

A Retrospective Study of Prescribing Error Associated with The Computerized Prescribing System and The Handwritten Prescribing System Among Prescriptions in a Private Hospital, Chiang Mai Province

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Abstract

OBJECTIVES: To compare prescribing errors arising from prescribing drugs by computerized prescribing system and handwritten prescribing system and to explore the possible factors that cause prescribing errors between the two systems.

MATERIALS AND METHODS: A retrospective study collected data from outpatient prescriptions at Bangkok Hospital Chiang Mai from January 1- December 31, 2019 by a simple random sampling method. A total of 18,211 drug prescriptions were included in this study which consisted of prescribing the drug with the computerized prescribing system and the handwritten prescribing system. The data obtained were analyzed by frequency distribution, percentage, mean and standard deviation. Factors that caused discrepancies in prescribing drugs during computerized prescribing and handwritten prescriptions were tested by means of Chi-square test. A value of 0.05 odds ratio and 95% Confident interval was considered statistically significant.

RESULTS: In this study, the discrepancy from the handwritten prescribing system was 2.6 % higher than that of the computerized prescribing system (0.24%). The study was also classified by the severity of the discrepancy which demonstrate both systems experienced the highest severity on a scale of 0 (Near miss event) by 2.6 % for the handwritten prescribing system and 0.2 % for the computerized prescribing system. In addition, the top three discrepancy errors from computerized prescribing were wrong time, wrong dose and wrong quantity at 0.07%, 0.06% and 0.05 %, respectively. As for the handwritten prescribing system, the discrepancy errors were wrong time, wrong quantity and wrong dose at 1.24%, 0.56% and 0.35%, respectively.

CONCLUSION: There were significant differences in the proportion of errors in the group of the handwritten prescribing system and the computerized prescribing systems (OR = 0.091, $p < 0.05$); namely, the risk of errors by the computerized prescribing systems was reduced by 91% compared with the handwritten prescribing system. However, there were no statistically significant differences in physician's work experience, departments, and age groups

Keywords: prescribing error, computerized prescribing system, handwritten prescribing system.

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Medication error is still a serious problem in many countries which lead to errors in administering medication. The errors are divided into working processes such as: prescribing error, transcribing error, dispensing error and administration error. Errors can occur throughout every step of drug administration.¹ The characteristic of the errors are wrong patient, wrong drug, wrong dose, wrong type, wrong quantity, wrong route, wrong drug concentration, wrong dosing rates or giving advice on the misuse of the drug or not specifying the name of the drug, the strength, the concentration, the frequency of drug usage.² Based on a study of medication errors, it was found that prescribing errors were the most common 77.8%³, and those also were classified by type of error, including errors of omission where patients were not prescribed medicines that they should have received (23 %), wrong dose

(20%), wrong type (16%), and wrong route (15%).⁴ These errors cause an adverse event to the patient themselves which can be severe and life-threatening and can also affect the patient's family and result in increasing costs for all parties.^{5,6} This study's results were in line with the study of Songkramsri, S. and Laopaiboon, M.⁷ which found that 88.3% of the drug errors were being screened and corrected by pharmacists prior to administration, and 11.7% of the patients had to stay in the hospital for an average of 2-5 days longer.

Prescribing systems are the methods and processes of physicians prescribing medications, these can be divided into 2 methods; computerized prescribing systems (Computerized Physician Order Entry; CPOE) and a handwritten prescribing system⁸ which is a system that allows doctors to write prescriptions along with entering the list of drugs that are prescribed into the system (as show in Figure 1). Based on a study of medication errors using computerized prescribing system, it was found that errors from the handwritten prescribing system were higher than the computerized prescribing system (errors from dispensing drugs by pharmacists) 0.35%, 0.29%, respectively.⁹ In addition, a study conducted by Shulman et al,¹⁰ comparing prescribing errors from computer systems and those from handwritten prescriptions, found a significant reduction in error rates for errors with computerized prescribing (4.8%) compared to handwritten prescription (6.7%). In accordance with evidence of best practice for health professionals, computerized prescribing systems could reduce errors such as administration errors caused by misreading the name of the drugs and also decrease the problem of being unable to read a physician's handwriting, etc. Similarly, a study conducted by a medical university in Poland showed that before the computer system was used, the error rate of drug prescribing was 2.3% and after its adoption, it decreased to 0.7%.¹¹ A comparative study in large tertiary care hospitals found that the effect of using a computer system in the drug prescribing process significantly lowered severe drug errors ($p = 0.01$) from 10.7 times to 4.86 times per 1,000 patient days, counting as a 55% decrease.¹² Thus, the computerized prescribing systems are suitable for prescribing drugs as they can decrease the rate of prescribing errors and their severities.^{13,14} It can be concluded that using computers to prescribe drugs can reduce discrepancy in copying and translating medication orders.

