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Research Article

Antiretroviral therapy adherence among patients living with HIV/AIDS in Thailand

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Abstract   The importance of antiretroviral therapy adherence for patients living with HIV/AIDS has been well documented. Despite this critical need, many do not follow prescribed regimens. To examine the barriers that lead to non-adherence, we used cross-sectional survey data from a randomized controlled intervention trial in northern and north-eastern Thailand. Of the 507 patients that were enrolled in the trial, we analyzed 386 patients on antiretroviral therapy in order to examine the barriers to adherence. In addition to demographic characteristics, depressive symptoms, physical health, access to care, social support, and internalized shame, HIV disclosure and family communication were examined. The correlation analysis revealed that adherence is significantly associated with internalized shame, access to care, depressive symptoms, and family communication. Based on the multiple logistic regression analysis, depressive symptoms, access to care, HIV disclosure, and family communication were significant predictors of adherence. Having depressive symptoms remains a significant barrier to adherence, while access to care, HIV disclosure, and family communication play important positive roles. Our findings underscore the critical importance of addressing these various challenges that can influence adherence to antiretroviral therapy.

Key words   adherence, antiretroviral therapy, HIV/AIDS, randomized controlled trial, Thailand.

INTRODUCTION

Antiretroviral therapy (ART) is considered to be a breakthrough in the battle against HIV/AIDS (Centers for Disease Control and Prevention, 1997; Deeks *et al.*, 1997; Crum *et al.*, 2006; Jones *et al.*, 2007; Simoni *et al.*, 2008). The available data suggest that long-term treatments with a $\geq 95\%$ adherence rate could suppress the augmentation of viral loads, improve immune system functioning (Paterson *et al.*, 2002; Chesney, 2003), and reduce HIV/AIDS-related mortality and morbidity (Kalichman *et al.*, 1999; Crum *et al.*, 2006), transforming the disease into a treatable chronic condition. At the same time, evidence shows that a lack of adherence can lead to failure of the treatment and even accelerated development of drug-resistant HIV (Amberbir *et al.*, 2008), as well as more rapid progression to AIDS (Bangsberg *et al.*, 2001). Therefore, adherence to prescribed ART regimens becomes an important predictor of treatment success, which has a direct impact on disease progression and patients' quality of life (McInerney *et al.*, 2008).

Over a decade of studies that examined ART adherence in the USA and Europe identified important factors impacting ART adherence (Simoni *et al.*, 2008). Antiretroviral therapy adherence research to date includes methodologically rigorous investigations, randomized controlled trials, and systematic reviews that examined the various factors associated with ART adherence, including the optimal level of adherence (Bangsberg *et al.*, 2007), association of adherence with viral load suppression (Gardner *et al.*, 2008), adherence assessment methodologies (Simoni *et al.*, 2007), predictors and correlates of adherence (Mills *et al.*, 2006), and the conceptualization of adherence (DiIorio *et al.*, 2009). In addition, the lessons that were learned from the adherence literature identified distinct categories of factors associated with ART adherence: the patient factor, the medication factor, the patient–health-care provider relationship factor, and the medical care infrastructure factor (Chesney, 2000). For the patient and medication factors, the failure to adhere to ART may be characterized as erratic, unwitting, or intentional (Donovan & Blake, 1992). Erratic non-adherence refers to patients who know and understand what to do, but for various reasons do not comply with medication instructions (e.g. too busy, forgetful, or run out of medicine), unwitting non-adherence refers to patients who fail to take the medication because they do not understand the dosing schedule (e.g. due to a compromised psychological state), and

intentional non-adherence refers to patients who give multiple reasons for not following their regimen (e.g. the regimen is too complex or it interferes with their lifestyle) (Donovan & Blake, 1992). We observed these behaviors during the early phase of ART introduction in the USA, where challenges to adherence were caused by the complex and inconvenient nature of ART (i.e. many pills to take on a very stringent time schedule, often with visible physical side-effects) (Remien *et al*., 2003). In addition to the patient and medication factors that are associated with non-adherence, research shows that system-level factors (e.g. access to care) might significantly impact adherence behaviors, directly or indirectly (Sharma *et al*., 2007).

