The effect of active training in reducing severe drug interactions

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ABSTRACT

Background: *Medication errors are among the most important medical errors. Considering the current trend of poly-pharmacy and a high average number of drugs in prescriptions, drug interactions are of great significance.*
Purpose: *To evaluate the effect of educational interventions including face-to-face, audit feedback and educational notes, among Gorgan physicians.*
Methods: *With an initial estimation of 8% severe drug interactions (95% confidence level, 7% accuracy), the sample size was calculated to include at least 5600 prescriptions. After classifying the observed interactions and identifying the physicians, a questionnaire was prepared and completed attending their offices. Training was provided using face-to-face conversation, audit feedback and educational notes. After training on the severe interactions, physicians' prescriptions were reviewed again after three months and the number of interactions was compared with that observed at baseline, to evaluate the effect of training. Data were classified, computerized and analyzed with SPSS-10 using Chi-square and McNemar tests. The interactions' clinical importance was also evaluated using relative test.*
Results*: Overall prevalence of drug interactions was 8.93%, of which 6.55% were major, 65.58% moderate and 27.87% minor. Interactions were mostly seen among male doctors. The physicians with an average drug number of more than 4 had significantly more interactions in their prescriptions. The majority of physicians with major drug interactions did not know their clinical significance. After training, there was a significant reduction in major drug interactions, but none in moderate and minor interactions for which no education was provided.*
Conclusion*: Drug interactions are common medical errors in Gorgan province and training can decrease their rate.*
Keywords. DRUG INTERACTIONS, ACTIVE TRAINING

Journal of Medical Education Fall 2004 6(1);107-112

Introduction

Medication errors are among the most important medical errors (1). About 100000 patients die annually worldwide as a result of these errors (2). Several factors influence medication errors including human factors (lack of scientific knowledge, dose miscalculation), physician-patient communication, and drug label, package or design (3).

Drug interactions are one of the most important medication errors and are defined as pharmacologic or clinical response to the prescription of two or more drugs which is different from the known effects of administration of each drug separately (1, 3). Drugs with low therapeutic index, patient's age, presence of other conditions, genetic features and using different drugs by the patient are effective on drug interactions (4-6).

Considering the current trend of poly-pharmacy and a high average number of drugs in each prescription, drug interactions have grown in significance. Studies performed in different countries have reported the rate of these interactions to vary between 6% and 17% (3,7-11). Drug interactions are classified into three groups according to the severity of their clinical signs and symptoms:

1. Major drug interactions with life-threatening effects that can cause permanent damage.

2. Moderate drug interactions that can lead to clinical problems and perhaps prolongation of hospitalization stay.
3. Minor drug interactions that have no considerable clinical effect or major influence on the course of treatment.

Training is of crucial importance for all health care providers to have access to ever-expanding knowledge, new techniques and modern directions. Therefore, all medical instructors and health directors favour continuous medical education as a necessity; however, much is needed to be done to improve its process and efficacy. It is demonstrated that educational interventions such as workshops or continuous medical courses as well as patient assessment, are the most practical methods to improve rational drug use. Educational interventions, if performed repeatedly, well-focused, clearly directed and with good quality (in regard of lecturer's expertise and knowledge, problem-solving and learner's active role in training), can be of significant benefit (14).

Thus, the current study was performed in the winter and spring of 2002 with the cooperation of Rational Drug Prescription Committee, in order to evaluate the effect of educational interventions – face-to-face, audit feedback and educational notes- on major drug interactions observed in Gorgan physicians' prescriptions.

Material and Methods

A descriptive cross-sectional study was initially performed in the summer and fall 2001 to estimate the rate of drug interactions in Gorgan province physicians' prescriptions. After finding an estimated 8% drug interaction (95% confidence interval, 7% accuracy), the minimum sample size was calculated to be 5600 prescriptions. Considering the distribution of general practitioners and specialists in the province, 2700 prescriptions from the former group and 2900 from the latter were randomly selected from all prescriptions that were registered. An interventional quasi-experimental study was performed regarding major drug interactions. After classifying the observed interactions and determining the physicians prescribing them, a questionnaire was prepared and completed attending the physicians' offices. The physicians' knowledge about drug interactions, interaction mechanism, pharmacologic classification of drugs, rate of interaction among high risk patients and drug interaction management was evaluated by five items specified in the questionnaire.
Face-to-face training on major drug interactions was performed and educational notes were distributed among these doctors. Their prescriptions were reviewed again after a three month period and the rate of major interactions were examined and compared with that observed before training. Data were categorized, and analyzed with SPSS-10 using Chi-square and McNemar tests. The interactions' clinical importance was also evaluated using relative test.

Results

The overall rate of drug interactions observed in insured prescriptions signed by Gorgan physicians was 8.9% (4442 cases) of which 6.55% were major interactions, 65.58% were moderate and 27.87% were minor. Of all physicians, 10% had major drug interactions in their prescriptions.