At Bangkok Hospital Chiang Mai, originally in 2015, a prescription was written down in outpatient department (OPD) form recorded by physicians, followed by keying this in to a computer system. Next, the pharmacist received a prescription and screened the doctor's order according to the A to G principle, the process to conduct a review prior to dispensing; and finally compared this to the prescription that was keyed into the computer system before dispensing the drugs to the patient. During the period from January-December 2017, there were 447 prescription errors out of 21,509 or equal to 2.08%.¹⁵

From January 2018 until today, a hospital campaign was launched to encourage physicians to key in the computer

system and route to the pharmacist when prescribing medications to the patients. The pharmacist then reviews the order according to the A to G principle before dispensing the medications; A) Appropriateness of drug, dose frequency, route of administration, B) therapeutic duplication, C) real or potential allergies, D) real or potential Interactions between the medication and other medication or food, E) variation for hospital criteria for use, F) patient's weight and other physiological information, and G) other contraindications.¹⁶ By using this process, medication dispensing errors are decreased and improve medication dispensing waiting time. However, some physicians continue to order medication via handwritten OPD record and then key in his/her medication order. Nevertheless, there is no clear reason why some physicians won't key in medication order in CPOE directly.

For this reason, the Medical Affairs Office recognizes the importance of information and interests in studying the incidence of medication errors arising from prescribing drugs via computer-based systems compared to the handwritten prescribing system. This will pave the way to minimize medication errors. As a result, patients are protected from using the wrong medication as much as possible and this in turn will help reduce costs incurred from adverse events.

Definition

Prescribing error is defined as any error caused by a doctor's prescription resulting from wrong drug selection, wrong dose selection, prescribing the wrong amount of medication, selecting wrong dosage and prescribing to the wrong patient, etc., with direct impact on patients. The handwritten prescribing system is defined as a physician's prescription written in the OPD record and keyed into the computer system sent to the pharmaceutical department. The pharmacist receives a paper prescription and then checks the prescription against electronic prescriptions using the A to G principle before dispensing medicine to the patient. The computerized prescribing system is defined as a physician's prescription by entering the prescription into a computer system instead of writing on paper. The pharmacist receives and checks the prescription, using the A to G principle, accessing only an electronic prescription and therefore not needing to compare the doctor's handwritten order before dispensing medicine.

Material and Methods

This retrospective study obtained data from prescribing drugs in the outpatient department of Bangkok Hospital Chiang Mai from January 1 - December 31, 2019 by a simple random sampling method. We received a sample of 18,211 prescriptions from both the computerized prescribing system and the handwritten prescribing system. The collected data were analyzed by using SPSS software and the details are as follows.

