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Standardization of clinical pharmacist's activities: Methodology

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ABSTRACT

Study objectives: Establishing standardized and controlled system of work at a clinical pharmacy department and establishing effective recording of activities of a group of four clinical pharmacist when providing clinical pharmaceutical care (CPC) in a hospital.

Methods: The duration of evaluated period is 5.5 years. The first part was defining the purpose, methods and activities of clinical pharmaceutical care, the next part was designing the software for recording patient's data and CPC activities. To verify the functionality of our system the third part was conducted (from January 1, 2015 to June 30, 2015).

Results: CPC activities were defined precisely. During the 6 months period, 3946 patients were reviewed (17% of patients admitted), in this group, 41% patients was labeled as risk (these patients had one or more risk factor). 1722 repeated reviews were performed, 884 drug therapy recommendations were recorded. The calculated average time necessary for one CPC activity is 28 min.

Conclusion: During the 5 year period, standardized system of work in clinical pharmacy department was established. This system is based on clearly defined activities and it enables external control. Our results supply data for negotiations with health insurance companies.

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1. Introduction

In daily routine, the elementary activity of a clinical pharmacist does not focus on scientific work but on the review and optimization of patients' medication, i.e. clinical pharmaceutical care (CPC). This activity includes the identification and solution of drug related problems and risks connected to the administration and usage of drugs in a particular patient. The evaluation is run based on the knowledge of therapeutic use of drugs, health-care records, the requests of attending physicians, and the needs of patients themselves. The goal is to achieve maximal therapeutic

effect of medication while minimizing the risks related to the use of drugs.

The clinical importance of potential or existing drug related problem has to be evaluated and the solution should be presented to the attending physician in the form of drug therapy recommendation (DTR). Although Standards of Practice for Clinical Pharmacist published by ACCP give a general description of the activities required for therapy evaluation, we needed more rigorous methods in order to get valid results (American College of Clinical Pharmacy, 2014). Methods described in previously published studies are usually too general as well. Based on data published earlier, instead of reactive approach, pro-active approach is preferred, i.e. action without request by physician (Viktil and Blix, 2008). Although the number of evaluated patients is lower in this case, the acceptance rate of interventions and possible economic benefits are higher (Patel et al., 2010).

The importance of CPC has been confirmed repeatedly in other countries, both on the level of quality of care (plasma drug levels, achieving optimal effect, adherence) (Viktil and Blix, 2008; Talasaz, 2012) and on the pharmacoeconomic level (shortening hospital length of stay, decreased number of rehospitalizations) (Viktil and Blix, 2008; Patel et al., 2010; Schumock and et al., 2003; Gallagher et al., 2014; Nesbit and et al., 2001). In Czechia, CPC

Abbreviations: CPC, clinical pharmaceutical care; DTR, drug therapy recommendation; MRA, medication review on admission; RDH, risk drug history; RR, repeated medication review.

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was provided in non-systematic way for a long time, without sufficient records, standards, and control.

The Department of Clinical Pharmacy, Na Bulovce Hospital, was established in 2010 with the task to provide CPC in hospital with 967 acute care beds, 34 follow-up care beds, and the annual count of 45,000 admitted patients. Present staff of the department consists of 1.0 clinical pharmacist specialist and 3.0 clinical pharmacists. Furthermore, the hospital pharmacy provides standard pharmaceutical care for wards.

The aim of this study was to summarize establishment of the standardized and controlled system of work at a clinical pharmacy department and to summarize establishment of the effective recording of clinical pharmacist's activities when providing clinical pharmaceutical care in a hospital. Another aim of this study was the detailed description of all clinical pharmacist's activities, which enables to establish condition for providing CPC in different health care facilities. Furthermore the third aim was to show which results of clinical pharmacist's activities can be valuable for management of the facility and for health insurance provider.

2. Methods

2.1. Defining the purpose, methods and activities concerning CPC: Years 2010–2011

2.1.1. Purpose of CPC

The review of medication on the admission to the hospital is performed so as to eliminate any errors in chronic/admission medication and to identify risk factors that may cause extant drug related problems and/or problems during the hospitalization and/or on the release of the patient.