The lessons that have been learned from ART research in the USA and Europe have high relevance in ART adherence investigations in Thailand. Although < 2% of people nationally are HIV-seropositive, > 610 000 Thais are living with HIV; most are adults > 15 years old (UNGASS, 2008). Therefore, ART adherence is a critical issue for people living with HIV (PLH) in Thailand. As a result of the reduction in cost of ART in Thailand, the Ministry of Public Health instituted the Access to Care program, which covered 6000–10 000 patients with HIV infection, in 2002. In 2004, the National Access to Antiretroviral Therapy for People with HIV/AIDS Program provided more extensive access – to an additional 50 000 Thai patients – and the number expanded rapidly with additional support from the Thailand Social Security Health Care Scheme in late 2004 and the Universal Health Care Scheme in 2005 (Maneesriwongul *et al*., 2006).

As Thailand continues the widespread use of ART with PLH, similar challenges are anticipated (Ammassari *et al*., 2004). In addition, a growing body of evidence suggests that psychosocial factors, including depression, HIV-related stigma, family relationships, and HIV status disclosure, play an important role in ART adherence (Tucker *et al*., 2003; Ammassari *et al*., 2004; Bouhnik *et al*., 2005; Hartzell *et al*., 2007; Ncama *et al*., 2008). As a result of their physical debilitation and the psychological impact of coping with HIV infection, PLH remain highly vulnerable to social isolation (Singh *et al*., 1999); social support might play a significant role in ART adherence (Ncama *et al*., 2008).

The various factors that are associated with ART adherence are interconnected. For example, a lack of access to care might contribute to ART non-adherence, which in turn could lead to depression that is caused by physical illness (Sharma *et al*., 2007). Conversely, the depression that is experienced by PLH could be the result of adverse physical side-effects that are caused by ART, HIV/AIDS-related stigma, strained family relations, and/or a lack of social support (Catz *et al*., 2000). Serological status disclosure to significant others has been identified as an indicator of the efforts of PLH to seek social support (Chanard, 2007), although the importance of such support might be in making patients feel safe and wanted in their social circle, rather than being related directly to the disease (Molassiotis *et al*., 2002). Ultimately, increasing social support and reducing depressive symptoms could result in increased ART adherence (Yun *et al*., 2005).

As Thailand continues to expand programs to disseminate ART, an examination of the multidimensional factors that are associated with ART adherence is critical to informing future implementation efforts (Maneesriwongul *et al*., 2006). Based on the number of personal and social factors that have been identified as possible factors in ART adherence (Ammassari *et al*., 2002; Fogarty *et al*., 2002; Ickovics *et al*., 2002; Simoni *et al*., 2008), we applied social cognitive theory (Bandura, 1997) as the guiding framework to examine the multidimensional factors that are associated with ART adherence. This conceptual model has been successfully applied in the examination of ART adherence (DiIorio *et al*., 2009). In this study, we examined access to care, social support, family relationships, HIV disclosure, depressive symptoms, and HIV-related stigma.

METHODS

This study uses the baseline data from a randomized controlled family intervention trial that was designed to improve the quality of life of PLH in the northern and north-eastern regions of Thailand (Li *et al*., 2009; Lee *et al*., 2010). These data were collected in 2007 from four district hospitals in the two regions (two district hospitals per region). The PLH were recruited when they sought medical care from the study hospitals. Health-care workers at the hospital informed the PLH of the study and the interested patients were introduced to the research staff. The research staff members, who were specifically hired for the study, introduced the study purpose and procedure. Once the PLH voluntarily agreed to participate in the study, written informed consent was obtained. Following informed consent, a trained interviewer administered the baseline survey to the PLH by using a computer-assisted personal interview. The refusal rate for the study recruitment was ~ 7%. The approval of this study was obtained from the Institutional Review Board of the University of California, Los Angeles, USA and the Ministry of Public Health's Ethical Review Committee for Research in Human Subjects, Bangkok, Thailand.

Among the 507 PLH that were enrolled in the intervention trial, 386 PLH (76%) were currently on ART at the time of the assessment. Only those participants who were currently on ART were included in this study. During the interview, the participants were asked about their age, sex, annual income, educational status, and questions about their perceived stigma, social support, physical health, access to care, depressive symptoms, HIV disclosure, and family functioning.

