ผลของการให้แนวทางการดูแลเพิ่มเติมในผู้ติดเชื้อเอชไอวีสูงอายุ
Effects of an Enhanced Standard Care in Elderly HIV Patients

นิพนธ์ต้นฉบับ **Original Article**

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วารสารไทยเภสัชศาสตร์และวิทยาการสุขภาพ2565;17(3):209-218.

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บทคัดย่อ

วัตถุประสงค์: ศึกษาผลของการให้แนวทางการดูแลเพิ่มเติมในกลุ่มผู้ติดเชื้อเอชไอวีสูงอายุชาวไทย (กลุ่มทดลอง) ต่อความต่อเนื่องในการกินยา ระดับ CD4 cell และคุณภาพชีวิตของผู้ป่วยเทียบกับการรักษาตามมาตรฐาน (กลุ่มควบคุม) **วิธีการศึกษา:** เป็นงานวิจัยรูปแบบการทดลองแบบสุ่มและมีกลุ่มควบคุม สุ่มตัวอย่างผู้ติดเชื้อเอชไอวีสูงอายุโรงพยาบาลบึงกาฬแบบกลุ่มย่อย และใช้วิธีการจับคู่ตามเพศและระดับ CD4 cell เริ่มต้น เข้ากลุ่มควบคุมและกลุ่มทดลองกลุ่มละ 40 คน โดยแนวทางในการดูแลรักษาเพิ่มเติม (กลุ่มทดลอง) นั้นมีการให้ความรู้ความเข้าใจในเรื่องโรค การดูแลตนเองและการกินยาต้านไวรัสเอชไอวีอย่างต่อเนื่อง จัดหากล่องยาสำหรับใส่ยาพกยาติดตัวเสมอ กิจกรรมกลุ่มย่อยเพื่อแลกเปลี่ยนเรียนรู้ปัญหาในกลุ่มผู้ติดเชื้อ รวมถึงให้การสนับสนุนและสร้างกำลังใจ ประเมินผลลัพธ์ในสัปดาห์ที่ 1, เดือนที่ 3 และเดือนที่ 6 เป็นร้อยละความสม่ำเสมอในการกินยาและปัญหาที่เกิดจากการใช้ยา ระดับ CD4 cell และคุณภาพชีวิตซึ่งประเมินโดยใช้แบบสอบถามคุณภาพชีวิต MOS-HIV ทดสอบความเปลี่ยนแปลงตามเวลาที่เปลี่ยนไป (3 ครั้ง) ของผลลัพธ์ในแต่ละกลุ่มโดยใช้ repated measures ANOVA **ผลการศึกษา:** กลุ่มทดลองมีร้อยละความสม่ำเสมอในการกินยาต้านไวรัสเอชไอวีสูงกว่ากลุ่มควบคุมในเดือนที่ 6 อย่างมีนัยสำคัญทางสถิติ (P-value = 0.002) และมีคะแนนคุณภาพชีวิตเฉลี่ยในกลุ่มทดลองในเดือนที่ 3 และเดือนที่ 6 สูงกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ (P-value < 0.001, ทั้งคู่) กลุ่มทดลองมีระดับ CD4 cell ที่เพิ่มขึ้นจากเริ่มการศึกษาอย่างมีนัยสำคัญทางสถิติ (P-value = 0.004) ส่วนกลุ่มควบคุมมีการเพิ่มแต่ไม่มีนัยสำคัญทางสถิติ แต่ความแตกต่างของ CD4 cell แต่ละครั้งระหว่างสองกลุ่มนั้นไม่มีนัยสำคัญทางสถิติ พบว่าที่ 6 เดือนสัดส่วนคนไข้ที่มีค่า CD4 cell counts $\geq$ 58.8 cells/mm^3 ในกลุ่มทดลองมีสัดส่วนสูงกว่ากลุ่มควบคุมแต่ไม่มีนัยสำคัญทางสถิติ **สรุป:** การให้แนวทางในการดูแลเพิ่มเติมในกลุ่มผู้ติดเชื้อเอชไอวีสูงอายุ สามารถเพิ่มความต่อเนื่องสม่ำเสมอในการกินยาต้านเอชไอวี และคุณภาพชีวิตของผู้ป่วยได้ ควรศึกษาผลลัพธ์เหล่านี้ในระยะยาวต่อไป

คำสำคัญ: ผู้ติดเชื้อเอชไอวีสูงอายุ, ความต่อเนื่องสม่ำเสมอในการกินยา, ระดับ CD4 cell counts, แนวทางการดูแลเพิ่มเติมในกลุ่มผู้ติดเชื้อเอชไอวี, คุณภาพชีวิต

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Abstract

Objective: To determine effects of enhanced standard care (test group) on elderly HIV patients on anti-HIV medication adherence, CD4 levels, and quality of life compared with the usual standard care (control group). **Method:** A randomized controlled trial with random sampling and matched pairing based on gender and baseline CD4 levels. A total of 80 patients at Buengkan Hospital were randomized to the test and control groups equally. The enhanced standard care consisted of provision of knowledge of AIDS, self-care, adherence enhacement, pill box and group activities for problem sharing, support and motivation. Outcomes were assessed at week 1, month 3 and month 6 including % medication adherence, drug relatd problems, CD4 cell counts, and quality of life measused by MOS-HIV questionnaire. Within-group changes of outcomes over 3 time points were tested using repeated measures ANOVA. **Results:** The test group had a significantly higher % medication adherence at month 6 (P-value = 0.002), and overall quality of life scores at monts 3 and 6 than than the control group (P-value < 0.001, for both). In the test group, their CD4 cell counts increased significantly (P-value = 0.004); while those in the control group also increased but not statistically significant. At each assessment, CD4 cell counts between the two groups were not statistically different. At month 6, proportion of patients reaching the CD4 cell counts of $\geq$ 58.8 cells/mm^3 in the test group was higher than that in the control group but with no statistical significance. **Conclusion:** The enhanced standard care for the elderly HIV patients improved anti-HIV medication adherence and quality of life. Studies on benefits in a longer duration should be conducted.

