Comprehensive evaluation of clinical pharmacists’ interventions in a large Austrian tertiary care hospital

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ABSTRACT
Objectives To analyse drug-related problems (DRPs) and describe clinical pharmacists’ interventions
Method A prospective 22-week observational descriptive clinical pharmacists’ intervention study on six different wards of an Austrian tertiary care university hospital. In-depth analysis of DRPs, performed interventions and inter-rater and intra-rater variability analysis of interventions’ significance assessment was conducted. Type and frequency of DRPs, clinical pharmacists’ interventions and the physicians’ acceptance rate were recorded. Further outcome parameters were the clinical significance of the interventions and the proportion of those with a cost-reducing potential.

Results A total of 478 DRPs were detected during 138 ward rounds. The most common DRPs related to specific therapy discussions (30.1%), organisational advice (14.2%), medical chart errors (7.7%), untreated indications (7.5%) and drug use without indication (6.9%). Clinical pharmacists provided information (42.9%), suggested the addition of new drugs (13.4%) and the adaptation of drug dosages (12.6%). Antibacterials for systemic use, antithrombotics and drugs for acid-related disorders were commonly implicated. The mean acceptance rate of interventions was 54.7%. Three out of four clinical pharmacists’ interventions were rated to be significant. The inter-rater reliability analysis of clinical significance immediately and 2 weeks after study completion showed a fair to moderate agreement (Fleiss’s $\kappa 0.35$, pairwise Spearman correlation coefficients between 0.5 and 0.74, all $p<0.0001$). One out of 20 interventions showed a cost-reducing potential.

Conclusions The results highlight a positive impact of clinical pharmacy services in a continually developing environment. Although, on average, every second intervention was immediately accepted, the proportion of significant interventions was high. Clinical pharmacy services are one method of addressing evident DRPs in hospitalised patients in Austria.

Introduction
Clinical pharmacy is defined as the part of pharmacy practice ‘that contributes directly to patient care and develops and promotes the rational and appropriate use of medicinal products and devices’. In many countries these services have emerged over time, and the involvement of clinical pharmacists in multidisciplinary patient care is beneficial and has been associated with positive patient outcomes and economic benefits.

The cornerstones of clinical pharmacy services are the detection, resolution and prevention of drug-related problems (DRPs). A DRP is defined as an ‘event or circumstance involving a patient’s drug treatment that actually, or potentially, interferes with the achievement of an optimal therapeutic outcome’. Several studies have shown that the presence of clinical pharmacists in inpatient wards leads to a reduction in the occurrence of common DRPs, for example, medication errors and adverse drug events, and therefore contributes to overall patient safety.

However, the extent of the development and implementation of clinical pharmacy services vary, primarily when comparing services in Europe to those in the USA, but also among European countries themselves. In 85% of European hospitals, some form of clinical pharmacy services is implemented. Differences regarding centralised (ie, wards visited at least once daily or less frequently) versus decentralised services (ie, at least 50% of time on the ward) and the overall time pharmacists spend on the ward exist.

In Austria, there is still a system of hospital pharmacy practice that focuses on traditional tasks, for example, production and logistics. The Ordinance Regulation on the Operation of how to run a pharmacy of 2005 clearly defines and describes, for the first time, the clinical and patient-oriented tasks of the hospital pharmacist in Austria. However, systematic full-time and comprehensive clinical pharmacy services are still non-uniformly implemented across Austrian hospitals. A survey of the Austrian Association of Hospital Pharmacists showed that there are only eight full-time clinical pharmacists compared with 140 full-time hospital pharmacists, when considering the overall time hospital pharmacists spend on ward-based services. To our knowledge, data on the benefits and extent of clinical pharmacy services in Austria are only available as poster abstracts and a narrative report. Further evidence supporting the value of clinical pharmacy services in Austria is urgently needed to pursue the development, implementation and acceptance of clinical pharmacy services, with the ultimate goal of improved patient care.

The Vienna General Hospital – Medical University Campus is the largest Austrian tertiary care hospital, with a capacity of 2130 in-hospital beds, 1450 physicians and 30 pharmacists, of whom being involved in the provision of clinical pharmacy services during ward round participation and other ward-based activities (eg, interdisciplinary rounds). Clinical pharmacy in our hospital mainly evolved from initial small-scale projects of shorter duration that have been adopted...
Research

into the routine. To date, clinical pharmacy services are implemented on three standard care units (SCUs) and three intensive care units (ICUs). In the ambulatory drug addiction clinic, clinical pharmacy services have been established in close conjunction with the provision of methadone and other opioids, as part of the outpatient treatment for opioid addiction maintenance therapy. The aim of this study was to perform a comprehensive evaluation of the implemented clinical pharmacy services across all clinical pharmacist-attended clinics by describing and analysing DRPs and consecutive clinical pharmacists’ interventions.

