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Potential Medication Errors in Electronic Prescribing in A Primary Health Care

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Abstract. An effort to reduce medication errors is to use drugs prescription electronically. However, this system may not be free from errors in medication. This study aimed to find out the description of prescribing flow, to examine electronic prescription completeness, and find out the potential medication errors that occur in the prescribing phase of electronic prescription using prescribing indicators . This study used observational method by extracting general practice outpatient prescription data of March 2018 in a healthcare service of telecommunication company located in Bandung and analyzed descriptively. The electronic prescriptions of medicines at this health care werewritten and inputted by physicians. When an error occurred on a computer system, the physician would prescribe the required drugs manually so that the patient can still be served. Incompleteness of the most common prescription were administrative requirements where all prescriptions did not list the physician's license, patient's gender, patient's body weight (BW), telephone number of the place of practice, and patient's contact number. Medication errors had the highest potency for the occurrence of prescription writing with two or more drugs interacting and this error was classified as category D according to The National Coordinating Council for Medication Error Reporting and Prevention (NCC-MERP).

Keyword: Electronic Prescription, Medication Errors, Prescribing Indicators, NCC-MERP

Abstrak.*Upaya_untuk_mengurangi_kesalahan_pengobatan_adalah_dengan_menggunakan resep_obat_secara_elektronik. Namun, sistim ini_belum_tentu_bebas_dari_kesalahan_dalam terapi. Penelitian_ini_bertujuan_untuk_mengetahui_gambaran_alur_pelayanan_resep_obat, mengkaji_kelengkapan_resep_elektronik, dan mengetahui_potensi_kesalahan_pengobatan yang terjadi pada fase_peresepan_resep_elektronik_menggunakan indikator peresepan. Penelitian_ini_menggunakan_metode_observasional_dengan_mengambil data resep_dokter umum pada pasien_rawat jalan bulan Maret 2018 di sebuah layanan kesehatan perusahaan telekomunikasi yang berlokasi di Bandung dan dianalisis_secara_deskriptif. Resep_obat elektronik di layanan kesehatan_ini ditulis dan diinput oleh dokter. Ketika kesalahan terjadi pada sistim komputer, dokter akan_meresepkannya_secara manual sehinggga_pasien_masih dapat dilayani.Ketidaklengkapan resep yang paling umum adalah persyaratan administrasi di mana semua resep tidak tercantum izin praktik dokter, jenis kelamin pasien, berat badan pasien, nomor_telepon_tempat_praktik, dan nomor_kontak_pasien. Kesalahan_pengobatan memiliki potensi paling besar untuk terjadinya penulisan resep dengan dua atau lebih obat yang berinteraksi dan kesalahan_ini_diklasifikasikan_sebagai_kategori D menurut NCC-MERP.*

Kata Kunci:*Resep Elektronik, Kesalahan Pengobatan, Indikator Resep, NCC-MERP*

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1. Introduction

Improper prescriptions of drugs can cause errors affecting patients, including clinical outcomes. The incidence of medication errors in the world reached 51.8% consisted of administrative, pharmacy and clinical aspects[1]. A research in Indonesia showed the potency for medication errors in hospitals occurred in many prescribing phases.As much as 74.53% of the prescriptions did not include dosage forms and 46.91% were administrative errors and also other significant events[2-4].

Errors can be caused by unclear communication, environmental conditions, work interruptions, work overloads, and poor education. Few efforts can be done to prevent errors in medication. One strategy is by improving the system using accurate electronic prescription (e-prescription). This system is free from distractions and can be recognized by pharmacist [5-7]. Manual prescription writing has been practiced with 6.5 % potential error due to unreadable or unclear prescriptions[2].

