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Pharmacist Participation in Prescribing Error Prevention Among HIV/AIDS Patients

การมีส่วนร่วมของเภสัชกรในการป้องกันความคลาดเคลื่อนจากการสั่งใช้ยาในผู้ป่วยเอชไอวี/เอดส์

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The objectives of this study were to analyse prescribing errors in the prescribing process for HIV/AIDS patients in term of types and rate of error, and to assess change of prescribing errors after pharmacist participation on prescribing process. The study was conducted in the HIV clinic at Samutsakhon hospital, divided into three phases. In phase 1, the prescribing process was observed and prescribing errors were assessed by the investigators for 1.5-month period. In phase 2, pharmacists with physicians and nurses develop the model of pharmacist participation in prescribing process and the model was tested for 1-month period. In phase 3, the role of pharmacist in the model and prescribing errors were evaluated for 1.5-month period. A total of 249 patients in phase 1 and 254 patients in phase 3 were evaluated. There were 123 prescribing errors (19.19 percent) in phase 1 but only 8 prescribing errors (1.20 percent) in phase 3. Types of errors most commonly found were prescribing medication with the incorrect time (not around the clock) 8.58 percent, did not specify strength 4.06 percent, which reduced to 0 percent in phase 3 and incorrect indication of opportunistic infections 13.01 percent which reduced to 0.15 percent in phase 3. Types of physician associated with prescribing errors were internist (45.45 percent), general practitioner (23.17 percent), and medical specialist (13.61 percent). All pharmacists' recommendations to physician were accepted, including clarification of order, time changing, and cessation of drug. The results indicated that a model of pharmacist participation in prescribing error prevention may reduce rates of prescribing errors.

Key words : Prescribing error, pharmacist participation, prescribing process, HIV/AIDS patient

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การศึกษานี้มีวัตถุประสงค์เพื่อวิเคราะห์ความคลาดเคลื่อนทางยาของกระบวนการสั่งใช้ยาแก่ผู้ป่วยเอชไอวี/เอดส์ แยกตามประเภท และอัตราการเกิดของความคลาดเคลื่อน รวมทั้งประเมินการเปลี่ยนแปลงของความคลาดเคลื่อนจากการสั่งใช้ยา หลังจากเภสัชกรเข้าไปมีส่วนร่วมในการป้องกันความคลาดเคลื่อนจากการสั่งใช้ยา โดยทำการศึกษาในคลินิกเอชไอวี โรงพยาบาลสมุทรสาคร แบ่งการศึกษาเป็น 3 ช่วง ช่วงที่ 1 เป็นการศึกษากระบวนการสั่งใช้ยาและประเมินความคลาดเคลื่อนในการสั่งใช้ยาโดยผู้สังเกตุการณ์เป็นระยะเวลา 1.5 เดือน ช่วงที่ 2 เป็นการพัฒนาระบบโดยการให้เภสัชกรเข้าไปมีส่วนร่วมในการป้องกันความคลาดเคลื่อนในกระบวนการใช้ยาเป็นระยะเวลา 1 เดือน และช่วงที่ 3 ศึกษาบทบาทเภสัชกรในระบบดังกล่าวและประเมินความคลาดเคลื่อนในการสั่งใช้ยาเป็นระยะเวลา 1.5 เดือน) ผู้ป่วยที่ถูกศึกษาในช่วงที่ 1 มีจำนวน 249 รายคน และในช่วงที่ 3 มีจำนวน 254 รายคน พบความคลาดเคลื่อนจากการสั่งใช้ยา 123 ครั้ง (ร้อยละ 19.19) ในช่วงที่ 1 แต่พบเพียง 8 ครั้ง (ร้อยละ 1.20) ในช่วงที่ 3 ประเภทความคลาดเคลื่อนที่พบมากที่สุดในช่วงที่ 1 ได้แก่ การสั่งใช้ยาผิดเวลา (ไม่เป็นไปตามช่วงเวลา) ร้อยละ 8.58, การสั่งยาไม่ระบุความแรง ร้อยละ 4.06 และไม่พบความคลาดเคลื่อนทั้ง 2 ประเภทในช่วงที่ 3 พบการสั่งใช้ยาป้องกันโรคติดเชื้อฉวยโอกาสผิดข้อบ่งใช้ ร้อยละ 2.49 และช่วงที่ 3 พบร้อยละ 0.15 ประเภทของแพทย์ที่สั่งจ่ายยาคลาดเคลื่อนคือ แพทย์เสริมทักษะร้อยละ 45.45, แพทย์ตรวจโรคทั่วไปร้อยละ 23.17 และแพทย์เฉพาะทางร้อยละ 13.61 คำแนะนำของเภสัชกรทั้งหมดได้รับการยอมรับจากแพทย์ ซึ่งได้แก่ การตรวจสอบคำสั่งใช้ยาซ้ำ การเปลี่ยนเวลาใช้ยา และ การงดยาบางรายการ ผลที่ได้จากการศึกษาบ่งชี้ว่าการมีส่วนร่วมของเภสัชกรในกระบวนการป้องกันความคลาดเคลื่อนก่อนที่แพทย์จะมีการสั่งใช้ยามีผลให้อัตราความคลาดเคลื่อนในการสั่งใช้จ่ายยาคลาดเคลื่อนลดจำนวนลง