Methods

The study was designed as a prospective 22-week observational and descriptive clinical pharmacists’ intervention study. A detailed overview of wards with regular clinical pharmacy services is given in table 1. In addition to participation in ward rounds, clinical pharmacists are available for consultations on call during the day. A quality management process for clinical pharmacy services has been developed and a schematic description of the clinical pharmacy sequence is depicted in figure 1. At the time of the study, no further patient care activities (eg, taking drug history on admission, medication reconciliation and others) were performed.

On the SCUs, the clinical pharmacists screened paper-based medical charts, including all relevant medical data and labs, discussed incidental DRPs and provided suggestions for their resolution (intervention) during ward rounds. The clinical pharmacists assigned to the ICUs prepared for ward rounds centrally in the pharmacy in advance, by accessing the electronic medical records, including relevant data, for example, drug therapy, diagnosis and lab values. However, potential DRPs were also discussed during ICU ward rounds. Ward round teams routinely consisted of a senior physician, several junior physicians, nursing staff, and medical students. The clinical pharmacists did not receive any formal training. The overall time of the individual clinical pharmacist’s attachment to the ward prior to study, average duration of ward rounds and years of hospital pharmacy experience are also given in table 1. There was no direct interaction between patients and the clinical pharmacists.

The type of DRP, the suggested intervention or contribution (a term related to informational or organisational issues), the status of acceptance of interventions, and the drug classification according to the WHO Anatomical Therapeutic Chemical (ATC) Code classification system, therapeutic subgroup level, were recorded. For documentation and categorisation purposes, a published and validated system was used. Few categories (see online appendix) were adapted and amended. Acceptance rates were assessed using a four-point rating scale comprising the categories ‘accepted’, ‘taken into consideration’, ‘rejected’ and ‘non-assessable’. The acceptance rate was not recorded for contributions related to organisation and information. Furthermore, all interventions were judged regarding their cost-reducing potential. A detailed explanation of the several documentation categories is shown in the online appendix. The clinical significance of interventions was assessed using a six-point significance-rating scale (adverse significance–extremely significant). Every intervention or any other contribution was rated by the clinical pharmacist immediately at the time of the intervention and again 2 weeks after the study ended.

Upon study completion, all interventions and contributions were assessed in random order by each clinical pharmacist who was blinded to the other clinical information. No other healthcare professionals were involved in significance assessment. No formal training in documentation or significance assessment was performed prior to the study.

The main outcome measures were the type and frequency of DRPs, the type and frequency of clinical pharmacists’ interventions and contributions, and the physicians’ acceptance rate. Further outcome parameters were the clinical significance of the interventions and the proportion of interventions with a cost-reducing potential. Analysis was performed for all DRPs and for the individual clinical setting. The drugs that were most commonly involved in DRPs are reported descriptively. Absolute and relative frequencies of DRPs, interventions, and commonly implicated drugs are provided. To assess the inter-rater and intra-rater variabilities of clinical significance, Cohen’s and Fleiss’s κ and Spearman correlation coefficients are reported. Bowker’s symmetry test was calculated to determine whether the first and second assessment were consistently different.

Results

During 138 ward rounds (25 in CS, 16 in GE, 14 in HE, 11 in ID, 38 in NE, 11 in NN and 25 in PC; see table 1 for definition of clinical codes), a total of 478 DRPs were addressed. Discordance between the actual and theoretical number of ward rounds according to study duration and frequency of participation was due to absence of the clinical pharmacists and periods of temporary closing of wards. A mean (±SD) of 0.3 (±0.4) and 3.5 (±1.5) DRPs were identified per patient and per ward round respectively.

The most common DRPs were related to specific therapy discussions and the need for information (30.1%), organisational advice (14.2%), medical chart errors (7.7%), untreated indications (7.5%) and drugs used without indication (unnecessary pharmacotherapy) (6.9%). The most frequent clinical pharmacists’ interventions and contributions were related to general information (42.9%), the addition of new drugs (13.4%) and dose adjustments (12.6%). The overall frequency of

Table 1: Overview of wards with regular clinical pharmacy services

<table>
<thead>
<tr>
<th>Clinic code</th>
<th>Description of clinics and ward type</th>
<th>Ward rounds/week</th>
<th>Average duration of ward rounds (h)</th>
<th>Provision of clinical pharmacy prior to study (years)</th>
<th>Hospital pharmacy experience (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>Department of Surgery, Division of Cardio Surgery, SCU</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>GE</td>
<td>Department of Medicine III, Division of Gastroenterology and Hepatology, ICU</td>
<td>1</td>
<td>0.7</td>
<td>1.5</td>
<td>2.5</td>
</tr>
<tr>
<td>HE</td>
<td>Department of Medicine I, Division of Haematology and Haematostasis, SCU</td>
<td>2</td>
<td>2</td>
<td>0.2</td>
<td>3</td>
</tr>
<tr>
<td>ID</td>
<td>Department of Medicine I, Division of Infectious Disease and Tropical Medicine, ICU</td>
<td>1</td>
<td>0.7</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>NE</td>
<td>Department of Medicine III, Division of Nephrology and Dialysis, SCU</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>NN</td>
<td>Department of Paediatrics and Adolescent Medicine, Division of Neonatology, Intensive Care and Neuropediatrics, ICU</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>PC</td>
<td>Department of Psychiatry and Psychotherapy, Division of Biological Psychiatry, AC</td>
<td>5</td>
<td>0.5</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

