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The Effect of a Computerized Pharmacist Communication Application-based SBAR Tool

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ABSTRACT

Background: Pharmacists communicate with a variety of healthcare experts to prevent medication errors. Situation-Background-Assessment-Recommendation (SBAR) is a tool used for concise and accurate communication. In 2018, we developed the pharmacy-SBAR (P-SBAR) to deliver pharmacists intervention more quickly and effectively through quality improvement activities. **Objectives:** This study evaluates the efficacy of P-SBAR on pharmacists' intervention activities before and after the implementation of P-SBAR applications. We assessed the impact of P-SBAR on reducing the burden of intervention work, promoting pharmacists' participation, and enhancing the acceptance rate. **Methods:** This is a retrospective study of the two groups before and after P-SBAR implementation. All pharmacists' intervention records during two periods (2016-2017 and 2019-2020) were extracted from the data warehouse system at Kyunghee University Hospital at Gangdong, Seoul. The outcome was the number of inpatients and pharmacists who participated in the prescription monitoring activity, the number of interventions, and the physicians' acceptance rate. **Results:** Although the total number of inpatients decreased (364,753 vs. 348,229), the number of pharmacists who participated in intervention activity increased (monthly mean: 15.8 vs. 18.0, p=0.001). The total number of interventions (2,767 vs. 4,389), the frequency of full acceptance (2,018 vs. 3,710), and the monthly acceptance rate increased significantly (73.8% vs. 83.8%, p<0.001). **Conclusion:** P-SBAR improved accessibility and convenience by digitalizing the intervention activities performed in an offline environment. Improvement in work burden and acceptance rate using P-SBAR is expected to contribute toward reducing medication errors.

KEYWORDS: Communication, medication error, patient safety, pharmacists, situation background assessment recommendation (SBAR)

Hospital pharmacists manage every area of medicine use in hospitals, from procurement, dispensing, preparation, delivery, administration, and monitoring to surveillance.[1-3] A prominent aspect of the pharmacist's multifaceted role is their pivotal responsibility as credible guardians against medication-related harm. The International Pharmaceutical Federation directs that hospital pharmacists should establish a pharmacovigilance and reporting system for medication errors, including near misses.[2] The Korean Patient Safety Act (Act no. 13113, January. 28. 2015) categorized pharmacists as personnel with exclusive rights over actions related to patient safety and medical service quality improvement.[4] Thus, in the area of patient safety, the weight of the pharmacists` role is becoming more important.

Typical patient safety for a pharmacist involves patient education, multidisciplinary teamwork, medication assessment,

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adverse drug reaction monitoring, and guideline development. In a recent literature review, the acceptance rate of physicians on hospital pharmacists' intervention activities had reached 80.5%.[5] Pharmacists communicate with a variety of experts, physicians, nurses, and others to prevent medication errors. Therefore, pharmacists must have practical communication skills.

SBAR (Situation-Background-Assessment-Recommendation) is a tool used for concise and accurate communication. SBAR provides a communication framework so that different healthcare providers can share information about a patient's condition.[6] The Institute for Healthcare Improvement recommended the use of SBAR in 2011, and the Joint Commission International also utilized SBAR to prevent medication errors resulting from errors in communication.[7] In Korea, hospital nursing departments have actively employed SBAR since 2015.[8-10]

In 2017, the pharmacy department of Kyunghee University Hospital at Gangdong, Seoul developed pharmacy-SBAR (P-SBAR) in order to deliver pharmacists` intervention more quickly and effectively through quality improvement activities at hospitals. P-SBAR is a software program that computerizes pharmacists' intervention activities within the electronic medical records (EMR) system. It standardizes the format of pharmacists' intervention notes and applies a structured classification, enabling the prompt recording of intervention tasks. The hospital information system (HIS) began to install P-SBAR in 2018. Since then, we, the creators of P-SBAR, have made improvements that reinforced template items and added a message delivery function to the nurse notes to aid communication. The P-SBAR tool consists of 10 categories and 73 subcategories per intervention content. Each intervention content arranged adequate text suitable for the SBAR frame. First, the pharmacist selects an appropriate subcategory for intervention, and then P-SBAR suggests a matched sample text for the SBAR frame. Next, the pharmacist confirms or modifies the sample text, then connects the text to a sentence. Finally, the HIS transmits the sentence via text message to the physician or nurse in charge (Figs. 1 and 2). The Journal of Korean Society of Health-System Pharmacists published this development process as an improvement activity case in 2019.[11]

This study assesses the effectiveness of P-SBAR in improving pharmacists' intervention activities both before and after the implementation of P-SBAR applications.

