Adherence to antiretroviral therapy and associated factors among HIV positive adults attending care and treatment in University of Gondar Referral Hospital, Northwest Ethiopia

Abiyot Abeje Molla¹, Abebaw Addis Gelagay², Habtamu Sewunet Mekonnen³* and Destaw Fetene Teshome⁴

Abstract

Background: Antiretroviral therapy has an impressive clinical effect on the human immunodeficiency virus although its effectiveness depends mainly on the adherence of patients to the therapy. Therefore, this study aimed to assess adherence status and associated factors of antiretroviral therapy among HIV infected adults on ART at the University of Gondar Referral Hospital, northwest Ethiopia.

Methods: An institutional based cross-sectional study was conducted from May to June 2015. The systematic random sampling technique was used to select 440 study participants. Data collected using an interviewer-administered questionnaire was entered using EPI Info version 7 and analyzed using SPSS version 20. Both bivariate and multivariate logistic regression analyses were done. In the multivariate analysis, variables with P-value ≤ 0.05 were considered statistically significant between independent variables and the outcome variable (medication adherence). Adjusted odds ratio (AOR) with a 95% confidence interval was used to determine the strength and direction of the association.

Results: A total of 440 participants were included in the study. The mean age of participants was 36.09 (SD ± 8.09) years. The overall rate of adherence to ART was 88.2% (95% CI = 85.2, 91.1). Urban residence (AOR = 6.99, 95% CI: 2.30, 21.27), no co-morbidity (AOR = 0.13, 95% CI: 0.05, 0.33), knowledge about HIV and ART (AOR = 7.54, 95% CI: 2.69, 21.15), and disclosed HIV status to partners (AOR = 3.65 (1.06, 12.61) and CD4 count of ≥ 500mm³ (AOR = 3.91, 95% CI: 1.19, 12.81) were significantly associated with adherence.

Conclusion: In this study, the rate of adherence to antiretroviral therapy was low compared to WHO standard. Prevention of co-morbidities, improving knowledge through health education, providing strong drug adherence counseling with more emphasis on the rural community, and encouraging HIV positive individuals to disclose their HIV status are crucial for ART adherence.

Keywords: HIV positive adults, Antiretroviral therapy, Adherence, Ethiopia

* Correspondence: habtsew@ymail.com

1Department of Medical Nursing, School of Nursing, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia

© The Author(s). 2018 Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.
Background
HIV/AIDS, with which 36.7 million people were living and 2.1 million newly infected at the end of 2016, has been one of the major health problems globally. From the beginning of the epidemic to 2016, 35 million people died from AIDS-related illnesses [1–3]. Although the burden of HIV continues to vary significantly across countries, Sub-Saharan Africa remains the most affected with almost 1 in every 25 adults (4.4%) living with it, accounting for nearly 70% of the global burden [2]. According to the 2014 estimate the national HIV prevalence in Ethiopia was 1.14%, and the number of people living with HIV is 769,600 with 15,700 new HIV infections and 35,600 AIDS-related deaths each year [4].

The Human Immunodeficiency Virus (HIV) infection does not only upset the health of individuals but also impacts on households, communities, and the development of nations. When countries are affected by HIV, they also suffer from other infectious diseases, food insecurity, and other serious problems [5]. Antiretroviral therapy has an impressive clinical effect in that it decreases the viral replication and viral load which in turn preserves the CD4 level, decreases the progress of AIDS, and reduces AIDS-related deaths [6].

However, the clinical outcomes of ART depend mainly on the adherence of patients to antiretroviral therapy. Studies show that adherence to antiretroviral therapy is essential to reduce the multiplication of the virus and improve disease outcomes [7, 8]. They further demonstrate that medication adherence is second to CD4 count for precisely anticipating progression to AIDS and death [9, 10]. All round efforts such as increasing accessibility of HIV screening, counseling, and ART services by private, government and non-government organizations have been made to reduce morbidity and maintain the quality of life of HIV-positive individuals [11]. Studies indicate that > 95% adherence to therapeutic schemes is required for an HIV infected patient to reach full viral suppression [12–15]. However, adherence to therapeutic regimens might be difficult for many reasons. For example, the side effects of HIV medicines could pose challenges on strict adherence. Besides, the medication dosing schedule might not fully the patient's daily activities [16, 17].