Keywords: elderly HIV patients, medication adherence, CD4 cell counts, enhanced standard care, quality of life

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Introduction

Acquired Immune Deficiency Syndrome or AIDS, as a non-curable disease, has been a major public health problem since 1981. Since long-term treatment is to control the human immunodeficiency virus (HIV) RNA at the lowest level possible, it is to prevent complications, improve the patient's quality of life and prolong life.[1,2] The elderly with AIDS is a unique group of patients. The Centers for Disease Control and Prevention (CDC) of the US defined the elderly with AIDs as those 50 years old or older, not the usual 60 years old. This is because there has been a vast amount of data indicating that HIV makes organs inflame and thus deteriorate the organs 10 years faster than usual.[3] The CDC reported that in the US in 2015, AIDS patients aged 50 years or older accounted for 17.02% (or 6,725 out of 39,513 cases) of all

AIDs patients; while those 50 – 54 years old were 44.76% of all the patients. The early detection of HIV infection in the elderly, as early as 50 years old, as well as the early start of anti-retroviral (ARV) drugs in this group of patients has been of great concern. This is because the increasing age and HIV infection could increase the risk of coronary heart disease, osteoporosis, and certain cancers.[1] These health problems cause large economic burden.[1,4] Unfortunately, there has been no specific guidelines to take care of HIV infected persons and AIDs patients who are 50 years or older.

In Thailand, in 2017, people 60 years old or older were 15.45% of the population (10,225,322 out of 66,183,314). As aging society, a higher proportion of HIV persons and AIDS patients with older age, like other illnesses, could be expected. Even the absolute number of HIV infections has been decreasing from 697,440 cases in 1997 to 440,000 cases in 2017, certain problems remain. A study in Thai patients showed that patients with less than 95% ARV drugs compliance were significantly associated with HIV viral failure, i.e., a viral load (VL) of more than 200 copies/mL after 6 months of ARV treatment (P-value < 0.001).[5]

A previous report of Buengkan Hospital, in the northeast region of Thailand, in 2017, among 23 elderly HIV patients (i.e., 50 years old or older patients), 69.56% of them had a high level of medication adherence (adherence rate of ≥ 95%), 26.09% had a good level (adherence rate of ≥ 85 - 94.99%), and 4.35% had a low level (adherence rate of < 65%).[6] The causes of non-adherence included taking ARV drugs deviating more than 30 minutes from the scheduled time (80%), and forgetting to take ARV drugs (20%).[6] In this report, a relatively large portion of the elderly HIV infected patients did not achieved a goal of 95% or higher of medication adherence. In addition, almost one-third of the patients (30.43%) did not have a high level of CD4 counts. A trend of more co-morbidities and medications prescribed was found. At the end of October, 2017, more HIV infected patients (580) were registered and 15% were those 50 years old or older.[6] With a trend of increasing number of HIV infected and AIDS patients especially those 50 years old or older which need to have strict adherence to ARV drugs to slow the deterioration of their body function in addition the viral control and complications, healthcare providers have applied various kinds of intervention to improve adherence to ARV drugs. However, with the outcomes not at the desirable level, there is a need to study any new interventions to take care this group of patients.

In addition to standard materials for educating HIV infected and AIDS patients, various innovative interventions have been created and tested. In a meta-analysis of Kanters and colleagues, 85 trials with 16,271 patients were summarized for medication adherence and viral suppression benefits.[7] To compare with standard care or usual care, the interventions added to the standard care could be classified into two categories, one guided by behavioral modifications and another on objective media, materials and devices. For the behavioral modifications, they were behavioral skills training or medication adherence training, cognitive behavioral therapy (CBT), supporter and incentives. These interventions aimed to improve motivation, knowledge, attitudes which could further promote better adherence behavior. For the more object-oriented methods, they were telephone call, short text message service (SMS) reminder, multimedia especially computerized and online ones, and device reminders (calendar as diary for home-based monitoring, alarm clock, and pill box). Overall it was found that all intervention modalities offer a slightly better medication adherence than the usual care but statistical significance was found only in SMS and supporter plus telephone call when all countries were considered and SMS, supporter and supporter plus telephone call when low and middle income countries were considered.[7] From the meta-analysis of Kanters and colleagues, we could conclude that most intervention modalities could be beneficial in improving medication adherence among HIV infected and AIDS patients. All intervention modalities were subject to discussion among healthcare providers to be selected as the enhanced standard care intervention suitable for our elderly HIV patients in the northeast region of Thailand.

To find an enhanced standard care for HIV infected and AIDS elderly patients, we performed a focus group discussion. In the discussion session, 1 physician, 2 nurses and 2 pharmacists of Buengkarn Hospital taking care of HIV infected and AIDS patients were invited to find intervention modalities suitable for these elderly HIV infected and AIDS patients. These participants were given information of intervention modalities from the actual care at Buengkarn Hospital, previous research[7,8], and the Thailand National Guidelines on HIV/AIDS Treatment and Prevention 2017.[9] The group agreed the enhanced standard care should contain knowledge about

HIV and AIDS provided by the physician, self-care by the nurse, and medications by the pharmacist. There should be small group training sessions to provide knowledge and get the patient motivated and supported by the nurse and pharmacist. Knowledge and experience about ARV drugs taking should also be shared for problem solving, if any. In terms of devices, pill box for be provided to the patient for convenience. This modality was approved as the suitable enhanced standard care for the context of healthcare for the patients under Buengkarn Hospital provision.

The established enhanced standard care for the HIV infected and AIDS elderly patients allowed us to test the benefits of this new innovative intervention in this research project. The main outcomes were medication adherence, clinical outcomes which was CD4 cell counts and a holistic outcome of quality of life. In our study, the choice of clinical outcome was based mainly on financial constraint. Being considered as one of appropriate clinical outcomes, viral load measurement was not included as an outcome because of its high cost and the National Health Security Office supports it free of charge once a year for a given patient. In most of our patients, their test of viral load would not be available during the study period. For CD4 cell counts, it was much less a financial burden for the research than viral load and was measured in our study.

Methods

This randomized controlled trial (RCT), with single blinding on the patients, used a block randomization. The participants randomized to the experimental intervention (test group) or the usual care (control group) were matched based on gender and baseline CD4 cell level because women responded to ARV drugs better with higher with CD4 cell counts.[10] Study population was HIV infected and AIDS patients who were 50 years old or older receiving outpatient care at Buengkan Hospital, Buengkan, Thailand. Study sample was those in study population who received ARV drugs for at least three consecutive months from March to August 2018.

