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USE OF AN ELECTRONIC EXPERT SUPPORT SYSTEM IN A SWEDISH COMMUNITY PHARMACY TO IDENTIFY AND RESOLVE DRUG-RELATED PROBLEMS

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Abstract

Objective: Drug-related problems (DRPs) can lead to consequences such as morbidity, mortality and increased costs. An electronic expert support system (EES) has been developed by the Swedish eHealth Agency to help pharmacists in community pharmacies identify potential DRPs, and to resolve actual DRPs. The objective of this study was to examine whether the use of the EES in a Swedish community pharmacy will result in more identified and resolved DRPs. Methods: In an open, prospective and controlled study, prescriptions were dispensed by three pharmacists with the use of EES during two weeks and without EES during two weeks in the spring of 2019. A DRP documentation template was developed and used. Identified DRPs, suggested actions and actions presented to patients and prescribers, and resolved DRPs, were documented and compared using Chi2-tests. Key findings: 100 patients were included in both the EES intervention group and in the control group. At least one actual DRP was identified in 26 intervention patients and 28 control patients. The number of patients with at least 1, 2 or 3–5 DRPs did not differ, but including the total number of DRPs reached statistical significance, favouring the EES-support group. EES-support helped pharmacists to present suggestions to physicians and consequently to resolve DRPs, primarily drug-drug interactions. Conclusion: Our study indicates that the EES dispensing support system contributes to the identification and resolution of DRPs, mainly DRPs related to drug-drug interactions and suggestions to the prescriber.

6. Main Text

Introduction

A Drug-related problem (DRP) has been defined as an event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes.[1] DRPs occur in different types and there are different classification systems.[2,3] DRPs reduce the quality of life, cause morbidity and mortality and thus cause significant economic costs and negative effects for both the individual and society.[4] Hence, pharmacists' identifications and resolutions of DRPs may result in both positive clinical outcomes and large societal cost savings.[5]

Identification, resolution and prevention of DRPs is one of the major tasks by community pharmacists, as have been demonstrated by studies.[6-11] The use of electronic prescriptions has long been fully implemented in Sweden. A governmentally owned clinical decision support system (CDSS), named Electronic Expert Support (EES), has been established, which analyses patients´ electronically stored prescriptions in the Swedish national prescription repository. It was developed according to the Drug Utilization Review (DUR) by Medco Health Solutions, used in various forms at community pharmacies in the US, and has been adapted to Swedish clinical practice.[12,13]The pharmacist can use the EES during dispensing prescriptions to identify potential DRPs. With EES, the electronic prescription is analyzed both individually and together with all

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the patient's other current prescriptions and alerts of potential DRPs and EES suggestions for resolutions of the DRPs. An alert is defined as a general term for a detected "potential" DRP. The Swedish e-Health Agency's expert group is responsible for quality assurance of EES content. Its information is designed as evidence-based rules, and is constantly updated based on science and information from government agencies.

EES can detect DRPs including Drug Drug Interactions (based on the Sfinx database with a classification system of four severity levels), therapy duplications (dispensing of two or more drugs within the same therapeutic category), high doses (a prescribed dose exceeding the maximum daily dose), drug-disease interferences (potential contraindications for a drug with a disease inferred by prescription information), drug gender warnings, and inappropriate drugs and doses for geriatric or pediatric patients.[13]

To close the alerts generated, the pharmacist must address them by selecting and specifying one of the seven different categories. The pharmacist should be able to assess the alerts and evaluate their clinical relevance before discussing them with a patient or prescriber.[13] Only a few studies have been performed on EES, then focusing on the doctors' views on the alerts[13] and the most common type of signals.[14] EES is used in about 1300 out of the 1400 pharmacies in Sweden, but only with approximately 20% of the patients (2018).[15]

A comparison of DRPs identified by pharmacists with and without EES support has previously not been studied. This study was conducted as a BSc in Pharmacy thesis at Malmö University, Sweden.

The aim of this study was to investigate whether the use of the pharmacy based EES would identify and resolve more actual patient DRPs.

Methods

Design

This was a prospective, open, controlled, four period comparative study, with and without CDSS (EES support), performed in the spring of 2019 in one community pharmacy in southern Sweden.