Poor adherence to highly active antiretroviral therapy (HAART) diminishes the effectiveness of ART and accelerates viral dissemination and drug resistance [18, 19]. This catastrophic event affects patients by reducing their quality of life and the community as well as the health system by increasing medical costs.

There has been a considerable progress of access to ART and HIV counseling and testing in Ethiopia [20]. There are however only a few studies on the adherence status of ART and its determinant factors in various parts of the country. The level of adherence is highly affected by the level of commitment of ART service providers in providing "drug adherence counselling services". Since this specialized hospital is providing services to more than 5 million people and over five thousand ART users in Amhara Region, knowing the level of ART adherence and its determinants is essential for making appropriate interventions.

Therefore, this study aimed to assess adherence status and associated factors of ART among HIV infected adult patients on ART at the University of Gondar Referral Hospital, northwest Ethiopia.

Methods
Study design and setting
An institution based cross-sectional study was conducted from May to June 2015 at the University of Gondar Referral Hospital Chronic HIV Care and Treatment Clinic. The hospital is found in Gondar town, 727 km from Addis Ababa, the capital of Ethiopia. This teaching hospital serves for more than five million people in the zone and nearby districts and started free ART service in 2006. Currently, it has four outpatient, one ART drug refill and pre ART follow up, one voluntary testing and counseling rooms, a pharmacy and a laboratory. More than 7500 adults and 700 pediatric patients were enrolled in the HIV care centre after the hospital started the care. More than 5100 of the adults were on ART at the movement. In Ethiopia, the first-line ART regimen is (TDF + 3TC + EFV), while AZT + 3TC + EFV, AZT + 3TC + NVP, and TDF + 3TC + NVP are used as an alternative. The second line regimen is TDF + 3TC + LPV/r or ATV/r and AZT + 3TC + LPV/r or ATV/r, whereas AZT + TDF + 3TC + (ATV/r or LPV/r) is given to patients with HBV co-infection.

Source/study participants
All HIV infected adults aged ≥18 years attending care and treatment the ART Clinic at the University of Gondar Referral Hospital were the study population. However, patients who had a hearing problem and known mental disorder were excluded.

Sample size determination and sampling procedure
The sample size was calculated using the single population proportion formula \( n = \left\lfloor \frac{Z^2 \cdot P \cdot (1-P)}{D^2} \right\rfloor \) with the assumption of a 95% level of confidence, 3.5% margin of error, 85% rate of adherence to ART detected in Harar and Dire Dawa, eastern Ethiopia [21], and a 10% nonresponse rate which yielded 440. Participants were selected using the systematic
random sampling technique, and every 12 patients were interviewed based on their order of arrival.

Data collection tool and procedure
A structured interviewer-administered questionnaire was used to collect data. The questions on the explanatory variables were prepared using the WHO conceptual model and by reviewing international literature.

Pill count is cost effective, simple, and more accurate than other methods [22]. However, the number of pills left does not necessarily reflect a consistent use of the drugs. Therefore, adherence status was assessed based on the number of pills reported to have been actually taken one month prior to the data collection period divided by the number of prescribed pills multiplied by 100%. Patients who reported an intake of ≥95% of the prescribed medication were considered adherent; those with a reported intake of <95% were classified as non-adherent.

The questionnaire was first prepared in English and translated to Amharic, the local language, and then retranslated to English to ensure the consistency of the tool. The pre-test was done on 26 HIV infected patients on ART at nearby hospital, and modifications were made based on the findings. One MSc and four BSc degree graduate nurses who were working out of the ART clinic were recruited for supervision and data collection, respectively, after they were trained for two days. The investigators and the supervisor monitored the data collection throughout the process.

