Int J Clin Pharm (2011) 33:674–682
DOI 10.1007/s11096-011-9526-x

RESEARCH ARTICLE

Drug-related problems in Parkinson's disease: the role of community pharmacists in primary care

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Received: 8 October 2010 / Accepted: 9 May 2011 / Published online: 28 June 2011

Abstract *Objective* Although Parkinson's disease is a common disorder in the elderly, there have been very few studies of the role of the pharmaceutical care services in detecting and reducing problems associated with drug treatment in community settings. The aim of this study was therefore to investigate the type and frequency of drug-related problems identified in patients with Parkinson's disease by community pharmacists over an 8-month period and to assess the pharmaceutical service interventions, the type and frequency of intervention outcomes and the clinical benefits for the patients. *Setting* Community pharmacies in Germany. *Method* Thirty-two community pharmacists recruited 113 outpatients with idiopathic Parkinson's disease who were receiving anti-Parkinsonian medication. *Main outcome measure* Drug-related problems. *Results* A total of 331 drug-related problems were identified by the pharmacists. Patients not receiving a medication, despite the presence of an indication or symptom, accounted for the highest proportion of drug-related problems (26.3%). The pharmacists proposed a total of 474 interventions, the most common of which was giving the patient treatment advice (19.6%). Intervention outcomes were recorded for 215 of the 331 drug-related problems, for which there were 553 individual outcome results. Adjustments of the drug regimen accounted for the highest percentage of individual results (43.6%). *Conclusion* Structured pharmaceutical care processes by community pharmacists have the potential to make a valuable contribution to health care and enhance the health outcomes of patients with Parkinson's disease.

Keywords Community pharmacist · Drug-related problems · Germany · Parkinson's disease · Pharmaceutical care

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Impact of the findings on practice

- Structured pharmaceutical care processes provided by community pharmacists have a high potential to provide a valuable contribution to improving the health care of patients with Parkinson's disease.

Introduction

In 1999, the Pharmaceutical Care Network Europe (PCNE) agreed upon the definition of drug-related problems (DRPs) as "events or circumstances involving drug therapy that actually or potentially interfere with desired health outcomes" [1]. Since then, much research effort has been put into processes to identify, evaluate and solve these DRPs.

The role of community pharmacists has become increasingly important over the years and has changed

from drug formulation and dispensing to providing advice and recommendations on drug regimes. Pharmacists are able to detect DRPs during the dispensing process. This includes continuous monitoring of potential drug interactions through current versions of the summary of product characteristics, and by review of the patient's drug regimen [2, 3]. In situations where the pharmacist is aware of a problem in a specific therapeutic area, they can actively approach patients who may be affected or at risk [4]. The aim of such a pharmacist intervention is to reduce inappropriate medication use, to improve medication management for patients and to cooperate directly with other health care professionals [3, 5]. This takes the form of direct discussions and a regular quarterly letter from the pharmacist detailing the patient's drug regimen and the potential for interactions and adverse events.

The increasing awareness of DRPs and their detrimental effect on patients' health [6, 7] has led to a number of studies of pharmaceutical care services [8–11]. However, although Parkinson's disease is the second most common neurodegenerative disorder in the elderly population, very few such studies exist in this area [12]. Given that age, multi-morbidity and polypharmacy are known risk factors for DRPs, Parkinson's disease outpatients are at particular risk of experiencing problems associated with long-term drug treatment [13, 14]. Not least, Parkinson's disease patients in the more severe stages of their disease often take up to 10 or more tablets/day for Parkinson's disease alone [15], thus confirming a patient population at risk for DRPs. Further confirmation for DRPs in this patient population is provided by a previous study in which we retrospectively searched for anti-Parkinsonian drug DRPs communicated in Parkinson's disease online forums. Over a 1-year period, 160 outpatients experienced 238 DRPs, of which 153 were adverse drug reactions (ADRs) [16]. The number and range of DRPs clearly substantiates the requirement for the facilitation of professional recommendation from pharmacists in primary care.