Patients, settings and pharmacists

All patients with at least five prescribed medications dispensed at the Hjärtat Pharmacy in the city of Eslöv were offered an opportunity to participate. The three pharmacists involved all had an MSc in Pharmacy and 25, 15 and 0.5 years of experience.

Intervention and control activities

The study was performed during four weeks in February- March 2019. Study week 1 and 3 were intervention periods, and 2 and 4 controls. In the intervention periods, the pharmacist used the EES support to detect potential DRPs after consent from the patient. All additional prescription dispense support information could be used by the pharmacist during both intervention and control periods to detect potential DRPs. After dispensing a drug in the control group, the patients were offered EES support in the next dispensing.

Documentation template

A separate documentation template was developed and evaluated by the research group, tested in two patients, and was used for documentation in both periods where an actual DRP was identified and documented to be acted upon (appendix 1). The template included basic demographic information, and focused on the type of identified actual DRPs, suggested actions, results of presented/not presented (reason should be given) suggested actions (to patient or prescriber), and also if the DRP was solved or not. Note that only identified potential DRPs that needed action according to the pharmacist were considered an actual patient DRP and documented, as a DRP in the template. No information on patient identity or responsible pharmacist was

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collected and each patient template only had a reference number. The DRPs were classified as high dose, C/D-interactions, drug duplications, medication inappropriate in children or in the elderly and other. For details on use and evaluation of the form see appendix 1.

Analyses and Statistics

All data were written in MS Excel 2016 (Microsoft Corp, USA). Chi-2 tests were used for all comparisons. We assumed the proportion of patients with at least one DRP to be 50% in the control group and that this would increase to 70% in the EES support group. With a 5%-significance level and power of 80%, we needed 190 patients in total, so we included 100 in each group [16].

Ethical consideration.

This study required no specific ethical approval according to the Malmö University guidelines since the patients were not exposed to any kind of danger and no personal data were collected. The EES is normally used voluntarily by the pharmacists and the patients not receiving the EES support were informed on the possibility to be used, in the next dispensing.

Results

26 of 100 patients in the EES-support and 28 of 100 in the control group had at least one documented actual DRP. Some demographic characteristics for these patients are presented in table 1.

Table 1 insert here

Table 2 gives comparisons between groups regarding the number of identified actual DRPs. For the comparison of the number of patients where the pharmacist found at least 1 DRP, for which the power calculation was based, there was a non-significant trend that the intervention failed, and the pharmacist found less DRPs using EES-support. For the other comparisons the pharmacist identified more DRPs using the EES-support. For the total (at least 1, 2 and 3-5 DRPs) the comparisons were statistically significant.

Table 2 insert here

Most DRPs were identified among elderly patients (>70 years), 85 and 79% in the EES-support- and control group, respectively. Table 3 shows comparisons of pharmacists' initiatives towards patients and prescribers between the groups regarding the total number of identified DRPs, documented suggestions, presented suggestions to the patient and/or prescriber, and resolved DRPs. For the EES-support group, a total of 47/52 of identified actual DRP action proposals have been documented (90%), 46/52 (88%) of these DRPs have been presented and 43/52 (82%) have been resolved. For the control group, the corresponding values are 35/39 (90%), 31/39 (79%), and 29/39 (74%). There was a significant difference favoring EES-support that it helped pharmacists to present suggestions to physicians and consequently to resolve DRPs. For patient initiatives there was a trend but no significant differences. Most suggestions and resolved problems were however directed towards patients.

Table 3 insert here

In the EES-support group drug-drug interactions were the most common DRP type (33%) (Table 4). In the control group it was drug duplications (38%).

Table 4 insert here

Table 5 describes initiatives performed (presented suggestions) toward the patient or the prescriber. In the EES-support group, initiatives were directed almost equally between the prescriber and the patient. In the control group most initiatives were directed toward the patients.

