

Factors associated with ART non-adherence and contributing influence of stock shortages at Nkongsamba Regional Hospital, Cameroon

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Abstract

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Global Health

Background

Antiretroviral therapy (ART) requires a high level of adherence for treatment success and viral suppression. Studies from Cameroon's capital report low levels of adherence and have identified multiple factors associated with non-adherence. This study described adherence to ART among HIV-infected patients receiving treatment at Nkongsamba Regional Hospital, and identified factors associated with non-adherence. This study also investigated the impact of stock shortages on the lives of patients.

Methods

This is a cross-sectional study conducted at Nkongsamba Regional Hospital's HIV center. Patients receiving ART aged over 21 years were randomly selected and interviewed using a mixed-methods questionnaire about their experience taking ART and their experience with stock shortages. Additional longitudinal data was extracted from HIV center records. Participants were grouped into adherent and non-adherent based on a composite score derived from a three questions tool developed by the Center for Adherence Support Evaluation (CASE). Pearson's chi-square tests and independent samples t-tests were performed to identify factors associated with adherence.

Results

201 patients were interviewed using the mixed-methods questionnaire. 127 (62.2%) were classified as adherent to ART and 76 (37.8%) classified as non-adherent according to the CASE index of adherence determination. Women were significantly more likely than men to report poor adherence to ART ($p=.08$). Married and widowed respondents were significantly more likely than those who were single, divorced or living with a partner to report good adherence to ART ($p=.08$). There was no association found between stock shortages of ART and adherence ($p=.56$). Responses to the open-ended questions revealed financial, psychological, and physiological adverse effects of stock shortages. Coping strategies related to religion, antibiotic use, stockpiling medication, calling ahead to the hospital, good nutrition, and good psychological health were reported to mitigate the adverse effects of stock shortages.

Conclusion

Non-adherence to ART remains unacceptably high in this population. Stock shortages of ART were not found to be significantly associated with non-adherence; however, the supplementary longitudinal and qualitative data suggests that stock shortages do have a negative impact on other aspects of patients' lives.

I. Background and Significance

Viral suppression in HIV-infected patients depends on a high levels of adherence (>90%) to antiretroviral therapy (ART) to prevent treatment failure, the development of drug resistance, increased HIV transmission, opportunistic infections, and death.^{1,2} However, a significant proportion of patients do not attain high levels of ART adherence. Non-adherence to ART has been associated with diverse factors including alcohol consumption, religion, ART regimen change, and stock shortages in Cameroon's capital city of Yaoundé.^{3,4} Socioeconomic factors including income, education and employment status were found to be positively associated with adherence in 15 studies of low- and middle-income countries.⁵ A systematic review of 34 studies done in sub-Saharan Africa found that travel distance and travel time were associated with poor adherence.⁶ After reviewing 41 quantitative studies, HIV-related stigma was found to undermine participants' abilities to successfully adhere to ART.⁷

The number of people receiving ART in Cameroon has increased considerably since the initiation of the program to increase access to ART in 2001. In 2010, an estimated 35.6% (89,455) of ART-eligible patients were receiving ART from 145 facilities with ART services.⁸ The ongoing scale up of ART has placed considerable stress on Cameroon's procurement and supply chain management systems and supply chain ruptures for HIV commodities are already documented.^{4,9} The 2012 Cameroon National Monitoring Report of HIV/AIDS reported that 42.5% of the 145 ART sites experienced a stock-out of at least one required ARV in the last 12 months.⁹ Inadequate supply of HIV commodities has serious implications for ART patient adherence leading to treatment interruptions, discontinuations or modifications.¹

No studies assessing adherence levels or exploring factors associated with non-adherence have been conducted outside of the capital in Cameroon. Additionally, to our knowledge, no studies using mixed-methods to assess the impact of stock shortages on ART adherence have been conducted in Cameroon. Therefore, the objective of this study was to assess adherence to ART at Nkongsamba Regional Hospital (NRH) and explore socio-demographic and clinical factors associated with ART non-adherence. Additionally, due to observed stock shortages of ART at NRH, this study investigated the impact of stock shortages on patient adherence to ART and other aspects of patient life in greater depth

II. Methods

Study design and setting:

This descriptive study was conducted at NRH's UPEC (Unit Prise en charge des Chroniques) HIV care center. NRH is a regional (third category health unit), public hospital located in Nkongsamba in the Littoral region of Cameroon. As of June 2014, NRH's UPEC provided ART first and second line treatment for 1,065 HIV positive patients (265 male, 780 female and 20 children). NRH's UPEC is the only HIV treatment center between Bafang and Njombe (approximately 175 kilometers) with patients traveling from the Southwest, West and Littoral regions of Cameroon to seek care. In 2011 the Cameroon National AIDS Control Committee reported a 4.3% prevalence of HIV in the general population and 15.4% in pregnant women in the Littoral region.¹⁰

ART is provided free to all patients and medication is transported by the hospital's pharmacy from the regional capital, Douala to Nkongsamba.