Methods

This study is a comparative, retrospective study of EMR profiles pre- and post-implementation of the P-SBAR tool. We

☞Reasons for intervention

Intervention items
- General part
+ Change dosage
+ Change drug
+ Add drug
+ D/C drug
+ Follow up
+ IV compatibility
- Oncology part
+ Change insurance
+ Change antiemetics
+ Add antiemetics
+ Change anticaner drug
+ D/C anticancer drug
+ Add anticancer drug
+ Change solution
+ D/C solution
+ Add solution
+ Consult to NST

☞Patient information

Termination

Pharmacy part	Inpatient pharmacy ▼	Intervention item	Change dosage	Reason for intervention	Laboratory ▼
Patient ID	12345678	Patient name		Date of prescription	2012-01-28
Ward	12W	Department	Nephrology	Administration No.	20360
Age/Sex	47 / F	Dosage	1	Unit	Ampule
Subject	Physician ▼	Drug name	Toranzin inj. 50mg/1mL (Tramadol)		
ICD code	D509 Iron defiency anemia		Laboratory	2021-01-27 ALT(GPT) 17	
	N185 Chronic kidney disease			2021-01-27 ANC 7895	
	F209 Schizophrenia			2021-01-27 AST(GOT) 25	
Date	2021-01-28	Situation (S)	among #SJ. Kim# # #12345678# prescription in #12W# on #2021		
Pharmacist ID	P201007	Background (B)	depending on #Laboratory results#		
Nurse note	○ Yes ◎ No	Assessment (A)	Toranzin inj. 50mg/1mL (Tramadol) is		
SMS	○ Yes ◎ No				
Severity	☐ 0 ☐ 1	Recommendation (R)	It is recommended that #dosage change#		

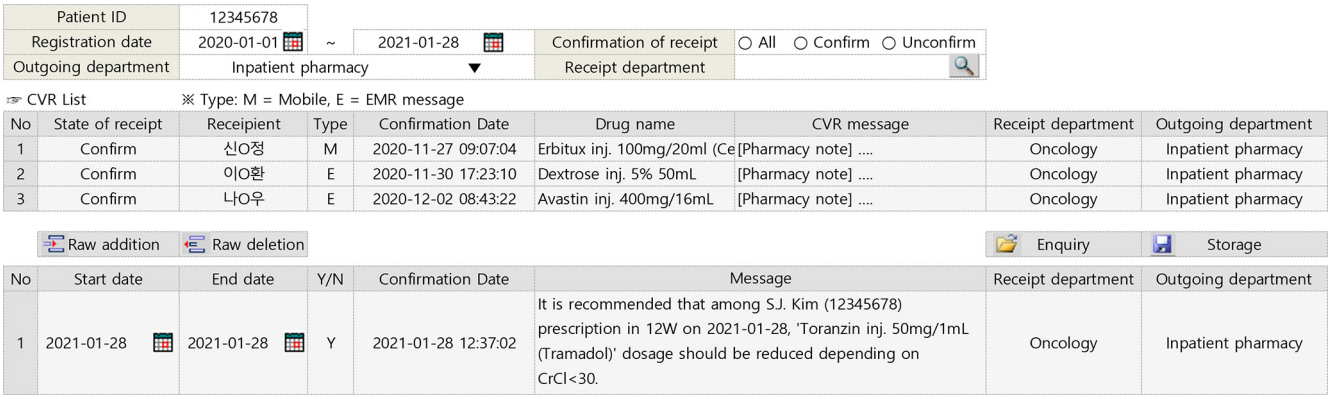
☞SBAR-message

▽ Aggretation

Intervention information (B-A-R)	It is recommended that among S.J. Kim (12345678) prescription in 12W on 2021-01-28, 'Toranzin inj. 50mg/1m (Tramadol)' dosage should be reduced depending on CrCl<30. *Editable text
Final message (S-B-A-R)	It is recommended that among S.J. Kim (12345678) prescription in 12W on 2021-01-28, 'Toranzin inj. 50mg/1m (Tramadol)' dosage should be reduced depending on CrCl<30. *Not editable text