The review of medication during the hospitalization is focused on drug related complications during the hospitalization, e.g. changes in dosing in renal and liver insufficiency, identification and interpretation of side effects, medication review prior to a diagnostic or therapeutic intervention.

The review of medication on the release from hospital is focused on patients:

- who exhibited inconsistency in chronic medication on admission that did not require immediate solution;
- whose medication had to be changed during the hospitalization and this justified change has to be handed over to the general practitioner or a specialized physician.

2.1.2. Method of providing CPC

Experience so far has suggested that identification of drug related problems by hospital software (i.e. computerized physician order entry system with clinical decision support) (Zaal and et al., 2013) or by the attending physician is not always sufficient. Providing CPC cannot be based on mere direct request of the attending physician. CPC should be based on active systemic search for risks and drug related problems in patients (Viktil and Blix, 2008; Patel et al., 2010). The consent of the particular head physician is necessary and the physicians have to be informed how the system works. Systemic providing of CPC is not possible without regular attendance to ward rounds, without communication with physicians and other personnel, or without direct contact with the patient.

With respect to the limitations on staff, the **systemic review** was divided according to intensity to two levels – complex and selective.

Complex systemic CPC is focused on following tasks:

- the admission to the hospital includes medication review by a clinical pharmacist within defined time limit and the risk rate of drug history with respect to the actual state of the patient and planned interventions is evaluated;
- medication is reviewed regularly during the hospitalization with the intervals between evaluations being set with respect to expected risks; daily contact with attending physician, other personnel and the patient is suitable;
- if necessary, a DTR, which is purposed for the general practitioner or another specialist, is written on release.

Selective systemic CPC is focused on the fact that the medication is reviewed in preset intervals, based on predefined risk factors and/or risk drugs. Some mechanisms used for setting selective medication review can be used to increase the efficiency of complex medication review.

Counselling CPC is drug review following direct request by physician.

2.1.3. Activities of CPC

2.1.3.1. *Medication review on admission (MRA)*. MRA is the first check of hospitalized patient by a clinical pharmacist. This may be a part of systemic or counselling CPC. If there is complex systemic CPC in the ward, the evaluation should be done as soon as possible. By this activity, the clinical pharmacist takes over the patient in his or her care. The review on admission is related to particular hospitalization, i.e. it is repeated on each admission of a particular patient.

This activity should include always:

- perusal of healthcare records;
- investigation of risk or unclear drug related information;
- evaluation of the relation between actual problems and the use or administration of drugs;
- medication evaluation targeted on the identification of factors and drugs that would cause risk in case of medication or health status change during the hospitalization.

It is necessary to discern between drug related problems that put the patient in immediate danger and those that do not. In the latter case, the clinical pharmacist just points out these problems and recommends their solution by the general practitioner or another specialist.

The outputs of MRA purposed for the attending physician:

- (a) medication evaluated without comments;
- (b) consultation with clinical pharmacist is recommended in case of health status change;
- (c) evaluation resulting in suggesting a change in medication in the form of DTR.

The delivery of the output to the physician should be apparent. The urgency of the problem has to be evaluated and the form of delivery has to be chosen accordingly. It is important that the clinical pharmacist has the possibility of feedback, i.e. whether the physician has read and accepted the output of medication review.

The outputs from MRA recorded by clinical pharmacist (shown in Fig. 1):

- (a) medication on admission was checked and no risk factor was identified – low risk patients; MRA is recorded;