Sample size was estimated using the equation of $n = (Z_{\alpha/2} + Z\beta)^2 \times 2\sigma^2 / \delta^2$. With a $Z_{\alpha/2} = 1.96$ for a type I error of 5% (two-sided), $Z\beta) = 0.84$ for a type II error of 20% (or power of test of 80%), $\sigma = 200.60$ from a previous study[11], and $\delta = 58.8$ from a previous study[12], a sample size of 366 patients was required. However, there were only 90 patients meeting the study sample definition, so all of them were approached for eligibility screening. To be eligible, they had to be taking ARV drugs provided by Buengkan Hospital for at least 8 consecutive weeks, to pass the Thai Mental State Examination (TMSE), to be able to take care of ARV drugs administration, and to be willing to participate in the study. TMSE is a tool for assessing cognitive function widely used to screen patients with dementia. For Thai patients, a total score of > 23 out of 30 points indicates normal cognitive functions while 23 points or lower indicates possible dementia. We excluded those patients with psychiatric problem requiring medications, those who wanted to remain anonymous, those incarcerated, those in monkhood, those moving and unable to contact, and those who were foreigners. As a result, only 80 patients passed the inclusion and exclusion criteria for randomization.

Randomized block allocations were calculated using the equation of N! / [T! * (N-T)!][13,14] With N = block size of 4, and T = 2 groups of experiment (test group and control group), 6 randomized block allocations were created (i.e., (4x3x2x1)/(2x1)(2x1) = 6, or allocations of 1 = AABB, 2 = BBAA, 3 = ABAB, 4 = BABA, 5 = ABBA and 6 = BAAB). Patients randomized to B were to receive the experimental intervention (test group) while those to A to the usual care (control group).

Research instruments

In this study, two kinds of tools were used, namely 1) assessment instruments and 2) experimental intervention. In the assessment instruments, there were three parts. The first part collected demographic and health status characteristics from in-person interview, data in medical records, and data in the National AIDS Program (NAP Plus) database. Data obtained from medical records and NAP Plus included gender, age, weight, body mass index (BMI), CD4 cell counts, % CD4, co-morbidities, medications, and history of drug allergy and serious side effects that caused discontinuation of medications. Data from in-person interview concerned marital status, education level, occupation, family monthly income, living arrangement with caregivers while ill, sexual risk behavior, and health risk behavior. Content validity was tested with three experts including a pharmacy instructor, a clinical physician and a clinic nurse. Content and wording were checked. Revision based on the suggestions was made.

The second part asked about medication adherence and drug related problems. Data obtained from in-person interview included number of doses of medications taken for estimating proportion of medications taken as prescribed, types and causes of medication non-adherence, and drug related problems. Data obtained from medical records and electronic medical records HOSxP were ARV drugs regimen, laboratory results, all medications prescribed from the last visit, and solving of drug related problems. Medication taking continuity was assessed by two methods, pill count and home-based diary of medication taking. Proportions obtained from the two methods were averaged at each visit.[15] Level of medication adherence was categorized as no, low, moderate, high and highest level (< 65%, 65 - 74.99%,75 - 84.99%, 85 - 94.99%, and ≥ 95% of medication taken, respectively). This tool was previously reported to have acceptable internal consistency reliability with Cronbach's alpha coefficients of 0.87, 0.82 and 0.92 at week 1, month 3 and month 6, respectively.

The third part was the Thai version of Medical Outcomes Study HIV Health Survey (MOS-HIV)[16] to asses quality of life in HIV infected and AIDS patients. With 13 main questions of 35 individual questions, 8 main questions (16 individual questions) were derived to reflect physical health summary score (PHS) and 5 main questions (19 individual questions) to reflect mental health summary score (MHS). In our study, internal consistency reliability was acceptable with Cronbach's alpha coefficients of PHS of 0.77, 0.85 and 0.85, at week 1, month 3 and month 6, respectively; while those of MHS of 078, 0.86 and 0.88, at week 1, month 3 and month 6, respectively.

The second set of tools was experimental instruments including medical records, prescriptions, manual for advice on AIDS, manual for advice on self-care, pill box, calendar for home-based medication taking diary, a display patch of ARV drugs sample, electronic medical record system HOSxP and the National AIDS Program (NAP Plus) database.

Participant protection

This study was approved by the Ethics Committee of Buengkarn Hospital (Approval number: BKHEC 2018-05, approval date: January 19, 2018) and the Ethics Committee for Human Study of Mahasarakham University (Approval number: 087/2561, approval date: July 25, 2018). All patients were provided with study objectives, procedures and risks and benefits. They were also informed about voluntary nature of the study and definite withdrawal at any time. The study started after written informed consent was obtained.

Study procedure and data collection

The control group

In the control group, participants were provided with standard care. Multidisciplinary team provided participants with knowledge and advice on ARV drugs. Participants were scheduled for next visits every 3 months. Medication adherence on ARV drugs was measured by methods of pill count and calendar as home-based diary on medication taking behavior. Percentage of number of medication taken was calculated. Drug related problems were identified, solved and prevented at each visit. Necessary laboratory investigations were done every 3 months including complete blood count (CBC), fasting blood sugar (FBS), creatinine (Cr), cholesterols, triglyceride, alanine aminotransferase (ALT), and CD4 cells. The increase in CD4 cell counts at month 6 as ≥ or < 58.8 cells/mm^3 was classified. This cut-off value of 58.8 cells/mm3 was based on the finding from the study of Grabar et al.[17] where patients age ≥ 50 years old were treated with ARV drugs for 5 years. They found that CD4 cell counts increased by 9.8 cells/mm3 per month. Therefore, in our study, we expected that at the 6-months follow-up, our patients should have their CD4 cell counts of at least 58.8 cells/mm3 (i.e., 9.8 times 6).

The test group

In the test group, participants were provided with the enhanced standard care created by the focus group discussion previously described in the introduction section. Pill box convenient for travelling was given to the participant in the first week. Participants were provided with knowledge about HIV and AIDS by the physician, self-care by the nurse, and medications by the pharmacist at week 1 and month 6. Small group training sessions to provide knowledge and get the patient motivated and supported by the nurse and pharmacist were held at month 3 only. In each session, 5 – 7 patients participated and it took about 60 minutes to complete. At the training sessions, knowledge and experience about ARV drugs taking were shared for problem solving. At all visits and training sessions, drug related problems were identified, solved and prevented.