Study Population:

Participants of the cross-sectional questionnaire were HIV infected adults aged ≥ 21 who had been receiving ART at NRH for at least 6 months at the start of data collection, June 2014, and who provided oral informed consent. Patients < 21 years of age or who had been receiving ART at NRH for less than 6 months at the start of data collection were excluded from participation. Participants were selected through convenience sampling using systematic methods. Non-probability sampling techniques were used to reduce the relative time and expense required to achieve the desired sample size with limited support. Additionally, probability sampling could have presented a risk to patient anonymity. Probability sampling would have required sampling from the patient registry book, which is de-identified, and pulling patient files to retrieve contact information, possibly compromising patient anonymity.

The population described in the supplemental longitudinal clinic data is the HIV positive patient population with active files receiving ART at NRH.

Study tools:

A cross-sectional, mixed-methods questionnaire was developed in order to assess factors associated with ART non-adherence and impact of stock shortages on patient lives (appendix A). A bilingual, HIV peer educator and French teacher translated the questionnaire into French. Health personnel at NRH approved both language versions of the questionnaire. The questionnaire was piloted with 5 patients receiving ART at NRH who met the questionnaire eligibility criteria. Feedback provided in informal interviews with pilot respondents was incorporated into the final version of the questionnaire. The study questionnaire covered respondents' socio-demographic characteristics, ART adherence, and patient experience with stock shortages. Open-ended questions were included to qualitatively describe challenges to adherence and coping strategies associated with pharmacy stock shortages.

The CASE Adherence Index developed by the New York Academy of Medicine's Center for Adherence Support Evaluation (CASE) was used to determine levels of adherence (appendix B). The CASE Adherence Index is based on the sum of three self-reported measures of adherence rated on a likert scale (included in appendix B).¹¹ Patient scores in the CASE Adherence Index range from 3 to 16 points and are classified into a binary variable as adherent or good adherence (> 10) and non-adherent or poor adherence (≤ 10).¹¹

The longitudinal clinic data was collected from monthly HIV clinic statistic forms. These forms are compiled at the end of each month by NRH UPEC's statistician using the patient registry book and submitted to Cameroon's National AIDS Control Committee. These forms show the number of patients prescribed each ART regimen and the number of patients with active files not seeking treatment in each month. All available forms were collected at the start of questionnaire administration, June 2014, totaling 14 forms and covering 1.5 years.

Data collection and analysis:

Data collection began with the administration of the questionnaire in June 2014 and was completed in September 2014. Every fifth health booklet was selected on patient visit days, Mondays and Wednesdays, and the corresponding patient was screened for eligibility and invited to participate. No more than 20 questionnaires were completed per day.

Quantitative data obtained from the questionnaire were analyzed with STATA version 13 (College Station, Tx). Baseline characteristics of participants with a CASE index score >10, termed ART adherent, and participants with a CASE index score ≤10, termed ART non-adherent, were compared using Pearson's chi-square and studentized t-tests for independent samples. The responses to the open-ended questions were read and reread to identify key issues, concepts and themes. Each major theme was entered into a chart in Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) with a column for every theme and a row for every category. The data were compared searching for commonalities and differences. This facilitated the identification of patterns. Representative quotes were selected for each category under each theme.

Longitudinal HIV center data was collected for January 2013-June 2014. May 2013 is missing from analysis because the monthly statistic from was unavailable for unspecified reasons. Descriptive figures were generated in Microsoft Excel.

Ethics considerations:

This study was approved by the Cameroonian National Ethics Committee as well as the University of Washington's Human Subjects Division of the Institutional Review Board. Oral informed consent was obtained from participants at the beginning of the interview, after the study was explained to them.

III. Results

Description of study sample:

201 patients answered all adherence questions and were analyzed. The median age was 43 years old (range: 25-77), 162 (80.6%) were female. This distribution corresponds fairly well with the larger gender distribution of patients receiving ART at NRH (74% female in June 2014). A large proportion of respondents were married 83 (41.3%), though a large proportion was widowed 52 (25.9%) and single 44 (21.9%). The majority of respondents had a primary school level of education 101 (50.2%) or some secondary school 82 (40.8%), very few had no formal schooling or a university level education 13 (6.5%) and 5 (2.5%) respectively.

Patients' median time since ART initiation was 5 years (range 1-19). Patients were primarily taking one of three first-line ART regimens, most commonly efavirenz (EFV)+tenofovir (TDF)/3TC, followed by nevirapine (NVP)+zidovudine (ZDV)/lamivudine (3TC), and NVP+TDF/3TC 87 (43.3%), 68 (33.8%), and 42 (20.9%) respectively. However, significant change of regimens 104 (73.8%) was reported in the sample. The majority of patients 151 (74.1%) did not know the name of the regimen they were currently taking, and were currently taking antibiotics as a prophylactic measure against opportunistic infections 122 (86.5%). Most participants, 152 (75.6%),

lived less than one hour from the hospital, and the median price paid for transport to the hospital was 1,000 CFA/ 2.00 USD (range 0-16,000 CFA/ 0-32.00 USD).