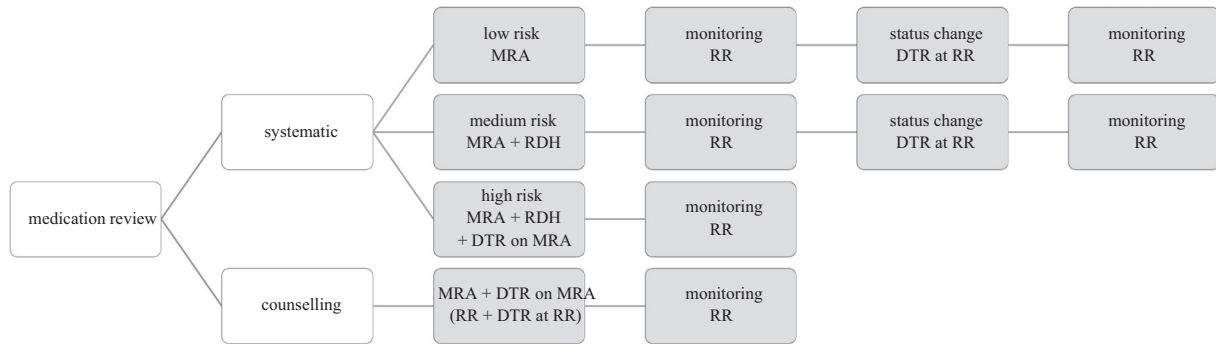


Fig. 1. Clinical pharmacy care activities record flowchart. The provided care can be systemic (without direct request by the physician) or counselling (requested directly by the physician). Systemic clinical pharmacy care starts with medication review on admission of the patient with subsequent stratification of patients according to identified risks. In more risk patients, repeated reviews follow during the hospitalization. DTR: drug therapy recommendation, MRA: medication review on admission, RDH: risk drug history, RR: repeated medication review, DTR on MRA: drug therapy recommendation on admission, DTR at RR: drug therapy recommendation at repeated medication review.

- (b) Risk drug history (RDH); one or more risk factors were identified, but the facts conferred by the attending physician or found in healthcare documentation demonstrate that the medication is set right under given conditions – medium risk patients; MRA and RDH are recorded; there may be common and individual risk factors (with respect to particular wards or beds);
- (c) RDH; one or more risk factors were identified, but the facts said by the attending physician or found in healthcare documentation suggest that the medication is not set correctly; this results in DTR – high risk patients; MRA, RDH, and DTR are recorded.

2.1.3.2. Repeated medication review (RR). In other words, it is the monitoring of medication during the hospitalization. The frequency of medication reviews depends on the rate of risk that was identified (low, medium, high), on the type of care (acute, follow-up, intensive, standard), and on the branch of medicine CPC is provided to. RR are preventative as well as focused on the evaluation of the impact of interventions stemming from DTR:

- feedback on the acceptance of proposed changes in medication by the physician and the patient;
- assessment of laboratory results with relation to set medication;
- suggestion of further medication procedure, mainly if the clinical status of the patient changed, the conditions of elimination organs changed or there were changes in medication.

The outputs of medication review during hospitalization purposed for the attending physician:

- recommendation to consult the clinical pharmacist in case of future health status change;
- DTR.

The outputs of medication review during hospitalization recorded by the clinical pharmacists:

- repeated review without suggesting changes;
- in case of DTR: RR and the ensuing recommendation.

2.1.3.3. Medication review on release of the patient. In course of systemic or counselling medication review, the clinical pharmacist identifies those patients who would benefit from DTR which should be included in the release report purposed for the general

practitioner or another specialist. If necessary, the report includes and describes:

- important changes in medication during the hospitalization, planned medication strategy – discontinuation of drugs, dose titration, recommendation to check plasma levels of drugs, offer of consultation;
- inconsistency between chronic medication and diagnosis listed in the record of the patient that should be resolved by the general practitioner or another specialist.

The output for the attending physician is the DTR. The outputs recorded by the clinical pharmacist are the DTR and the release report.

2.1.3.4. Education of the patient concerning pharmacotherapy. During the hospitalization and/or prior to release, the clinical pharmacist should play active role in the education of patients concerning their medication, thus increasing the compliance in medication use. The attending physician has to be aware of this activity and it has to be recorded in the health record of the patient.

The output recorded by the clinical pharmacist: education of the patient.