In the two groups, necessary laboratory investigations were done every 3 months including complete blood count (CBC), fasting blood sugar (FBS), creatinine (Cr),

cholesterols, triglyceride, alanine aminotransferase (ALT), and CD4 cells. The increase in CD4 cell counts at month 6 as ≥ or < 58.8 cells/mm^3 was classified.[17]

Statistical data analysis

Demographic and clinical status characteristics were presented as mean with standard deviation (SD) and frequency with percentage. Differences of continuous variables between the two groups were tested using independent t test or Mann-Whitney U test, if not normally distributed, as appropriate. For categorical variables, differences were tested using chi-square test or Fisher's exact test, as appropriate. For within-group differences, means of CD4 cell counts and quality of life before and after the intervention were tested using paired t test or Wilcoxon signed rank test, if not normally distributed. Scores of adherence to ARV medications (i.e., % adherence) and scores of quality of life at baseline, month 1 and month 6 within each group were tested using repeated measures analysis of variance (ANOVA). All statistical significance was set at a type I error of 5% or *P*-value < 0.05. All analyses were performed using software program SPSS version 20.

Results

Of all 80 participants, they were 54.04 years old by average (Table 1). The majority of them were men (61.30%), had normal weight (healthy, or BMI of 18.50 – 22.99 kg/m^2) (51.25%), were married (62.50%), had no formal education or incomplete primary school (53.75%) followed by primary school (23.75%), were in agriculture/fishery (52.50%) followed by labors (23.75%), monthly family income of 5,001 - 10,000 Baht (38.75%), living with spouse or offsprings (56.25%), having spouse or offsprings as caregivers when ill (77.50%), revealed their HIV status to their spouse only (33.75%) followed by family members only (27.50%), and had no sexual risk behavior (93.75%). No statistical significance was found in any of these characteristics between the two groups (Table 1).

In terms of health status, the majority of participants had no health risk behavior (57.50%) followed by alcohol consumption (21.25%), had no history of severe drug allergy or adverse drug reactions (90.00%), had basic ARV regimen of Teevir® (emtricitabine + tenofovir + efavirenz) (86.25%), had been diagnosed with HIV at least 4 years (72.50%), had 1 – 3 kinds of medications prescribed (75.00%), took 1 – 3 tables per day (53.75%), had at least on co-morbid disease (52.50%) with hyperlipidemia (22.50%) and diabetes/hypertension (16.25%) as mostly found diseases, had CD4 cell counts of 200 - 499 cell/mm^3 (57.50%) or as 14 – 28% (60.00%), had viral load of zero copies (72.50%) (Table 2). No significant differences between the two groups were found.

Table 1 Demographic characteristics of participants (N = 80).

Characteristics	Control group (n = 40)		Test group (n = 40)		Total, N (%)	*P*-value[a]
	N	%	N	%	(N = 80)	
Gender						0.65
Men	26	65.00	26	65.00	49 (61.30)	
Women	14	35.00	14	35.00	31 (38.80)	
Age (years) (mean ± SD)	54.43 ± 4.46		53.65 ± 4.29		54.04 ± 4.36	0.35
Body mass index (BMI) (kg/m^2)						0.35
Underweight (< 18.50)	4	10.00	8	20.00	12 (15.00)	
Normal weight (healthy) (18.50 – 22.99)	19	47.50	22	55.00	41 (51.25)	
Obesity level 1 (overweight) (23.00 - 24.99)	9	22.50	4	10.00	13 (16.25)	
Obesity level 2 (obese) (25.00 – 30.00)	5	12.50	5	12.50	10 (12.50)	
Obesity level 2 (highly obese) (> 30.00)	3	7.50	1	2.50	4 (5.00)	
Marital status						0.64
Single	2	5.00	3	7.50	5 (6.25)	
Coupled/married	27	67.50	23	57.50	50 (62.50)	
Widowed/divorced/separated	11	27.50	14	35.00	25 (31.25)	
Education level						0.92
No formal education or incomplete primary school	21	52.50	22	55.00	43 (53.75)	
Primary school	9	22.50	10	25.00	19 (23.75)	
Secondary/primary vocational school	8	20.00	7	17.50	15 (18.75)	
Associate degree/secondary vocational school	2	5.00	1	2.50	3 (3.75)	
Occupation						0.80
No job	3	7.50	4	10.00	7 (8.75)	
Agriculture/fishery	17	42.50	25	62.50	42 (52.50)	
Labors	14	35.00	5	12.50	19 (23.75)	
Small business	6	15.00	4	10.00	10 (12.50)	
Government employee	0	0	2	5.00	2 (2.50)	
Monthly family income (Baht)						0.64
0 - 5,000	6	15.00	7	17.50	13 (16.25)	
5,001 - 10,000	17	42.50	14	35.00	31 (38.75)	
10,001 - 15,000	5	12.50	9	22.50	14 (17.50)	
> 15,000	12	30.00	10	25.00	22 (27.50)	
Living arrangement						0.86
Living alone	2	5.00	4	10.00	6 (7.50)	
Living with spouse/offsprings	23	57.50	22	55.00	45 (56.25)	
Living with parents/siblings	8	20.00	7	17.50	15 (18.75)	
Living with spouse/offsprings/ siblings	7	17.50	7	17.50	14 (17.50)	
Caregivers when ill						0.82
Spouse/offspring	31	77.50	31	77.50	62 (77.50)	
Parents/siblings	8	20.00	7	17.50	15 (18.75)	
Spouse/offsprings/siblings	1	2.50	2	5.00	3 (3.75)	
HIV status revelation						0.21
No revelation	3	7.50	2	5.00	5 (6.25)	
Revealed to spouse only	18	45.00	9	22.50	27 (33.75)	
Revealed to family only	8	20.00	14	35.00	22 (27.50)	
Revealed to family and siblings	3	7.50	6	15.00	9 (11.25)	
Openly revealed	8	20.00	9	22.50	17 (21.25)	
Sexual risk behavior						0.37
No risk behavior	37	92.50	38	95.00	75 (93.75)	
Risk with same sex	0	0	1	2.50	1 (1.25)	
Risk with spouse with no condom	3	7.50	1	2.50	4 (5.00)	

[a] Chi-square test.