Measures

Internalized shame

This was measured as a subscale of HIV-related stigma, based on the work of Herek and Capitanio (1993), and validated by the Thai investigators in Nakhon Ratchasima Province, Thailand (Apinundecha *et al*., 2007). The subscale was based on nine items (e.g. "I am punished by evil", "My life is tainted", and "I am a disgrace to society"). The response categories ranged from 1 ("Strongly disagree") to 5 ("Strongly agree"). Composite scores were created for internalized shame

(range = 9–45). The Cronbach's α of 0.80 for this scale suggested high inter-item reliability.

Social support

This was constructed as a composite variable, based on the Medical Outcomes Study Social Support Scale (Sherbourne & Stewart, 1991), and was used in the same group in Thailand (Li *et al.*, 2009). The scale reflects tangible social support, consisting of four items: (i) someone to help you if you are confined to bed; (ii) someone to take you to a doctor if you need it; (iii) someone to prepare your meals if you are unable to do so; and (iv) someone to help you with daily chores if you are sick. The responses to individual items ranged from 1 ("None of the time") to 5 ("All of the time"). This summative composite score ranged from 4–20, with a satisfactory level of internal consistency (α = 0.81).

Physical health

This was assessed by the Medical Outcome Study-HIV Health Survey's physical health subscale, consisting of six items (Revicki *et al.*, 1998), and was used in the sample population in Thailand (Li *et al.*, 2010). The PLH were asked which activities they might do during a typical day. They were asked to report how much their health limited these activities (0 = "Not limited", 1 = "Marginally limited", and 2 = "Greatly limited"). The six items were: (i) vigorous activities, such as lifting heavy objects, running, or participating in strenuous sports; (ii) moderate activities, such as moving a table or carrying groceries; (iii) walking uphill or climbing; (iv) bending, lifting, or stooping; (v) walking around for one block; and (vi) eating, dressing, bathing, or using the toilet. The subscale was transformed into a 100-point scale. It had high internal consistency (α = 0.83).

Access to care

This was measured by using seven items that were created into a single composite variable as a proxy to access to care: (i) "I have regular visits to my doctor or medical providers"; (ii) "If I get sick, I know where to go to get treatment"; (iii) "If I need more information about my illness, I know where to get it"; (iv) "I know to go for my check-up regularly, even when I am not sick"; (v) "I know where to get information to protect myself from getting sick (e.g. opportunistic infections)"; (vi) "I know where to get information to eat right to get proper nutrition to stay healthy"; and (vii) "I know where to get information to exercise to stay healthy". The Cronbach's α for this variable was 0.55.

Depressive symptoms

These were assessed with a 15-item screening test that was developed and used previously in Thailand (Department of Mental Health, 2008). As a screening tool, this measure captures depressive symptomatology and has been used in this population (Li *et al.*, 2009; Rotheram-Borus *et al.*, 2009). These questions asked about the problems that had bothered the participants in the past week (e.g. feeling depressed most of the time, feelings of hopelessness or worthlessness, loss of self-confidence, or fear of death), with response categories from 0 ("Not at all") to 3 ("Usually [5–7 days per week]"). A summative composite scale was developed, with a range of 0–45 and excellent internal consistency (α = 0.91).

HIV disclosure

This was a single composite measure that was based on the extent to which PLH disclosed their serostatus to various people (0 = "No one", 1 = "Some", and 2 = "All") (e.g. sexual partners, co-workers, family members outside of their household, health-care workers, village leaders, village health volunteers, or other people in the community). Based on the eight items, a summative composite scale was developed, with a range of 0–16 (α = 0.79) (Lee *et al.*, 2010).

Family functioning (communication)

This was a subscale from the Thai Family Functioning Scale, which was adapted from the Family Assessment Device (FAD) that was developed by the Butler/Brown Family Research Group. The FAD is based on the McMaster Model of Family Functioning (Epstein *et al.*, 1983). Consisting of eight items (e.g. "family members hardly expressed their love and care", "I could not tell what my family members felt by the words they spoke", and "when family members got mad, they did not talk to each other"), it is scored on a scale of 0 ("Never") to 3 ("Always"). A summative composite subscale was developed, with a range of 0–24 (α = 0.65), and was validated among this group (Rotheram-Borus *et al.*, 2009).

Sociodemographic characteristics

These included sex, age (years), marital status, education, employment status, number of years since HIV diagnosis, and annual income.