2.1.3.5. Requested counsel. Requested counsel is counsel that was requested directly by the physician in a ward where there is no systemic complex CPC provided. Furthermore, counsel can be requested in case of outpatients. In wards where there is complex systemic CPC, the cooperation between the physician and the clinical pharmacist is so close that it is difficult to tell the difference between requested and unrequested counsel. Counselling medication review can deal with medication the clinical pharmacist has or has not evaluated before (counselling on admission or repeated counselling).

The output of counselling medication review for the attending physician is the DTR that includes the conclusion of evaluation. The recommendation is written also in case no changes in medication are necessary and no risk factors/medications were identified.

The output recorded by the clinical pharmacist: the request for counsel, counselling on admission or repeated counselling, and respective DTR.

2.1.3.6. Drug therapy recommendation (DTR). The recommendation is written complete conclusion of the medication review, purposed for the attending physician, including the plan for rationalization of medication, and suggestion and justification for changes in medication. One or more interventions can be suggested. The

recommendation is based on medication review and information from healthcare documentation, the physician, and the patient.

The suitability of a drug and its dose are evaluated based on diagnoses and on individual characteristics of the patient. The route of administration, interval and time of administration, and dosage form are evaluated with respect to the individual character of the patient. The clinical pharmacist respects evidence-based medicine, valid pharmacotherapeutic standards, and pharmacology. The suggestion contains a brief opinion, clear justification of the suggestion, and concrete recommendation for the attending physician.

Any suggestion to change the medication has to be recorded in healthcare record. The clinical pharmacist has to ascertain that the attending physician is aware of the recommendation in time and to be able to find out whether the physician accepted the recommendation. If the recommendation was oral and the clinical pharmacist and the attending physician agreed on the proceedings, an additional record is required.

Formal requests for the recommendation:

- providing department;
- provided department;
- name of the physician;
- name, identification number and health insurance company of the patient;
- date of recommendation;
- name of the clinical pharmacist.

DTR: classification of interventions

The recommendation is one of the important activities the clinical pharmacist records. Nevertheless, its written content has to be transformed to a classified form for the purpose of various analyses concerning identified drug related problems. The classification used is based on the record of concrete and intrinsically simple interventions that describe what the attending physician should do to eliminate or minimize the risk. Furthermore, one or more reasons that led to the recommendation being recorded.

The drug that the intervention deals with is clearly identified by its ATC code. Following types of interventions which are used: introduction, re-introduction, or discontinuation of a drug, change in dosing, change in time and/or interval of administration, change in dosage form, suggestion to run further exams (physical, laboratory) necessary for a decision, consulting the change in medication with another specialist, therapeutic drug monitoring and its interpretation. Further interventions can be added to the software with respect to the needs of particular department, monitored care quality indicators, research intentions, etc. Subsequently, the reason for change is recorded.

One DTR may include more intervened drugs or more interventions can be related to a single drug.

2.2. Designing the software to record patients, CPC, and DTR: Years 2011–2012

The software was developed to be able to include the patient record containing the identification of the patient, i.e. name, date of birth, health insurance identification number, as well as the possibility to add further notes. The software is able to record all above mentioned activities of the clinical pharmacist concerning actual hospitalization, to archive records concerning previous hospitalization, to record DTR including their classification (see below). The medication of a particular patient can be labeled as RDH including the reason why there is a risk, e.g. risk drug clearly identified by its ATC code, risk diagnosis identified by its ICD-10 code, or other factors. These factors can be common – narrow therapeutic range drug, age above 75 years, renal insufficiency (glomerular filtration

rate < 30 ml/min), albumin < 20 g/l, more than 8 systemic acting drugs in the chronic medication, unclear reason for medication – or individual as characteristic for particular wards. Furthermore, the software is able to run routine analyses of individual activities, risk drug histories, drug related problems, predefined quality of care indicators related to medication, pharmacoeconomics of provided CPC, etc.

2.3. Collection of data

The results are based on data collected between 1st January 2015 and 30th June 2015.

Four pharmacists are employed in the department (40 hours/week/pharmacist).