AC, ambulatory clinic; ICU, intensive care unit; SCU, standard care unit.

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Analysis of the clinical pharmacists' self-assessment of the significance of interventions upon first-time detection showed an overall significance of 75.3% of interventions rated as significant (subsumed under 'significant'). One intervention was judged to have adverse significance. The majority of DRPs (n=413, 86.4%) were addressed and interventions were immediately performed by the clinical pharmacist. In total, 15.5% of DRPs resulted in an increased need for time to address them (n=46, 10% up to 1 h, n=17, 3.6% more than 1 h).

The mean (±SD) acceptance rate of the suggested clinical pharmacists’ interventions was 86.5, 87.8, 61.1, 64.3, 70.8, 74.0 and 84.6 for CS, GE, HE, ID, NE, NN and PC respectively. During the study period, there were no interventions classified as ‘extremely significant’. One intervention was judged to have adverse significance. This intervention was related to the provision of false information regarding the stability of a reconstituted drug on the basis of outdated information. The error was detected shortly after providing the dated information. The error was detected shortly after providing the dated information.

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false information and no subsequent errors or patient harm occurred. Regarding the significance of interventions, there was a trend towards lower significance assessment at the end of the study compared with the initial assessment (symmetry test p<0.006). The inter-rater reliability analysis of clinical significance immediately and 2 weeks after study completion showed a fair to moderate agreement (Fleiss’s κ 0.35, pairwise Spearman correlation coefficients between 0.5 and 0.74, all p<0.0001). The overall frequency of each significance level of interventions is depicted in figure 4.

Anti-infectives for systemic use, drugs affecting the nervous system, and those affecting the alimentary system and metabolism were involved in the majority of DRPs (see figure 5). Half of the DRPs detected in our study were related to a drug from the 10 most prevalent ATC code groups. Drug interactions (all four subcategories) represented a common DRP among drugs affecting the nervous system (ATC Code N), immunosuppressants (ATC Code L04) and anti-infectives for systemic use (ATC Code J). The frequency of drug interactions was significantly higher in immunosuppressants compared with non-immunosuppressants (Fisher’s exact test, p=0.004). Furthermore, drugs used without indication and underdosages and overdosages were more prevalent among systemic anti-infectives compared with other drug classes (χ² tests, p=0.02 and p=0.014 respectively).

Discussion

Our study suggests a valuable contribution of the clinical pharmacist to multidisciplinary patient care during ward rounds by addressing DRPs, performing interventions and providing information and organisational support. DRPs are highly prevalent in hospitalised patients, and optimisation of drug therapy by preventing DRPs positively influences costs, reduces mortality and improves patients’ quality of life. Evidence regarding clinical pharmacy services is published for several patient groups and clinical settings, for example, SCUs, ICUs and the psychiatric setting, comparable to those where clinical pharmacy services are implemented in our hospital.

In our study, 50% of interventions were accepted, with a change happening immediately. This proportion is lower than published average rates, which range between 80% and 90%. However, 39% of interventions were taken into consideration by physicians but did not lead to immediate changes (either because of missing data or because other information was needed for decision making). We believe that these suggestions highlight the problem DRPs and should at least prompt a reconsideration of addressed DRPs by the physicians. Thus, by adding this proportion to the crude acceptance rate, it increases to the aforementioned rates from other studies. Furthermore, the acceptance rates are influenced by several crucial factors, for example, the clinical pharmacists’ knowledge, clinical experience and communication skills, the physicians’ confidence in the pharmacists’ intervention and the multidisciplinary working climate. Shortcomings concerning the management of these factors and the low familiarity with clinical pharmacy services among clinicians should be urgently addressed as one method of improving acceptance rates in our setting.