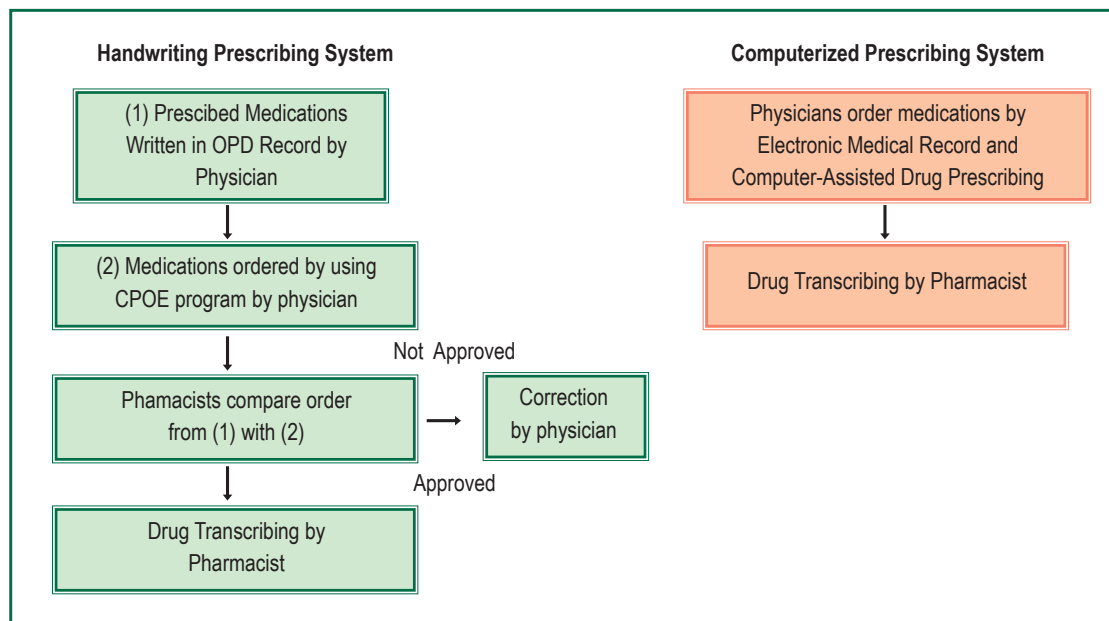


Figure 1: Prescribing systems

1. Demographic information of participants such as gender, age range groups, department and physician's work experience.
2. Information about the type of errors that occurs, by the level of severity that affects the patient and prescribing drugs using computerized prescribing system (Computerized Physician Order Entry; CPOE) and handwritten prescribing system both analyzed by frequency distribution, percentage, mean and standard deviation. Moreover, analyzing the difference in the proportion of medication errors arising from computerized prescriptions and handwritten prescriptions. The statistical significance level was determined at 0.05.
3. Factors, including gender, age, department and Physician's work experience were compared and the relationship between the factors with the incidence was analyzed using chi square statistics and also presenting the odds ratio with a 95 % confidence interval.
4. Criteria for determining the level of severity used in Bangkok Hospital Chiang Mai are categorized as follows:⁹
 - Level 0 None: an error occurs but pharmacists can detect errors before dispensing.
 - Level 1 Minor: an error occurs, and reaches a patient but it is not dangerous to the patient. No treatment required.
 - Level 2 Significant: an error occurs and it may be dangerous to a patient. No special treatment is required.
 - Level 3 Serious: an error occurs and it may cause serious harm to a patient. The patient needs additional treatment and may cause patient to stay in the hospital longer.
 - Level 4 Potentially cause: an error occurs and may cause a patient to be permanently disabled.
 - Level 5 Potentially Lethal: an error occurs and may cause a patient's death.

Ethical consideration

This study was approved by Institutional Review Board Bangkok Hospital Chiang Mai. (Project ID BCM-IRB-2020-04-002)

Results

Demographic information collected from the outpatient department divided into handwritten prescribing system (6,288 orders) and computerized prescribing system (11,923 orders). For the handwritten prescribing system, the majority of the drug prescriptions were male (55.4%) with an age group between 19 - 45 years (46.9%). Of all, the highest proportion found was in the emergency service department (25.4%) and when a physician's experience was of working more than 3 years (82.4%). As for, the computerized prescribing system, the majority of the drug prescriptions were female (56.5%) with an age group between 19 - 45 years (43.6%). The highest proportion was in the pediatrics unit (20.3%) and when a physician's experience was of working more than 3 years (68.5%), see Table 1.

Handwritten prescriptions had a higher risk of prescribing errors than computerized prescriptions, 95% CI = 0.061, 0.135, indicating that there was significant difference in prescribing errors between computerized prescribing system and handwritten prescribing system. (OR = 0.091, $P < 0.05$), see Table 2.

A study of the prescribing errors showed that the prescription of drugs using the handwritten prescribing system would cause the highest frequency errors in level 0, 162 times (2.60%), followed by level 1(0.02%) and level 2 (0.02%). Meanwhile, computerized prescribing system generates the highest frequency errors in level 0, 24 (0.20%). followed by level 1(0.03%) and level 3 (0.01%) respectively. (Table 3).

Table 1: Demographic and characteristics data in this study (n =18,211)

Characteristics	Handwritten (n = 6,288)	Computerized (n = 11,923)
	n (%)	n (%)
Gender		
Female	2,806 (44.6)	6,740 (56.5)
Male	3,482 (55.4)	5,183 (43.5)
Age(years)		
0-1	114 (1.8)	733 (6.1)
2-5	427 (6.8)	1,309 (11.0)
6-18	600 (9.5)	940 (7.9)
19-45	2,947 (46.9)	5,196 (43.6)
46-60	1,089 (17.3)	1,943 (16.3)
>60	1,111 (17.7)	1,802 (15.1)
Department		
Anti-Aging Center	31 (0.5)	204 (1.7)
Bangkok Women s Health Center	157 (2.5)	1,637 (13.7)
Beauty	215 (3.4)	709 (5.9)
Dental Center	616 (9.8)	0 (0.0)
Ear Nose Throat Center	724 (11.5)	290 (2.4)
Emergency Service Department	1,600 (25.4)	251 (2.1)
Eye Center	791 (12.6)	0 (0.0)
GI & Liver Center	36 (0.6)	642 (5.4)
Health Promotion Center	3 (0.0)	40 (0.3)
Heart Clinic	71 (1.1)	514 (4.3)
Hemodialysis Center	12 (0.2)	83 (0.7)
Internal Medicine Unit	542 (8.6)	1,840 (15.4)
Neurology Unit	59 (0.9)	330 (2.8)
Oncology Unit	85 (1.4)	103 (0.9)
Orthopedic Unit	633 (10.1)	920 (7.7)
Pediatrics Unit	271 (4.3)	2,423 (20.3)
Rehabilitation Center	11 (0.2)	185 (1.6)
Special Unit	86 (1.4)	653 (5.5)
Surgery Unit	345 (5.5)	1,099 (9.2)
Physician's work experience		
< 2 years	669(10.6)	1,810 (15.2)
2-3 years	446(7.0)	1,938 (16.3)
> 3 years	5,179(82.4)	8,175 (68.5)