In four wards, a more intensive way of care was established, i.e. the combination of systemic complex (basic) and systemic selective and counselling (supplementary) CPC: general surgery, orthopedics, pneumology, and oncology. In the oncology ward and in most beds of pneumology ward, the systemic complex care prevails. Less intensive way of care, based on systemic selective and counselling care, was established in following wards: infectious diseases, internal diseases, anaesthesia and resuscitation, neurologics, and plastic surgery.

3. Results

The department of clinical pharmacy provides daily routine of the CPC to hospitalized patients. Monitored period covered 3760 working hours as a result of 8 hour working time and 4.0 pharmacists.

Recorded activities of CPC for observed period are presented in [Table 1](#). The list includes the total number of activities within the hospital, data for selected wards with more intensive CPC, and for the wards with less intensive CPC. 3946 hospitalized patients were evaluated, i.e. 17% of patients admitted to the hospital in monitored period. The ratio was 43% in wards with more intensive CPC. In pneumology and oncology wards, where complex systemic CPC prevails, this amounted to 85%, respectively to 88%. 1617 risk drug histories were labeled, i.e. 41% of patients on whom review on admission was run were identified as risk from the point of view of possible occurrence of drug related problem during the hospitalization. The most frequent risk factors included narrow therapeutic range drug, age above 75 years, renal insufficiency, more than 8 systemic acting drugs in the chronic medication, and unclear reason for medication. 1722 repeated reviews were performed. In total, 884 DTRs were recorded; 466 of them were on admission (11.8 recommendations per 100 reviews on admission) and 418 on repeated review (24.3. recommendations per 100 repeated reviews). In wards with prevailing complex systemic CPC, the number of recommendations is higher. In total, 1595 drug interventions were recorded, for details see [Table 2](#). On average, 40.4 drug interventions per 100 hospitalized patients were recorded. Only those recommendations that were accepted by the physician are included in the analysis. Potential drug related problems are monitored on the level of identification and recording of risk drug histories and subsequent monitoring of medication. Even potential risk has to be evaluated as relevant in the context of healthcare record, and information obtained from thy physician and the patient. If potential drug related problems are identified based on incomplete information, the medication in RDH is labeled as “requires further investigation”. This occurred in 197 cases. There is no software that would identify potential drug interactions in the hospital. The review on admission therefore includes an estimation of the risk of drug interaction. This was performed in 363 cases of review on admission. Similar rules apply to the identification of generic duplications. This was observed in 47 reviews on

Table 1

Recorded activities of clinical pharmacy care (CPC). SUR – surgery, ORT – orthopedics, PNEU – pneumology, ONCO – oncology.

	CPC					Less intensive	
	Whole hospital	More intensive Systemic complex, systemic selective, counselling				Systemic selective, counselling	
		Total	Selected wards				Other wards
	Total	SUR	ORT	PNEU	ONCO	Total	Total
Number of beds	1001	84	148	81	60	373	628
Review on admission	3946	844	489	897	533	2763	1183
% of reviewed patients out of total admitted patients	17	46	17	85	88	43	7
Risk drug history at review on admission	1617	332	200	329	236	1097	520
% of risk drug histories out of total drug histories	41	39	41	37	44	40	44
Repeated medication review	1722	174	144	160	783	1261	461
Drug therapy recommendation	884	54	80	156	511	801	83
Drug therapy recommendation at review on admission	466	28	63	129	194	414	52
Drug therapy recommendation at repeated medication review	418	26	17	27	347	387	31
Drug interventions within drug therapy recommendations	1595	70	184	323	850	1427	168
Release report	11	1	7	0	2	10	1
Requested counselling in wards without systemic complex CPC	26	9	4	0	9	22	4

Table 2

Recorded interventions within DTRs.

	Total drug interventions	Introduction or re-introduction	Discontinuation	Change in dosing	Continuation	Change in time or interval of administration, change in dosage form	Therapeutic drug monitoring	Additional laboratory, physical, or specialised examination required
Whole hospital								
Total	1595	344	495	159	291	83	94	114
More intensive clinical pharmacy care: systemic complex, systemic selective, counselling								
Surgery	70	12	18	16	6	0	4	13
Orthopedics	184	17	37	11	85	10	0	24
Pneumology	323	63	117	22	61	16	16	28
Oncology	850	242	287	95	94	40	51	41
Total	1427	319	459	144	246	67	71	106
Less intensive clinical pharmacy care: systemic selective, counselling								
Total	168	25	36	15	45	16	23	8
Example – enoxaparine								
Enoxaparine	135	43	11	22	34	2	0	23

Table 3

Selected interventions and underlying reasons.