Operational definition
Knowledgeable
Those respondents who scored points at mean and above for the knowledge question prepared on HIV and its treatment otherwise not.

Comorbidity
The presence of any of the chronic disease along with HIV/AIDS.

Data processing and analysis
Each item of the questionnaire was checked for completeness and coded manually before data entry. The data were entered using Epi info version 7 and exported to SPSS version 20 for data analysis. Descriptive statistics, including frequencies, means and standard deviations were used to describe the data. Bivariate logistic regression analysis was carried out and variables with P-values of ≤0.2 were entered into the multivariate logistic regression for final analysis. Hosmer and Lemeshow fitness of Good test was computed. And adjusted odds ratio with a 95% Confidence interval (CI) was computed to see the presence

| Table 1 | Socio-demographic characteristic of HIV positive adults attending care and treatment in University of Gondar Referral Hospital, Northwest Ethiopia, 2015 (n = 440) |
|-----------------|-----------------|-----------------|
| Variable        | Frequency       | Percent (%)     |
| Sex             | 176             | 40.0            |
| Male            | 264             | 60.0            |
| Female          |                 |                 |
| Age             |                 |                 |
| 18–28           | 77              | 17.5            |
| 29–38           | 212             | 48.2            |
| 39–48           | 119             | 27.0            |
| > =49           | 32              | 7.3             |
| Marital status  |                 |                 |
| Single          | 66              | 15.0            |
| Married         | 236             | 53.6            |
| Divorced        | 69              | 15.7            |
| Widowed         | 69              | 15.7            |
| Religion        |                 |                 |
| Orthodox        | 378             | 85.9            |
| Protestant      | 15              | 3.4             |
| Muslim          | 47              | 10.7            |
| Ethnicity       |                 |                 |
| Amhara          | 375             | 85.2            |
| Tigre           | 25              | 5.7             |
| Kimant          | 40              | 9.1             |
| Residence       |                 |                 |
| Urban           | 377             | 85.7            |
| Rural           | 63              | 14.3            |
| Educational status |             |                 |
| No formal education | 106           | 24.1            |
| Primary school  | 83              | 18.9            |
| Secondary school| 210             | 47.7            |
| College/University | 41           | 9.3             |
| Occupational status |              |                 |
| Government employee | 87            | 19.8            |
| Private employee | 75             | 17              |
| Housewife       | 93              | 21.1            |
| Merchant         | 86              | 19.5            |
| Farmer          | 33              | 7.5             |
| Daily laborer   | 26              | 5.9             |
| Others a        | 40              | 9.1             |
| Income b        |                 |                 |
| < 1000          | 118             | 26.8            |
| 1000–2000       | 127             | 28.9            |
| 2001–3000       | 85              | 19.3            |
| > 3000          | 110             | 25              |

| a Student, garden |
|-------------------|
| b In Ethiopian Birr |
of strength and the direction of association between dependent and independent variables.

**Result**

**Socio-demographic characteristics of participants**

A total of 440 participants were interviewed with a 100% response rate. The mean age of participants was 36.09 (SD ± 8.09) years. More than half, 264 (60%), of the participants were females, 378 (85.9%) Orthodox Christians and 375 (85.2%) Amhara by ethnicity. The majority, 377 (85.7%), and a quarter, 106 (24.1%), of the participants were urban dwellers and had no formal education, respectively (Table 1).

**Clinical characteristics of participants**

Of the participants, 297 (67.5%) were knowledgeable about HIV/AIDS and its treatments; more than half, 240 (54.5%) knew about the HIV status of their partners, and 200 (45.5%) of the partners were seropositive; the CD4 count of 266 (60.5%) was < 500 mm$^3$ (Table 2).

The overall level of adherence to antiretroviral therapy

In this study, the rate of adherence to antiretroviral therapy was 88.2% (95% CI = 85.2, 91.1). The rate is higher (92.0%) among urban and lower (65.1%) among rural residents.

