

EVALUATION OF THE INITIAL RESULTS OF APPLYING INFORMATION TECHNOLOGY TO PREVENT CONTRAINDICATED DRUG INTERACTIONS IN PRESCRIPTIONS AT THE MILITARY HOSPITAL 7, MILITARY REGION 3

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ABSTRACT

Purpose: Building a list of contraindicated drug interactions and evaluating the initial results of applying information technology to prevent contraindicated drug interactions in prescriptions at the Military Hospital 7.

Subjects and Methods: A retrospective, descriptive study evaluated 158,213 prescriptions before integrating the drug interaction warning utility and 18,222 prescriptions after integrating the drug interaction at the Military Hospital 7.

Results: Successfully built and integrated 82 pairs of contraindicated drug interactions in Hospital information system (HIS) software, including 54 pairs with contraindicated drug interactions in combination and 28 pairs of contraindicated drug interactions in specific clinical contexts. In 158,213 prescriptions before integrating the drug interaction warning utility, 45 prescriptions with contraindicated drug interactions were identified (including nine prescriptions with contraindicated drug interactions in combination, with two pairs of drug interactions, and 36 prescriptions with contraindicated drug interactions in specific clinical contexts, with seven pairs of drug interactions). In 18,222 prescriptions after integrating real-time contraindicated drug interaction warnings on HIS software, no prescriptions with contraindicated drug interactions detected.

Conclusions: The initial application of information technology has improved a positive effect in preventing contraindicated drug interactions in prescriptions at Military Hospital 7.

Keywords: contraindicated drug interactions, prescription, errors.

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1. INTRODUCTION

Drug interactions (DI) are interactions between drugs or between drugs and the body's pathophysiological/pathological condition. DI can increase or decrease the therapeutic effects or lead to unwanted effects. According to the World Health Organization (WHO), errors related to DI are one of the unintended factors causing harm to patients worldwide [8]. Therefore, checking and controlling the process of prescribing drugs and evaluating medical orders to identify and avoid potential errors and misunderstandings were important tasks for clinical pharmacists in hospitals (Vietnam Government has regulations in Decree No. 131/2020/ND-CP dated November 2, 2020 [1]).

At Military Hospital 7 (Military Region 3), the traditional method of checking and warning of errors in drug prescriptions requires considerable time and human resources. However, the effectiveness was not high because it was difficult to review all prescriptions regularly, in detail and specifically. To gradually implement the National health digital

transformation program, Military Hospital 7 has started to build a database to verify some errors related to DI in prescriptions by information technology, at the same time, implementing real-time DI warning intervention on the hospital information system (HIS) to improve the effectiveness of checking, controlling and preventing errors in the drug prescription process.

However, the effectiveness was not high because it was difficult to review all prescriptions regularly, in detail and specifically. From the above facts, we conducted this study to build a list of DI contraindications and evaluate the initial results of applying information technology to prevent DI contraindications in drug prescription at Military Hospital 7.

2. SUBJECTS AND METHODS

2.1. Subjects

A total of 176,435 prescriptions for the treatment of patients covered by health insurance at Military Hospital 7 examined, covering the period from January 2023 to September 2023, including

158,213 prescriptions before the implementation of the real-time DI alert in the hospital information system (HIS) (from January 1, 2023 to August 31, 2023) and 18,222 prescriptions after integrating the real-time DI warning intervention utility on HIS (September 2023). Exclude prescriptions for which patients had to pay out of pocket.

2.2. Methods

- Study design: a retrospective, descriptive study and comparing results before and after implementing integrated real-time DI warning intervention utility on HIS.

- Research methods:

+ Compilation of a list of DI contraindications in clinical practice (according to Decision No. 5948/QD-BYT of December 30, 2021 of the Minister of Health) [2].

3. RESULTS AND DISCUSSION

3.1 Compilation of a list of DI contraindications in clinical practice

Table 1. List of DI contraindications of combination drugs in Military hospital 7