Table 5 insert here

Discussion

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Based on a literature search and review, and on questions to our international network, we believe this is the first prospective and controlled study to evaluate a community pharmacy based CDSS on pharmacists' identification and resolution of DRPs. Our study is small, but it indicates that the EES-support system contributes to identification of actual drug related problems (DRPs). The number of patients with at least one DRP did not increase but the number of patients with at least 1, 2 and 3-5 DRPs did. This is what should be expected for a support system. EES gives a total review of all prescriptions. This helped the pharmacist to suggest initiatives towards physicians, but not toward patients to resolve DRPs. The help mainly concerned drug-drug interactions. This seems to be the major contribution of EES, to assist pharmacists in suggesting the removal or switch of a drug, or decrease the dose due to drug-drug interactions. In fact, if the drug-drug interaction DRPs are removed (table 4) there is no apparent difference between the groups.

There have been few publications on systematic documentation and resolution of DRP in community pharmacies.[7-11] In a German study from 2005, DRPs were examined at 1,114 pharmacies.[7] The pharmacists documented approximately 10,500 DRPs, and more than 80 percent of the DRPs could be resolved, in large part in consultation with the prescriber. In another German study, 141 pharmacists documented 912 medication reviews during 2012-2015.[11] In 869 of these (95%), the pharmacist documented at least one DRP. In total they found 5248 DRPs. In 3972 of these (76%), an action to solve the problem was documented and in 3198 (61%) it was rated as resolved. In a Dutch study from 2012, data was collected from 268 community pharmacies.[8] In total, 4579 medication reviews were performed and 13,366 DRPs were found, on average 2.9 per patient, of which 0.90 led to medication changes. A French study from 2014 included 892 patients from 55 pharmacies. 334 DRPs were identified, 259 actions were reported and 89 were sent to the physician who implemented 70 of these.[10]

All studies were performed on populations similar to ours, with limited access to health-care patient data, but in several community pharmacies: They used standardized documentation templates but the method or support system (CDSS) for identification of DRPs was not described. We have found only one community pharmacy study using a CDSS and reporting DRP signals similar to our study.[11] This is a Dutch study from 2014 where they took a random sample of 10% from a CDSS database from 123 pharmacies, generating 1,672,169 dispensed prescriptions from 81,742 patients. Of the dispensed prescriptions 43% led to one or more safety alerts, 31-55% range over pharmacies. They reported that the majority of the alerts were clustered in a minority of patients and involved mainly drug-drug interaction (15%), disease-drug interactions (14%), duplicate medications (13%) and dosing alerts (7%). They did not report actions or resolution rates.

We were very surprised by the low number of identified DRPs in our study, compared to other studies [7-11] and our power calculation was consequently not fully appropriate. The definition of a DRP is part of the discrepancy. It seems as most of DRPs in the described studies are potential. In our study only actual DRPs were documented. Our study pharmacy has for many years had a close collaboration with the local GPs and also a continuity among the patients coming to the pharmacy. It could be that the patients in fact are very well treated, having a low number of DRPs.

Two studies have previously been published in the EES-support system based on nursing home patients with multi-dose drug dispensing.[13-14] In order to get an idea of the clinical significance of EES signals, physicians' views on the signals were assessed.[13] Sixty-eight percent (502/740) were considered clinically relevant and in 276 of these had the physician intended to take action. For 135 of these 276, the measures were to either insert or withdraw drugs, or reduce or increase the dose. Following up, it was shown that 85 of these 135 had led to an actual change in the prescription. In another study EES alerted in 76 percent of patients.[14] The most common alerts were drug-drug interactions, drug duplications and inappropriate drugs or high doses in older patients. The basics in these studies are similar to ours but but the higher number of DRPs could be explained because they also documented potential DRPs.

There are some limitations in our study. The participating pharmacists were aware of the study and the EES support period. However the number of patients with at least 1 DRP was in fact lower in the EES-group which indicates a low risk of attention bias. Due to a single center study design involving only three pharmacists with different experiences the generalizability could be low. However, since the use of EES is

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very standardized, the different experiences among our pharmacists might increase the generalizability.