Computerized Physician Order Entry (CPOE) has begun to develop in Indonesia, but there are still limited hospitals that use this system. The use of electronic prescriptions does not guarantee that medication errors can be avoided. The errors comprise wrong amount of medications, wrong direction of measurement, wrong duration of therapy, wrong dose formulation and inflexible order format in prescribing ofmost anti-infective, nervous system, inhaler, eye drop and topical agents[8]. A study conducted in Indonesia indicated that out of 997 electronic prescriptions, 63.8%had incomplete prescriptions. Additionally,26.0% of them had problems with potential drug interactions, 6.3% were prescribed with incorrect drugs, 2.1% were multiple drug prescriptions, and 1.8%had unusual dosages (1.8%)[9].

Therefore, this system still needs to be studied to assure safe treatment given to patients. This study aimed to find out the description of electronic prescribing flow, to examine e- prescription completeness, and analyzed the potential medication errors that occur in the prescribing phase of e-prescriptions using prescribing indicators[10-11].

2. Methods

This retrospective descriptive observational study was carried out byanalyzing the flow of electronic prescription services and retrieving data from e-prescription sheets (n=342)consisted of 1,383 prescriptions in a health care center Bandung period March-April 2018. The assessment results are in the form of electronic drug prescription flow.Assessment of administrative completeness was only limited to administrative completeness and pharmaceutical suitabilityby referring to the Permenkes RI No. 72 year 2016 concerning Standard of Pharmaceutical Services in Hospitals, and potential medication errors by using prescribing indicators[9]. The average number of drugs per sheet was further analyzed and

categorized based on the study that stated that polypharmacy could be categorized as minor (if there were 2-3 different drug classes provided to a patient), moderate (if there were 4-5 different drug classes provided to patient) and primary (if> 6 different drug classes provided to patient) [12].

3. Results and Analysis

The flow of electronic prescription services can be seen in Figure 1. The flow of the service can be described as follow:

3.1 Registration

Once the patients arrived at the health care centre, theyimmediately registeredusing the system that had been automated. Previously registered patients were required to submit the Personnel Registration Number because their data have already been in the system. Each of these patients entered his or her name and the physician'sname going to seek for treatment. After registration, each of these patients received a queue number and waited in the available waiting room.

3.2 Identification of Patients and Drug Prescribing

When the patients had registered, the physicians automatically had data of the patientswho requested for examination and accessedthe dataas well as the patients' medical and medication histories on the information system. After the assessment, the physicians wrotethe prescriptions by searching the availability of drugs that would be prescribed in the information system, printed out the e-prescriptions, and handed inthe prescriptions to the correspondingpatients. It was found that sometimes few prescriptions were written manually when errors occurred in the system. Thus, the patients could be served.