No.	Drug pair				No.	Drug pair			
	Active ingredient	Code	Active ingredient	Code		Active ingredient	Code	Active ingredient	Code
1	Aceclofenac	40.25	Ketorolac	40.39	28	Domperidon	40.688	Levosulpirid	40.951
2	Amiodarone hydrochloride	40.483	Domperidon	40.688	29	Domperidon	40.688	Propofol	40.21
3	Atorvastatin	40.549	Gemfibrozil	40.555	30	Domperidon	40.688	Sevofluran	40.22
4	Azithromycin	40.219	Domperidon	40.688	31	Domperidon	40.688	Sulpirid	40.956
5	Celecoxib	40.28	Ketorolac	40.39	32	Erythromycin	40.221	Lovastatin	40.556
6	Ciprofloxacin	40.227	Tizanidin hydrochlorid	40.840	33	Erythromycin	40.221	Simvastatin	40.559
7	Ciprofloxacin	40.227	Domperidon	40.688	34	Erythromycin	40.221	Ivabradin	40.485
8	Clarithromycin	40.220	Lovastatin	40.556	35	Etoricoxib	40.33	Ketorolac	40.39
9	Clarithromycin	40.220	Simvastatin	40.559	36	Felodipin	40.502	Itraconazol	40.292
10	Clarithromycin	40.220	Ivabradin	40.485	37	Fluvastatin	40.554	Gemfibrozil	40.555
11	Clarithromycin	40.220	Felodipin	40.502	38	Gemfibrozil	40.555	Repaglinid	40.809
12	Clarithromycin	40.220	Lercanidipin	40.509	39	Gemfibrozil	40.555	Simvastatin	40.559
13	Clarithromycin	40.220	Domperidon	40.688	40	Gemfibrozil	40.555	Lovastatin	40.556
14	Clorpromazin (hydrochlorid)	40.943	Domperidon	40.688	41	Gemfibrozil	40.555	Pravastatin	40.557
15	Diclofenac	40.30	Ketorolac	40.39	42	Ibuprofen	40.37	Ketorolac	40.39
16	Diltiazem	40.477	Ivabradin	40.485	43	Itraconazol	40.292	Lovastatin	40.556
17	Domperidon	40.688	Donepezil hydrochlorid	40.946	44	Itraconazol	40.292	Simvastatin	40.559
18	Domperidon	40.688	Haloperidol	40.949	45	Itraconazol	40.292	Ivabradin	40.485
19	Domperidon	40.688	Spiramycin	40.224	46	Itraconazol	40.292	Verapamil hydrochloride	40.489
20	Domperidon	40.688	Spiramycin Metronidazol	40.225	47	Ketoprofen	40.38	Ketorolac	40.39
21	Domperidon	40.688	Moxifloxacin	40.231	48	Ketoprofen	40.38	Meloxicam	40.41
22	Domperidon	40.688	Levofloxacin	40.228	49	Ketoprofen	40.38	Nabumeton	40.45
23	Domperidon	40.688	Itraconazol	40.292	50	Ketoprofen	40.38	Naproxen	40.46

+ Coding of DI data, writing a code to check contraindication that could run on Navicat software, including DI pairs of contraindication that should be contraindicated in all clinical situations and in all different patients (DI combinations contraindicated)), and DI pairs of contraindication in specific clinical contexts or in concrete patient populations (contraindicated DIs in specific clinical contexts).

+ Integrate the real-time contraindication DI warning intervention utility on HIS.

+ Evaluation of the effectiveness of the real-time contraindication DI warnings before and after integration on HIS

- Data analysis: Performed by R software (version 4.3.2), with statistical significance set at $p < 0.05$.

24	Domperidon	40.688	Fluconazol	40.288	51	Ketoprofen	40.38	Piroxicam	40.55
25	Domperidon	40.688	Erythromycin	40.221	52	Levodopa + carbidopa	40.419	Metoclopramid	40.690
26	Domperidon	40.688	Levomemazin	40.950	53	Levodopa + carbidopa	40.419	Sulpirid	40.956
27	Domperidon	40.688	Ondansetron	40.691	54	Metoclopramid	40.690	Pramipexol	40.423

Table 2. List of contraindicated interactions of combination drugs in specific clinical contexts in the Military Hospital 7