Previous studies[13-14] have shown the clinical significance of the system and pharmacist suggestions. This study adds information that EES-support increases the identification, suggestions and resolving of DRPs. Future studies should focus more on clinical effects of EES-support, and cost-effectiveness. A major problem is also to involve the pharmacies/pharmacists in the establishment of a correct medication list of what medicines the patients actually take. We have previously studied this as part of the Lund Integrated Medicines Management model and found major problems in the correctness of medication lists when patients are admitted and discharged from hospital.[17] Cancelation of not used prescriptions is possible by pharmacists and could be an active and integrated part to help patients and health-care professionals to establish a correct medication list, which needs to be studied.

Conclusion

Our study indicates that EES-support contributes to identification and resolution of DRPs in a Swedish community pharmacy setting, mainly due to DRPs related to drug-drug interactions and suggestions to the prescriber for changes in the drug treatment

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9. Conflict of interest statement

We have no conflicts of interest to disclose.

Data availability: All authors state we had complete access to the study data that support the publication.

Ethical consideration: This study was a student project for examination of Bachelors thesis in Pharmacy. The patients were invited to participate verbally and in writing based on an information leaflet. This study required no specific ethical approval according to the Malmö University guidelines since the patients were not exposed to any kind of danger and no personal data were collected. The EES is normally used voluntarily by the pharmacists and the patients not receiving the EES support were informed on the possibility to be used, in the next dispensing.

https://www.mah.se/english/faculties/Health-and-Society/Education/Ethical-review/

Author contributions: AD performed this project as a BSc thesis in Pharmacy with TW and TE as supervisors. All authors designed the project, AD informed and recruited pharmacists, collected data from the documentation template and wrote a Swedish draft manuscript. TE wrote an English draft manuscript for scientific publication. AD, TE, and TW finalized the BSc thesis and the scientific manuscript.

10. Tables

Table 1. Descriptive data for patients with actual drug related problems. Numbers and proportions (%)

	EES
Female	13 (5
Age above 70	20 (7
More than 10 medications	8 (31
Medications ACE-inhibitor Beta-blocker Oral anti-coagulant/anti-trombotic Anti-depressant Paracetamol or NSAID	3 (12

Tabell 2. Comparisons of number of DRPs. Number and proportion (%)

At least 1 DRP	26 (100)	28 (100)	0.785

		EES-support (n=26)	Control (n=28)	P-value
Total identified actual DRPs	Total identified actual DRPs	52 (100)	39(100)	
Patient	Documented suggestions	26 (50)	24 (62)	0.777
	Presented suggestions	25 (48)	21 (54)	0.555
	Resolved DRP	23 (44)	20 (51)	0.647
Prescriber	Documented suggestions	21 (40)	11 (28)	0.077
	Presented suggestions	21 (40)	10 (26)	0.048
	Resolved DRP	20 (38)	9 (23)	0.041

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Table 4. Type and number of actual Drug Related Problems (DRPs). Numbers and proportions (%)

DRP type	DRP type	EES-support	Control
High dose	High dose	11 (21)	11 (28)
Drug–drug interaction	C	17(33)	4 (10)
	D	1 (2)	0 (0)
Drug duplication	Drug duplication	10 (19)	15 (38)
Inappropriate drug	Inappropriate drug	4 (8)	4 (10)
Other	*Other	7 (13)	5 (13)
Total	Total	52 (100)	39 (100)

* Not identified using EES, includes mostly adverse effects but also compliance, missed indication for use, and wrong time.

Table 5. Presented suggestions to patients and prescribers. Numbers and proportions (%)

		EES-support	Control
Patient	Cancelation of prescription	7 (15)	8 (26)
	Referred to the prescriber	6 (13)	5 (16)
	Was informed of the maximum recommended dose	3 (7)	5 (16)
	Was informed about not taking medications at the same time	5 (11)	1 (3)
	*Other	4 (9)	2 (6)
	Subtotal	25 (55)	21 (67)
Prescriber	Removed drug	7 (15)	4 (13)
	Decreased dose	9 (19)	5 (16)
	Switch of drug	3 (7)	1 (3)
	*Other	2 (4)	0 (0)
	Subtotal	21 (45)	10 (32)
Total	Total	46 (100)	31 (100)

* Includes advice on compliance, informed about the right dosage, informed about the right time for drug administration, increased dose.

11. Figure Legends

No figures in this publication

12. Appendices

Separate file