Reason for introduction	No	Reason for discontinuation	No	Reason for change in dosing	No
Diagnosis in anamnesis	27	Contra-indication	4	Underdosing	44
New diagnosis during the hospitalization	60	Risk of side effect	41	Overdosing	16
Better pharmacologic properties	63	Side effect	56	Renal insufficiency	29
Better drug therapy procedure	84	Missing indication	30	Risk of side effect	9
Unspecified	110	Unnecessary drug/no evidence-based medicine	80	Side effect	8
		Drug becoming unnecessary during the hospitalization	64	Drug interaction	2
		Drug interaction	30	Unspecified	51
		Generic duplications	43		
		Change in elimination functions	30		
		Unspecified	117		

admission. Errors in prescription that prevent the nurse from administering the drug to the patient are labeled as “formal errors”. They are recorded but do not count as interventions within DTR.

Table 2 lists recorded interventions within recommendations. Data for the whole hospital and particular wards with various intensity of CPC are presented, including an example of classes and number of interventions regarding particular drug – enoxaparine.

For the monitored interval, the reasons for and frequency of selected interventions – introduction, discontinuation, and change in dosing are listed in Table 3.

Table 4 lists selected intervened drugs that were used for pharmacoeconomic analysis of CPC in monitored period. Enoxaparine 0.4 ml and enoxaparine 0.6–1.0 ml are indicated under different

circumstances. Therefore they are listed apart. Pharmacoeconomic analyses are presented to hospital management or health insurance companies.

4. Discussion

In 2010, the process of setting CPC was started by monitoring and analyzing the situation, clarifying the requests of the hospital management and attending physicians, and building of strategy that was implemented gradually, with modifications according to actual demands. In 2013–2014, the staff of the clinical pharmacy department stabilised and daily clinical practice could rely on methodology approved by respective scientific society.

In ideal case, any patient admitted to the hospital should be in systemic complex CPC. This is impossible at 4.0 clinical

Table 4
Selected intervened drugs as data for possible pharmaco-economic evaluation.

Drug (reason for intervention)		Drug (reason for intervention)		Drug (reason for intervention)		Drug (reason for intervention)	
Introduction of a drug	No	Discontinuation of a drug	No	Change in dosing	No	Therapeutic drug monitoring	No
Enoxaparine 0.4 ml (diagnosis in anamnesis)	4	Nadroparine (unspecified)	14	Enoxaparine 0.4 ml (risk of side effect)	2	Phenytoin (drug interaction)	21
Enoxaparine 0.6–1 ml (diagnosis in anamnesis)	2	Dabigatran (contraindication)	1	Enoxaparine 0.4 ml (renal insufficiency)	2	Vancomycin	26
Enoxaparine 0.4 ml (new diagnosis during the hospitalization)	3	Warfarin (other than side effect)	10	Enoxaparine 0.6–1 ml (renal insufficiency)	2	Valproic acid	10
Enoxaparine 0.6–1 ml (new diagnosis during the hospitalization)	2	Warfarin (side effect)	2	Enoxaparine 0.4 ml (underdosing)	2	Digoxine	8
Enoxaparine 0.4 ml (better pharmacologic properties)	7	Gabapentin (unspecified)	11	Enoxaparine 0.6–1 ml (underdosing)	2	Theophylline	6
Enoxaparine 0.6–1 ml (better pharmacologic properties)	3	Atorvastatin (unspecified)	11	Enoxaparine 0.4 ml (overdosing)	2	Enoxaparine	4
Enoxaparine 0.4 ml (better drug therapy procedure)	6	Enoxaparine 0.4 ml (side effect)	1	Enoxaparine 0.6 ml (overdosing)	1	Gentamicin	7
Enoxaparine 0.6–1 ml (better drug therapy procedure)	4	Enoxaparine 0.4 ml (risk of side effect)	2	Enoxaparine (unspecified)	9	Carbamazepine	4
Enoxaparine (unspecified)	11	Enoxaparine 0.6 ml (contraindication)	1	Morphine (unspecified)	11		
Morphine (unspecified)	27	Enoxaparine (unspecified)	7	Metamizole (unspecified)	8		
Electrolytes (unspecified)	14	Theophylline (unspecified)	9	Vancomycin (renal insufficiency)	7		