No.	Drug pair				No.	Drug pair			
	Active ingredient	Code	Active ingredient	Code		Active ingredient	Code	Active ingredient	Code
1	Acid tranexamic	40.451	Estradiol valerat	40.785	15	Chlopromazin HCl	40.493	Moxifloxacin	40.231
2	Amiodarone hydrochloride	40.483	Moxifloxacin	40.231	16	Chlopromazin HCl	40.493	Haloperidol	40.949
3	Amiodarone hydrochloride	40.483	Chlopromazin HCl	40.493	17	Colchicin	40.61	Itraconazol	40.292
4	Amiodarone hydrochloride	40.483	Haloperidol	40.949	18	Colchicin	40.61	Erythromycin	40.221
5	Amiodarone hydrochloride	40.483	Fluconazol	40.288	19	Colchicin	40.61	Verapamil hydrochloride	40.489
6	Amiodarone hydrochloride	40.483	Colchicin	40.61	20	Colchicin	40.61	Diltiazem	40.477
7	Atropin sulfat	40.1	Kaliclorid	40.1005	21	Donepezil HCl	40.946	Fluconazol	40.288
8	Azithromycin	40.219	Haloperidol	40.949	22	Fluconazol	40.288	Ondansetron	40.691
9	Calci clorid	40.1014	Ceftriaxon	40.183	23	Fluconazol	40.288	Haloperidol	40.949
10	Carvedilol	40.497	Colchicin	40.61	24	Haloperidol	40.949	Moxifloxacin	40.231
11	Ceftriaxon	40.183	Ringer lactate	40.1026	25	Haloperidol	40.949	Levofloxacin	40.228
12	Clarithromycin	40.220	Fluconazol	40.288	26	lobitridol	40.642	Metformin	40.807
13	Clarithromycin	40.220	Haloperidol	40.949	27	lohexol	40.644	Metformin	40.807
14	Clarithromycin	40.220	Colchicin	40.61	28	Kaliclorid	40.1005	Trihexyphenidyl (hydroclorid)	40.425

Building a list of contraindications DI in clinical practice started from January to August 2023. We have built 82 DI pairs, including 54 pairs with contraindications to combination, 28 pairs with contraindications to combination in some specific clinical contexts. This list coded according to a common set of directory codes applied in medical examination and treatment management and health insurance payment (version 6), issued with Decision No. 7603/QD-BYT dated December 25, 2018 and Decision No. 4905/QD-BYT dated October 21, 2019 of the Ministry of Health [3].

3.2 Results of the review of some errors related to DI contraindications

Table 3. Results of reviewing DI contraindications in health insurance drug prescriptions at the Military Hospital 7, period from January 1, 2023 to August 31, 2023

Type of interaction	Drug pair	Number of prescriptions	Frequency per 10,000 prescriptions (n = 158,213)
Contraindicated Drug Interaction		45	2.844
Contraindicated Drug Interaction (Combination)	Ciprofloxacin - Tizanidin hydroclorid	6	0.379
	Ivabradin - Diltiazem	3	0.190
	Total	9	0.569

Contraindicated drug interaction in specific clinical Contexts	Metformin HCl - Iohexol	4	0.253
	Colchicin - Itraconazol	4	0.253
	Haloperidol - Levofloxacin	2	0.126
	Ceftriaxon - Calci clorid	12	0.758
	Amiodarone - Moxifloxacin	1	0.063
	Atropin sulfat - Kali clorid (drink)	9	0.569
	Trihexyphenidyl - Kali clorid (drink)	4	0.253
	Total	36	2.275

After unifying and synchronizing the prescriptions data, using the code written for the Navicat software to review of 158,213 health insurance prescriptions from January 1, 2023 to August 31, 2023. We identified 45 prescriptions with contraindicated drug interactions, including 9 prescriptions with contraindicated drug interactions in combination (with two interaction pairs: Ciprofloxacin - tizanidine hydrochloride and ivabradine - diltiazem), and 36 prescriptions with contraindicated drug interactions in specific clinical contexts (with 7 interaction pairs).

The results of the study showed that before intervention, integration of the real-time contraindicated drug interaction warning utility on HIS, the frequency of occurrence of contraindications in 10,000 prescriptions at the Military hospital 7 was 2,844 and the contraindication for combination per 10,000 prescriptions was 0.569. According to research by Le Thi Ha and colleagues at the Department of Examination, Bach Mai Hospital, from June 2019 to March 2021, the frequency of contraindicated drug interactions was 3.776 [4].

The study by Nguyen Thi Dua and colleagues on outpatient prescriptions at Saint Paul Hospital from January 1, 2021 to September 31, 2021 found that the frequency of occurrence of contraindicated drug interactions for combination was 5.3 [5]. The study by Nguyen Thu Huong and colleagues on outpatient prescriptions at Duc Giang General Hospital in 2020 found that the frequency of contraindicated drug interactions in combination was 1.1 [6]. The results of our study were lower than those of previous studies, with a statistically significant difference ($p < 0.05$). This difference may be because Bach Mai Hospital, Duc Giang General Hospital and Saint Paul Hospital are large hospitals, with many beds and patients coming for examination and treatment than military hospital 7. Therefore, before integrating the real-time contraindicated drug interactions warning utility on the prescriptions software at larger hospitals with more extensive and diverse drug lists, the frequency of contraindicated drug interactions was also higher.