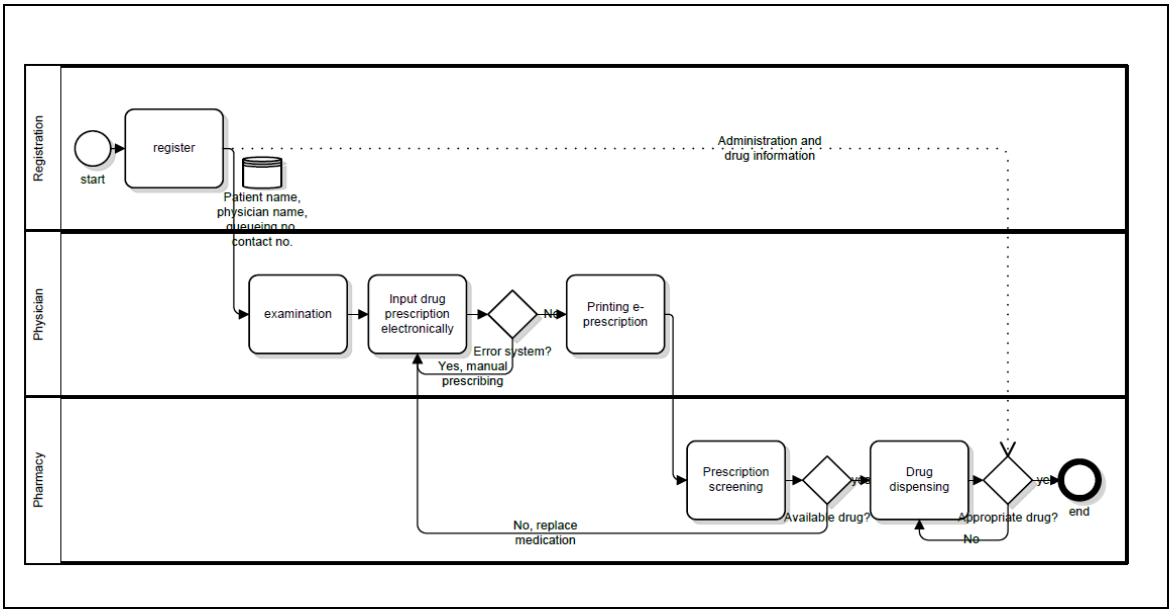

Figure 1. Flow of Electronic Prescription Services

3.3 Identification of e-Prescription and Drug Administering to Patients

The written prescriptions were submitted to the pharmacy for further processing. The pharmacy personnel identified the received prescription sheets and checked the availability of the drugs required. If drugs were available, the pharmacy personnel would prepare the necessary medications according to the prescriptions. The prepared medications wererechecked by the pharmacists before being handed into the patients. The prescribed drugs during the study period can be seen in Table 1. The most frequently prescribed drugs were antihypertension, drugs to treat dyslipidemia, anticoagulant, antiplatelet, andfibrinolyticdrugs. According to dosage form, the most frequently prescribed drugs were tablet/caplet/capsule which reached 98.84%.

Table 1. Description of the Drugs Prescribed

Category	Number of drug items	Percentage (%)
Therapeutic Class		
Antihypertension	539	38.97
Dyslipidemia	155	11.21
Anticoagulant, Antiplatelet, andFibrinolyticdrugs	113	8.17
Antidiabetic drugs	109	7.88
Vitamin and Minerals	103	7.45
NSAIDs	49	3.54
Antacids, Antireflux Agent & Antiulcer	49	3.54
Cough & Cold	35	2.53
Hyperuricemia and Gout	34	2.46
Bladder and Prostate Disorders	34	2.46
Others	163	11.79
Total	1,383	100
Dosage form		
Tablet/Caplet/Capsule	1,367	98.84
Syrup	15	1.09
Inhaler	1	0.07
Total	1,383	100

In the pharmacy unit, the pharmacistsonly reviewed2 out of 3 aspects of screening of the prescriptions namely administrative completeness and pharmaceutical suitability. The results obtained from the study of administrative completeness and pharmaceutical suitability are listed in Table 2.

Table 2. e-Prescription Completeness and Compatibility Assessment

Aspects	N (%)			
	Complete	**Incomplete**	**Appropriate**	**Inappropriate**
Administrative completeness (n=342)				
Patient's name	342 (100)	0(0)	-	-
Patient's age	341 (99.7)	1 (0.3)	-	-
Physician's license	0(0)	342(100)	-	-
Practice contact number	0(0)	342(100)		
Patient'sgender	0 (0)	342 (100)	-	-
Patient's BW	0 (0)	342 (100)	-	-
Physician's name	342 (100)	0 (0)	-	-
Address of Practice	342 (100)	0(0)	-	-
Physician's signature	334 (97.7)	8 (2.3)	-	-
Additional Formats in Electronic Prescription				
Prescription Number	334 (97.7)	8 (2.3)	-	-
Registration Number	334 (97.7)	8 (2.3)	-	-
Special health service	334 (97.7)	8 (2.3)	-	-
Type of clinic	334 (97.7)	8 (2.3)	-	-
Employment ID number	342 (100)	0(0)	-	-
Patient address	139 (40.6)	209 (59.4)	-	-
Patient contact number	60 (17.5)	282 (82.5)	-	-
Practice contact number	0(0)	342 (100)	-	-
Pharmaceuticals (n=1,383)				
Dosage form	1,284 (92.8)	99 (7.2)	1,243 (89.88)	140 (10.12)
Dose strength	1,247 (90.2)	136 (9.8)	1,378 (99.64)	5 (0.36)
Number of drugs	1,383 (100)	0 (0)	-	-
Usage Instruction	1,383 (100)	0 (0)	-	-