The vast majority, 182 (90.5%) participants reported having experienced an incidence of ART stock shortage at Nkongsamba Regional Hospital. Fewer than half, 77 (38.3%) reported a coping strategy to deal with stock shortages of ART, despite the majority, 138 (68.7%) reporting an adverse effect due to stock shortages.

Table 1 Socio-demographic, clinical, and stock shortage characteristics of the study population

Characteristics	Subcategory	n=201(%)
Socio-demographic characteristics		
Gender	Male	39(19.4)
	Female	162(80.6)
Median age (IQR)	In years	43 (37;52)
Level of Education	No formal education	13(6.5)
	Primary	101(50.2)
	Secondary	82(40.8)
	University	5(2.5)
Marital status	Single	44(21.9)
	Married	83(41.3)
	Divorced	7(3.4)
	Living with partner	15(7.5)
	Widowed	52(25.9)
Clinical Characteristics		
ART Adherent*	Adherent	125(62.2)
	Non-adherent	76(37.8)
Median time on ART (IQR)	In years	5(3;7)
ART Regimen	NVP + ZDV/3TC	68(33.8)
	EFV + ZDV/3TC	2(1)
	EFV + TDF/3TC	87(43.3)
	NVP + TDF/3TC	42(20.9)
	NVP + ABC/3TC	0
	EFV + ABC/3TC	0
	LPV/r + TDF/3TC	2(1)
	LPV/r + ZDV/3TC	0
ART regimen name known	Yes	50(24.8)
	No	151(75.1)
ART regimen changed	Yes	104(73.8)
	No	37(26.2)
On antibiotics	Yes	122(86.5)
	No	19(13.5)
Time required for transportation to hospital	Less than one hour	152(75.6)
	One hour or more	49(24.4)
Median cost of transportation to hospital (IQR)	In CFA/USD**	1000/1.60 (500;1500/.80;2.40)
Stock Shortage Characteristics		
Reported a pharmacy ART stock shortage	Yes	182(90.5)
	No	19(9.5)
Reported coping strategies to deal with stock shortages	Yes	77(38.3)
	No	124(61.7)
Reported adverse effects due to stock shortages	Yes	138(68.7)
	No	63(31.3)

IQR: interquartile range; ART: antiretroviral therapy; CFA: Central African franc; USD: United States dollar

*Adherent>10 on the Center for Adherence Support and Evaluation(CASE) adherence index, non-adherent≤10 on the CASE adherence index

**624.96 CFA=1.00 USD

Status of ART adherence:

Among the 201 study participants, 127 (62.2%) were found to be adherent to ART and 76 (37.8%) were non-adherent according to the CASE method of adherence determination (Table 1). Ninety-eight (48.8%) respondents reported missing at least one dose of therapy at least once per week. This is consistent with the 90 (44.8%) respondents who reported having missed a dose of medication in the past month. These numbers are quite higher than the 38 (18.9%) respondents who reported difficulty taking their medication on time most of the time or all the time. This indicates that there could be some bias or difficulty interpreting a more subjective criterion.

Factors associated with ART adherence

Bivariate analysis revealed that adherence to ART among respondents differed significantly at p-value $\leq .08$ by gender ($p=.08$) and marital status ($p=.08$) (Table 3). Female, single or divorced patients were found to be more likely to self-report poor adherence than male, married or widowed patients. No other factors analyzed in the bivariate analysis were found to be significantly associated with ART non-adherence.

Table 2 Bivariate analysis exploring factors associated with ART adherence

Characteristics	Subcategory	*ART adherent (n=125) 62.2(%)	PRR	P-value
Socio-demographic characteristics				
Gender	Male	29(74.4)	3.05	0.08
	Female	96(59.3)		
Median age (IQR)	In years	44 (38;51)	-0.75	0.45
Level of Education	No formal education	10(76.9)	4.6	0.21
	Primary	61(60.4)		
	Secondary	49(59.8)		
	University	5(100.0)		
Marital status	Single	22(50.0)	8.3	0.08
	Married	56(67.5)		
	Divorced	5(71.4)		
	Living with partner	6(40.0)		
	Widowed	36(69.2)		
Clinical Characteristics				
Median time on ART (IQR)	In years	5(3;7)	0.08	0.43
ART Regimen	NVP + ZDV/3TC	41(60.3)	1.6	0.82
	EFV + ZDV/3TC	1(50.0)		
	EFV + TDF/3TC	58(66.7)		
	NVP + TDF/3TC	24(57.1)		
	NVP + ABC/3TC	0		
	EFV + ABC/3TC	0		
	LPV/r + TDF/3TC	1(50)		
	LPV/r + ZDV/3TC	0		
	ART regimen name known	Yes		
No		94(62.3)		
ART regimen changed	Yes	62(59.6)	0.09	0.76
	No	21(56.8)		
On antibiotics	Yes	72(59.0)	0.009	0.93
	No	11(57.9)		
Time required for transportation to hospital	Less than one hour	93(61.2)	0.27	0.61
	One hour or more	32(65.3)		
Median cost of transportation to hospital (IQR)	In CFA/USD**	1000/1.6 (400;1500/.64;2.40)	0.3	0.56
Stock Shortage Characteristics				
Reported a pharmacy ART stock shortage	Yes	112(61.5)	0.3	0.56
	No	13(68.4)		
Reported coping strategies to deal with stock shortages	Yes	49(63.6)	0.1	0.74
	No	76(61.3)		
Reported adverse effects due to stock shortages	Yes	83(60.1)	0.8	0.38
	No	42(66.7)		