Aim of the study

The primary aim was to investigate the type and frequency of DRPs identified in Parkinson's disease patients by community pharmacists and to assess the clinical benefits of providing DRP-targeted pharmaceutical service interventions.

Method

Pharmacy service and data collection

Thirty-two German community pharmacists participated in this multicentre, longitudinal study. The pharmacists were identified following their participation in an advanced training course on pharmaceutical care services in local pharmacies in the month prior to the start of the study. All pharmacists fulfilled requirements for qualification as "local pharmacies" in accordance with the cooperation agreement between the national health insurance fund "Barmer Ersatzkasse" and the German Pharmacists' Association [17]. This cooperation agreement covers a structured program based on current principles of pharmaceutical care [18]. The "local pharmacies" agreement comprises two categories: "drug service" with its requirements for data collection and advising patients, and "pharmaceutical management". This includes closer examination of patients' history and drug regimens and software-supported checks for DRPs, as well as interventions for management/prevention of DRPs [19].

Pharmacists were provided with a list of frequently occurring DRPs in Parkinson's disease patients. This checklist was prepared using a stepwise approach based on analysis of on-line patient forums [16], an unpublished survey among neurologists and systematic literature research (Fig. 1).

The unpublished survey involved sending a standardized questionnaire to 32 neurologists (20 office-based, 12 clinicians; mean practical experience 8 years) between November 2004 and August 2005. The neurologists were asked about their preferred treatment approaches for Parkinson's disease and commonly occurring therapeutic complications in everyday clinical practice. DRPs were included in the checklist if reported by at least three doctors.

The literature search was performed in August 2005 in Medline and Embase, with the language restricted to English, French or German. Keywords comprised drug-related problems, medication problems, medication-related problems, adverse drug events, adverse drug effects, adverse drug reactions, prescription errors, medication errors, inappropriate medication, inappropriate drug, inappropriate prescription, medication misadventures in combination with [idiopathic] Parkinson's disease, anti-Parkinsonian agents, anti-Parkinsonian drugs, and community, ambulance, outpatient or primary care. The final checklist provided a list of common DRPs associated with anti-Parkinsonian agents, problem descriptions and recommendations for problem solutions within the scope of the structured pharmaceutical service programme.

Between January 1st and March 1st 2006, the 32 pharmacists recruited outpatients who fulfilled the following inclusion criteria: diagnosis of idiopathic Parkinson's disease according to UK Brain Bank Criteria[20] (determined by a neurology specialist prior to the study), age >35 years, receiving one or more anti-Parkinsonian medication(s), sufficient physical and cognitive ability to complete the

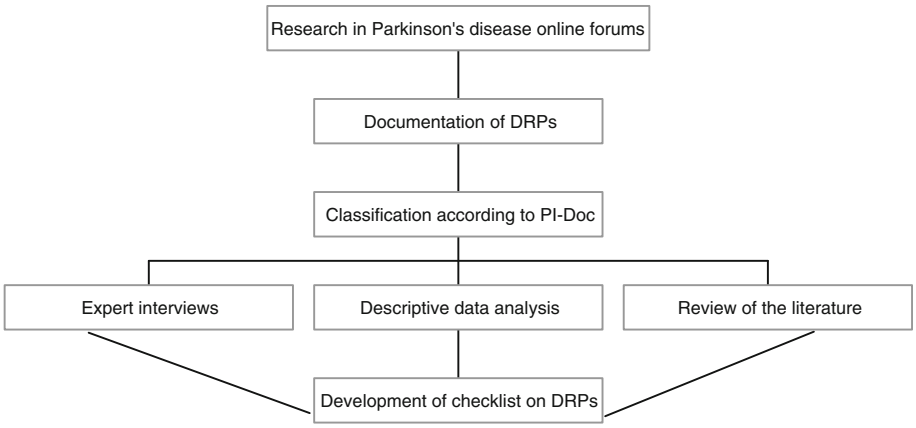

Fig. 1 Development of a checklist of DRPs in Parkinson's disease patients. *DRPs* drug-related problems, *PI-Doc* problem intervention documentation. For further information on, or permission to use, the detailed checklist, please contact Prof. Dr. Marion Schaefer

