvitegravir, Raltegravir or Darunavir: An Observational Study. Infect Dis Ther 2020; 9:41–52. Available at: https://doi.org/10.1007/s40121-019-00274-5.

3. Brehm TT, Franz M, Hertling S, Schmiedel S, Degen O, Kreuels B. Safety and efficacy of elvitegravir, dolutegravir, and raltegravir in a real-world cohort of treatment-naïve and -experienced patients. 2019; 0:1–7.

4. Molina JM, Clotet B, van Lunzen J, et al. Once-daily dolutegravir versus darunavir plus ritonavir for treatment-naïve adults with HIV-1 infection (FLAMINGO): 96 week results from a randomised, open-label, phase 3b study. Lancet HIV 2015; 2:e127–e136. Available at: http://dx.doi.org/10.1016/S2352-3018(15)00027-2.

5. Davy-Mendez T, Napravnik S, Zakharova O, Wohl DA, Farel CE, Eron JJ. Effectiveness of integrase strand transfer inhibitors among treatment-experienced patients. AIDS 2019; 33:1187–1195.

6. Messiaen P, Wensing AMJJ, Fun A, Nijhuis M, Brusselaers N, Vandekerckhove L. Clinical use of HIV integrase inhibitors: a systematic review and meta-analysis. PLoS One 2013; 8:e52562–e52562. Available at: https://www.ncbi.nlm.nih.gov/pubmed/23341902.

7. Davy-Mendez T, Eron JJ, Zakharova O, Wohl DA, Napravnik S. Increased Persistence of Initial Treatment for HIV Infection with Modern Antiretroviral Therapy. J Acquir Immune Defic Syndr 2017; 76:111–115.

8. Norwood J, Turner M, Bofill C, et al. Brief Report: Weight Gain in Persons With HIV Switched From Efavirenz-Based to Integrase Strand Transfer Inhibitor-Based Regimens. J Acquir Immune Defic Syndr 2017; 76:527–531.

9. Horberg MA, Oakes AH, Hurley LB, et al. Association of raltegravir use with long-term health outcomes in HIV-infected patients: an observational post-licensure safety study in a large integrated healthcare system. HIV Clin Trials 2018; 19:177–187.

10. Zash R, Holmes L, Diseko M, et al. Neural-Tube Defects and Antiretroviral Treatment Regimens in Botswana. N Engl J Med 2019; 381:827–840. Available at: https://doi.org/10.1056/NEJMoa1905230.

11. Daumit GL, Crum RM, Guallar E, et al. Outpatient prescriptions for atypical antipsychotics for African Americans, Hispanics, and whites in the United States. Arch Gen Psychiatry 2003; 60:121–128.

12. Greenberg AE, Hays H, Castel AD, et al. Development of a large urban longitudinal HIV clinical cohort using a web-based platform to merge electronically and manually abstracted data from disparate medical record systems: Technical challenges and innovative solutions. J Am Med Informatics Assoc 2016; 23:635–643.

13. Lau B, Gange SJ, Moore RD. Interval and clinical cohort studies: Epidemiological issues. AIDS Res Hum Retroviruses 2007; 23:769–776.
17. Wensing, Annemarie M.; Calvez, Vincent; Ceccherini-Silberstein, Francesca; Charpentier, Charlotte; Gunthard, H.F.; Paredes, R.; Shafer, R. W.; Richman DD. 2019-Drug-Resistance-Mutations-Figures. Top Antivir Med 2019; 27.
18. Jacobson K, Ogbuagu O. Integrase inhibitor-based regimens result in more rapid virologic suppression rates among treatment-naïve human immunodeficiency virus-infected patients compared to non-nucleoside and protease inhibitor-based regimens in a real-world clinical setting: A. Medicine (Baltimore) 2018; 97:e13016.
19. Vu QM, Shouse RL, Brady K, Brooks JT, Weiser J. Changes in HIV antiretroviral prescribing practices in the United States. Int J STD AIDS 2020; 31:22–29.
20. Eaton EF, Tamhane A, Davy-Mendez T, et al. Trends in antiretroviral therapy prescription, durability and modification: new drugs, more changes, but less failure. AIDS 2018; 32:347–355. Available at: https://www.ncbi.nlm.nih.gov/pubmed/29194118.
21. Poteat TC, Radix A. HIV Antiretroviral Treatment and Pre-exposure Prophylaxis in Transgender Individuals. Drugs 2020; 80:965–972. Available at: https://doi.org/10.1007/s40265-020-01313-z.
22. Sevelius JM, Patouhas E, Keatley JG, Johnson MO. Barriers and facilitators to engagement and retention in care among transgender women living with human immunodeficiency virus. Ann Behav Med 2014; 47:5–16.
23. Klein PW, Psihopaidas D, Xavier J, Cohen SM. HIV-related outcome disparities between transgender women living with HIV and cisgender people living with HIV served by the Health Resources and Services Administration’s Ryan White HIV/AIDS Program: A retrospective study. PLoS Med 2020; 17:1–16. Available at: http://dx.doi.org/10.1371/journal.pmed.1003125.
24. Meditz AL, MaWhinney S, Allshouse A, et al. Sex, race, and geographic region influence clinical outcomes following primary HIV-1 infection. J Infect Dis 2011; 203:442–451.