Table 2 Health status characteristics of participants (N = 80).

Characteristics	Control group (n = 40)		Test group (n = 40)		Total, N (%) (N = 80)	*P*-value[a]
	N	%	N	%		
Health risk behavior						0.37
None	22	55.00	24	60.00	46(57.50)	
Alcohol consumption	9	22.50	8	20.00	17(21.25)	
Cigarrette smoking	3	7.50	4	10.00	7(8.75)	
Narcotics use	1	2.50	0	0	1(1.25)	
Alcohol consumption and cigarrette smoking	5	12.50	4	10.00	9(11.25)	
History of severe drug allergy or adverse drug reactions						0.84
None	35	87.50	37	92.50	72(90)	
Nevirapine	0	0	1	2.50	1(1.25)	
Efavirenz	1	2.50	0	0	1(1.25)	
Nevirapine and efavirenz	1	2.50	0	0	1(1.25)	
Amoxiciilin	2	5.00	0	0	2(2.50)	
Tenofovir	0	0	1	2.50	1(1.25)	
Cotrimoxazole	1	2.50	0	0	1(1.25)	
Carbamazepine + amitriptyline	0	0	1	2.50	1(1.25)	
ARV regimen						0.28[a]
Teevir®*	32	80.00	29	72.50	61(86.25)	
GPO-vir Z250	6	15.00	3	7.50	9(11.25)	
Tenofovir + emtricitabine and Kaletra*	2	5.00	4	10.00	6(7.50)	
Others	0	0	4	10.00	4(5.00)	
Duration since diagnosed with HIV (years)						0.70
≤ 1	2	5.00	5	12.50	7 (8.75)	
2	2	5.00	2	5.00	4 (5.00)	
3	6	15.00	5	12.50	11 (13.75)	
4 or longer	30	75.00	28	70.00	58 (72.50)	
Number of kinds of medications						0.10a
1 – 3	34	85.00	26	65.00	60 (75.00)	
4 – 6	5	12.50	13	32.50	18 (22.50)	
7 or higher	1	2.50	1	2.50	2 (2.50)	
Number of tables taken per day						0.08
1 - 3	24	60.00	19	47.50	43 (53.75)	
4 - 6	15	37.50	14	35.00	29 (36.25)	
≥ 7	1	2.50	7	17.50	8 (10.00)	
CD4 cell counts (cell/mm^3)						1.00
< 200	4	10.00	4	10.00	8 (10.00)	
200 – 499	23	57.50	23	57.50	46 (57.50)	
≥ 500	13	32.50	13	32.50	26 (32.50)	
CD4 cell counts (%)						0.61
< 14	66	15.00	9	22.50	15 (18.75)	
14 - 28	26	65.00	22	55.00	48 (60.00)	
≥ 29	8	20.00	9	22.50	17 (21.25)	
Viral Load (VL) ล่าสุด (Copy)						0.27
Not known	0	0	1	2.50	1 (1.25)	
0	32	80.00	26	65.00	58 (72.50)	
1 - 50	7	17.50	9	22.50	16 (20.00)	
≥ 51	1	2.50	4	10.00	5 (6.25)	
Co-morbidities						0.13
None	16	40.00	22	55.00	38 (47.50)	
Diabtest/hypertension	4	10.00	9	22.50	13 (16.25)	
Hyperlipidemia	13	32.50	5	12.50	18 (22.50)	
Cardiovascular disease	1	2.50	0	0	1 (1.25)	
Viral B or C hepatitis	4	10.00	3	7.50	7 (8.75)	
Musculoskeletal and joint disease	1	2.50	1	2.50	2 (2.50)	
Benign prostatic hyperplasia	1	2.50	0	0	1 (1.25)	

[a] Chi-square test.

* Teevir® = emtricitabine + tenofovir + efavirenz; Kaletra® = lopinavir + ritonavir.

they forgot to take medications (57.41%). Most of them had no drug related problems at present (95.00%) and all drug related problems were solved (100.00%). There were no significant differences between the two groups in any aspects of non-adherence and drug related problems (Table 3).

Table 3 ARV medication non-adherence (N = 80).

ARV medication non-aderence	Control group (n = 40)		Test group (n = 40)		Total, N (%) (N = 80)	*P*-value[a]
	N	%	N	%		
% of adherence						1.00[a]
75 – 84.99 (moderate level)	1	2.50	1	2.50	2 (2.50)	
85 – 94.99 (high adherence)	7	17.50	6	15.00	13 (16.25)	
95 – 100 (highest adherence)	32	80.00	33	82.50	65 (81.25)	
Type of ARV drug non-adherence[c]						-
Taking ARV > 30 minutes than scheduled	14	50.00	13	50.00	27 (50.00)	
Out of drug supply	8	28.57	10	38.46	18 (33.33)	
Wrong frequency per day	3	10.71	2	7.69	5 (9.26)	
Taking ARV > 30 minutes than scheduled and missing the dose	3	10.71	1	3.85	4 (7.41)	
Causes of ARV drugs non-adherence						-
Forgetting to take medications	14	50.00	17	65.38	31 (57.41)	
Medications not brought with when travelling, so medications not taken on time	3	10.71	2	7.69	5 (9.26)	
Medications not brought with when travelling, so the dose missed	3	10.71	4	15.38	7 (12.96)	
Dose nottaken on time because of continuous work	2	7.14	0	0	2 (3.70)	
Forgetting to take medications and medications not brought with when travelling	1	3.57	1	3.85	2 (3.70)	
Falling a sleep	2	7.14	0	0	2 (3.70)	
Repeating the dose	1	3.57	1	3.85	2 (3.70)	
Forgetting to take medications and medications not brought with when travelling so medictions not taken on time	1	3.57	1	3.85	2 (3.70)	
Visit missed so no medication supply	1	3.57	0	0	1 (1.85)	
Having drug relatedproblems						0.70[b]
No	38	95.00	38	95.00	76 (95.00)	
Yes	2	5.00	2	5.00	4 (5.00)	
Type of drug related probems						-
Need additional drug therapy	1	50.00	1	50.00	2 (50.00)	
Dosage too high	1	50.00	0	0	1 (25.00)	
Adverse drug reactions	0	0	1	50.00	1 (25.00)	
Drug related problems solved						
Yes	2	100	2	100	4 (100.00)	

[a] Chi-square test, [b] Fisher's exact test.