คำสำคัญ : ความคลาดเคลื่อนจากการสั่งใช้ยา, กระบวนการสั่งใช้ยา, การมีส่วนร่วมของเภสัชกร, ผู้ป่วยเอชไอวี/เอดส์

INTRODUCTION

The human immunodeficiency virus (HIV) is a retrovirus that infects cells of the human immune system, destroying, or impairing their function. In the early stage of infection, person has no symptom. However, as infection progresses, the immune system becomes weaker, and the person becomes more susceptible to opportunistic infections. The most advanced stage of HIV infection is acquired immunodeficiency syndrome (AIDS). It can take 10-15 years for an HIV-infected person to develop AIDS; antiretroviral drugs can slow down the process even further.

About 33 million people are now living with HIV, of whom more than 30 million

live in low and middle income countries. The World Health Organization (WHO) estimates that at least 9.7 million of these people are in need of antiretroviral treatment (ART). As of December 2007, only 3 million people had access to ART in low- and middle-income countries.[1]

In Thailand, about 700,000 people out of a population of 63 million are infected with HIV. It is estimated that 2 percent of men and 1 percent of women are currently living with HIV. There are 30,000 to 50,000 new AIDS and HIV infected patients each year. As a result of successful prevention campaigns, the incidence of newly HIV infected has stabilized.[2]

Current treatment for HIV infection that is widely acceptable consists of highly active antiretroviral therapy, or HAART, which combine at least three ARV drugs. These ARV drugs belong to, at least, two types of anti-retroviral agents. Typical regimens consist of two nucleoside analogue reverse transcriptase inhibitors (NRTIs) plus either a protease inhibitor or a non-nucleoside reverse transcriptase inhibitor (NNRTI)

There are 22 antiretroviral agents within the four classes which were approved for the treatment of HIV infection by the US Food and Drug Administration (FDA). Prescribing ARV therapy is complicated since the medications have multiple names, abbreviations, dosing strategies, and regimen permutations. In addition, the nationwide shortage of pharmacists places extra time constraints on careful filling, double-checking, and counseling of any complicated medication regimen including ARV. People who are infected with HIV may not be familiar with the number of tablets per dose, frequency of administration, dietary requirements of their regimens, side-effect management, and the dangers of nonadherence-despite multiple educational sessions. These factors as well as others make the ARV agents a target for potential medication errors.[3]

Pharmacist as an important health care team should have active role in participating in HIV care. Specifically, to improve the efficient use of the ARV, a pharmacist should participate in prescribing error prevention among HIV-AIDS patients. All of the potential medication errors which could be found in prescribing process should be decreased upon pharmacist participation. A model of pharmacist participation in prescribing error prevention may be a complimentary alternative of improving efficiency of ARV care.

