Electronic prescribing reduces prescription errors in Sanglah General Hospital Denpasar

Ni Luh Putu Nurhaeni,[1,2*] I Ketut Suarjana,[2,3] I Made Ady Wirawan[2,3]

Abstract

Background and purpose: Medication error is any preventable event that may lead to inappropriate medication use or patient harm. Prescription error, one component of medication error, at Sanglah General Hospital Denpasar is high. An electronic prescribing has been piloted at Angsoka Ward, Sanglah General Hospital Denpasar to reduce prescription errors. However, the evaluation of such implementation is never been conducted. This study aims to evaluate the effect of electronic prescribing on prescription errors at Sanglah General Hospital Denpasar.
Methods: An evaluation study was conducted by adopting pre and post control design at Sanglah General Hospital Denpasar. Prescription errors at Angsoka Ward where the electronic prescribing is implemented, were compared to Kamboja Ward that uses manual prescribing. Heterogeneity of patients in these two wards was comparable. Prescription samples were selected using a simple random sampling. Prescription samples prior to implementation of electronic prescribing were taken from June and July 2016, while samples after implementation were taken from March and April 2017. Prescription samples from the control group were also taken from the same periods. A total of 96 prescriptions were taken from each arm - leading to 384 prescription samples in total. Prescription error was evaluated using three requirements namely: administrative (9 components), pharmacy (5 components) and clinical (3 components).

Results: Our study found that there was a significant difference of prescription errors between pre and post implementation of electronic prescribing at Angsoka Ward (p<0.05). The median values [IQR] for prescription error based on administrative requirements between pre and post intervention were 2 [3] vs. 0 [0] (p<0.001); based on pharmacy requirements were 1 [2] vs. 0 [0] (p<0.001); based on clinical requirements were 1 [2] vs 0 [0] (p<0,001). In contrast, prescription error based on administrative and pharmacy requirements in Kamboja Ward was insignificantly reduced. The median values [IQR] for prescription error based on administrative requirements between pre and post intervention were 2 [2] vs. 2 [2] (p=0.505) and based on pharmacy requirements were 1 [2] vs. 1 [1] (p=0.295). There was a significant difference of prescription errors (p<0.05) based on clinical requirements with median values [IQR] of 1 [1] vs. 1 [1]. Implementation of electronic prescribing reduced the proportion of prescription errors by 67.8%. After implementation of electronic prescribing, some errors were still apparent related to drug administration and order duplication.
Conclusions: Implementation of electronic prescribing reduces prescription errors. Scaling-up of electronic prescribing followed by training on standardised prescribing practices are warranted.

Keywords: medication error, prescription error, electronic prescribing

[1]Sanglah General Hospital Denpasar,
[2]Public Health Postgraduate Program Udayana University,
[3]School of Public Health Faculty of Medicine Udayana University University

*Correspondence to:
Ni Luh Putu Nurhaeni, Sanglah General Hospital Denpasar
putunurhaeni@yahoo.co.id

INTRODUCTION

Medication is one aspect of patient safety standard, and it is vulnerable to errors or also called medication errors.[1] National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) defined medication errors as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer".[2]

Medication errors could occur at three different levels – prescribing, dispensing, or administration. Several studies documented that medication error is quite common during the prescribing stage, which is also called prescription error. Studies suggested that the prevalence of prescription error is higher in Asian than European countries.[3,4,5] A study conducted in tertiary hospitals in Bangladesh found the prevalence of prescription error during

the study period (October – December 2011) was 44.86%.[3] A study in tertiary heart hospitals in India also found that the prevalence of prescription error was 23.35% - which was the highest among all components of medication errors.[4] Similarly, a prospective study involving 20 hospitals in England found that the total cases of prescription error was 11,235 out of 124,260 medication orders.[5]