questionnaires without assistance, no prior involvement in a "local pharmacies" service programme and German as a native language. Exclusion criteria were atypical Parkinsonism and dementia. All patients provided written informed consent. The pharmacists gave written confirmation that they would adhere to the general regulations for data protection. Ethical approval of the institutional review board was not required. The study was conducted within the scope of daily pharmaceutical routine and observed existing clinical and pharmaceutical practice in accordance with German pharmacy regulations.

Pharmacists had access to the information required in the study for providing pharmaceutical care service in daily pharmaceutical routine. As "local pharmacies", they documented further information gathered from patients and physicians in accordance with the cooperation agreement between the "Barmer Ersatzkasse" and the German Pharmacists' Association. There was no assignment to different groups, and the study used standard questionnaires with patient data remaining anonymous.

Following inclusion of the patients in the "local pharmacies" service programme, the pharmacists contacted the treating neurologist and provided information on the study and data communication among health care professionals in accordance with the service programme. The pharmacists received information on neurological status, date of Parkinson's disease diagnosis, Hoehn and Yahr severity stage [21] (where 0 = no signs of the disease; and 5 = symptoms are very severe) and cardinal motor symptoms. Demographic data and medical history were collected and the patients completed questionnaires including a new 23-item Parkinson's Scale (PS-23) (Sabrina Schröder, personal communication), Parkinson's Disease Questionnaire-8 (PDQ-8) [22] and EuroQol (EQ-5D) [23] plus visual analogue scale (EQ-5D-VAS).

Symptom severity was determined by the PS-23 using a 5-point Likert-scale. The PS-23 has been shown to be a valid, reliable and responsive Parkinson's disease-specific instrument (Sabrina Schröder, personal communication). The scale covers four dimensions of self-reported health status (bodily discomfort, mobility, cognitive functioning and emotional well-being), and includes one factor for total health status and one for non-motor symptoms worsened by ADRs. The PDQ-8 is the short form of the Parkinson's Disease Questionnaire-39 (PDQ-39), the most widely used and validated Parkinson's disease-specific measure for self-reported health status [16–19] with documented responsiveness [20]. The instrument covers eight dimensions of health (mobility, activity of daily living, emotional well-being, stigma, social support, cognition, communication and bodily discomfort). The generic EQ-5D covers five dimensions of self-reported health status (mobility, self-care, usual activities, pain/discomfort, anxiety/depression).

Within the scope of the pharmaceutical service routine, pharmacists recorded the services provided for the patients over an 8-month follow-up period. The number and duration of patient visits, patient details, medication details, description of DRPs, reasons for intervention, nature and description of intervention, and whether contact with the physician was established to discuss detected problems, were collected and anonymously documented.

Classification of drug-related problems

Drugs were classified according to the Anatomical Therapeutic Chemical (ATC) system [24]. DRPs were coded according to the Problem Intervention Documentation (PI-Doc) system [25, 26]. The original PI-Doc system has two levels of classification (problem analysis and intervention recommendation)[1, 9, 25] whereby a code for a problem-solving intervention is allocated to each code for a DRP. The open hierarchical structure of the classification system made it possible to allocate DRPs to one of six predefined major problem categories: ADRs, drug interactions, inappropriate

dosage, inappropriate drug use by the patient/compliance problems, inappropriate drug choice, and other problems. The modified version of the PI-Doc used in this study has a third level of classification that covers the intervention outcome: improving patient's status of health, increasing patient's safety and drug regimen adjustment [27].