Objectives

1. To describe type and error rate of prescribing errors among HIV/AIDs patients.

2. To assess the change in type and error rate of prescribing error after pharmacist participation on prescribing error prevention among HIV/AIDs patients.

Method

1. **Study Design** This study was a descriptive and quasi-experimental study.

2. **Study Population**

The study population was patients at the Samutsakhon hospital, outpatient HIV clinic (around 200-250 patients per month). The study was divided into three phases. Data was collected in phase 1 (October 1, 2007 to November 15, 2007) and phase 3 (December 15, 2007 to January 31, 2008). All prescriptions consisting of anti-retroviral and opportunistic infections (OIs) drug were screened to detect prescribing error. Based on the series of clinical trials[4,5] chemoprophylaxis to prevent initial episodes of certain opportunistic infections (primary prophylaxis) and subsequent episodes (secondary prophylaxis) became the standard of HIV care, thus OIs drug were also investigated.

Inclusion criteria:

Patients who received anti-retroviral medicine

Exclusion criteria:

New HIV/AIDs patient who first received anti-retroviral medicine

Patients who took only OI drugs

3. **Instrument** Prescribing error collecting forms

4. **Step of Investigation**

Phase 1: Analysis of Prescribing Error in the Former System of Prescribing Process

1. All prescriptions that contained anti-retroviral (ARV) and opportunistic infections drugs were investigated for prescribing errors. The errors were then classified by types of error including incorrect time, not specified strength, incorrect indication, adverse drug reaction (ADR), drug interaction, incorrect dose, incorrect regimen, incorrect quantity, and incorrect drug. The frequencies were calculated for the prevalence of prescribing errors.

2. Prescribing order was considered to contain a prescribing error if any medical order such as drug name, strength, indication, dose, or others was not in accordance with National ARV Treatment Guideline, Ministry Of Public Health 2006/2007[6].

Phase 2: The Implementation of Pharmacist Participation on Prescription Error Prevention.

The pharmacist consulted with physician to identify methods to prevent errors. A pharmacist-recommended regimen stamp was finally chosen as a model to prevent medication error. The model consisted of pharmacist's role and doctor's role. Pharmacist's role was on the day before HIV clinic as followed; pharmacist reviewed the latest order of ARV and/or OI, compared the regimen with those

suggested by National ARV Treatment Guideline, Ministry Of Public Health 2006/2007, predicted the number of tablets or capsules left, calculated the number of tablets or capsules to be ordered for this visit, and finally stamped the regimen with calculated number of tablets or capsules on the order. This order was then added into the patient's medical record on the day of HIV clinic and doctor's role started. Doctor had free decision to agree or disagree with the regimen shown on the order.

Phase 3: The Analysis of Prescribing Error after Pharmacist Participation.

One month after implementing the system, all personnel understood and could run the system properly. The orders were investigated again for prescribing errors as were performed in phase 1.

5. Data analysis The following data collected from phase 1 and phase 3 were analyzed:

5.1 Demographic data of patients was described by descriptive statistics.

5.2 For prescribing error rate calculation, errors were counted cumulatively every visit during each evaluation phase (1 and 3) Prescribing error rate was reported as percent error of total opportunities for error [TOE]. TOE was the sum of all regimen and OIs medication prescribing orders.