Studies related to prescription error in Indonesia also reveal similar trend. A study in four major cities in Java Island namely Jakarta, Bandung, Yogyakarta, and Surabaya involving 16 pharmacists in Indonesia found that the majority of medication errors occurred during the prescribing stage. This study documented four types of precription error which included: no information related to patient's age (86%), no information on patient's body weight (48.7%), inaccurate information on using

instructions (14.4%), and inaccurate information on dosing (7.4%).[6] Another study conducted in public hospitals in Yogyakarta found the prevalence of prescription error was 99.12%.[7] An analytic observational study in a public hospital in Bali Province revealed that the prevalence of prescription errors was 95.38%.[8]

A study conducted in New York in 2009 found that electronic prescribing can reduce the incidence of prescription error due to several explanations: (1) the writing can be clearly understood, (2) potential drug allergy could be identified, and (3) potential drug interactions could also be recognised.[9] Another study in the US also documented that electronic prescribing can improve efficiency of care as well as efficiency of the overall health financing.[10] A study in Brazil showed that the implementation of electronic prescribing reduced prescription errors from 18.2% to 8.2%.[11] Similarly, a study conducted in England found that the proportion of prescription errors among electronic prescribing was lower than manual prescribing (8% vs. 15% respectively).[12]

Prescription error is one out of several indicators for patient safety and is used to measure clinical quality of hospital services in Bali Province. The fact that the prevalence of prescription error is still high, it emerges as one key area for quality improvement and patient safety programs. A pilot project on electronic prescribing has been implemented at Angsoka In-patient Ward, Sanglah General Hospital since August 2016. However, an evaluation study in order to measure its effectiveness in reducing prescription errors has never been conducted until now. This study aims to compare prescription errors between electronic and manual prescribings at Sanglah General Hospital Denpasar.

METHODS

A pre-post control design study was conducted in Sanglah General Hospital Denpasar that included three research locations namely Angsoka In-Patient Ward, Kamboja In-patient Ward, and Pharmacy Instalation. Electronic prescribing was implemented at Angsoka Ward and it was used as the intervention group which consists of three wards – Angsoka 1, 2, and 3. Kamboja Ward was used as the control group because it still implements a manual prescribing. Characteristics of patients at Angsoka and Kamboja wards were comparable. These wards were used for patients from multi divisions: internal medicine, surgery, cardiology, ENT, and eye. Other wards in Sanglah Hospital are specific wards, for example children ward, geriatric ward, cardiology ward, infectious disease ward, or stroke

centre. Therefore for the purpose of our study, only Angsoka and Kamboja wards were included.

The conventional prescribing implemented at Sanglah General Hospital uses a standard form called the drug request form. The form consists of all dates for a month and requested drugs are written down on a specific date by following a standardised prescribing method. On a single form, a maximum of three drugs can be requested. Patients may have more than one form if they require more than three drugs or if they hospitalised for a long period of time. Once the patients being discharged from the hospital, these forms were collected by Pharmacy Instalation of Sanglah General Hospital. Electronic prescribing has been implemented at Angsoka Ward Sanglah General Hospital Denpasar since August 2016. This electronic prescribing system was generated by Information and Technology Instalation of the hospital. Patient's identity and doctor's identification were only required for the first prescription. The next prescriptions require only the patient's medical record number. Electronic prescribing is done from the computer room at Angsoka Ward which directly connected to the pharmacy unit. Prescriptions will be reviewed by the pharmacy unit. However, this electronic prescribing cannot confirm the stock-out drugs as well as potential interactions of prescribed drugs. This electronic prescribing system has been informed to all doctors who work at Angsoka Ward.

Our study population was all prescriptions from Angsoka and Kamboja wards between 2016 and 2017. Samples for pre-intervention were collected from all prescriptions between June and July 2016 while samples for post-intervention were collected from all prescriptions between March and April 2017. All samples had to meet inclusion criteria of: (1) prescriptions from June - July 2016 from Angsoka Ward (503 prescriptions) and Kamboja Ward (117 prescriptions), (2) electronic prescriptions for all new patients at Angsoka Ward between March and April 2017 (1020 prescriptions), (3) prescriptions from March and April 2017 at Kamboja Ward (335 prescriptions). Our exclusion criteria were: (1) chemotherapy drugs because it uses specific form, (2) dispensable materials as it does not count as drugs, (3) medical equipment as it also does not count as drugs. Samples were selected using a simple random sampling technique with a total of 96 prescriptions for each group. In total we selected 384 prescriptions as our samples.