Factors associated with adherence to antiretroviral therapy

The multivariate logistic regression analysis showed that urban residence, absence of co-morbidity, knowledge about HIV/AIDS, and ART; disclosing HIV status to partner and recent CD4 count ≥ 500 mm$^3$ were significantly associated with adherence to antiretroviral therapy.

Thus, HIV infected patients who lived in urban settings were 7 times (AOR = 6.99, 95% CI: 2.30, 21.27) more likely to adhere to their antiretroviral therapy (ART) than rural residents. Participants without co-morbidity were 87% (AOR = 0.13; 95% CI: (0.05, 0.33) less likely to adhere than participants with co-morbidity. Furthermore, participants who were knowledgeable about HIV and antiretroviral therapy were 7.5 times (AOR = 7.54 95% CI: 2.69, 21.15) more likely to be adherent compared with non-knowledgeable

| Variables | Frequency | Percent |
|-----------|-----------|---------|
| Comorbidities |
| Yes | 117 | 26.6 |
| No | 323 | 73.4 |
| Knowledge about treatment |
| Knowledgeable | 297 | 67.5 |
| Not knowledgeable | 143 | 32.5 |
| Knowing HIV status of partners |
| Yes | 240 | 54.5 |
| No | 200 | 45.5 |
| HIV status of the partner (n = 240) |
| Positive | 200 | 83.3 |
| Negative | 40 | 16.7 |
| Family disclosure status |
| Yes | 321 | 73.0 |
| No | 119 | 27.0 |
| CD4 count |
| < 500 mm$^3$ | 266 | 60.5 |
| ≥ 500 mm$^3$ | 174 | 39.5 |
| Substance use in the past 1 year |
| Yes | 29 | 6.6 |
| No | 411 | 93.4 |
| Partner in the past 1 year |
| Yes | 314 | 71.4 |
| No | 126 | 28.6 |
| Length of stay with a current partner (n = 314) |
| < 1 year | 67 | 21.3 |
| 1–4 year | 39 | 12.4 |
| 4 year | 208 | 66.3 |
| Number of partners (n = 314) |
| One | 268 | 85.4 |
| More than one | 46 | 14.6 |
| Discussion about safe sex (n = 314) |
| Yes | 256 | 81.5 |
| No | 58 | 18.5 |
| Duration since tested HIV positive |
| < 1 year | 30 | 6.8 |
| 1–5 year | 172 | 39.1 |
| 5–10 year | 231 | 52.5 |
| > 10 years | 7 | 1.6 |

**Table 2** Clinical characteristics and antiretroviral therapy condition of the study participants, University of Gondar Referral Hospital, Northwest Ethiopia, 2015 (n = 440) (Continued)
Table 3: Bivariate and multivariate analysis for adherence to antiretroviral therapy among HIV positive adults attending care and treatment in University of Gondar Referral Hospital, Northwest Ethiopia, 2015 (n = 440)