Data analysis

All the analyses were carried out by using SAS statistical software, version 9.1 (SAS Institute, Cary, NC, USA). Descriptive statistics were used to describe the treatment adherence of PLH by using demographics, followed by calculating Pearson's correlation coefficients to examine the relationships between ART adherence, demographics, internalized shame, social support, physical health, access to care, depression, HIV disclosure, and family functioning. These variables were determined a priori to be included in the logistic regression model, based on the existing literature and previous studies. The logistic regression model was carried out with the ART adherence variable, simultaneously controlling for the participants' demographic characteristics, internalized shame, social support, physical health, access to care, depression, HIV disclosure, and family functioning. For the final logistic regression model, continuous predictors (e.g. internalized shame, social support, and access to care) were transformed into dichotomous variables by designating the

median value as the cut-off point. The significance of the predictors remained consistent to the model, where the predictors were considered as continuous variables. The transformation was done to facilitate the interpretation of the findings. Odds ratios (ORs) from the multiple logistic regression estimation and their significant level (P-value) are reported.

RESULTS

Demographic characteristics of the sample

The participants' age ranged from 23–64 years (Table 1), with a mean age of 38.0 years (standard deviation = 6.4). Most of the participants were women (67.3%). The high percentage of women in the sample reflects the result of heterosexual transmission in the region. A large proportion of women lost their husband due to AIDS and subsequently found out about their HIV status. Most of the participants (85.4%) had less than a high school education. Most PLH on ART reported being employed (84.5%) and being married or living with a partner (59.3%). The average individual annual income was 30 623 baht per year (equivalent to $US875). Over one-third of the PLH on ART (37.6%) reported knowing their serostatus for > 7 years.

Antiretroviral therapy adherence

Almost one-third (n = 121, 31.4%) of the PLH reported "Yes" to the question of "Have you ever forgotten to take ARV medications in your lifetime?" We found no significant differences in the demographic characteristics (sex, age, education, employment, marital status, and number of years since diagnosis) when we examined the relationship with never forgetting ART medications, with the exception of personal income. The PLH who reported failing to adhere to ART reported significantly higher incomes (P < 0.05) (Table 1).

Among the 121 PLH who reported failing to adhere to ART, 49 PLH (40.5%) reported failing to adhere to ART in the past month. A majority of the PLH who reported failing to adhere to ART in the past month reported that they simply forgot to take the medication (78%) (Table 2). About one-fifth of the PLH (18%) reported that the reason for non-adherence was because they were afraid of stigma if their HIV status was disclosed. The other reasons that were given included: trouble visiting the doctor (6%); running out of medication (6%); not understanding the medication or believing that the medication would not help (6%); and being too sick to retrieve the medication from the hospital or wanting to avoid side-effects (4%).

Correlation analyses

The correlation coefficients among ART adherence, demographic characteristics, social support, internalized shame, physical health, access to care, depression, HIV disclosure, and family functioning are presented in Table 3. Significant negative correlations were observed between ART adherence and internalized shame (r = −0.12, P < 0.05) and depression (r = −0.15, P < 0.05). In contrast, significant positive correlations were found between ART adherence and access to care (r = 0.14, P < 0.05) and positive family functioning (r = 0.15, P < 0.05). As expected, internalized shame was

Table 1. Characteristics of people living with HIV by antiretroviral therapy (ART) adherence (n = 386)

Characteristic	ART adherence Yes† N (%)	No‡ N (%)	Total N (%)
Sex			
Female	179 (67.8)	80 (66.1)	259 (67.3)
Male	85 (32.2)	41 (33.9)	126 (32.7)
Age (years)			
≤ 30	22 (8.3)	15 (12.5)	37 (9.7)
31–40	158 (60.3)	70 (58.3)	228 (59.7)
41–50	74 (28.2)	27 (22.5)	101 (26.4)
> 50	8 (3.1)	8 (6.7)	16 (4.2)
Education			
Lower than elementary school	45 (17.8)	11 (10.0)	56 (15.4)
Elementary/junior school	175 (69.2)	79 (71.8)	254 (70.0)
Some high school or more	33 (13.0)	20 (18.2)	53 (14.6)
Employment			
Employed	219 (82.6)	107 (88.4)	326 (84.5)
Unemployed	46 (17.4)	14 (11.6)	60 (15.5)
Marital status			
Married/cohabiting	151 (57.6)	76 (62.8)	227 (59.3)
Divorced/separated	39 (14.9)	17 (14.1)	56 (14.6)
Widowed	70 (26.7)	26 (21.5)	96 (25.1)
Never married	2 (0.8)	2 (1.7)	4 (1.0)
Personal income (baht)*			
≤ 35 000	200 (75.8)	67 (55.4)	267 (69.2)
35 001–55 000	44 (16.6)	34 (28.1)	78 (20.2)
≥ 55 001	21 (7.9)	20 (16.5)	41 (10.6)
Number of years since diagnosis			
> 7 years	102 (38.5)	43 (35.5)	145 (37.6)
≤ 7 years	163 (61.5)	78 (64.5)	241 (62.4)

*P < 0.05. †Total: 264 (68.6%); ‡total: 121 (31.4%).