[c] More than one type could be found in a given patient.

Medication non-adherence and drug related problems

Majority of participants had adherence at the highest level (81.25%) followed by good ARV medication adherence (16.25%) (Table 3). Among types of non-adherence, they took ARV drugs > 30 minutes than scheduled (50.00%), followed by out of drug supply (33.33%). For causes of non-adherence,

Effects on CD4 cell counts

At baseline, 2nd (month 3) and 3rd (month 6) measurements, CD4 cell counts of the group were not significantly different (Table 4). When each group was considered, CD4 cell counts of the test group increased significantly over time (*P*-value = 0.004), while those of the control group did not (*P*-value = 0.181). At month 6,

proportions of patients with the increase in CD4 cell counts at month 6 as ≥ or < 58.8 cells/mm^3 between the two groups were not different (*P*-value = 0.22) (Table 5).

Table 4 CD4 cell counts between the two groups at 3 measurements (N = 80).

Groups	CD4 cell counts, mean (SD), by measurments			*P*-value[a]
	1st (baseline)	2nd (month 3)	3rd (month 6)	
Control group	435.08 (212.72)	467.55 (257.57)	445.73 (224.50)	0.181
Test group	414.79 (199.33)	411.80 (171.45)	457.48 (179.96)	0.004
P-value[b]	0.66	0.26	0.80	-

[a] Repeated measures ANOVA.

[b] Independent t test.

Table 5 The increase in CD4 cell counts at month 6 between the two groups (N = 80).

CD4 cell counts at month 6	Control group (n = 40)		Test group (n = 40)		*P*-value[a]
	N	%	N	%	
Increase ≥ 58.8 cells	9	22.50	15	37.50	0.22
Increase < 58.8 cells	31	77.50	25	62.50	

[a] Chi-square test.

Effects on adherence to ARV medications

At week 1, month 3 and month 6, patients in both groups were more likely to have high and highest adherence to ARV medications (Table 6). However, at month 6, more patients in the test group were significantly in the high and highest levels than those in the control group (*P*-value = 0.002).

Table 6 Levels of adherence on ARV medications between the two groups (N = 80).

Adherence levels	Control group (n = 40)		Test group (n = 40)		*P*-value[a]
	N	%	N	%	
Adherence levels at week 1					1.00
< 65% (no adherence)	0	0	0	0	
65 - 74.99% (low adherence)	0	0	0	0	
75 – 84.99% (moderate adherence)	1	2.50	1	2.50	
85 – 94.99% (high adherence)	7	17.50	6	15.00	
95 – 100% (highest adherence)	32	80.00	33	82.50	
Adherence levels at month 3					0.48
< 65% (no adherence)	0	0	0	0	
65 - 74.99% (low adherence)	0	0	1	2.50	
75 – 84.99% (moderate adherence)	0	0	1	2.50	
85 – 94.99% (high adherence)	9	22.50	11	27.50	
95 – 100% (highest adherence)	31	77.50	27	67.50	
Adherence levels at month 6					0.02
< 65% (no adherence)	0	0	0	0	
65 - 74.99% (low adherence)	1	2.50	0	0	
75 – 84.99% (moderate adherence)	6	15.00	0	0	
85 – 94.99% (high adherence)	10	25.00	6	15.00	
95 – 100% (highest adherence)	23	57.50	34	85.00	

[a] Fisher's exact test.

Once original % adherence at 3 measurements was considered, % adherence in the control group significantly decreased from 97.31% at baseline to 93.47% at month 6 (*P*-value = 0.001) (Table 7). On the other hand, % adherence in the test group increased but with no statistical significance (*P*-value = 0.053).

Table 7 % adherence between the two groups at 3 measurements (N = 80).

Groups	Scores of adherence, mean (SD), by measurments			*P*-value[a]
	1st (baseline)	2nd (month 3)	3rd (month 6)	
Control group	97.31 (3.57)	97.12 (3.61)	93.47 (7.21)	0.001
Test group	97.07 (3.56)	95.75 (6.71)	98.10 (2.61)	0.053
P-value[b]	0.36	0.81	0.002	

[a] Repeated measures ANOVA.

[b] Mann-Whitney U test.

Effects on quality of life

At week 1, there were differences in mean scors of 11 dimensions of quality of life based on the Thai version of Medical Outcomes Study HIV Health Survey (MOS-HIV), and its physical and mental summary scores between the two groups (Table 8). However, at month 3, three mean scores in the test group were significantly higher than those in the control group (*P*-value < 0.001, 0.01 and 0.001, respectively). The same differences were also found at month 6 (*P*-value < 0.001 for all 3 scores). In terms of within-group changes, mean scores of 11 dimensions in the control group decreased significantly from week 1 to month 6 (*P*-value = 0.003); while those in the test group increased significantly (*P*-value < 0.001).

Table 8 Mean scores of quality of life† between the two groups at 3 measurements (N = 80).

Quality of life score at each measurement	Possible range	Scores, mean ± SD, by group		*P*-value
		Control group (n = 40)	Test group (n = 40)	
Week 1				
Mean score of 11 dimensions	0 - 100	80.48 ± 8.52	82.34 ± 5.99	0.32[a]
Physical health summary score	0 - 100	83.29 ± 10.79	86.67 ± 7.97	0.11[a]
Mental health summary score	0 - 100	75.15 ± 8.50	78.72 ± 6.47	0.73[a]
Month 3				
Mean score of 11 dimensions	0 - 100	78.10 ± 9.73	85.32 ± 7.58	< 0.001[a]
Physical health summary score	0 - 100	80.55 ± 13.29	83.13 ± 15.39	0.01[b]
Mental health summary score	0 - 100	76.05 ± 8.48	82.82 ± 8.68	0.001[a]
Month 6				
Mean score of 11 dimensions	0 - 100	76.21 ± 8.87	87.68 ± 4.37	< 0.001[a]
Physical health summary score	0 - 100	78.01 ± 13.22	90.09 ± 5.22	< 0.001[b]
Mental health summary score	0 - 100	74.72 ± 6.69	85.67 ± 5.61	< 0.001[a]
P-value[C]		0.003	< 0.001	

[a] Independent t-test.