$$\% \text{ Error} = \frac{\text{Errors} \times 100}{\text{TOE}}$$

Results

1. Demographic data The important demographic data are presented in Table 1. The number of patients in phase 1 was 249. There were 138 males (55.4 percent) and 111 females (44.6 percent). The number of patients in phase 3 was 254. There were 126 males (49.6 percent) and 128 females (50.4 percent). Therefore, in phase 3, the percentage of male patients was less than in phase 1 and the percentage of female patients was greater than phase 1. Most regimens for treatment in phase 1 and 3 were GPO-VIR30 (63.21 and 61.11 percent, respectively). Patients were mostly treated by medical specialist in both phases (56.07 percent in phase 1 and 56.60 percent in phase 3). General practitioner played roles in phase 1 more than phase 3 (40.36 and 35.07 percent) but Internist played roles in phase 1 less than phase 3 (3.57 and 8.33 percent). Most opportunistic infections were Pneumocytis pneumonia and Cryptococcosis both in phase 1 and 3. The major co-disease were the diseases in endocrine and metabolism system and cardiovascular system.

2. Prescribing Errors Prescribing error occurred in 103 patients in phase 1 and 7 patients in phase 3. The number and error rate of prescribing errors are presented in Table 2.

3. Type of physician associated with prescribing errors The type, number, and

Table 1 Characteristics of patients and relating factors in phase 1 and phase 3.

Characteristic	Number of Patients (percent)	
	Phase 1	Phase 3
Sex		
Male	138 (55.42)	126 (49.61)
Female	111 (44.58)	128 (50.39)
Total	**249 (100)**	**254 (100)**
Major regimens for treatment		
GPO-VIR 30	177 (63.21)	176 (61.11)
d4T+3TC+EFV	30 (10.71)	41 (14.24)
AZT+3TC+NVP	22 (7.86)	27 (9.38)
GPO-VIR Z	17 (6.07)	10 (3.47)
GPO-VIR 40	13 (4.64)	14 (4.86)
AZT+3TC+EFV	13 (4.64)	13 (4.51)
d4T+3TC+IDV+RTV	5 (1.79)	2 (0.69)
AZT+3TC+RTV+IDV	2 (0.72)	1 (0.35)
DDI+IDV+RTV+NFV	1 (0.36)	1 (0.35)
3TC+EFV+IDV+RTV	0 (0.00)	2 (0.69)
AZT+DDI+RTV+IDV	0 (0.00)	1 (0.35)
Total	**280 (100)**	**288 (100)**
Types of physician		
Medical specialist	157 (56.07)	163 (56.60)
General practitioner	113 (40.36)	101 (35.07)
Internist	10 (3.57)	24 (8.33)
Total	**280 (100)**	**288 (100)**
The opportunistic infections prophylaxis		
Pneumocytis pneumonia	119 (59.20)	121 (58.74)
Cryptococcosis	74 (36.82)	76 (36.89)
Mycobacterium avium complex	5 (2.49)	3 (1.46)
Toxoplasmic encephalitis	3 (1.49)	4 (1.94)
Penicillosis	0 (0.00)	2 (0.97)
Total	201 (100)	206 (100)
Major co-disease of patient		
Endocrine and metabolism	23 (30.67)	22 (27.85)
Cardiovascular	19 (25.33)	17 (21.52)
Respiratory	15 (20.00)	14 (17.72)
Gastrointestinal	10 (13.33)	15 (18.98)
Dermatology	2 (2.67)	3 (3.80)
Neurology	2 (2.67)	3 (3.80)
Psychiatric	1 (1.33)	2 (2.53)
Other	3 (4.00)	3 (3.80)
Total	**75 (100)**	**79 (100)**

Table 2 The number and error rate of prescribing error classified by type of error

Type	Phase 1 (Total Orders=641)		Phase 3 (Total Orders=673)	
	Number of Error	Error Rate (percent)	Number of Error	Error Rate (percent)
Incorrect time*	55	8.58	0	0
Not specified strength	26	4.06	0	0
Incorrect indication				
- drug used without indication	12	1.87	0	0
- untreated indication**	4	0.62	1	0.15
Adverse drug reaction (ADR)	7	1.09	2	0.30
Drug interaction	5	0.78	3	0.45
Incorrect dose	5	0.78	1	0.15
Incorrect regimen	5	0.78	1	0.15
Incorrect quantity	3	0.47	0	0
Incorrect drug	1	0.16	0	0
Total	**123**	**19.19**	**8**	**1.20**

* physician prescribed drug not around the clock.