Table 2. Reasons for not adhering to antiretroviral therapy in the past month (n = 49)

Reason	N	%
Forgot to take the medication	38	78
Afraid of stigma if one's HIV status is disclosed to others	9	18
Trouble visiting a doctor at a hospital	3	6
Ran out of the medications	3	6
Believed the medications cannot help them/did not understand the methods to take them	3	6
Too sick to get medication at the hospital/wanted to avoid side-effects	2	4

Table 3. Correlation coefficients and significance levels across demographics and predictors of antiretroviral therapy (ART) adherence

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ART adherence	1.00	–	–	–	–	–	–	–	–	–	–	–	–	–
2. Female	0.03	1.00	–	–	–	–	–	–	–	–	–	–	–	–
3. Age	0.01	0.13*	1.00	–	–	–	–	–	–	–	–	–	–	–
4. Education	-0.02	0.02	0.18*	1.00	–	–	–	–	–	–	–	–	–	–
5. Annual income	-0.05	-0.09	0.06	0.10	1.00	–	–	–	–	–	–	–	–	–
6. Marital status	-0.04	-0.19*	0.16*	-0.05	-0.02	1.00	–	–	–	–	–	–	–	–
7. Employed	-0.07	-0.08	0.02	-0.01	0.05	0.24**	1.00	–	–	–	–	–	–	–
8. Number of years since diagnosis	0.03	0.17*	0.10	0.01	-0.03	-0.03	-0.02	1.00	–	–	–	–	–	–
9. Social support (tangible)	0.03	0.06	0.04	0.22**	0.08	0.01	-0.06	0.04	1.00	–	–	–	–	–
10. Internalized shame	-0.12*	0.05	-0.06	-0.16*	0.02	-0.04	0.01	0.00	-0.05	1.00	–	–	–	–
11. Physical health	0.02	-0.02	0.04	0.07	0.04	0.07	0.14*	0.01	0.01	-0.26**	1.00	–	–	–
12. Access to care	0.14*	0.04	0.01	0.11*	-0.03	0.08	0.05	0.07	0.11	-0.08	0.06	1.00	–	–
13. Depressive symptoms	-0.15*	0.15*	0.06	-0.02	-0.05	-0.03	-0.04	0.07	-0.08	0.44**	-0.38**	-0.01	1.00	–
14. HIV disclosure	0.09	0.19*	-0.04	-0.02	-0.08	-0.17*	0.03	0.17*	0.08	0.01	-0.06	0.04	0.09	1.00
15. Family functioning (communication)	0.15*	0.01	-0.08	0.13*	0.08	0.03	-0.04	-0.07	0.43**	-0.10	0.11*	0.12*	-0.24**	0.04

*$P < 0.05$ and **$P < 0.0001$.

negatively correlated with physical health ($r = -0.26$, $P < 0.0001$) and positively correlated with depression ($r = 0.44$, $P < 0.0001$). Physical health also was negatively correlated with depression ($r = -0.38$, $P < 0.0001$) and positively correlated with family functioning ($r = 0.11$, $P < 0.05$), which was positively correlated with access to care ($r = 0.12$, $P < 0.05$) and negatively correlated with depression ($r = -0.24$, $P < 0.0001$).

Significant correlations also were found among the demographic characteristics of PLH and tangible social support, internalized shame, physical health, access to care, depression, HIV disclosure, and family functioning. For example, being female was significantly correlated with depression ($r = 0.15$, $P < 0.05$) and education was positively correlated with tangible social support ($r = 0.22$, $P < 0.0001$), access to care ($r = 0.11$, $P < 0.05$), and family functioning ($r = 0.13$, $P < 0.05$).