| Variables                 | Adherence Status | COR (95% CI) | AOR (95% CI) |
|---------------------------|------------------|--------------|--------------|
|                           | Adherent | Non Adherent |               |               |
| **Sex**                   |          |              |               |               |
| Male                      | 153      | 23           | 1            |               |
| Female                    | 235      | 29           | 1.22(0.68,2.18)|               |
| **Age (in year)**         |          |              |               |               |
| 18–28                     | 66       | 11           | 1.11(0.35,3.50)|               |
| 29–38                     | 191      | 21           | 1.168(0.59,4.84)|               |
| 39–48                     | 104      | 15           | 1.28(0.43,3.85)|               |
| >= 49                     | 27       | 5            | 1            |               |
| **Marital status**        |          |              |               |               |
| Single                    | 54       | 12           | 0.76(0.31,1.91)|               |
| Married                   | 213      | 23           | 1.57(0.71,3.48)|               |
| Divorced                  | 62       | 7            | 1.50(0.54,4.20)|               |
| Widowed                   | 59       | 10           | 1            |               |
| **Educational status**    |          |              |               |               |
| No formal education       | 97       | 9            | 1.17(0.34,4.02)|               |
| Primary school            | 75       | 8            | 1.01(0.29,3.58)|               |
| Secondary school          | 79       | 31           | 0.62(0.21,1.88)|               |
| College/University        | 36       | 5            | 1            |               |
| **Occupation**            |          |              |               |               |
| Government employee       | 79       | 8            | 3.75(0.97,10.24)|               |
| Private employee          | 70       | 5            | 5.31(0.89,16.64)|               |
| Housewife                 | 85       | 8            | 4.03(0.87,10.99)|               |
| Merchant                  | 74       | 12           | 2.34(0.93,5.89)|               |
| Farmer                    | 27       | 6            | 1.71(0.55,5.25)|               |
| Daily laborer             | 20       | 6            | 4.55(0.92,22.56)|               |
| Others                    | 29       | 11           | 1            |               |
| **Residence**             |          |              |               |               |
| Urban                     | 347      | 30           | 6.21(3.28,11.75)\(^a\) | 6.99(2.30,21.26)\(^b\) |
| Rural                     | 41       | 22           | 1            | 1            |
| **Income\(^c\)**         |          |              |               |               |
| < 1000                    | 92       | 26           | 0.28(0.12,0.64)\(^a\) | 0.42(0.12,1.52) |
| 1000–2000                 | 116      | 11           | 0.83(0.32,2.14) | 0.95(0.24,3.69) |
| 2001–3000                 | 78       | 7            | 0.87(0.30,2.51) | 1.09(0.27,4.41) |
| > 3000                    | 102      | 8            | 1            | 1            |
| **Comorbidities**         |          |              |               |               |
| Yes                       | 82       | 35           | 0.13(0.07,0.24)\(^a\) | 0.13(0.05,0.33)\(^b\) |
| No                        | 306      | 17           | 1            | 1            |
| **Knowledge about treatment** |      |              |               |               |
| Knowledgeable             | 282      | 15           | 6.56(3.46,12.45)\(^a\) | 7.54(2.69,21.15)\(^b\) |
| Not Knowledgeable         | 106      | 37           | 1            | 1            |
| **Knowing HIV status of partners** | | | | |
patients. In addition, participants who disclosed their HIV status to their partners were 3.7 times (AOR = 3.65 (1.06, 12.61)) as likely to be adherent as those who did not disclose. The odds of ART adherence was found high among participants with a CD4 count of \( \geq 500 \text{mm}^3 \) (AOR = 3.91 (95% CI: 1.19, 12.81)) (Table 3).

**Discussion**

In this study, the rate of adherence to antiretroviral therapy was found to be 88.2% (95% CI = 85.2, 91.1). This is almost in-line with those of studies done at Dessie referral hospital [3], Debre Markos referral hospital [7], Eastern Ethiopia [5], and Global Hospital [10], and Nepal [6], which reported 90, 88.6, 85%, and, 90.8, and 85.5%, respectively.

However, it is higher than there of studies done in Savannakhet and Sethathirath hospitals (60%) [4], Dubti hospital (81.1%) [11], Myanmar (76.24%) [12], China (81.8%) [13], and a Tertiary care hospital in Aurangabad (78%) [1]. This difference might be due to differences in socio-demographic characteristic, sample size large in this study, and difference in study designs.

This finding is lower than that of another study conducted in Debre Birhan referral hospital and health center (95.5%) [9]. The variation might be due to differences in study settings and socio-demographic characteristics.