pharmacists in a hospital with 1000 beds. That was the reason why the strategy combining more and less intensive method on various wards was chosen.

In four departments, more intensive CPC was introduced (general surgery, orthopedics, pneumology, oncology). In other, a less intensive way was introduced (infectious diseases, internal medicine, anaesthesia and resuscitation, neurology, plastic surgery). Systemic selective CPC is provided on those wards or their parts where high risk patients are hospitalized – e.g. intensive care patients, HIV-positive patients, and patients with deteriorated drug elimination. Furthermore, the focus lies on anticoagulants and the interpretation of drug plasma concentration (mainly of antibiotics). In some wards, the evaluation on admission is performed less frequently, e.g. once in a week or controls on the way of prescription are run. All other wards are offered the possibility of counselling care.

1595 interventions were recorded within the total of 884 DTRs. This number correlates with the number of actual drug related problems. Primary drug problems are not recorded. The record includes particular recommendations for interventions, respectively conclusions of the evaluation (actual acceptance rate lies at more than 90%, i.e. the upper end of range observed elsewhere). (Viktil and Blix, 2008) The reason for this procedure is the fact that although the focus lies with drug related problems it is not always clear which drug the problem is related to or if it is drug related problem at all. The most frequent interventions and underlying reasons are listed in Tables 2 and 3. They correspond with drug related problems classified in various ways. (Patel et al., 2010; LaPointe and Jollis, 2003; Gallagher et al., 2014; Kuo et al., 2013) Should truly united international classification of drug related problems emerge one day, the system in use can be adapted accordingly. Another reason for the procedure is the fact that mere identification of drug related problem is insufficient in many aspects, e.g. for the evaluation of economic benefit of CPC within hospital or healthcare system in general. Table 4 shows that such evaluations demand the analyses of interventions with respect to particular drugs. The most important are those cases, where the impact can be calculated in case the attending physician does not intervene according to the recommendation by the clinical pharmacist. Based on published results, the outputs may include

the impact on health status of the patient, prolonged hospitalization, or increased healthcare costs.

3946 reviews on admission represent 17% of all patients admitted in monitored period. Therefore, approximately five time more clinical pharmacists would be necessary for complex systemic CPC in the hospital. Based on this ratio, it can be concluded that in Czech healthcare system, 1.0 clinical pharmacists per 50 acute care beds would be sufficient. When thinking about the optimal number of clinical pharmacists providing care it seems that not only the evaluation of number of beds in wards, but also the ratio of patients who were identified as risk on admission would be necessary. The risk is identified only from the point of view of the clinical pharmacist and in the context of care he or she provides. The results (see Table 1) show that the ratio of risk patients is 41%, 12% being high-risk patients, and 29% medium-risk patients. These are the patients, in whom one or more risk factors were identified on admission. The ratio of risk patients is similar in various wards. However, note that CPC is provided only in acute care beds. Within particular wards, there are significant differences. In intensive care beds the ratio will be near 100%, whereas in some acute care beds it will be near 0%. Correct definition of risk factors is essential for the classification of risk patients and relevant estimation of demands on personnel. Within the healthcare system, where there are different types of care – acute (intensive or standard), follow-up, long-term – with additional differences according to the ward, this definition will be possible only after conducting a multicentric study.