Logistic regression analyses

Table 4 outlines the logistic regression model, which examined the factors that were associated with ART adherence. Controlling for the demographic variables, depression remained a significant negative predictor of ART adherence (OR = 0.69, $P = 0.03$). In addition, higher access to care (OR = 1.98, $P = 0.02$), HIV disclosure (OR = 1.70, $P = 0.03$), and positive family functioning (OR = 1.74, $P = 0.03$) all were significantly associated with ART adherence. Internalized shame, physical health, and social support were not significant predictors of ART adherence in the final logistic regression model.

DISCUSSION

Antiretroviral therapy has transformed HIV infection into a treatable chronic condition. However, successful treatment and sustained viral suppression require high levels of adherence to prescribed regimens. Our study revealed that ART adherence in Thailand remains a significant challenge. A modest percentage of participants (69%) on ART were committed to adequate adherence; if social desirability bias was taken into consideration, the real ART adherence rate could be lower. Among the 121 PLH who reported failing to adhere to ART, 49 PLH (40%) reported failing to adhere to ART in the past month. The challenges that are associated with ART are anticipated to escalate in Thailand. For example, given the high numbers of treatments that are experienced by inpatients in Thailand, an examination of the virological response and ART resistance is essential (Maneesriwongul *et al.*, 2006).

The PLH in Thailand displayed all three features of ART non-adherence (erratic, unwitting, and intentional). These findings are consistent with the existing literature (Donovan & Blake, 1992; Amberbir *et al.*, 2008) and suggest that PLH on ART in Thailand face the same types of challenges that are faced by patients in the USA and other countries. Murphy *et al.* (2000) found that patients who had predictable daily schedules often had an easier time adhering to ART. A common strategy was to tie their ART to routine daily events, such as eating breakfast or right before taking a child to

Table 4. Multiple logistic regression examining the predictors of antiretroviral therapy adherence

Predictor	Odds ratio	95% confidence limit		P-value
		Lower	Upper	
Female	1.023	0.63	1.71	0.90
Age	1.110	0.66	1.87	0.69
Married	1.100	0.84	1.45	0.50
Education	0.670	0.36	1.24	0.21
Employment	0.600	0.30	1.20	0.15
Number of years since diagnosis	0.970	0.60	1.57	0.89
Internalized shame	0.830	0.51	1.36	0.46
Social support (tangible)	1.070	0.68	1.71	0.76
Physical health	1.230	0.76	1.99	0.40
Depressive symptoms	0.690	0.41	0.98	0.03
Access to care	1.980	1.10	3.59	0.02
HIV disclosure	1.700	1.07	2.70	0.03
Family functioning (communication)	1.740	1.06	2.83	0.03

school. As Thailand prepares to disseminate ART in more hospitals, it is important to understand how patients integrate ART into the context of their daily life and which strategies should be used to motivate them to sustain good adherence rates.

Consistent with the existing literature (Singh *et al.*, 1996; Carrieri *et al.*, 2006; Berg *et al.*, 2007; Horberg *et al.*, 2008), the presence of depressive symptoms proved to be a barrier to ART adherence in this study. This finding sheds light on the complexity between the association of depressive symptoms with ART adherence. For example, ART non-adherence, caused by other factors (e.g. adverse side-effects), could cause PLH to develop depressive symptoms. However, the depressive symptoms of PLH might contribute directly to the failure to adhere to ART. Our finding underscores the importance of addressing patients' mental health in order to improve ART adherence. Moreover, a number of factors showed a significant association with depressive symptoms in the univariate analysis, such as being female, internalized shame, and poor physical health. Although they were not significant in the multiple logistic regression analysis, these associations suggest the "warning signs" of which health-care providers should be aware (e.g. more attention should be paid to female AIDS patients). Continuous efforts will be needed to reduce stigma and discrimination from the community and the patients themselves.