Message transmission | To nurse note | Storage

Fig. 1. The Pharmacy-SBAR template view of an EMR



Patient ID	12345678				
Registration date	2020-01-01 ~	2021-01-28	Confirmation of receipt	○ All ○ Confirm ○ Unconfirm	
Outgoing department	Inpatient pharmacy		Receipt department		

☞ CVR List ※ Type: M = Mobile, E = EMR message

No	State of receipt	Receipient	Type	Confirmation Date	Drug name	CVR message	Receipt department	Outgoing department
1	Confirm	신O정	M	2020-11-27 09:07:04	Erbitux inj. 100mg/20ml (Ce	[Pharmacy note]	Oncology	Inpatient pharmacy
2	Confirm	이O환	E	2020-11-30 17:23:10	Dextrose inj. 5% 50mL	[Pharmacy note]	Oncology	Inpatient pharmacy
3	Confirm	나O우	E	2020-12-02 08:43:22	Avastin inj. 400mg/16mL	[Pharmacy note]	Oncology	Inpatient pharmacy

Raw addition Raw deletion Enquiry Storage

No	Start date	End date	Y/N	Confirmation Date	Message	Receipt department	Outgoing department
1	2021-01-28	2021-01-28	Y	2021-01-28 12:37:02	It is recommended that among S.J. Kim (12345678) prescription in 12W on 2021-01-28, 'Toranzin inj. 50mg/1mL (Tramadol)' dosage should be reduced depending on CrCl<30.	Oncology	Inpatient pharmacy

Fig. 2. Examples of a critical value report (above) and a nursing note message (below)

reviewed the medical records of all pharmacist interventions conducted at Kyunghee University Hospital at Gangdong, from January 1, 2016, to December 31, 2017, and from January 1, 2019, to December 31, 2020.

The control group was a data-oriented PRE group that covered interventions before 2018, while the test group included data from a data-oriented POST group after 2019. During the PRE period, pharmacists communicated intervention information through EMR messaging and direct phone calls. In the POST period, they employed electronic messages via P-SBAR for intervention communication. We extracted the intervention-related items from the data warehouse system and prescription items from the pharmacy EMR.

The prescription items are composed of inpatients, prescriptions, drug items, and the number of items calculated monthly. Furthermore, the result presented both the 24-month sum and their monthly means. The intervention items included the number of pharmacists who participated in the daily prescription-monitoring work, the number of interventions, and the number of acceptances. The presentation method for both results was identical. The results for the physician's acceptance of intervention were expressed as percentages and classified as rates of full, partial, or non-acceptance.

To compare the two groups, the independent t-test or Mann-Whitney U test analyzed the continuous variables according to the data distribution. The threshold for statistical significance was set at $p<0.05$. SPSS software (version 18.0; IBM, Armonk, NY, USA) conducted the statistical analysis.

Results

This study compared the differences between the two groups by presenting prescription and intervention items during the 24 months elapsed before and after P-SBAR application.

The total number of inpatients in the PRE group (from 2016 to 2017) was 364,753 people, who received 584,278 prescriptions, and the total number of drug codes prescribed was 2,883,157. The mean number of pharmacists participating in the intervention activity was 15.8 (ranging from 14 to 19). The total number of intervention cases was 2,767 (with a monthly average of 115.3 cases), and the intervention rate, relative to the total number of prescriptions, was 0.47%.

The total number of inpatients in the POST group (from 2019 to 2020) was 348,229, who received 554,515 prescriptions, and the total number of drug codes prescribed was 2,656,497. These numbers were lower than those in the PRE group. However, the monthly mean number of pharmacists functioning as prescription monitors was 18.0 (14-21), which was a significant increase. The total number of interventions was 4,389; the monthly mean value was 182.9; and the intervention rate was 0.79%, which was a significant increase compared to the PRE group ($p<0.001$, Table 1).