3.3. Evaluate the results of applying information technology in real-time contraindication DI warnings integrated on HIS software

After the successful integration of the utility, real-time DI contraindicated drug interactions warnings on hospital information system (HIS) based on the coded database of DI contraindicated drug interactions aimed to support doctors when prescribing drugs, if the prescription contains contraindicated drug interactions, a real-time warnings will appears in the form of a pop-up with specific warning content: degree of interaction; the mechanism of interaction; the consequences of the interaction and solutions.

For prescriptions with contraindicated drug interactions, after consulting the warning information, the doctor can choose “do not add” to remove the drug with DI from other drugs in the prescription or “add” to continue prescribing the drug with DI. In case the physician decided to continue a prescription with contraindicated drug interactions, the utility supports the function to record the reason for the prescription directly in the contraindicated interactions warning window.

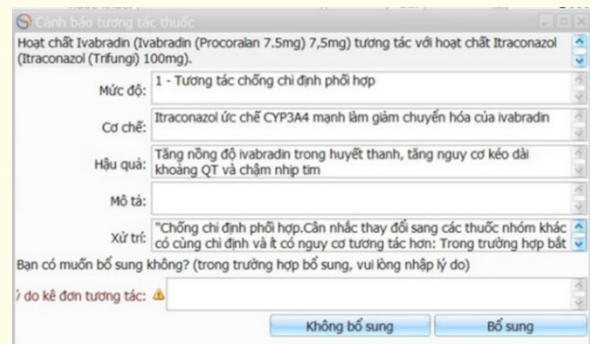


Figure 1. Warning window for contraindicated drug interactions in the on HIS.

- Evaluate the initial results of preventing some errors in prescriptions related to contraindicated drug interactions after integrating the utility and real-time DI contraindication warning: Extracting data of 18,222 health insurance prescriptions from September 1, 2023 to September 30, 2023 (after HIS integrated real-time contraindications DI warnings) at the Military Hospital 7, using code reviewing contraindicated drug interactions running on Navicat software, we used a contraindicated

drug interaction review code running on Navicat software, comparing the frequency of occurrence of contraindicated drug interactions in September 2023 with the months of January, February, March, April, May, June, July, and August 2023. The results (Figure 2) showed that the frequency of contraindicated drug interactions per 10,000 prescriptions in September 2023 was lower than in January, February, March, April, May, June, July, and August 2023), with a significant difference ($p = 0.0001$). This result was consistent with studies at some hospitals when implementing real-time warning applications on the prescribing software, such as Duc Giang General Hospital and 108 Military Central Hospital [6], [7].

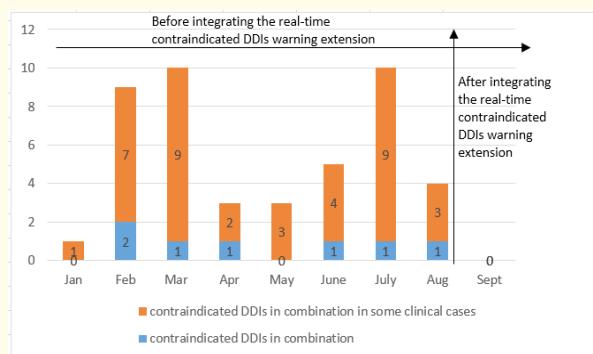


Figure 2. Graph of contraindicated drug interactions in health insurance prescriptions at Military Hospital 7, from January 1, 2023 to September 30, 2023.

4. CONCLUSIONS

After reviewing 176,435 health insurance prescriptions of patients coming for medical examination and treatment at the Military Hospital 7 from January 2023 to September 2023 to develop a list of contraindicated drug interactions and evaluate the initial results of using information technology to prevent contraindicated drug interactions in drug prescriptions at the Military Hospital 7, we draw the following conclusions:

- We successfully created and integrated 82 pairs with contraindicated drug interactions into the HIS software, including 54 pairs with contraindicated drug interactions in combination and 28 pairs with contraindicated drug interactions in specific clinical contexts.

- Reviewed 158,213 health insurance prescriptions from January 1, 2023 to August 31, 2023, identifying 45 prescriptions with contraindicated drug interactions, including nine prescriptions with combined contraindicated drug interactions with two pairs with interactions and 36 prescriptions with contraindicated drug interactions in specific clinical contexts with seven pairs of interactions.

- After integrating real-time contraindicated drug interactions warnings on HIS, there were no cases of contraindicated drug interactions in the total of 18,222 prescriptions in September 2023.

Application of information technology has proven positive effects in preventing contraindicated drug interactions in drug prescriptions at the Military Hospital 7.

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