In the assessment of administrative completeness, the requirement of the prescriptions were checked according to Regulation of the Minister of Health of the Republic of Indonesia No. 72 year 2016 concerning the Standards of Pharmaceutical Services in the Hospital (also referred by health clinics), as well as aspects already listed in the electronic prescriptions. This study found that all (100%) of the prescription sheets had nophysician's license number and practice contact number as well as gender, body weight and contact numbers of the patients.

In term of pharmaceutical suitability, as much as 9.8% (136 items)of the 1,383 drugs analyzeddid not include dose strength, 10.12% (140 items) did not match the existing dosage form and 0.36% (5 items) were inappropriate with existing dose strengths.

In prescribing phase, the indicators that have been studied and used in the assessment were overall number of drugs and averagenumber of drug items per prescription sheet, occurrence of wrong drug, wrong dose, and error/unclear prescribing, occurrences of prescription writing with 2 or more potential drug interactions. Drugs prescribed by number of drugs per sheet are shown in Table 3. Of the 342 prescriptions extracted, there were 1,383 drugs prescribed. The average number of drug items per prescription was 4.04 rounded to4.

Table 3. Drugs prescribed byNumber of Drugs per Sheet

Number of drugs per sheet	Number of sheets	Number of Drug Items
1	31	31
2	45	90
3	70	210
4	61	244
5	54	270
6	43	270
7	27	189
8	9	72
9	1	9
10	1	10
Total	342	1,383
Average Number of Drug Items per Sheet		4.04

The number and average number of drug items per prescription sheet were calculated to determine the incidence of polypharmacy (the simultaneous use of multiple drugs to treat a single ailment or condition). The more the number of drugswritten in each prescription, the higher the potency of medication errors to occur. This present study found that the average number of drug items written in a prescription sheet was 4.04 and categorized into moderate polypharmacy.

Occurrence of wrong drug, wrong dose, and error/unclear prescribing are listed in Table 4. The present study was conducted only limited to the inappropriate dosage form (incorrect dosage form) and the occurrence of contraindication due to the limited data obtained fromthe electronic prescriptions. In the electronic prescriptions the patients' clinical conditions were not available. The incidence of inappropriate dosage forms was seen from the suitability of the dosage form written in the prescription with the available dosage form. For contraindications, it was seen from whether there is medication indicated for condition prohibited for the drugs.

The potential medication errors occurred were categorized into category D in which this category stated that 'there is an error experienced by the patient and monitoring is needed to confirm that it does not cause any harm to the patient and/or intervention needed to prevent the harm[13]. This event could occur due to the diseases and symptoms of the disease experienced by the patient (complications), so that the prescribers wrote more than one drug to meet the needs of these patients.

Table 4. Occurrence of Wrong Drug, Wrong Dose, and Error/Unclear Prescribing[11]

Prescribing Indicators	N (%)	Medication Error Category
Wrong Drug Prescribing		
Inappropriate dosage forms	140 (10.12)	B
Contraindications	0 (0)	A
Total	140 (10.12)	
Wrong Dose		
Too Low	103 (7.4)	D
Too High	12 (0.9)	D
Total	115 (8.3)	
Error/Unclear Prescribing		
Drug name	5 (0.4)	B
Drug Amount	46 (3.3)	B
Drug Dose	5 (0.4)	B
Total	56 (4.1)	