Data were collected from May until June 2017. Data were collected using a check list table on administrative, pharmacy, and clinical aspects of prescriptions.[13] Several subvariables were modified based on medication form available at Sanglah General Hospital Denpasar. We excluded

the registration number of doctors because all doctors working at Sanglah General Hospital went through credential processes as well as equipped by a medical license or a clinical assignment letter. Several aspects of the prescription were also not the focus of our study which included indication, contra-indication, and drug interactions.

Administrative requirements were assessed based on several indicators: patient's name, medical record number, patient's sex, patient's body weight, doctor's name, doctor's signature, date of the precription, and name of the ward. Pharmacy requirements were assessed based on five aspects which included name of the drug, dose, preparation, route of administration, and frequency of administration. Clinical requirements were assessed based on three elements which were diagnosis, order duplication (when different doctors order the same drugs for one patient), and drug allergy. We scored each component '0' if it followed the standard and we scored it '1' when it was absent from the prescription. Data were analysed using a Wilcoxon Signed Rank Test to examine the difference of prescription errors before and after the implementation of electronic prescribing for both wards. One way ANOVA test was also performed to examine the difference of prescription errors between electronic and conventional prescribing after the implementation. Our study protocol has been approved by the Human Research Ethics Committees Faculty of Medicine Udayana University and Sanglah General Hospital Denpasar.

RESULTS

Table 1 shows the characteristics of prescription error in Angsoka Ward and Kamboja Ward before and after the implementation of electronic prescribing. The proportion of prescription error at Angsoka Ward based on administrative requirements was reduced from 94.8% to 0% after the implementation of electronic prescribing. However, the proportion of prescription error at Kamboja Ward based on administrative requirements stayed the same from 92.7% to 95.8% between pre and post test measurements. From all elements of administrative requirements, the highest error at Angsoka Ward was found on the failure to record patient's body weight (84.4%) but reduced to 0% after implementation of electronic prescribing. In Kamboja Ward we also found that the highest error was on the failure to record patient's body weight (89.6% - pre) but increased to 93.8% at the post-test measurement.

Prescription error based on pharmacy requirements in Angsoka Ward before intervention was 75% but reduced to 21.9% after the intervention.

While at Kamboja Ward, this proportion was slightly reduced from 72.9% to 67.7%. From all components of pharmacy requirements, we found the highest error in Angsoka Ward was on the failure to provide information on drug preparations. This was reduced from 58.3% to 0% after the implementation of electronic prescribing. However, after the intervention we observed an increased error on the failure to provide information on route of drugs administration from 7.3% to 21.9%. In Kamboja Ward the highest error was found on the failure to provide information on drug preparation. This was 64.6% at pre-test and was only slightly reduced to 56.3% at post-test.

Prescription error based on clinical requirements in Angsoka Ward was reduced from 72.9% to 15.6% after the implementation of electronic prescribing. In contrast, at Kamboja Ward we observed an increased from 65.6% to 87.5% after the intervention. From all components of clinical requirements, we found the highest error at Angsoka Ward was on the failure to provide information on drug allergy. This was reduced from 64.6% to 0% after the electronic prescribing. However, after the electronic prescribing, we observed an increased error on the order duplication from 15% to 15.6%. In Kamboja Ward, we identified that the highest error was on the failure to provide information on drug allergy. This increased from 63.5% (pre-test measurement) to 84.4% (post-test measurement).