Approximately one-third suggested interventions in our study were lost during the assessment of acceptance rates, as they were related to informational or organisational issues only. Our analysis highlights a need for specific therapy discussions and information across all clinical areas of all involved healthcare professionals, especially among nursing staff, as reflected by the high proportion of 78% of information/organisation-related interventions. The proportion of drug interactions that were detected as DRPs is comparatively higher on ICUs than on SCUs. The detection of drug interactions in this area is facilitated and therefore enhanced by the availability of an electronic medical record that allows for an electronic pre-check before attending the ward rounds. Drug interactions were, not surprisingly, a prevalent problem among immunosuppressants. Anti-infectives were the drugs that were most affected by interventions, and the clinical pharmacists generally addressed the cessation of anti-infectives that were no longer indicated or that microorganisms were not susceptible to. Anti-infectives were commonly underdosed or overdosed. In this study, antiviral agents were especially common. Correct dosing is crucial, and multiple dose adaptations are common, especially if renal function is rapidly changing during the clinical course.

Clinical pharmacy services have also proved to be cost effective, although the generalisability of economical studies is often limited due to their dependency on local settings and the availability of resources. By determining the proportion of interventions associated with a cost reduction potential, we wanted to highlight the potential cost savings that result when DRPs are addressed. With 5% of interventions in our study resulting in cost savings, our proportion was rather small compared with another clinical pharmacy study, which reported a proportion of 32%. However, our finding of a small cost-reduction potential is difficult to interpret because the four categories used were not meant to be a comprehensive list, but rather a sample choice. Furthermore, we did not investigate a cost-increasing potential of our performed interventions. Our study was not designed to determine the economical benefit or cost-effectiveness of clinical pharmacy services, and at that time, we cannot provide an estimate
of potentially associated cost savings. The evaluation of cost savings compared with costs of providing clinical pharmacy services has to be the focus of further studies.

The analysis of clinical significance shows that 75% of interventions were significant to some extent when self-assessed immediately at the time of documentation. We decided to use independent, blinded and random coassessment of all performed interventions by all clinical pharmacists at two different time points to reduce assessment bias. Correlation coefficients show a fair to moderate agreement among different raters. Consistency using the same rater was moderate. We believe that the moderate level of agreement was due to new implementation of the concept of significance assessment and consequently a low level of familiarity. Furthermore, the specialisation of each clinical pharmacist in his or her clinic and the body of experience may influence objective assessment abilities. From our point of view, the issue of significance assessment warrants great attention and is important for our further projected studies. Assessment of the value of services is a critically important step in health-service research, also with regard to potential reimbursement of additional services. This is not yet a matter of broad discussion in Austria, as there is a relative lack of systematic services. The documentation and rating process was described as time consuming by all clinical pharmacists. The relative simplicity of the system, however, led to a notion of usability and acceptance.

There are several limitations to our clinical pharmacy services that influence the way they are currently implemented. The frequency and continuity of ward round participation overall has to be increased, as once weekly ward attendance, for example, complicates the follow up of addressed DRPs, suggested interventions and patient outcomes and the overall multidisciplinary team work. In particular, the continuous offering of clinical pharmacy services, even when the assigned clinical pharmacist who is normally responsible for the ward is on leave, has to be pursued. Although the clinical pharmacy service process is standardised, the individual characteristics depend on each clinical pharmacist and his or her performance, which is in turn influenced by knowledge and wealth of experience. Furthermore, the monitoring, determination and documentation of patient outcomes, in addition to our investigated surrogate parameters, should be the focus of further clinical pharmacy work as a method of efficiency determination in our hospital. Due to the absence of additional patient care activities (eg, discharge planning, patient education, and others) the scope of our current services is narrow. This has to be considered when discussing and comparing our study results with those reporting the impact of advanced and comprehensive clinical pharmacy services.

Obstacles to the advancement of clinical pharmacy services and promotion of clinical pharmacy research may include the low staffing impact of advanced and comprehensive clinical pharmacy services. The lack of any systematic clinical pharmacy education and the availability of labs, drug prescriptions and physician’s notes in medical records. The availability of an electronic patient record and the relative absence of a promising model for professional advancement of services, the quality of clinical pharmacy research and overall patient care.

Conclusion

This study shows the beneficial impact of clinical pharmacists’ activities in a continually developing setting by describing DRPs and clinical pharmacists’ interventions and by using surrogate measures (eg, acceptance rate, significance). To our knowledge, this is the first published study reporting comprehensive results for the Austrian hospital setting. Although only half of the interventions were immediately accepted, the proportion of significant interventions was high. Clinical pharmacy services will be one method of addressing evident DRPs in hospitalised patients in Austria. However, the professional advancement of clinical pharmacy services has to be pursued to increase the continuity and professionalism of services, the quality of clinical pharmacy research and overall patient care.

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Contributors

GS was responsible for study design, data collection, analysis, and interpretation, and drafting of the manuscript. GLW, JK, PF, SM, SS were responsible for data collection, analysis, and interpretation, and drafting of the manuscript. SZ was responsible for study design, statistical analysis of data and preparation of the manuscript. ED was responsible for study design, data interpretation and drafting of the manuscript. All authors read and approved the final manuscript.

Competing interests

None.

Provenance and peer review

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