PRR: Pearson's chi-square statistic; IQR: interquartile range; ART: antiretroviral therapy; CFA: Central African franc; USD: United States dollar

*Adherent>10 on the Center for Adherence Support and Evaluation(CASE) adherence index, non-adherent≤10 on the CASE adherence index

**624.96 CFA=1.00 USD

Open-ended Questionnaire Responses

Despite no statistically significant association being found between stock shortages and adherence in the bivariate analysis, the impact of stock shortages on patients' lives was explored through several open-ended questions included in the questionnaire. Questions included, describe your experience with stock shortages at Nkongsamba Regional Hospital, and how do stock shortages of ART affect other parts of your life. Themes arising from the responses to these open-ended questions included reported adverse effects and coping mechanisms.

Patients reported a number of adverse effects due to stock shortages of ART. Many patients cited wasted resources including time and money from traveling to the hospital multiple times during periods of stock shortage to access medication. « When the medication doesn't come, you go to the hospital each week to look for it and pay transportation every time. We lose money. *Quand le médicament n'est pas venu, tu*

viens à l'hôpital chaque semaine pour le chercher et paye le transport chaque fois. On gaspille l'argent.»

Patients frequently cited psychological effects including depression, hopelessness, fear, anger and anxiety.

« Without medication I feel that I am already dead. My moral is very low. *Sans médicament dans ma tête je pense que je suis déjà meurt. Ma morale est en bas.* »

Many patients also described physical reactions to stock shortages including weakness, feeling ill or relapsing, and losing weight.

« It affects my health, I sleep a lot because of fatigue. *S'affecte la sante, je dors beaucoup à cause de fatigue.* »

Another pattern that emerged from the qualitative responses to the open ended questions was coping strategies patients utilized in response to stock shortages.

Although patients were not specifically asked about coping strategies, six strategies were identified through responses to other questions. Patients frequently mentioned God and religion as a way to manage the stress related to stock shortages.

« God is protecting me when the medication is not there. *Dieu me protège quand le médicament n'est pas la.* »

As previously mentioned, the majority of patients were actively taking antibiotic prophylaxis at the time the study was conducted (86.5%) to mitigate the effects of opportunistic infections. One reason for the high number of people on antibiotics might be to minimize the effect of stock shortages. Pharmacy records show that in June 2014 350 patients out of 1,065 were prescribed antibiotics during a stock shortage of NVP+ZDV/3TC. It's likely that even more patients were taking antibiotics than prescribed as antibiotics are easily accessible at pharmacies in Cameroon at low cost.

« We've become habituated to take bactrim when the medication is not available. *On s'habitue du bactrim quand le médicament n'est pas disponible.* »

Several patients mentioned that they had experienced stock shortages of ART at Nkongsamba Regional Hospital but that they were not affected because they kept reserves of medication stockpiled in their home.

« Usually I take two pill but when there is no medication I take only one pill each day to conserve. *Normalement je prends deux comprimé par jour mais quand il n'y a pas je prends juste un comprimé par jour pour conserver.* »

Another way patients mitigated the effects of stock shortages was to call ahead to the health center to see if medication is available before traveling. This helps to minimize the excess transport cost and wasted time associated with stock shortages.

« You have to call the hospital personnel ahead of time to see if the medication is there. *Tu doit appeler avant le personnel de sante pour voir si le médicament est la.* »

Some patients reported changed eating habits in response to stock shortages including eating more generally as well as more fruits and vegetables.