[b] Mann-Whitney U test.

[C] Repeated measures ANOVA for mean score of 11 dimensions within each group.

† Thai version of Medical Outcomes Study HIV Health Survey (MOS-HIV).

Discussions and Conclusion

In this randomized controlled trial, the enhanced standard care for HIV infected and AIDS elderly patients was compared

with the usual care on ARV medication adherence, CD4 cell counts and quality of life. Some noteworthy findings were as follows.

The majority of patients participating in our study had no formal education or incomplete primary education (53.75%). They had relatively low education because this province is an up-country area and when these patients were young there was no compulsory primary education. Our finding was consistent with the survey in 2017 where people aged 60 years old or older had only 5.05 years of formal education (i.e., about year 5 of the 6-year primary school).[18] This could affect the level of adherence to ARV medications. As the majority of them were in agriculture or fishery (52.50%), this could relate to a low monthly family income of 5,001 – 10,000 Baht (38.75%) which was lower than the average of general population in Buengkarn province of 20,207 Baht.[19] Most patients had no sexual risk behavior (93.75%) which could be attributable to their elderly age. With the social stigma, large portions of them revealed their HIV status only to spouse (33.75%) and family members (27.50%). As the elderly in Thai society, they lived with their spouse or offsprings (56.25%) and had spouse or offsprings as their caregiver when ill (77.50%).

In terms of health status, a certain portion of the patients had alcohol consumption risk behavior (21.25%) which would prompt psychological attention. Most of them had been taking ARV medications more than 4 years (72.50%) and about half had BMI in the normal range (51.25%). Their HIV control was somewhat satisfactory with CD4 cell counts of 200 - 499 cell/mm^3 (57.50%) and viral load of 0 copies (72.50%). Most of them had no history of severe drug allergy or adverse drug reactions (90.00%). These findings were consistent with a study in Thailand where they found that 91.67% had no drug allergy history, 31.25% had alcohol consumption risk behavior, and they had been taking ARV drugs for 5.43 years by average.[11] Based on our study and the other[11], these patients had been taking ARV medications for a relatively long time, their CD4 cell counts could be elevated to a normal level, and their BMI could be normalized.

Since most patients took Teevir® which was a combination pill requiring only one a day dosing, the pill burden in both groups was low with 1 – 3 medications and 1 – 3 tablets taken per day, and ultimately adherence at highest level (at least 95% of medications taken as prescribed) of 81.25% and high level of 16.25%. This finding was consistent with a study in Thailand of which most patients took a combined pill with a daily dosing and 62% of them had the highest adherence (i.e., at least 95% of medications taken as prescribed) and had their CD4 cell counts increased.[20]

For patients with non-adherence, taking medications more than 30 minutes after the scheduled time was found the most kind (50.00%) as expected, followed by short of medication supply (33.33%). The most found cause of non-adherence was forgetting to take medications (57.41%), followed by not bringing medications with them when going outside (12.96%). Their forgetfulness could be due to their older age. Our finding was somewhat different from another study where staying outside or travelling was the most found cause of not taking medications (17.00%), followed by uninterrupted work (9.66%).[21]

Our enhanced standard care provided the patients knowledge about the disease, self-care and ARV medications, as well as pill box convenient for bringing with them when going out. In addition, small group training at month 3 was held by nurses and pharmacists at HIV clinic to provide knowledge and allow experience sharing between patients. This could enhance adherence as more patients with higher levels of adherence were significantly found in the test group than the control group at month 6 (P-value = 0.02). Our finding was consistent with the work of Kanters and colleagues[7] which we also used information to mold our enhanced standard care. All devices an materials in addition to support, motivation, cognitive modification, and message to remind the patients could improve adherence to ARV medications, CD4 cell counts, as well as knowledge, attitude and quality of life.[7] In our study, with a small number of pills of stable regimen taken for a relatively long time, drug related problems were infrequent.

Effects of the enhanced standard care was moderate on CD4 cell counts. At baseline, month 3 and month 6, no differences of CD4 cell counts between the two groups were found. However, while CD4 cell counts in the control group slightly increased at month 6 with no significance; a more obvious increase in the test group at month 6 was significant (P-value = 0.004). Once a target of the increase of at least 58.8 cell/mm^3 at month 6 was used, there was also no significant difference in proportions of patients reaching that goal between the two groups. Our finding was consistent with study of Grabar and co-workers where patients 50 years old or older with baseline HIV RNA levels of < 5 log copies/mL^{-1}

had CD4 cell counts increased 14.1 cells/mm^3/month when treated for 6 months.[17] However, CD4 cell counts decreased to 9.8 cells/mm^3/month thereafter. They also found that patients with baseline HIV RNA levels $\geq$ 5 log copies/mL^{-1} had CD4 cell counts increased 36.9 cells/mm^3/month when treated for 6 months and decreased to 15.6 cells/mm^3/month thereafter.[17] It has been known that the increase in CD4 cells in the elderly is moderate. This could be due to those 50 years old or older have rapid deterioration and inflammation in their organs thus defect in response to ARV drugs could increase CD4 cell counts slower than their younger counterparts.[22]

In terms of quality of life, scores of the Thai version of Medical Outcomes Study HIV Health Survey (MOS-HIV) in the test group were significantly higher than those in the control group at month 3, and further significantly even higher at month 6, in all three scores (i.e., mean score of 11 dimensions, physical summary score, and mental summary score). When within-group mean score of the 11 dimensions, no significant change from baseline to month 3 and month 6 was found in the control group; while significant increase was found in the test group. The improvement in quality of life scores in the test group at months 3 and 6 could be due to the the small group training sessions held at month 3.