** having indication but no treatment

error rate of physicians associated with prescribing errors are shown in Table 3. In phase 1, the types of error frequently found were "*incorrect time*" and "*do not specify strength*" which occurred in every type of physicians. Considering the internist, this group of physician generates higher incorrect indication errors than other types of errors.

Table 3 The type, number, and error rate of prescribing error associated with type of physician

Type of error	Internist		General Practitioner		Medical Specialist	
	Phase 1	Phase 3	Phase 1	Phase 3	Phase 1	Phase 3
Incorrect time	2	0	28	0	25	0
Not specified strength	1	0	17	0	8	0
Incorrect indication						
- drug used without indication	2	0	3	0	7	0
- untreated indication*	1	0	2	0	1	1
Adverse drug reaction (ADR)	1	2	4	0	2	0
Drug interaction	0	0	2	2	3	1
Incorrect dose	0	0	5	1	0	0
Incorrect regimen	0	0	2	0	3	1
Incorrect quantity	2	0	0	0	1	0
Incorrect drug	0	0	1	0	0	0
Total errors	**9**	**2**	**64**	**3**	**50**	**3**
Total orders	**22**	**55**	**259**	**239**	**360**	**379**
Error rate (%)	**40.91**	**3.64**	**24.71**	**1.26**	**13.89**	**0.79**

* having indication but no treatment

4. Pharmacist's Recommendations for Modifying Physician Order on HIV Clinic Visit Day Pharmacist's recommendations were recorded after pharmacist discussed with the physicians and modifying physician order. Role of pharmacists and their participation in prescribing error prevention was well accepted by physicians, as evidence by the fact that all of the recommendations in the pharmacist-recommended regimen stamp were accepted. The number and type of pharmacist's recommendation in phase 1 and phase 3 are shown in Table 4

Table 4 The number of pharmacist's recommendations classified by type

Type of recommendation	Number (percent)	
	Phase 1	Phase 3
Clarification of order	22 (30.99)	1 (20.00)
Changing time	18 (25.35)	0 (0.00)
Cessation of drug	12 (16.90)	0 (00.00)
Substitution of drug	9 (12.68)	1 (20.00)
Changing dose	5 (7.04)	2 (40.00)
Drug addition	5 (7.04)	1 (20.00)
Total	**71 (100)**	**5 (100)**

5. Factor Associated with Medication Errors The regimens for treatment in this study were 11 regimens and classified into 2 groups. First group included one tablet combination regimen (GPO-VIR30, GPO-VIR40 and GPO-VIR Z). The remaining regimen was in the other group. When testing the error associated with the types of regimen by using chi-square test, the result showed that the group of regimen which contained one tablet combination had error less than other group significantly ($p<0.06$) as shown in table 5.

Table 5 Types of regimen related to the errors

Types of Regimen	Medication Errors		Total
	Yes	No	
One tablet combination regimen	62	145	207
More than one tablet regimen	46	27	73
Total	**108**	**172**	**280**

$P<0.06$, $X^2=24.89$

Discussion

Error rates in phase 1 and phase 3 were 19.19 and 1.20 percent, respectively. After pharmacist participation in phase 3 the error rates were lower than the error rates in phase 1. There were several explanations for the results. During phase 3, it was possible that physicians received more information on prescribing errors analysis. During phase 3, it was possible that physicians were notified for the prescribing errors previously occurred. Therefore, they paid more attention to drug information consultation with the pharmacist before prescribing the drug. Regimen preparation by pharmacist prior to physician's prescribing provide the opportunity for pharmacist to solve the problem which came from the physician in term of poor handwriting, lack of drug knowledge, prescribing incorrect drug or dose, or forgetting to prescribe drug.