The variability in monitored activities and identified risks is obvious in Table 1. This stems from the type of the ward, the length of hospitalization, etc, but also from the experience of the clinical pharmacist and the fact whether CPC is perceived already as a standard care. This is the case in the oncology ward of the Na Bulovce Hospital. Further studies monitoring longer period will be necessary for the evaluation of differences in the activities of a clinical pharmacist in various wards. The low number of release reports and patient education reports that were recorded results from the fact that CPC is provided in as many wards as possible, leading to inevitable reduction of some activities.

The time necessary to run a review on admission, to write a DTR, or to run repeated review has to include not only the time

necessary to go through healthcare records, but also the time spent at ward rounds, consulting the attending physician or other personnel, discussing with the patient, and administering the records.

The clinical pharmacist has to devote his or her time to other activities connected to CPC that lead to effective systemic impact on medication on the level of particular wards or in hospital in general, as well as to research, teaching, and education. About 80% of working hours are devoted to CPC, the rest to the above mentioned collateral activities.

The number of recorded activities, excluding individual interventions within recommendations was 6552 (3946 reviews on admission, 884 DTRs, and 1722 repeated reviews), being performed within 3008 hours. The average time necessary for one item is 28 min, with some activities more time-consuming and some less.

Daily timetable of 1.0 clinical pharmacist could run as follows: providing CPC for 6.5 hours, coining on average 13.93 items on record. The collateral activities would demand the remaining 1.5 hours. Within the department of clinical pharmacy, the ratios can be shifted to some extent between individual employees.

It is evident that recording the number of reviews on admission ($n = 3946$) is correct. During this activity, the patients have to be stratified as low-risk, medium-risk, and high-risk. Therefore, a unification of risk factors is essential. High-risk patients are those with RDH, review on admission resulting in DTR, showing one or more risk factors and with clearly incorrect medication based on their healthcare record and information from the attending physician. The number of high-risk patients corresponds to the number of reviews on admission resulting in DTR ($n = 466$). The medium-risk patients are those with RDH, one or more risk factors, but with clearly correct medication based on their healthcare record and information from the attending physician. Their number ($n = 1151$) corresponds to the number of risk drug histories minus high-risk patients. The recording and numbers of repeated reviews are important. Health insurance companies are willing to pay for two recorded repeated reviews in high-risk patients and one repeated review in medium-risk patients.

The analysis showed that it is important to unite and update risk factors, thus enabling clear definition of a risk patient and allowing for comparison among individual clinical pharmacy departments and controls by health insurance companies who pay for the care. Risk factors should include:

- (1) Eight or more systemic-acting drugs in chronic medication.
- (2) Narrow therapeutic range drug (vancomycin, aminoglycoside antibiotics, phenytoin, carbamazepine, valproic acid, warfarin, low molecular weight heparin in therapeutic dose, ciclosporin, everolimus, tacrolimus, temsirolimus, digoxine, theophylline, and other drugs whose plasmatic levels have to be monitored in case of dosage modification based on changed function of elimination organs, side effects, or drug interaction.
- (3) Drug with high interaction potential; drug with interactions described in literature as serious or very serious.

- (4) Renal insufficiency – glomerular filtration rate under 30 ml/min.
- (5) Laboratory markers of liver insufficiency – albumin < 20 g/l, ALT, AST, GMT, or bilirubin more than three times the norm.
- (6) Other important changes in biochemical and/or hematologic parameters
- (7) Intensive care patient.
- (8) At least one of following diagnosis: diabetes mellitus treated with peroral antidiabetics and/or insulin; epilepsy treated with antiepileptics; atrial fibrillation; cancer treated with drugs; Parkinson syndrome.
- (9) Long-term (at least one week) treatment with systemic corticoid or other immunosuppressant.

5. Conclusion

Within five years, standardized and controlled system of work in clinical pharmacy department was established and efficient recording of the activities of the clinical pharmacist providing CPC was introduced. Based on analysis, risk factors were re-evaluated and unified, enabling clear definition of a risk patient and allowing for comparison between various clinical pharmacy departments and controls by health insurance companies. Setting of this system supplied data necessary for negotiations with health insurance companies.

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