The number of intervention items increased considerably in the POST group. In the PRE group, the intervention items consisted of five categories (TPN consults, dispensing, medicine, drug interaction, and others) and 12 subcategories. However, in the POST group, they consisted of 10 categories and 28 subcategories. The five additional categories were formulation, chemotherapy, intravenous medicine, allergy, and insurance. The additional intervention categories reflected pharmacists' input during the development of P-SBAR (Table 2).

In the PRE group, physicians fully accepted 2,018 total cases, partially accepted 59 cases, and did not accept 690

Table 1. P-SBAR efficiencies in the PRE and POST groups

Variables	PRE group		POST group		*p*-value
	n	Monthly mean±SD	n	Monthly mean±SD	
Months (year)	24 (2016-2017)		24 (2019-2020)		
Inpatients*	364,753	15,162.68±990.945	348,229	14,453.94±1,274.899	0.066
Prescription	584,278	24,344.92±899.071	554,515	23,104.79±1,956.631	0.008
Drug code	2,883,157	120,131.54±5,366.042	2,656,497	110,687.38±8,272.614	<0.001
Pharmacists	379	15.79±1.841	431	17.96±2.349	0.001
Pharmacists' intervention	2,767	115.29±30.833	4,389	182.88±32.605	<0.001

*Mann-Whitney test

cases. In the POST group, the number of cases physicians fully accepted increased to 3,710, which was a statistically significant increase (p<0.001). Partial acceptance decreased to 58 in the POST group, which was not a statistically significant change. The number of cases not accepted decreased to 621 in the POST group. After the implementation of P-SBAR, the number of cases that were fully accepted increased significantly (Fig. 3). The monthly mean acceptance rate was 73.8% (59.5-87.8) in the PRE group, whereas it was 83.8% (67.5-94.4) in the POST group, an increase of approximately 10% (p<0.001) (Fig. 4).

Discussion

The monitoring and intervention activities on the physician's prescription mainly contributed to patient safety. We discovered a quality improvement method for patient safety in 2017, and developed the P-SBAR computerized tool in 2018 to improve intervention work by utilizing the SBAR tool.[11] Utilizing the SBAR structure for intervention activities that required communication with doctors enhanced the convenience, speed, and accessibility of prescription monitoring work. P-SBAR improved the quality of interventions by recording every intervention, and prevented unnecessary repetitive interventions by sharing those records.

Poor communication in the medical environment leads to medication errors.[12-13] To overcome poor communication, SBAR has recently been utilized as a communication tool between experts.[14-16] SBAR is used primarily, in various ways, for clarity of communication with nurses. The nursing department at Kyunghee University Hospital at Gangdong also strived to deliver accurate patient information quickly, and developed SBAR tables suitable for each ward and attached them to telephones or desktop monitors. Pharmacists have also used SBAR as a method of communication. Pharmacists have learned root cause analyses, failure mode effects analyses, and other practical communication tools for drug safety. Education and practice of these methods are basic courses of pharmacy schools in U.S.[17-19]

Although there have been many studies on the effectiveness of student practice and education with SBAR, few cases have applied computerized SBAR to pharmacists` services, and few prior studies have examined its effects. Müller et al. systematically reviewed previous studies to investigate the effect of SBAR on patient safety.[13] SBAR was utilized to improve telephone, team, and hand-off communication, with subjects who were primarily nurses or physicians. However, that review included no studies in which SBAR was utilized to improve pharmacy tasks, or where pharmacists were the subject of the SBAR usage. Recently, Kane-Gill et al. reported on pharmacists who used SBAR in their work; utilizing the SBAR tool, they employed structured recommendations while performing intervention services against adverse drug reactions in nursing facility patients.[20] That is as far as we know, P-SBAR was the first case that applied SBAR to pharmacists` overall intervention work.