The results of the analysis showed that there were potential errors in writing dosage forms. This potential medication errors can be classified into category B in which an error has occurred but the error does not reach the patient, because upon delivery, the drug was given according to the available dosage form. In the occurrence of wrong dosage prescribing, the literature states that the dose of cetirizine was 5-10 mg per day, but the dose given was 10 mg 3 times a day, so the dose given can be categorized as too high. Based on the results of the analysis using the algorithm for determining Medication Errors or NCC MERP Index for Categorizing Medication Errors, the incidence of too low and too high doses were categorized into category D namely the occurrence of errors that reach the patient and monitoring is needed to confirm that it does not cause harm to the patient and/or interventions is needed to prevent harm. Provision of too low dose can lead to ineffective treatment in which the disease suffered by the patient was not properly treated.Too high doses mayresult in toxic effects to the body organs, reduce the patients' quality of life, and even death. However, thisanalysis was only conducted from the e-prescriptions and the pharmacy point of view. The patient's clinical conditionsare also the crucial determinantsin writing prescriptions. Thus, further studies are required to confirm these findings.

Potential interactionsbetween 2 or more drugs with different severity in thee-prescriptions are shown in Table 5. From the analysis of potential drug interactions, there were 144 antagonistic pharmacodynamic interactions with the most frequently occurred were between amlodipine and metformin with moderate severity (quite clinically significant).

Table 5. Potential interactions between 2 or more drugs in thee-prescriptions [12-14]

Mechanism of Interaction / Severity	**Category of Medication Errors**	
	C	**D**
Pharmacodynamic Antagonist		
Minor	1	1
Moderate	0	135
Major	0	7
Total	1 (0.1)	143 (10.3)
Pharmacokinetics		
Minor	3	0
Moderate	0	7
Major	0	32
Total	3(0.2)	39 (2.8)
Synergistic		
Minor	0	0
Moderate	0	62
Major	0	2
Total	0	64 (4.6)
Total	4 (0.3)	246 (17.8)

Potential medication errors were grouped based on the NCC MERP category, namely the NCC algorithm for the Index for Categorizing Medication Errors.The most frequently occurred pharmacodynamic interactions were between amlodipine and metformin categorized into moderate severity (quite clinically significant). Amlodipine, a calcium channel blocker, can reduce the effects of metformin (biguanide group) with unknown mechanism. Based on NCC MERP Index for Categorizing Medication Errors, as many as 4 events were identified as potential errors included into category C (errors that occur and reach the patient but does not endanger the patient).There were 246 events included into category D (errors that reach the patient and monitoring is needed to confirm that it does not cause harm to the patient and / or intervention needed to prevent harm [13]. The drugs included into category D were combination of amlodipine and simvastatin with a pharmacokinetic interaction mechanism. Both amlodipine and simvastatin are metabolized by CYP3A4 and the interactions could occur as a result of competition when metabolized[14]. Theseare classified as major severity; thus, this combination should be avoided[15]. Other efforts to avoid the interaction is to reduce the dose of simvastatin to minimize the risk of side effects or replace simvastatin with other statin drugs that are not metabolized by CYP3A4.

According to the analysis of error/unclear prescribing using the NCC algorithm, the Index for Categorizing Medication Errors, the incident belongs to category B in which errors occurred but the error did not reach the patient. The prescribers had corrected the amount of drug items before the prescription was given to the patients, so the errorswere avoided.

4. Conclusions

The e-prescription flow in the health care has a path that can facilitate pharmacy service when an error occurs in the system, in which the physician will write the prescription manually so that the patient can still be served. Therefore, the medication errors were identified using prescribing indicator.

The most frequently occurred prescriptions incompleteness was administration requirements in which 100% of the prescriptions had no physician's practice license and practice phone numbers, patient contact number aswell as gender and body weight of the patients.

The the present study indicated that errors still occurred eventhough with the use of electronic prescribing system. Efforts should always be done to avoid and minimize these potential medication errors,especially category D which requires further monitoring or intervention since this event can result in many negative impacts on the patients' health.

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