« I eat a lot to feel better. *Je mange beaucoup pour améliorer.* »

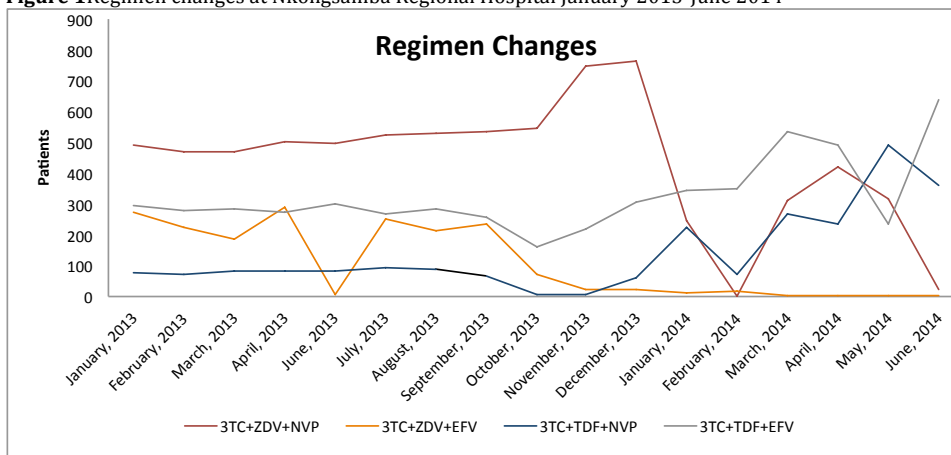
Finally, many patients reported fewer adverse effects due to good psychological health including not reflecting or overthinking and thinking HIV is like any other disease to reduce stigma.

« I remain hopeful and with a positive attitude. *Je garde espoir et garde le moral.* »

Longitudinal Clinic Data

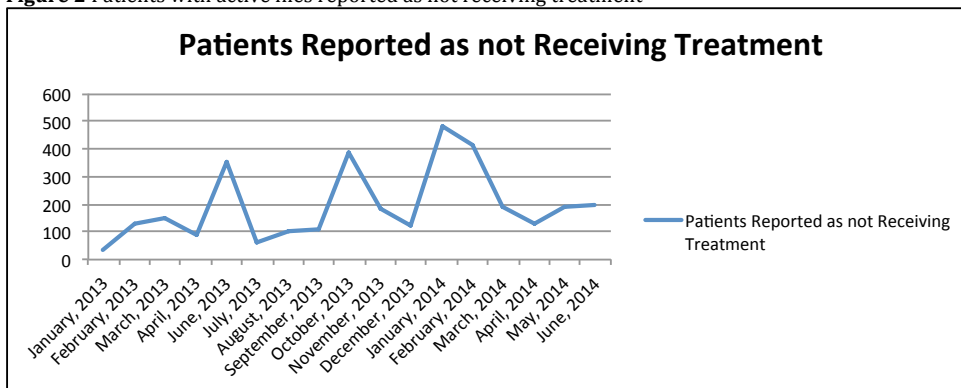
The supplemental longitudinal data provided an interesting complement to the cross-sectional questionnaire. Stock shortages are not explicitly recorded in the clinic data; however, their impact can be seen when looking at a graph of patient regimen change (Figure 1). At several times the number of patients prescribed to a regimen drops from several hundred to zero. The logical explanation for changing the regimen of that many patients for a single month is stock shortages. This is supported by information from the qualitative questions in the cross-sectional questionnaire. When patients were asked to describe their experience with stock shortages at NRH, several patients reported that they were prescribed a different ART regimen when their current regimen was not available because of stock shortages. « Quand il n y a pas, ils donnent une peu ou bien changent le médicament. (When there isn't any they give a little at a time or change our medication.) »

Figure 1 Regimen changes at Nkongsamba Regional Hospital January 2013-June 2014



The effect of stock shortages can also be seen when looking at a graph of patients with active files reported as not receiving treatment (Figure 2). Comparing the two graphs one can see that the months with high numbers of patients not receiving treatment correlates to the months with drops in patient prescription.

Figure 2 Patients with active files reported as not receiving treatment



IV. Discussion

The current study conducted in Cameroon between June 2014 and October 2014 assessed the prevalence of ART non-adherence and factors associated with it at Nkongsamba Regional Hospital through a cross-sectional questionnaire. Male gender, being married and being widowed was significantly associated with self-report of good ART adherence, while female gender, being single or being divorced was significantly associated with self-report of poor ART adherence. Longitudinal clinic data and qualitative responses to open-ended questions provided supplemental data about the impact of stock shortages of patient adherence and other aspects of patient life in greater depth.