P-SBAR provides SBAR-formatted examples for each subject, such as drug change, dose change, and drug discontinuation. Furthermore, P-SBAR helped create a certain standard for recording pharmacists' notes, reduced the writing burden, and also helped pharmacists avoid records to participate in intervention work. The growing trend of interventions reflected this advantage of P-SBAR, as the number of cases in the POST group increased by about 1.6 times compared to the PRE group. Although the number of inpatients, prescriptions, and drug codes in the POST group were low, the number of

Table 2. Classifications of pharmacy intervention items in the PRE and POST groups

PRE group					POST group				
Intervention items	The number of acceptance				Intervention items	The number of acceptance			
	Non	Partial	Full	All		Non	Partial	Full	All
I. TPN consult					I. TPN consult				
PN formula	0	0	17	17	EN and PN formula	0	0	65	65
					NPO and PN formula	0	0	307	307
					Diet and PN formula	0	0	4	4
II. Dispensing					II. Dispensing				
Formulation change	4	1	20	25					
Partial dispensing	2	0	3	5					
Powder dispensing	1	0	0	1	Powder dispensing	4	0	3	7
					III. Formulation				
					Double order of low content	19	0	52	71
					Division of high content	15	0	73	88
					Not allowance of crush/powder	5	0	18	23
III. Medicine					IV. Medicine				
Addition	61	9	282	352	Available age	5	0	17	22
Change of taking	97	9	294	400	Contraindication	20	0	39	59
Discontinuation	112	13	359	484	Duplication	38	3	276	317
Dosage change	205	15	506	726	Duration	2	2	32	36
Drug change	77	6	373	456	Error of prescription unit	0	0	10	10
Error of prescription unit	3	0	16	19	Laboratory result	179	12	501	692
					On dialysis	5	1	8	14
					Standard dosing	147	12	678	837
					TDM result	3	2	14	19
					Use range	11	1	75	87
IV. Drug interaction	62	4	47	113	V. Drug interaction	31	3	82	116
					VI. Chemotherapy				
					Chemotherapy toxicity	0	0	3	3
					CINV grade	0	1	2	3
					Standard regimen	8	0	124	132
					VII. Intravenous medicine				
					IV compatibility	15	6	709	730
					Concentration range	0	0	16	16
					Volume error	0	0	24	24
					VIII. Allergy				
					Adverse drug reaction	46	9	332	387
					Drug allergy	1	0	5	6
					IX. Insurance	0	0	1	1
V. Others	66	2	101	169	X. Others	67	6	240	313
Total (%)	690 (25.0%)	59 (2.1%)	2,018 (72.9%)	2,767 (100%)	Total	621 (14.2%)	58 (1.3%)	3,710 (84.5%)	4,389 (100%)

TPN, total parenteral nutrition; PN, parenteral nutrition; EN, enteral nutrition; NPO, nothing per oral; TDM, therapeutic drug monitoring; CINV, chemotherapy induced nausea and vomiting; IV, intravenous

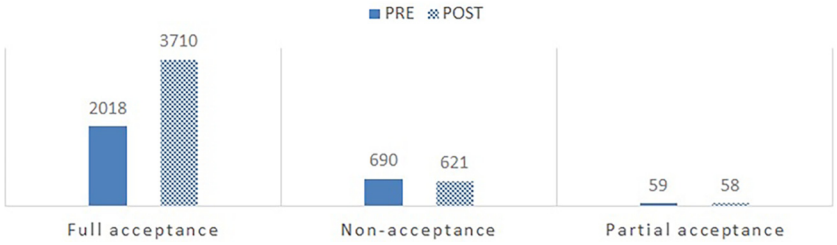


Fig. 3. Acceptance in the PRE and POST groups.

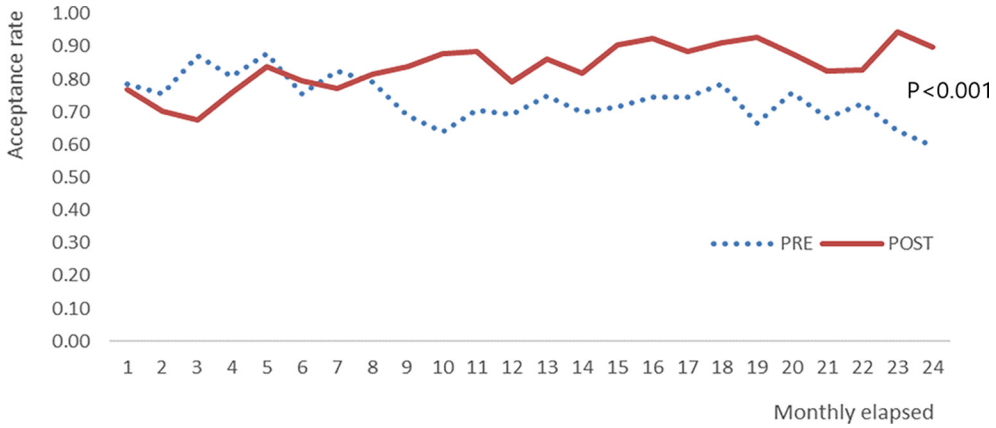


Fig. 4. The PRE and POST group acceptance rates. PRE includes the 2016-2017 period; POST includes 2019-2020.