Table 2: Number and percentage of prescribing errors classified by type of computerized prescribing system and handwritten prescribing system (n =18,211).

Category	Prescribing error	
	Yes	No
Handwritten	164 (2.60)	6,124 (97.40)
Computerized	29 (0.24)	11,894 (99.76)

* 95% CI = 0.061 - 0.135, $P < 0.05$, Odds Ratio = 0.091 times

With regards to errors from drug prescribing classified by type of errors, the result showed that for the handwritten prescribing system the top 5 errors were: wrong time (1.24%), followed by wrong quantity (0.56%), wrong dose (0.35%), wrong drug (0.21%) and omission (0.08%), respectively. Regarding drug prescribing by the computerized prescribing system, the top 5 errors were: wrong time (0.07%) followed by wrong dose (0.06%), wrong quantity (0.05%), wrong patient (0.03%) and wrong drug (0.02%), omission (0.02%), respectively (Table 4).

Prescribing errors were classified by patient age groups. For handwritten prescribing system, most of them (1.34%) were in the range of 19-45 years old. As for computerized prescribing system, most of them (0.09%) were in the same age group as the handwritten prescribing system (Table 5).

Table 3: Number and percentage of prescribing errors from computerized prescribing system and handwritten prescribing system classified by level of severity.

Level of severity	Handwritten (n = 6,288), n (%)	Computerized (n = 11,923), n (%)
Level 0 None	162 (2.60)	24 (0.20)
Level 1 Minor	1 (0.02)	4 (0.03)
Level 2 Significant	1 (0.02)	0 (0.00)
Level 3 Serious	0 (0.00)	1 (0.01)

Table 4: Number and percentage of prescribing errors from computerized prescribing system and handwritten prescribing system classified by type of errors.

Type or errors	Handwritten (n = 6,288) n (%)	Computerized (n = 11,923) n (%)
Omission	5 (0.08)	2 (0.02)
Wrong drug	13 (0.21)	2 (0.02)
Wrong dose	22 (0.35)	7 (0.06)
Wrong patient	2 (0.03)	4 (0.03)
Wrong quantity	35 (0.56)	6 (0.05)
Wrong time	78 (1.24)	8 (0.07)
Know allergy	1 (0.02)	1 (0.008)
Wrong form	2 (0.03)	0 (0.00)
Wrong IV solution	2 (0.03)	0 (0.00)
Wrong route	1 (0.02)	0 (0.00)
Drug information incomplete	3 (0.05)	0 (0.00)

Table 5: Number and percentage of prescribing errors from computerized prescribing system and handwritten prescribing system classified by age groups.

Age (years)	Handwritten (n = 6,288) n (%)	Computerized (n = 11,923) n (%)
0 - 1	1 (0.02)	2 (0.02)
2 - 5	10 (0.16)	2 (0.02)
6 -18	20 (0.32)	5 (0.04)
19 - 45	84 (1.34)	11 (0.09)
46 - 60	25 (0.40)	7 (0.06)
> 60	25 (0.40)	4 (0.03)

Prescribing errors were classified by department revealed that the top 3 medication errors using the handwritten prescribing system occurred in the Hemodialysis Center (16.67%), Neurology Unit (5.08%) and Ear Nose Throat Center (4.83%),

respectively. As for the computerized prescribing system, the top 3 errors were found in Health Promotion Center (2.50%), Ear Nose Throat Center (0.69%) and Heart Clinic (0.58%), respectively. (Table 6).

Table 6: Number and percentage of prescribing errors from computerized prescribing system and handwritten prescribing system classified by departments.