Table 2 presents outcomes from the Wilcoxon Signed Rank Test. It revealed that prescription error based on administrative, pharmacy, and clinical requirements after the intervention in Angsoka Ward was reduced significantly. The negative rank vs. positive rank values for prescription error based on administrative requirements were 46 vs. 0 with median values [IQR] between pre and post intervention were 2 [3] vs. 0 [0] ($p<0.001$); based on pharmacy requirements were 35.23 vs. 21.50 with median values [IQR] of 1 [2] vs. 0 [0] ($p<0.001$); based on clinical requirements were 32.92 vs. 19.50 with median values [IQR] of 1 [2] vs 0 [0] ($p<0,001$). In contrast, we found that prescription error based on administrative and pharmacy requirements in Kamboja Ward was insignificantly reduced. The negative rank vs.positive rank values for prescription error based on administrative requirements were 38.19 vs. 38.77 with median values [IQR] between pre and post test measurements were 2 [2] vs. 2 [2] ($p=0.505$); based on pharmacy requirements were 37.23 vs. 34.50 with median values [IQR] of 1 [2] vs. 1 [1] ($p=0.295$). We observed that prescription error based on clinical requirements at Kamboja Ward was reduced significantly. The negative rank vs. positive rank values for prescription error based on clinical requirements were

Table 1 Characteristics of prescription error before and after implementation of electronic prescribing

	Angsoka ward				Kamboja ward			
	Prescription error				Prescription error			
	Before		After		Before		After	
Observed variables	n	%	n	%	n	%	n	%
Administrative	**91**	**94.8**	**0**	**0**	**89**	**92.7**	**92**	**95.8**
Patient's name	1	1	0	0	0	0	0	0
Date of birth	24	25	0	0	18	18.8	10	10.4
Medical record	3	3.1	0	0	2	2.1	1	1
Sex	30	31,3	0	0	25	26	44	45.8
Patient's body weight	81	84.4	0	0	86	89.6	90	93.8
Doctor's name	25	26	0	0	15	15.6	2	2.1
Doctor's signature	11	11.5	0	0	1	1	2	2.1
Date of prescription	41	42.7	0	0	31	32.3	34	35.4
Prescription room	28	29.2	0	0	34	35.4	39	40.6
Pharmacy	**72**	**75**	**21**	**21.9**	**70**	**72.9**	**65**	**67.7**
Drug's name	6	6.3	0	0	1	1	0	0
Drug's dose	23	24	0	0	23	24	17	17.7
Drug's preparation	56	58.3	0	0	62	64.6	54	56.3
Route	7	7.3	21	21.9	6	6.3	11	11.5
Frequency	13	13.5	1	1	9	9.4	5	5.2
Clinical	**70**	**72.9**	**15**	**15.6**	**63**	**65.6**	**84**	**87.5**
Diagnosis	29	30.2	0	0	16	16.7	28	29.2
Duplication	14	14.6	15	15.6	5	5.2	13	13.5
Allergy	62	64.6	0	0	61	63.5	81	84.4

Table 2 Comparison of prescription errors before and after implementation of electronic prescribing at Angsoka and Kamboja Wards

	Angsoka ward				Kamboja ward			
Observed variable	Median (IQR) pre	Median (IQR) post	Mean rank (- vs +)	p value	Median (IQR) pre	Median (IQR) post	Mean rank (- vs +)	p value
Administration	2 (3)	0 (0)	46 vs 0	<0.001	2 (2)	2 (2)	38.19 vs 38.77	0.505
Pharmacy	1 (1.75)	0 (0)	35.23 vs 21.50	<0.001	1 (2)	1 (1)	37.23 vs 34.50	0.295
Clinical	1 (2)	0 (0)	32.92 vs 19.50	<0.001	1 (1)	1 (1)	31.40 vs 35.11	0.001
Total errors	5 (3)	0 (1)	47.5 vs 0	<0.001	4 (4)	5 (3)	48.91 vs 40.30	0.186

IQR: Interquartile Range

31.40 vs. 35.11 with median values [IQR] between pre and post test measurements were 1 [1] vs. 1 [1] (p=0.001).

Total prescription error at Angsoka Ward after the implementation of electronic prescribing was reduced significantly. The negative rank vs. positive rank values for prescription error were 47.5 vs 0 with median values [IQR] between pre and post intervention were 5 [3] vs. 0 [1] (p<0,001). In contrast, total prescription error at Kamboja Ward between pre-test and post-test measurements remained steady. The negative rank vs. positive rank

values for prescription error at Kamboja Ward were 48.91 vs. 40.30 with median values [IQR] between pre and post test measurements were 4 [4] vs. 5 [3] (p=0.186).