The status of non-adherence in the study population (37%) is comparable to a 2013 study done in Cameroon's capital, which estimated 35% non-adherence prevalence using the CASE index.³ The prevalence of non-adherence in this study is higher than previous studies using the CASE index, including a 2011 study from Nairobi, Kenya that reported 18% non-adherence.⁹

This study found that women were significantly more likely than men to report poor adherence. The findings on the association between gender and adherence are inconsistent with the findings of other studies in Cameroon. Marcelin et al. reported that there was a significant relationship between male gender and ART interruption.⁴ This association is supported by qualitative data collected among health professions in Cameroon in 2007, which found that HIV positive men have more difficulties accepting their diagnosis and entering the long term process of care.¹² Similarly, a systematic review of 9 publications on ART adherence in Cameroon found that female gender was positively associated with adherence, possibly because males are more likely to engage in behaviors that negatively influence adherence, such as binge drinking, tobacco use and drug use.¹³

Marital status was found to be significantly associated with adherence in this study ($p=.08$). Analysis showed that married and widowed respondents were more likely than single and divorced respondents to report good adherence. Other studies have reported mixed results. In Cameroon, having a stable partner was not found to be a predictor of adherence.⁴ Similarly, in Kenya no association was found between marital status and adherence.¹⁴ However, Byakika *et al* found a positive association between being married and adherence in Uganda among patients purchasing therapy.¹⁵

In this study, having experienced stock shortages was not significantly associated with non-adherence. This finding is inconsistent with a 2007 study done in Yaoundé, Cameroon where it was found that patients exposed to ARV drug shortages were 3.25 times as likely to interrupt ART.⁴ Additionally, Kranzer and Ford's 2011 systematic review of unstructured ART interruption found that pharmacy stock outs and poor access to drugs were reported in three of the four studies from developing countries that reported treatment interruptions.² Recognizing that ART interruption and adherence are not synonymous, treatment interruptions can lead to poor adherence.

Regimen change was a factor measured in the cross sectional questionnaire; however, no association was found between adherence and regimen change in this study. This is inconsistent with data from two studies done in Cameroon, which found that ART regimen changes were associated with non-adherence.^{3,16}

This study has several limitations. Several methodological factors limit the applicability of the study including its cross-sectional nature and sample size. Cross-sectional studies are able to determine associates but preclude causality. Additionally, the study's sample size was determined using calculations that overestimated the proportion of patients that had not experienced stock shortages. Thus, this study is limited due to its failure to capture a robust comparison group. While 90.5% of the study population having experienced stock shortages is a significant finding, it presented problems during the analysis stage. Finally, the convenience sampling method used might have resulted in a biased sample.

Assessment of ART adherence based on self-report has been shown to be subject to recall and social desirability bias that may result in an over-estimation of adherence.¹⁷ Additionally, different measures of self-report result in different measures of adherence. The CASE adherence index had low agreement when used in conjunction with CPCRA index in Cameroon.³ However, there is evidence that measures of self-report provide a sensitive measure of non-adherence that is frequently reliable.¹⁸ Additionally, self-report was the only feasible method of adherence measure in this context. Other methods, such as viral load count or MEMS caps are more objective but their implementation and use in low-resource settings is limited.

Only patients who had come to the hospital on patient visit days were included in this study. Hence, this study may have slightly over-estimated the actual adherence among patients receiving treatment at Nkongsamba Regional Hospital. Patients who came to the hospital on patient visit days are demonstrating good health behaviors and might be more likely to be adherent to ART. Additionally, this study could be subject to sampling bias as a result of the convenience sampling methods used to recruit participants in the cross-sectional questionnaire.

Given the limitations of this study, no definitive conclusions can be made about factors associated with ART non-adherence at Nkongsamba Regional hospital. However, the prevalence of non-adherence found in this study is consistent with other studies done in Cameroon.

This study contributes to the scientific literature on factors associated with non-adherence in Cameroon in several ways. As previously mentioned, this is the only study to our knowledge that explores adherence prevalence, factors associated with non-adherence, and impact of stock shortages outside of Cameroon's capital. Additionally, to our knowledge this is the only study utilizing mixed-methods to assess the impact of stock shortages on ART adherence in Cameroon. The supplemental data provided by the responses to the open-ended questions and clinic data provides a rich description of the impact of stock shortages on patient life.

The prevalence of non-adherence described in this study is high, and could contribute to ART resistance and treatment failure. Further research needs to be done to understand the effects of high prevalence of non-adherence, and factors influencing non-adherence, in order to identify areas of intervention.