A majority of prescribing error in phase 1 was "*incorrect time*". Physicians usually prescribed drug for bid and written as 1×2 pc, in general it means after breakfast and dinner but did not specify the time. However, for all the NNRTI and NRTI classes, the dosing interval should be 12 hour. (around the clock). Taking medication not on time or skipping a dose can have several possible effects, such as increasing viral load and resistance to treatment[7,8]

"*Do not specify strength*" was the second frequent type of error. Because of the large number of patient visits and numerous medications prescribed, physician did not have enough time to specify the strength of medication. Regimens prepared by pharmacists were suitable for solving this problem because the former order was reviewed and drug strength was chosen based on patient's body weight.

In this study, "*incorrect indication*" was found to be associated with drug regimen for prophylaxis opportunistic infections. During phase 1, physicians forgot to prescribe OI drugs in 4 cases and prescribed OI drugs without indication in 12 cases. One error occurred in phase 3 was the regimen prepared by the pharmacist that not covered OI drug, This case was caused by pharmacist error. The reason may be because of knowledge of individual pharmacists in ARV and OI drugs not enough to detect errors.

According to this study, there were many types of regimen for the treatment. Result of the study showed that regimens which were one tablet combination regimen having less error than more than one tablet regimen. In addition, dose, drug-drug interaction, contraindication, and allergy in each item of regimen were needed to be considered. Thus, physicians might make more errors than prescribing one tablet combination regimen.

Concerning polypharmacy in HIV/AIDS patients, these groups of patient usually

received more than three drugs unless they have co-disease. In this study, major co-disease of patient were endocrine and metabolism, cardiovascular, and respiratory. Therefore the patient would be at risk in medication use. Checking regimen by pharmacist before physician prescribing could reduce prescribing errors especially drug-drug interaction and duplicate therapy.

After establishing a system that pharmacist check regimen before physician prescribing, almost every type of prescribing error decreased, especially the errors from prescribing medication with the incorrect time, unspecified strength, incorrect quantity, and incorrect drug. These types of errors were not found in phase 3. The incorrect indication and incorrect regimen still existed in this study because of human error including forgetfulness and carelessness. Errors of drug-drug interaction should be prevented after establishing a system to prepare regimen. However, 3 cases still occurred in phase 3. These errors were found by the investigator after patient went back home. The investigator discussed with the hospital pharmacist for correction in the next visit. Occurrence of drug-drug interactions might come from pharmacist knowledge, workload of pharmacist, and lack of concurrent medication use of patient.

In this study, there were many types of physician prescribed HAART regimen. The internist had high error rate in prescribing than medical specialist and general practitioners in both phases. The reasons that internists may have high error rate than medical specialist and general practitioners were their less experiences in prescribing HAART and in estimating the risks and benefits of therapies or their poor access to the data sources which can be the reference of their therapeutic decisions.[9]

According to this study, the pharmacist has an important role in the error prevention and alteration of physician's treatment decision. The benefit of pharmacist's recommendation is to prevent drug toxicity and enhance appropriate drug use. Some prescribing errors, that had less effects, were still occurred and not consulted with the physicians. In some cases, physicians allowed the pharmacist to modify the orders such as setting the suitable schedule of follow-up for each patient, adding or decreasing drug quantity to be sufficient till the next visit.

Conclusion

This study was performed to analyze the errors in prescribing process and to assess the pharmacist role in participation in reducing prescribing error. Results indicated the substantially reduction of physician prescribing error rate came from pharmacist participation. Role of pharmacist in prescribing error prevention included collaborating physician to prescribe the appropriate dose

and duration of therapy, screening for drug-drug interaction between HIV's and other drugs used by patients and monitoring adverse drug reaction that might occur to patients.

Results might be a model for other hospitals who want to improve the prescribing process in order to reduce and prevent the prescribing errors.

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