interventions increased significantly. There was one more full-time pharmacist in the POST group than in the PRE group, but the monthly mean number of pharmacists using P-SBAR increased by two in the POST group, since more pharmacists can easily participate in interventions.

Another reason for the increase in intervention cases was the addition of intervention subjects and items to the P-SBAR. When developing the P-SBAR, we queried pharmacists for their complaints and collected suggestions for improved replies, and subdivided the intervention categories for P-SBAR templates. The PRE group did not fully monitor intravenous compatibility; however, the POST group added an intravenous compatibility template, and this allowed pharmacists to monitor the inappropriate prescription between injections and solutions. Thus, P-SBAR can easily broaden the scope of intervention services by adding new SBAR templates when new intervention items are necessary for practice. This could result in tighter surveillance of patient safety.

P-SBAR delivered pharmacists` intervention records to physicians and nurses via electronic messages. It also sent them to the EMR screen and, in an emergency, it could transmit them directly to a mobile phone through a critical value report. P-SBAR is suitable for ensuring patient safety through rapid communication of any medication errors. The increase in the acceptance rate indicates the efficacy of P-SBAR.

The results of this study revealed no statistically significant differences between the partial and non-acceptance rates of the two groups, but the full acceptance rate doubled in the POST group. P-SBAR proved that digital messages or direct intervention activity between communication subjects via P-SBAR were more effective than telephone conversations or message delivery methods via a third party.

The monthly mean acceptance rate in the POST group was 83.8%. This result was higher than 80.5% which was the result from a meta-analysis of acceptance rates in pharmacists' intervention in Korea.[5] To date, the range of reported acceptance rates has been very wide. The acceptance rate in the intensive care unit (ICU) team was as high as 99%, and the rate in the ICU and bone marrow transplant ward was 92.8%.[21-22] However, the acceptance rate in the elderly ward was between 59.7 and 80.0%, while in the surgical ward it was 78.0%.[23-24]

These acceptance rates are primarily the results of clinical

pharmacists working in specific wards. However, the 83.8% rate in this study was very encouraging because the intervention activities involved all general pharmacists, not just clinical specialists, and it covered every regular prescription issued on a given day. In particular, the number of 'drug interaction' cases were comparable between the PRE period (113 cases) and the POST period (116 cases), but the acceptance rate saw a significant increase from 41.6 to 70.7%. This indicates that P-SBAR is appropriate for use in intervention services, and that electronic approaches such as P-SBAR templates are effective at improving pharmacist services.

In addition, P-SBAR stored specific records per patient. In cases where a pharmacist consulted with a doctor and decided to keep the existing prescription, P-SBAR shared the information so that other pharmacists did not repeat the intervention with the same content. This function reduced the unnecessary work burden and stress on the two communicators, and increases the reliability of the P-SBAR.

Although the SBAR tool is widely utilized, high-quality research proved that it lacked effectiveness.[13] This study proved the efficacy of patient safety by setting acceptance rate as its outcome variable, and not variables for improving activity or survey satisfaction.

Conclusion

P-SBAR improved accessibility and convenience by mechanizing the intervention activities performed in an offline environment. This allowed the acceptance rate to make remarkable progress through clear-cut communication. In the future, P-SBAR should continue to add various new intervention items. Pharmacists should conduct secondary quality improvement activities to correct any medication errors by using the data accumulated by P-SBAR. This may consequently result in safer pharmacotherapies.

Conflicts of Interest

The authors have no conflicts of interest to declare with regards to the contents of this study.

Ethics approval

The study protocol was approved by the institutional Review Board at the Kyunghee University Hospital at Gangdong (IRB no. KHNMC 2021-02-017).

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