References

1. Pasquet A, Messou E, Gabillard D, Minga A, Depoulosky A, Deuffic-Burban S, Losina E, Freedberg KA, Danel C, Anglaret X, Yazdanpanah Y. Impact of drug stock-outs on death and retention to care among HIV-infected patients on combination antiretroviral therapy in Abidjan, Cote d'Ivoire. *PLoS One*. 2010; 5(10): e13414. doi:10.1371/journal.pone.0013414
2. Kranzer K, Ford N. Unstructured treatment interruption of antiretroviral therapy in clinical practice: a systematic review. *Tropical Medicine and International Health*. 2011; 16(10): 1297-1313. doi:10.1111/j.1365-3156.2011.02828.x
3. Pefura-Yone EW, Soh E, Kengne AP, Balkissou AD, Kuaban C. Non-adherence to antiretroviral therapy in Yaounde: Prevalence, determinants and the concordance of two screening criteria. *Journal of Infection and Public Health*. 2013; 6(4): 307-315. doi:http://dx.doi.org/10.1016/j.jiph.2013.02.003
4. Marcellin F, Boyer S, Protopopescu C, Dia A, Ongolo-Zogo P, Kolla-Shiro S, Abega SC, Abe C, Moatti JP, Spire B, Carrieri MP. Determinants of unplanned antiretroviral treatment interruptions among people living with HIV in Yaoundé, Cameroon. *Tropical Medicine and International Health*. 2008; 13(12): 1470-1478. doi:10.1111/j.1365-3156.2008.02170.x
5. Peltzer K, Pengpid S. Socioeconomic factors in adherence to HIV therapy in low- and middle-income countries. *J Health Popul Nutr*. 2013; 31(2): 150-170.
6. Lankowski AJ, Siedner MJ, Bangsberg DR, Tsai AC. *AIDS Behav*. 2014; 18: 1199-1223. doi:10.1007/s10461-014-0729-8
7. Katz IT, Ryu AE, Onuegbu AG, Psaros C, Weiser SD, Bangsberg DR, Tsai AC. Impact of HIV-related stigma on treatment adherence: systematic review and meta-synthesis. *Journal of the International AIDS Society*. 2013; 16(2): 18640. doi:10.7448/IAS.16.3.18640
8. HIV drug resistance working group, National AIDS control committee in Cameroon. Guidelines for the evaluation of Early Warning Indicators for HIV resistance (EWI). 2010
9. Billong SC, Fokam J, Armand SN, Kembou E, Milenge P, TSomo Z, Dion GN, Aghokeng AF, Eitel MN, Ndumbe PM, Colizzi V, Nfetam JBE. Early Warning Indicators for HIV drug resistance in Cameroon during the year 2010. *PLoS Oen*. 2012; 7(5): e36777. doi:10.1371/journal.pone.0036777
10. Rapport National de Suivi de la Declaration Politique sur le VIH/SIDA Cameroun (2012).
11. Mannheimer SB, Mkhherjee R, Hirschhorn LR, Dougherty J, Celano SA, Ciccarone D, Graham KK, Mantell JE, Mundy LM, Eldred L, Botsko M, Finkelstein R. The CASE adherence index: A novel method for measuring adherence to antiretroviral therapy. *AIDS Care*. 2006; 18(7): 853-861. doi:10.1080/09540120500465160
12. Djetcha S. Gender perceptions and experience of antiretroviral treatment in Cameroon. Abstract 297, 8th International AIDS Impact Conference, 1-4 July 2007. Marseilles, France.
13. Mbuagbaw L, Thabane L, Ongolo-Zogo P, Yondo D, Noorduynd S, Smieja M, Dolovich L. Trends and determining factors associated with adherence to

antiretroviral therapy (ART) in Cameroon: a systematic review and analysis of the CAMPS trial. *AIDS Research and Therapy*. 2012; 9(37). doi:10.1186/1742-6405-9-37

14. Waibi SN, Ng'ang'a ZW, Mbugua GG. Factors associated with non-adherence to highly active antiretroviral therapy in Nairobi, Kenya. *AIDS Research and Therapy*. 2011; 8(43). doi:10.1186/1742-6405-8-43
15. Byakika-Tusiime J, Oyugi JH, Tumwikrize WA, Katabira ET, Mugenyi PN, Bangsberg DR. Adherence to HIV antiretroviral therapy in HIV+ Ugandan patients purchasing therapy. *Int J STD AIDS*. 2005; 16(1): 38-41.
16. Kranzer K, Ford N. Unstructured treatment interruption of antiretroviral therapy in clinical practice: a systematic review. *Tropical Medicine and International Health*. 2011; 16(10): 1297-1313. doi:10.1111/j.1365-3156.2011.02828.x
17. Boyer S, Clerc I, Bonono CR, Marcellin F, Bile PC, Ventelou B. Non-adherence to antiretroviral treatment and unplanned treatment interruption among people living with HIV/AIDS in Cameroon: individual and healthcare supply-related factors. *Social Science and Medicine*. 2011; 72(8):1383-92. doi:10.1016/j.socscimed.2011.02.030
18. Simoni JM, Kurth AE, Pearson CR, Pantalone DW, Merrill JO, Frick PA. Self-report measures of antiretroviral therapy adherence: A review with recommendations for HIV research and clinical management. *AIDS Behavior*. 2006; 10(3): 227-245. doi:10.1007/s10461-006-9078-6

Appendix A: Cross-sectional Questionnaire

I. INTAKE/ELIGIBILITY

DATE: ____ / ____ / ____ INTERVIEWER: _____

ID: _____

INTRODUCTION: THANK YOU VERY MUCH FOR YOUR INTEREST IN TAKING PART IN THIS PROJECT. BEFORE WE GET STARTED, I'LL NEED TO ASK YOU A FEW QUESTIONS TO MAKE SURE THAT YOU ARE ELIGIBLE TO TAKE PART.