A pairwise comparison test showed that electronic prescribing reduced the overall prescription error by 67.8% (R^2 0.678; $p \le 0.001$).

DISCUSSION

A standardised prescription must meet three requirements namely administrative, pharmacy,

and clinical.[13] Our study revealed that prescription error based on administrative requirements at Angsoka Ward was reduced significantly from 47.5% to 0% after the implementation of electronic prescribing. On the contrary, prescription error based on administrative requirements at Kamboja Ward that uses manual prescribing remained high at 48.91% (pre test measurement) and 40.30% (post-test measurement). This can be explained that electronic prescribing system offers several practicalities for doctors in order to ensure the completeness of every prescription. All required fields must be filled by doctors. If any required fields was missed, the prescription will not be processed by the system.

Several studies have revealed that implementation of electronic prescribing system can reduce prescription error. A study in England found that electronic prescribing can reduce prescription error by 25%.[14] A study in Indonesia has also documented that electronic prescribing system can reduce medication errors during the prescribing phase as well as reduce waiting time at the healthcare facilities.[15] Other study in Indonesia discovered that electronic prescribing system can reduce the prevalence of prescription error – especially with regard to incomplete prescription and incomprehensible writing. This study also found that the actual utilisation of electronic prescribing system by health providers was determined by perceived benefits and convenience.[16]

Even though electronic prescribing has been implemented in Angsoka Ward, Sanglah General Hospital Denpasar, prescription error based on pharmacy and clinical requirements is still apparent. Errors usually occurred during the data entry processes. The most common errors included the failure to provide information on route of drug administration as well as order duplication. Sanglah General Hospital Denpasar is a type 'A' education hospital as well as a national reference hospital. It manages complex cases where doctors in trainning also provide care for patients. This leads to lack of coordination between health providers resulting in order duplication. In addition, completing medical record is often time consuming – leading to lack of time to review treatment advices from other health professionals or specialists. Previous study suggested that implementation of electronic prescribing system is associated with several errors which included dosing, route of drug administration, and order duplication.[17]

Our study found that prescription error based on administrative, pharmacy, and clinical requirements in Kamboja Ward was high. Previous study has documented that prescription error was caused by the lack of knowledge on drug management among health providers who directly involved in patient's care.[18] Other study conducted in Indonesia suggested that medication errors was commonly caused by prescription error especially related to incomplete information on drug preparations, dosing, and incomprehensible writing.[19] A study conducted in Fortis Escorts New Delhi revealed that prescription error was mostly associated with administrative errors and incomprehensible writing of the doctors. Prescription error is a critical stage of treatments. Failure to recognise prescription error will lead to further medication errors that could harm the patients.[4]

We only took our samples from two wards that have comparable patient characteristics. Doctor's ID is not included in our study due to multiple rotations of doctors at our study locations. As a result, we cannot assess the effect of prescriber variation on the proportion of prescription error. However, this new electronic system has been informed to all health providers at the hospital. We assume that all health providers complied to this new electronic prescribing system standard and procedure

CONCLUSION

Electronic prescribing system reduces the proportion of prescription error, even though some errors are still apparent due to data entry processes. Electronic prescribing system can be scaled-up followed by ongoing training to health providers regarding standardised prescribing practices.