The most common interactions were between clonidine and TCA and beta blockers (29.5%), penicillins and tetracycline (22%), and digoxin and potassium sparing diuretics (14%) (Table 1).

As seen in Table 2, those physicians with an average drug number of less than 4 in each prescription had significantly fewer interactions than those with more than 4 drug per prescription ($p<0.01$).

Only about 30% of major interactions were considered clinically important by physicians prescribing them. There was a significant gender difference in prescribing major interactions, so that 95.7% were administered by male doctors ($p< 0.01$).

Of all major interactions, 56.4% were prescribed by general physicians and 43.6% by specialists; the difference was not statistically significant ($p> 0.05$) (Table 3).

Figure 1 compares the rate of drug interactions before and after educational intervention. As obvious, major interactions were significantly decreased (0.4% before vs 1.5% after training) ($p<0.05$); regarding moderate and minor interactions, for which no education was provided, however a slight increase was observed although not statistically significant.

Physicians' knowledge on different aspects of drug interactions was significantly improved after training ($p<0.05$). However, assessment of physicians' knowledge about some other important confounding factors in rational drug prescription

TABLE 1. Type and prevalence of major drug interactions

Interaction	Prevalence	
	Number	Percent
Clonidin + TCA & Beta blockers	23	29.5
Penicillines + Tetracyclines	17	22
Digitalis glycosids + Thiazid Diuretics	11	14
Sympathomimetics (Adult Cold, Pedigrip) + Furazolidone	8	10.3
Beta blockers + Verapamil	5	6.45
Methotroxate + NSAIDs	3	3.85
Digitalis Glycosids + Loop Diuretics	3	3.85
Anti cholin-esterase + Adrenocorticosteroids	3	3.85
Lovastatin + Gemfibrozil	2	2.6
Digoxin + Verapamil	1	1.2
Terfenadin + Erythromycin	1	1.2
Terfenadin + Ketoconazol	1	1.2
Total	78	100

TABLE 2. Frequency distribution of major drug interactions in physicians' prescriptions according to the number of drugs in each prescription ($p < 0.01$)

Number Of Drugs / Major Interaction	Four and less		More than four		Total	
	No.	%	No.	%	No.	%
With interaction	14	17.95	64	82.05	78	100
Without interaction	3836	73.46	1386	26.54	5222	100

TABLE 3. Frequency distribution of major drug interactions in prescriptions of general physicians and specialists

Physician's Degree / Major Interaction	General Practitioner		Specialist		Total	
With interaction	44	56.4	34	43.6	78	100
Without interaction	17890	56.4	15069	43.6	32059	100
Total	17934	100	15103	100	33037	100

(such as the average number of drugs administered per prescription, percentage of injecting drugs, percentage of antibiotics and corticosteroids) before and after training, showed that without any direct educational reference, there was no significant difference in their knowledge ($p>0.05$) (Table 4).

As seen in table 5, the most major drug interactions were prescribed by physicians graduated before 1976, i.e. elder doctors, and the least were reported among younger physicians (graduated after 1998); although the difference was not statistically significant.

Discussion

New drugs are discovered and presented each year as a result of extensive research and development programs. These drugs bring new hope for controlling and treating diseases. Along with their developments, however, drug interactions or adverse effects have always been disturbing to physicians and pharmacologists.

Drug interactions are one of the most important preventable medical errors that are

caused by various elements such as personal and human factors, increasing number of drugs per

TABLE 4. Comparison of physicians' knowledge about drug interaction before and after training ($p < 0.05$)

Subjects	Knowledge Percentage	
	Before Training	After Training
Overall	27	81.1
Types and Mechanism	29.7	62.2
Pharmacologic classification	13.5	48.7
Prevalence among high-risk patients	18.9	54.1
Treatment or management	24.3	70.3

TABLE 5. Classification of physicians with major drug interactions based on their Medical Council Number (MCN) and graduation year

Interaction / MCN (graduation year)	Physicians with interaction		Physicians without interaction		Total	
	No.	%	No.	%	No.	%
Under 20000 (Before 1976)	6	11.1	48	88.9	54	100
20000-40000 (1977-91)	10	10.5	85	89.5	95	100
40000-60000 (1992-97)	12	10.4	103	89.6	115	100
Above 60000 (After 1998)	7	8.2	79	91.8	86	100

prescription, and the lack of communication between physician and patient (15).

The results showed that the rate of drug interactions in Gorgan province is considerably high. Also it was demonstrated that different educational interventions can significantly reduce the drug interaction rate.