1. How old are you?

|_____| YEARS OLD [IF LESS THAN 21 SKIP TO CLOSE]

2. When did find out that you had HIV (if unknown check health book)?

|_____| |_____| |_____|
DAY MONTH YEAR

3. How long have you been receiving treatment at Nkongsamba Regional Hospital (if unknown check health book)?

|_____| MONTHS [IF LESS THAN 6 MONTHS AS OF JANUARY 2013 SKIP TO CLOSE]

[CLOSE]: THANK YOU FOR YOUR INTEREST AND YOUR TIME TODAY. UNFORTUNATELY YOU DO NOT MEET THE REQUIREMENTS NEEDED TO TAKE PART IN THIS PROJECT.

[IF ELIGIBLE FOR IMMEDIATE PARTICIPATION, BEGIN QUESTIONNAIRE]

II. QUESTIONNAIRE

IN THIS PROJECT, WE ARE INTERESTED IN LEARNING ABOUT YOUR EXPERIENCE WITH TREATMENT AT NKONGSAMBA REGIONAL HOSPITAL AND YOUR EXPERIENCE WITH YOUR MEDICATION.

4. Gender?

MALE 1

FEMALE..... 2

5. Which of these choices best describes you right now? [READ EACH OPTION]

MARRIED..... 1

DIVORCED	2
SINGLE	3
LIVING WITH PARTNER	4
WIDOWED	5
OTHER (SPECIFY) _____	6

6. Thinking about school, which of these choices best describes you? [READ EACH OPTION]

NO FORMAL SCHOOLING	1
PRIMARY	2
SECONDARY.....	3
COLLEGE/LYCEE	4
UNIVERSITY	5

7. Do you know the name of your HIV medication?

YES	1
NO.....	2

If YES record regime here, if NO check the health book and record here

NVP + ZDV/3TC	1
EFV + ZDV/3TC	2
EFV + TDF/3TC	3
NVP + TDF/3TC	4
NVP + ABC/3TC	5
EFV + ABC/3TC	6
LPV/r + TDF/3TC	7
LPV/r + ZDV/3TC	8

8. How often do you feel that you have difficulty taking your HIV medications on time? [READ EACH OPTION]

NEVER	4
RARELY	3
MOST OF THE TIME	2

ALL OF THE TIME 1

9. On average, how many days per week would you say that you missed at least one dose of your HIV medications? [READ EACH OPTION]

- EVERYDAY 1
- 4-6 DAYS PER WEEK 2
- 2-3 DAYS PER WEEK 3
- ONCE A WEEK 4
- LESS THAN ONCE A WEEK 5
- NEVER 6

10. When was the last time you missed at least one dose of your HIV medications? [READ EACH OPTION]

- WITHIN THE PAST WEEK 1
- 1-2 WEEKS AGO 2
- 3-4 WEEKS AGO 3
- BETWEEN ONE AND THREE MONTHS AGO 4
- MORE THAN THREE MONTHS AGO 5
- NEVER 6

11. Have you ever been told that your medication is not available after arriving at the hospital due to stock shortages of your medication?

- YES 1
- NO 2 [IF NO SKIP TO 14]

Please describe your experience [PROMPT: about how often does this occur]

12. Do you feel that stock shortages make it more difficult to take your medication on time?

YES 1

NO 2

If YES why?

13. How do stock shortages affect other parts of your life? [PROMPT: stress, wasted time and money]

14. How long does it take you to get to the hospital from your home? [READ EACH OPTION]

LESS THAN ONE HOUR 1

MORE THAN ONE HOUR 2

15. How much does it cost to get to the hospital from your home?

|_____| CFA

THESE ARE ALL THE QUESTIONS I HAVE FOR YOU. DO YOU HAVE ANY QUESTIONS FOR ME?

HERE IS MY CONTACT INFORMATION IN CASE YOU HAVE ANY QUESTIONS LATER. THANK YOU FOR YOUR TIME AND FOR SHARING THIS IMPORTANT INFORMATION WITH ME.

Appendix B: CASE Adherence Index

Please ask each question and circle the corresponding number next to the answer, then add up the numbers circled to calculate Index score.

A1. How often do you feel that you have difficulty taking your HIV medications on time?
By 'on time' we mean no more than two hours before or two hours after the time your doctor told you to take it.

- 4 Never
- 3 Rarely
- 2 Most of the time
- 1 All of the time

A2. On average, how many days per week would you say that you missed at least one dose of your HIV medications?

- 1 Everyday
- 2 4-6 days/week
- 3 2-3 days/week
- 4 Once a week
- 5 Less than once a week
- 6 Never

A3. When was the last time you missed at least one dose of you HIV medications?

- 1 Within the past week
- 2 1-2 weeks ago
- 3 3-4 weeks ago
- 4 Between 1 and 3 months ago
- 5 More than 3 months ago
- 6 Never

INDEX SCORE: _____

>10 = good adherence ≤10 = poor adherence