In the current study, associations were observed between adherence to ART and different variables. Urban residence had a significant association with good adherence. The possible justification could be

---

**Table 3** Bivariate and multivariate analysis for adherence to antiretroviral therapy among HIV positive adults attending care and treatment in University of Gondar Referral Hospital, Northwest Ethiopia, 2015 (n = 440) (Continued)

| Variables                        | Adherence Status | COR (95% CI) | AOR (95% CI) |
|----------------------------------|------------------|--------------|--------------|
|                                  | Adherent | Non Adherent |              |              |
| Yes                              | 220      | 20           | 0.33(0.16,0.68)* | 0.57(0.64,4.96) |
| No                               | 58       | 16           | 1            | 1            |
| HIV status of partners           |          |              |              |              |
| Negative                         | 35       | 5            | 0.57(0.19,1.66) | 0.91 (0.21, 4.01) |
| Positive                         | 185      | 15           | 1            | 1            |
| Discuss about safe sex with a partner |        |              |              |              |
| Yes                              | 232      | 24           | 0.4(0.19,0.85)* | 0.83(0.18,3.88) |
| No                               | 46       | 12           | 1            | 1            |
| Disclosing HIV status of partners|          |              |              |              |
| Yes                              | 369      | 42           | 4.62(2.02,10.60)* | 3.65(1.06,12.61)b |
| No                               | 19       | 10           | 1            | 1            |
| Recent CD4 count                 |          |              |              |              |
| < 500 mm\(^3\)                  | 227      | 39           | 1            | 1            |
| \( \geq 500 \text{mm}^3 \)      | 161      | 13           | 2.13(1.1,4.11)* | 3.91(1.19,12.81)b |
| Number of partner                |          |              |              |              |
| 1                                | 240      | 28           | 1.81(0.77,4.25) | 1.01(0.21,4.73) |
| > 1                              | 38       | 8            | 1            | 1            |
| Length of stay with current partner |        |              |              |              |
| < 1 year                         | 56       | 11           | 0.45(0.20,1.02) | 2.9(0.47,17.97) |
| 1–4 years                        | 31       | 8            | 0.35(0.14,0.87)* | 0.76(0.19,3.14) |
| > 4 years                        | 191      | 17           | 1            | 1            |
| Duration since tested HIV positive |        |              |              |              |
| < 1 year                         | 24       | 6            | 0.67(0.07,6.64)   |              |
| 1–5 year                         | 154      | 18           | 1.43(0.16,12.52) |              |
| 5–10 year                        | 204      | 27           | 1.26(0.15,10.86)  |              |
| > 10 years                       | 6        | 1            | 1            | 1            |

*Significant variables in bivariate analysis,  
**Significant variables in multivariate analysis,  
In Ethiopian Birr
that in this study urban residents were more educated. This might increase their awareness and access to HIV therapy. The presence of co-morbidity had a significant association with the outcome variable. In the study, participants without co-morbidity had good adherence to antiretroviral therapy, like a similar study reported elsewhere [5]. The possible explanation might be that when patients had co-morbidities, they might have pill burden. As a result, they might miss ART medications as they give more attention to the acute problem.

Being knowledgeable about HIV and antiretroviral therapy had a significant association with good adherence. This is similar to the results of studies done in Nepal [6] and China [13]. Disclosure of status of HIV to family/partner also had a significant association with good adherence. This agreed to the findings of studies done in Dessie referral hospital, eastern Ethiopia, Felege-Hiwot and Gondar University hospitals [3, 5, 8] and Nepal [6].

Recent CD4 count was significantly higher among patients with good ART adherence. This is similar to the findings of a study done in HIV Epidemiology Research (HER) in the US [2].

In this study, adherence was assessed according to data actually taken during the previous one month. So, the participants might be subjected to recall bias. Since the data was collected using an interviewer administered technique, it might also be exposed to social desirability bias. However, the participants were adequately informed about the relevance of the study and the importance of genuineness. Additionally, the data collectors were professionals working out of the ART clinics. Patients attending health centers were not included in this study. This might impose a limitation on the generalization of the findings to all ART users in the region.