The effects of education on decreasing the rate of drug interactions have been vastly studied in recent years. In a study performed in 1995 in North Carolina, 83% of medical students and 80% of residents believed they have received no training about drug interactions, especially on the interaction of drugs and food. Among all respondents, 79% thought that physician is responsible for informing the patients on interactions. The authors concluded that medical students' knowledge can be increased using educational programs (19). Training graduated physicians can also be a way to prevent drug interactions (14, 17, 18).

In another study in Boston, 3600 adverse drug reactions were found among 9900 patients who have totally received 83200 drugs. Of this number, 234 (6.5%) were due to drug interactions (7). Another survey on 1800 surgical patients showed that 17% had at least one potential drug interaction in their prescriptions (8).

Blaschke et al found that 19% of patients in New York nursing homes receive drugs that have known adverse interactions (20). Borda et al found this rate to be 22% in hospitalized patients (21).

In another research on outpatient centers, a slightly higher rate (23%) was reported (14). Yet another study showed 8% of hospitalized patients are admitted because of an adverse drug reaction, of which 20% were due to drug interactions (6).

Bahrami concluded that drug interaction is a major and common medical problem in Isfahan, Iran (11), while Roshandel estimated the drug interaction rate to be 8.22% in 2001 in Golestan province, Iran (12).

The present study showed that the interaction rate is significantly higher among male doctors, which confirms the results of Roshandel (12). This significant difference can be due to higher number of male physicians, female doctors' greater attentiveness in prescribing drugs, the kind and class of drugs prescribed by males and females, and the demographic characteristics of patients referring to female physicians (mainly women and children). However, more research is needed to determine the exact source of this difference.

Different factors can be suggested as a cause for the higher rate of drug interactions among general physicians (Table 3), including greater number of consultations with GPs, a lower level of knowledge among GPs, and extensive drug administration by GPs.

Regarding factors such as physician's age and graduation year, the results showed that elder doctors have more drug interactions, although not statistically significant. This could be due to more fresh-remained knowledge among younger physicians, or elder physicians' less enthusiasm to participate in CME programs. However, this remains to be further investigated.

It was shown in this study that increasing the number of in each prescription to more than 4 can significantly increase the rate of major drug interactions. Various studies have also shown that there is direct relation between the number of drugs per prescription and adverse drug effects and interactions (17, 18). Therefore, it must be emphasized again that the lower the number of drugs, the less the drug interactions.

Investigations performed in India, France and Iran confirm the results of the current study that face-to-face education and providing educational notes, as well as re-education programs and workshops can significantly influence and reduce the rate of drug interactions (5, 7, 15, 16, 17, 22).

Moderate and minor drug interactions, which were not mentioned in the educational intervention, showed no difference before and after training (Table 2). Moreover, variables such as mean drug number in prescriptions, percentage of injecting drugs, percentage of antibiotics and corticosteroids, which were used as control measures and no training was provided for, had no significant change. This proves the efficacy of face-to-face education in decreasing medical errors, especially medication errors, and improving rational drug prescription. This is also in accordance with other studies (23-25). For example, a 1998 study in the US on 180 physicians and pharmacists showed that training about the interactions of anti-coagulation drugs was useful in reducing these interactions (25).

In addition, an Indonesian study revealed that self-education and physicians' active participation in educational programs was the main factor in improving incorrect trends for drug prescription. Reduction of 26% in poly-pharmacy, 51% in antibiotic misuse, 74% in injections and 17% in the number of drugs per prescription, were all achieved in this study simply through self-monitoring (26).

In the current study, moreover, only 30% believed that observed drug interactions were of clinical significance, whereas according to literature, this figure is 100% (5). Other studies had different results, e.g. in India, Ray et al concluded that 55% of medical graduates did not know the

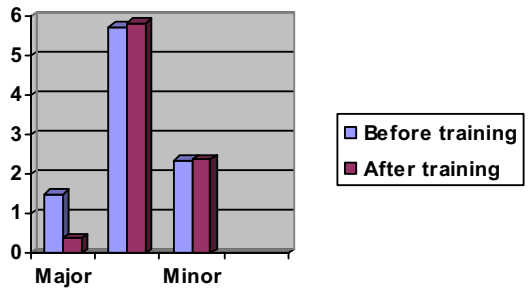

Figure 1. The effect of active training on reducing major drug interactions in physicians' prescriptions

principles of rational drug prescription and 95% believed that CME programs are necessary regarding this problem (23).

The reason for physicians' lack of knowledge about clinical significance of drug interactions was that about 80% had inadequate training on the different kinds of interaction and their mechanism, classification, prevalence and management. The main reason of this problem has to be explored further.

Considering the results, it seems necessary to pay more attention to continuous and effective education of medical experts on major as well as moderate and minor drug interactions. Active training and multi-facet educational programs (face-to-face, audit feedback, educational notes) are appropriate methods to reduce the interaction rate, which in turn can decrease the adverse drug effects and medication errors.

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