Department	Handwritten		Computerized	
	N	n (%)	N	n (%)
Anti-Aging Center	31	1 (3.22)	204	1 (0.49)
Bangkok Women's Health Center	157	3 (1.91)	1,637	1 (0.06)
Beauty	215	4 (1.86)	709	0 ^a
Dental Center	616	7 (1.14)	0	NA ^b
Ear Nose Throat Center	724	35 (4.83)	290	2 (0.69)
Emergency Service Department	1,600	42 (2.63)	251	1 (0.40)
Eye Center	791	13 (1.64)	0	NA ^b
GI & Liver Center	36	1 (2.78)	642	3 (0.47)
Health Promotion Center	3	0 ^a	40	1 (2.50)
Heart Clinic	71	1 (1.41)	514	3 (0.58)
Hemodialysis Center	12	2 (16.67)	83	0 ^a
Internal Medicine Unit	542	24 (4.43)	1,840	6 (0.33)
Neurology Unit	59	3 (5.08)	330	0 ^a
Oncology Unit	85	2 (2.53)	103	0 ^a
Orthopedic Unit	633	16 (2.53)	920	2 (0.22)
Pediatrics Unit	271	7 (2.58)	2,423	7 (0.29)
Rehabilitation Center	11	0 ^a	185	0 ^a
Special Unit	86	0 ^a	653	1 (0.15)
Surgery Unit	345	3 (0.87)	1,099	1 (0.09)
Total	6,288		11,923	

^aIn cases where prescriptions are available but there is zero error, this is considered zero percent.

^bIn cases where there is no prescription available for evaluation is considered NA (not applicable).

Discussion

In this study, prescribing errors from two different prescribing systems, namely handwritten and computerized prescribing system were analyzed and the factors causing the errors were compared and were discussed according to two objectives of the study as follows:

First, studying factors and comparing prescribing errors between two prescribing systems. It was found that there was significant difference in the proportion of prescribing errors between computerized prescribing system and handwritten prescribing system and the risk of errors by the computerized prescription was reduced by 91% compared to handwritten prescriptions. As for doctors' work experiences in hospitals, age groups and departments, it was found that there was no statistically significant difference. According to Zakharov S et al.,¹⁷ studying the incidence of medication errors in pediatric patients compared with adults showed that prescribing errors occurred in pediatric patients in the range of 1-5 years old (26%) more than other groups. Kaushal R et al.¹⁸ also found the most common error was wrong dose (28 -31%). More interestingly, it was caused by physicians with less working experience.

Second, this study showed that the errors were more prevalent in handwritten prescriptions (2.6%) than in computerized prescriptions (0.24%). This finding was in line with the result of the study in Songklanagarind Hospital, which showed that prescribing errors resulting from the handwritten prescribing system produced errors at a rate of 0.16%, compared to the computerized prescribing system (0.14%).⁹ In addition, the results of an analysis of the ITS Computerized Prescription Efficiency Study (CPOE) in conjunction with the Basic Clinical Decision Support System (CDSS) found that the CPOE/CDSS system helps to decrease prescribing errors from 47.9% to 7.6%.⁶ Furthermore, a study conducted by Songkhramsri S.⁷ in Nonghan Hospital Udonthani Province about drug prescribing by computer system in reducing prescribing errors, showed that prescribing error rate was reduced by using computerized medication prescribing systems of a significant 39.6 per 10,000 bed days.

Next, the results of the level of severity in this study, showed that the highest level of severity was level 0 (near miss event), which in drug prescriptions in the handwritten prescribing system (2.6%) and computerized prescribing

system (0.2%). Accordingly, the study of Songkhramsri⁷ studying the effect of the computerized prescribing system for reducing prescribing errors in the inpatient ward, found most of the errors to be at the level of severity B (77.3 %) , equivalent to level 0; not dangerous to the patient because the errors were screened and corrected by pharmacists before dispensing.

Finally, the finding of this study, classified by type of errors, found that the top 3 errors from computerized prescribing system were wrong time, wrong dose, and wrong quantity respectively. As for the handwritten prescribing system, the top 3 most common errors were wrong time, wrong quantity and wrong dose. According to Mary P Tully's study¹⁸, regarding errors from drug prescriptions in hospitals, it was reported that both computerized drug prescriptions and the handwritten prescribing system produces a similar type of errors. A study of drug prescribing errors by Kaushal et al¹⁹ revealed that the most common rate of errors was wrong dose (28-31%).

The limitation of this study is that it is only the pharmacist who is reporting medication errors. If pharmacists are too busy with workload, they might forget to report the medication error incidents.

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Conclusion

It can be concluded from this study that the computerized prescribing system significantly reduced the errors from prescribing in the outpatient department compared to the handwritten prescribing system. Apart from that, there is no difference between methods. The satisfaction of users and the factors influencing the usage of CPOE systems by physicians would be of interest for further study.

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