Conclusion
In this study, antiretroviral therapy adherence was found low compared to the WHO standard. Urban residence, no co-morbidity, being knowledgeable about HIV and its treatment, disclosing HIV status to partners and CD4 count ≥ 500 mm$^3$ were factors significantly associated with good ART adherence. High CD4 count was found to be a proxy indicator of good ART adherence. Thus, prevention of co-morbidities, improving knowledge through health education, providing strong drug adherence counseling with more emphasis on the rural community, and encouraging HIV positive individuals to disclose their HIV status are crucial for ART adherence.

Abbreviations
AOR: Adjusted odds ratio; ART: Antiretroviral Therapy; COR: crude odds ratio; HIV/AIDS: Human immune deficiency virus/ Acquired immune-deficiency syndrome; PLWHA: people living with HIV/AIDS; SPSS: a Statistical package for social sciences

Acknowledgments
Authors would like to express our gratitude to the University of Gondar College of Medicine and Health Science Research and Ethical Review committee for the approval of the ethical clearance. The authors would like to thank data collectors and supervisors for their commitment and the study participants for their valuable information.

Availability of data and materials
The raw data would not be provided for the reason of protecting patients’ confidentiality. But, the summary data are available in the main document.

Authors’ contributions
AAM wrote the proposal, participated in data collection, analyzed the data and drafted the manuscript. AAG, HSM, and DFT approved the proposal with revisions, participated in data analysis and revised subsequent drafts of the manuscript. All authors read and approved the final manuscript.

Competing interest
The authors declare that they have no competing interests.

Authors’ information
AAM: MSc infectious disease working in HIV care and treatment clinic, University of Gondar Hospital, Gondar, Ethiopia. AAG: Assistant professor in Reproductive Health, Institute of Public Health, College of Medicine and Health Science, University of Gondar, Ethiopia. HSM: lecturer in Department of Medical Nursing, School of Nursing College of Medicine and Health Science, University of Gondar, Ethiopia. DFT: Lecturer in Department of Epidemiology and Biostatistics, Institute of Public Health, University of Gondar, Ethiopia.

Ethics approval and consent to participate
The study was approved by University of Gondar College of Medicine and Health Sciences Research and Ethical Review Committee. A permission and supportive letter were obtained from the clinical director of the University of Gondar Referral Hospital. Each study participant was informed about the purpose, method, expected benefit, and risk of the study. They were also informed about their full right not to participate or withdraw from the study at any time, and deciding not to participate had no impact on their services. Since it is a cross-sectional study, participating in this study cannot result any negative consequences on the study participants. Hence, informed verbal consent was obtained from study participants before the data collection. This was also approved by the Ethical Review Committee. Confidentiality was maintained during data collection, storage, analysis, and report.

Publisher’s Note
Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Author details
1HIV care and Treatment Clinic, University of Gondar Referral Hospital, Gondar, Ethiopia. 2Department of Reproductive Health, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia. 3Department of Medical Nursing, School of Nursing College of Medicine and Health Science, University of Gondar, Gondar, Ethiopia. 4Department of Epidemiology and Biostatistics, Institute of Public Health, College of Medicine and Health Sciences, University of Gondar, Gondar, Ethiopia.