ACKNOWLEDGEMENT

REFERENCES

1. Hospital Patient Safety Committees. Pedoman pelaporan insiden keselamatan pasien (IKP) [Reporting guidelines on patient safety incident]. 2nd ed. Jakarta: Hospital Patient Safety Committees; 2008.
2. National Coordinating Council for Medication Error Reporting and Prevention. About Medication Errors. [cited 2017 August 9]. Available from: http:// www.nccmerp.org.
3. Sultana F, Rahman A, Paul TR, et al. Prescribing pattern and prescription errors: a study at a tertiary care hospital of Bangladesh. Bangladesh Pharm J. 2015; 18: 20–24.
4. Sukhbir L, Vikas S, Balram C, et al. Retrospective analysis: to enhance patient safety by minimizing medication errors in tertiary care cardiac hospital. International Research Journal of Pharmacy. 2012; 3: 110–114.
5. Ashcroft DM, Lewis PJ, Tully MP, et al. Prevalence, nature, severity and risk factors for prescribing errors in hospital inpatients: prospective study in 20 UK Hospitals. Drug Saf. Epub ahead of print. 2015.
6. Purba AV, Soleha M, Sari ID. Kesalahan dalam pelayanan obat (medication error) dan usaha pencegahannya [Medication errors and its prevention strategies]. Buletin Penelitian Sistem Kesehatan. 2007; 10: 31–36.

7. Perwitasari DA, Abror J, Wahyuningsih I. Medication errors in outpatients of a government hospital in Yogyakarta Indonesia. International Journal of Pharmaceutical Sciences Review and Research. 2010; 1: 8–10.

8. Putra DGARK. Hubungan budaya keselamatan pasien dengan jumlah laporan kejadian nyaris cedera di ruang rawat inap Rumah Sakit Umum Pusat Sanglah Denpasar [Association between patient safety practices and total reported nearly injured cases at in-patient services Sanglah General Hospital Denpasar]. Denpasar: Fakultas Kedokteran Universitas Udayana, 2015.

9. Agrawal A. medication errors: prevention using information technology systems. British Journal of Clinical Pharmacology. 2009; 67: 681–686.

10. Porterfield A, Engelbert K, Coustasse A. Electronic prescribing: improving the efficiency and accuracy of prescribing in the ambulatory care setting. Perspective in Health Information Management. 2014; 11.

11. Volpe CRG, Melo EMM, Aguiar LB, et al. Risk factors for medication errors in the electronic and manual prescription. Revista Latino-Americana de Enfermagem. 2016; 24: e2742.

12. Tully MP. Prescribing errors in hospital practice. British Journal of Clinical Pharmacology. 2012; 74: 668–675.

13. Ministry of Health of Indonesia. Peraturan Menteri Kesehatan Republik Indonesia nomor 58 tahun 2014 tentang standar pelayanan farmasi di rumah sakit [The Indonesia Ministry of Health Regulation No. 58/2014 on the standard of hospital pharmacy services]. Jakarta: Ministry of Health of Indonesia; 2014.

14. Seden K, Kirkham JJ, Kennedy T, et al. Cross-sectional study of prescribing errors in patients admitted to nine hospitals across North West England. BMJ. 2013; 1–14.

15. Kusumarini P, Dwiprahasto I, Wardani P. Penerimaan dokter dan waktu tunggu pada peresepan elektronik dibandingkan peresepan manual [Acceptability of doctors and waiting time between electronic and manual prescriptions]. Jurnal Manajemen Pelayanan Kesehatan. 2011; 14: 133–138.

16. Widiastuti MS, Dwiprahasto I. Peran resep elektronik dalam meningkatkan medication safety pada proses peresepan [Role of electronic prescription to improve medication safety]. Jurnal Manajemen Pelayanan Kesehatan. 2014; 17: 30–36.

17. Amato MG, Salazar A, Hickman TTT, et al. Computerized prescriber order entry-related patient safety reports: analysis of 2522 medication errors. Journal of American Medical Informatics Association. 2017; 24: 316–322.

18. Wardani IAK. Analisis manajemen fokus manajemen penggunaan obat di rawat inap Ruang Angsoka RSUP Sanglah Tahun 2014 [Managerial analysis focusing on drugs utilisation management at Angsoka Ward Sanglah General Hospital Denpasar]. Jakarta: University of Indonesia; 2014.

19. Timbongol C, Lolo WA, Sudewi S. Identifikasi kesalahan pengobatan (medication error) pada tahap peresepan (prescribing) di Poli Interna RSUD Bitung [Identification of medication errors during prescribing at Internal Medicine Polyclinic of Bitung District Hospital]. Pharmacon Jurnal Ilmiah Farmasi. 2016; 5: 1–6.