Mean scores of 11 dimensions of the Thai MOS-HIV in the control and test groups were comparable at baseline (72.50 and 73.13 points, respectively). These scores in our study were consistent with that in a study in Ubonratchathani with the Thai MOS-HIV with a mean score of 71 points.[23] Another study in Thai patients using the Thai MOS-HIV found physical summary score of 80.10 points and mental summary score of 76.20 points.[24] In our study, the improvement in months 3 and 6 coud be attributable to the additional support, motivation, and experience sharing provided in the test group/

Our study had certain limitations. The sudy duration of 6 months was relatively short. Future study with longer duration should be conducted to prove sustainable long-term benefits. The number of enrolled particpants was lower than the estimated sample size. The study could be underpower for statistical test and its results should be interpreted with caution. Future studies with more than one setting should be conducted to recruite adequate number of participants.

Our findings and conduct could suggest better intervention to improve ARV medication adherence, CD4 counts and quality of life in HIV-infected and AIDS elderly patients. The intervention should at least contain support, motivation and experience sharing with the use of pill box for convenient package and reminding. Support could be in the form of knowledge, motivational, emotional and information support.

In conclusion, enhanced standard care for HIV infected and AIDS elderly patients consisting of various supports (knowledge, emotional, motivational, information, and experience sharing) with devices such as pill box as a reminder and convenient package could improve ARV medication adherence, CD4 cell counts, and quality of life.

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References

1. Wing EJ. HIV and aging. *Int J Infect Dis* 2016;53:61-68.
2. The Antiretroviral Therapy Cohort Collaboration. Causes of death in HIV-1–infected patients treated with antiretroviral therapy, 1996–2006: Collaborative analysis of 13 HIV cohort studies. *Clin Infect Dis* 2010; 50(10):1387-1396.
3. Centers for Disease Control and Prevention. AIDS among persons aged ≥ 50 years - United States 1991–1996. *MMWR* 1998;47:21-48.
4. Mpondo BCT. HIV infection in the elderly: Arising challenges. *J Aging Res* 2016:1-10. (Article ID 2404857) (doi: https://doi.org/10.1155/2016/2404857)
5. Oonsakol S. Factors associated with virological failure in AIDS and HIV patients in Akat-amnuay Hospital. *J Office DPC* **7** *Khon Kaen* 2015;3: 47-58. (in Thai)
6. Seanglam N. Adherence and drug related problems to antiretroviral medication among HIV/AIDS patients in Buengkan Hospital. *J Prev Med Assoc Thai* 2020;10:146-156. (in Thai)
7. Kanters S, Park JJH, Chan K, et al. Interventions to improve adherence to antiretroviral therapy: a systematic review and network meta-analysis. *Lancet HIV* 2017;4:e31-40.
8. Chaiyachati KH, Ogbuoji O, Price M, Suthar AB, Negussie EK, Bärnighausen T. Interventions to improve adherence to antiretroviral therapy: a rapid systematic review. *AIDS* 2014;28(Suppl 2):187-204.
9. Bureau of AIDS, TB and STIs, Department of Disease Control, Ministry of Public Health. Guidelines for the treatment and prevention of HIV infection in Thailand in 2017, 1st edition. Bangkok. The Printing House of the Agricultural Cooperative Assembly of Thailand Limited, 2017. (in Thai)
10. Maskew M, Brennan AT, Westreich D, McNamara L, MacPhail AP, Fox MP. Gender differences in mortality and CD4 count response among virally suppressed HIV-positive patients. *J Women Health* 2013;22:113-120.
11. Virotjariyakorn S. Effects of the pharmacist-managed medication refill clinic for HIV infected patients at Ronpiboon Hospital. Thesis. Master of

Pharmacy program. Sonngkla. Prince of Sonngkla University, 2017. (in Thai)
12. Grabar S, Weiss L, Costagliola D. HIV infection in older patients in the HAART era. *J Antimicrob Chemother* 2006;57:4-7.
13. Altman DG, Bland JM. How to randomize. *BMJ* 1999;319:703-704.
14. Thesakorn W, Sahasanont D. Sampling and concealment. In: Clinical research textbooks. Bangkok. 2012. pp.145-170. (in Thai)
15. Bureau of AIDS, TB and STIs, Department of Disease Control, Ministry of Public Health. Guidelines for the treatment and prevention of HIV infection in Thailand in 2010. 1st edition. Bangkok. The Printing House of the Agricultural Cooperative Assembly of Thailand Limited, 2010. (in Thai)
16. Chariyalertsak S, Wansom T, Kawichai S, Ruangyuttikarna C, Kemerer VF, Wu AW. Reliability and validity of Thai versions of the MOS-HIV and SF-12 quality of life questionnaires in people living with HIV/AIDS. *Health Qual Life Outcomes* 2011;9:1-9.
17. Grabar S, Kousignian I, Sobel A, Philippe LB, Gasnault J, Enel P, et al. Immunologic and clinical responses to highly active antiretroviral therapy over 50 years of age. Results from the French Hospital Database on HIV.AIDS 2004;18:2029–2038.
18. Secretariat of the Education Council, Ministry of Education. Average academic year of the Thai population in 2017; September 2018.1-110. (in Thai)
19. Bueng Kan Provincial Statistical Office. Provincial statistical report. 2020. (Accessed on May 12, 2020, at http:// bungkan.nso.go.th/) (in Thai)
20. Laisakun K. Health-related quality of life amongst persons living with HIV/AIDS receiving antiretroviral drug at the secondary level hospital in Samut Sakhon Province. Thesis. Master of Nurse Practitioner program. Nakhonpathom. Christian University of Thailand, 2012. (in Thai)
21. Gokarn A, Narkhede MG, Pardeshi GS, Doibale MK. Adherence to antiretroviral therapy. *J Assoc Physicians India* 2012;60:16-20.
22. Silverberg MJ, Leyden W, Horberg MA, DeLorenze GN, Klein D, Quesenberry CP. Older age and the response to and tolerability of antiretroviral therapy. *Arch Intern Med* 2007;167:684-691.
23. Choopan K. Individual quality of life in HIV-infected/AIDS patients at Warinchumrab Hospital. Thesis. Master of Pharmacy program. Bangkok. Chulalongkorn University, 2011. (in Thai)
24. Bunjoungmanee P, Chunloy K, Tangsathapornpong A, Khawcharoenporn T, Apisarnthanarak A. Quality of life assessment among patients living with HIV/AIDS at a tertiary care hospital in Thailand. *Southeast Asian J Trop Med Pub Health* 2014;45:834-842.