Received: 27 February 2018 Accepted: 30 May 2018 Published online: 08 June 2018

References
1. FACT SHEET on GLOBAL HIV Statistics In: UNAIDS, editor. 2017. http://www.unaids.org/en/resources/fact-sheet.
2. WHO. Global Health Observatory (GHO) data. 2018. http://www.who.int/gho/hiv/en/.
3. GLOBAL HIV AND AIDS STATISTICS. 2016. http://www.unaids.org/sites/default/files/media_asset/global-update-2016_en.pdf.
4. WHO. Ethiopia | HIV/AIDS. WHO regional office for Africa, 2015. http://www.afro.who.int/countries/ethiopia.
5. Foundation THKF. The Global HIV/AIDS Epidemic. 2017. http://files.kff.org/attachment/Fact-Sheet-The-Global-HIV-AIDS-Epidemic.
6. UNAIDS. GLOBAL AIDS UPDATE. 2016. http://www.unaids.org/en/resources/documents/2016/Global-AIDS-update-2016.
7. Jean B, Nachega MH, Dowdy DW, Chaissin RE, Regensberg L, Maartens G. Adherence to nonnucleoside reverse transcriptase inhibitor–based HIV therapy and virologic outcomes. Ann Intern Med. 2007;146:564–73.
8. Jean B, Nachega MH, Nguyen H, Dowdy DW, Chaissen RE, Regensberg L, Cotton M, Maartens G. Antiretroviral therapy adherence, virologic and immunologic outcomes in adolescents compared with adults in southern Africa. J Acquir Immune Defic Syndr. 2009;51(1):65–71.
9. Patricia García de Olalla HK, Alexia Carmona AG, LLópez-Colomés J, ACaylà J. Impact of adherence and highly active antiretroviral therapy on survival in HIV-infected patients. JAIDS Journal of Acquired Immune Deficiency Syndromes. 2002;30(1):105–10.
10. Robert S, Hogg KH, Bangsberg D, Yip B, Press N, O'Shaughnessy MV, Montaner JS. Intermittent use of triple-combination therapy is predictive of mortality at baseline and after 1 year of follow-up. An official international AIDS society. 2002;16(7):1051–8.
11. Oguntibeju OO. Quality of life of people living with HIV and AIDS and antiretroviral therapy. HIV/AIDS - Research and Palliative Care. 2012;4:117–24.
12. David L, Paterson M, BS, FRACP, Swindells S, Mohr J, MSW, Brester M, RN, Emanuel N, Vergis, MMW CS, Singh N. Adherence to protease inhibitor therapy and outcomes in patients with HIV infection. Ann Intern Med. 2002;133(1):21–30.
13. Sharon Mannheimer GF, Mats J, Child C, Chesney M. The consistency of adherence to antiretroviral therapy predicts biologic outcomes for human immunodeficiency virus–infected persons in clinical trials. Clin Infect Dis. 2002;34(8):1115–21.
14. Howard AAA, Julia H, Lo Y, Vlahov D, Rich JD, Schuman P, Stone VE, Smith DK, Schoenbaum EE. A prospective study of adherence and viral load in a large multi-center cohort of HIV-infected women. International AIDS society. 2002;16(16):2175–82.
15. Edward L, Machtinger DRB. Adherence to HIV antiretroviral therapy. University of California san Francisco: HIV InSite Knowledge Base chapter; 2006.
16. Guidelines for the Use of Antiretroviral Agents in HIV-1-Infected Adults and Adolescents: AIDSinfo; 2016 [updated July 14, 2016.
17. Kenneth L. Schaecher M, FACP, CPC. The Importance of Treatment Adherence in HIV. Am J Manag Care. 2013;19(12):231-7.
18. Li JZ, SG HR, Heisey A, Bangsberg DR, Kuritzkes DR. Incomplete adherence to antiretroviral therapy is associated with higher levels of residual HIV-1 viremia. AIDS. 2014;28(2):181–6.
19. ID JAGS, de Brito AM, da Silva CAL. Factors associated with non-adherence to antiretroviral therapy in adults with AIDS in the first six months of treatment in Salvador, Bahia state, Brazil. Cad Saúde Pública, Rio de Janeiro. 2015;31(6):1–11.
20. Yibeltal Assefa DJ, Luiseged S, Ooms G, Van Damme W. Rapid scale-up of antiretroviral treatment in Ethiopia: successes and system-wide effects. PLoS Med. 2009;6(4):e1000056.
21. Shiferaw Letta AD, Olijira L, Dessie Y. Factors associated with adherence to antiretroviral therapy (ART) among adult people living with HIV and attending their clinical care, Eastern Ethiopia. BMC International Health and Human Rights. 2015;15(33).
22. Lam WY, Fresco P. «Medication Adherence Measures: An Overview.» BioMed Research International. 2015;2015;12. Article ID 217047. https://doi.org/10.1155/217047.