Better access to care was significantly associated with better ART adherence. Our access-to-care measure captured whether or not the PLH had regular visits to their doctors, as well as whether or not they had knowledge on how and where to access care. This finding is important because having access to care can have direct positive effects on ART adherence, as well as depressive symptoms. It is also evidence of the positive role that health-care providers can play during ART. A study that was conducted in China showed that the patient–provider relationship positively impacted patients and their ability to maintain their health, especially when they were isolated from other sources of support due to intense AIDS stigma (Chen *et al.*, 2007). Thailand has suc-

cessfully expanded access to HIV treatment and support services for PLH and their family. Antiretroviral therapy has been included in the National Health Security Scheme and the government issued two compulsory licenses for ART drugs (UNAIDS, 2008). As of 2007, the number of PLH in Thailand undergoing ART reached 133 539 persons (UNGASS, 2008). The estimate of coverage of PLH who should receive ART – Thai standards include symptomatic and asymptomatic patients with a CD4 level of < 200 cells/cu mm – was found to be 41.0–52.9% (UNGASS, 2008). Given the wide variation in the potential barriers to basic access to care, our findings underscore the critical importance of ensuring access to care and positive patient–provider relationships in Thailand.

HIV disclosure was a significant predictor of increased adherence to ART, after adjusting for the other variables. This is consistent with previous studies showing that HIV disclosure is a necessary facilitator to ART adherence (Ncama *et al.*, 2008). Our findings suggest that it is very important for physicians to know their patients' disclosure status before administering ART and that disclosure should be discussed during pre-ART counseling. For those who have not disclosed their HIV status, the providers should explain the importance of disclosure for the success of ART and help them to make a disclosure plan, if possible. However, as a general principle, the decision should be made by the patients and the providers always should respect their choice. Additional efforts should be made to ensure adherence for patients who do not wish to disclose their status (e.g. taking medication with routine daily events or using a medication box). Furthermore, it is very important to establish a supportive environment that will facilitate the disclosure decision, not only for the purpose of ART but also so PLH can lead a normal life.

Positive family communication was a significant contributor to ART adherence, as family members provide medication reminders for daily treatment, support to overcome side-effects, and reinforce a stable life. Moreover, those patients who perceive a need to meet family responsibilities

might be motivated to stay healthy (Watt *et al.*, 2009). Contrary to some previous studies (Gonzalez *et al.*, 2004; Vyava-harkar *et al.*, 2007), we did not find a statistical association between social support and treatment adherence in either the univariate or multivariate analyses. However, we showed that family communication was significantly associated with social support and adherence, suggesting that social support might influence adherence through an associated increase in positive family communication.

This study shares with others some of the general limitations related to data based on patients' self-reports, which might be affected by social desirability or recall bias. Thus, the rate of treatment adherence that is reported in this study should be interpreted cautiously in light of the possibility of a self-reporting bias. The ART measure that we used in our study poses limitations (e.g. self-report on lifetime ART adherence and 30 day recall among non-adherent PLH). However, given that our measure of lifetime adherence is based on PLH reporting whether or not they had ever forgotten to take ART medications, we believe that this is a measure of strict adherence and the rate of non-adherence in our study is conservative and would tend to underestimate the level of non-adherence. In addition, the 30 day recall follow-up question among those who reported "Yes" to "Have you ever forgotten to take ARV medications in your lifetime?" is consistent with other studies using similar 30 day recall questions. This measure has been used with the same population in Thailand (Rotheram-Borus *et al.*, 2009). Second, as our analyses were limited to PLH who were already on ART, the characteristics of the study participants might be different compared to PLH not on ART. Finally, because we used cross-sectional data for this study, our findings cannot be interpreted as causal relationships. Despite the limitations, our findings highlight the complex and multidimensional nature of ART adherence. For instance, HIV disclosure significantly impacts the mental health of PLH which, in turn, might influence ART adherence. In addition, a lack of access to care might contribute to increased depressive symptoms, as well as not having enough resources to assist PLH with HIV disclosure, which in turn influences their level of ART adherence. Further studies on HIV disclosure, access to care, depressive symptoms, and family functioning are necessary to gain better understanding of their relationship with ART adherence.

Our study underscores the critical importance of establishing a comprehensive therapeutic alliance between patients and clinicians to assess and address the various factors that influence a patient's treatment adherence in developing countries where the second line of ART is not readily available. These identified factors are amenable to health and behavioral intervention. For example, depressive symptoms should be recognized and treated in a timely way. A multidisciplinary approach is necessary to address psychological, social, and behavioral challenges. Based on our study findings and past lessons that have been learnt from past behavioral interventions in resource-poor developing countries (Simoni *et al.*, 2008), we are currently mounting an intervention trial to examine the barriers and concerns around ART adherence within the district hospitals in northern and north-eastern Thailand. The findings from this study will shed light on the design of future interventions and programs addressing the barriers and challenges around ART adherence in Thailand and other countries.

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