The clinical significance of the DRPs was assessed by a multidisciplinary expert panel consisting of four physicians with clinical experience in internal medicine, geriatrics, neurology and psychiatry, and one experienced pharmacist. As described in a previous study [28], each expert independently rated the clinical significance of the DRPs as extremely important, or of major, moderate or minor importance (Table 1). The final evaluation of the clinical significance was categorized by consensus of the expert panel.

ADRs were coded according to the World Health Organisation Adverse Reaction Terminology (WHO-ART) and attributed to a specific System and Organ Class (SOC) [29]. The expert panel also rated the seriousness of ADRs according to the criteria of the Council for Informational Organizations of Medical Sciences (CIOMS), corroborated by the Working Group IV of the CIOMS and the European Medicines Agency (EMEA) in 1995 [30, 31]. The criteria for a serious ADR are: death, life threatening, hospitalisation or prolongation of hospitalisation, persistent or significant disability/incapacity, and congenital anomaly/birth defect. The panel also checked for unexpected ADRs defined as an adverse reaction, the nature or severity of which was not consistent with the product information as supplied to the patient in the form of the patient information leaflet or in the summary of product characteristics.

Statistical analyses

Simple descriptive statistical methods were used for the evaluation of DRPs. Frequency was calculated for each type of DRP according to PI-Doc (3 level) [27] and categories of clinical significance, as well as for the pharmacist service interventions and interventions' outcomes. Categorical patient data were given as absolute frequency and percentages; continuous data were described using mean and standard deviation.

Results

Patient characteristics

Of the 148 eligible patients, 113 agreed to participate in the study. The baseline demographic and medical characteristics are shown in Table 2. Thirteen patients were lost to follow-up: five died, four had very severe disease, two were misdiagnosed with idiopathic Parkinson's disease and two refused to complete follow-up.

The mean number of patients reviewed by each pharmacist at baseline was 3.5 (range 2–10); 3.1 patients per pharmacist (range 1–10) continued at follow-up. Over the 8-month follow-up period, the mean number of visits to the pharmacist was 4.8/patient (range 2–17).

Type and frequency of DRPs

A total of 331 DRPs (approximately 2.9/patient) were identified by the pharmacists over the 8-month period. Patients not receiving a medication despite the presence of an indication or symptom accounted for the highest proportion of DRPs (26.3%) (SP6) (Table 3). Other common categories included symptoms of an ADR (12.4%), unsuitable time of intake (10.0%), under-dosage (9.7%) and drug interactions (9.4%). Of the 331 DRPs, 159 (48.0%) were related to anti-Parkinsonian agents (33 to dopamine agonists, 92 to L-dopa and 34 to other agents).

Clinical significance of DRPs

The clinical significance of the DRPs was categorised as extremely important in 4.5% of cases, major in 27.2%, moderate in 29.0% and minor in 39.3%. The following three DRPs were rated as serious according to EMEA guidelines: bloody faeces (Stalevo®), falls (L-dopa) and insulin hypoglycaemia (insulin lispro). The first two required hospitalisation whilst the third was considered life-threatening. There were four unexpected ADRs according to EMEA guidelines: bloody faeces (Stalevo®), hair loss (L-dopa), hypertension (rasagiline) and angina pectoris (simvastatin).

Table 1 Categories of DRP clinical significance [25]

1	Extremely important	Interventions against these DRPs have the potential to prevent mortality or severe irreversible detrimental effects (e.g., serious drug-intoxication)
2	Major	Interventions against these DRPs have the potential to prevent major to moderate serious reversible detrimental effects. Or, generally accepted evidence-based therapy is lacking
3	Moderate	Interventions against these DRPs are of moderate benefit for the patient
4	Minor	Interventions against these DRPs are of only minor benefit for the patient or the DRPs have little clinical effect

Table 2 Baseline demographic and medical characteristics (n = 113 patients)

Age (years) (mean ± SD)	71.50 ± 9.48
Male/female (%)	52.2/47.8
Retired or unable to work (%)	91.3
Compulsory health insurance (%)	91.1
Duration of disease (years) (mean ± SD)	8.35 ± 5.37
H&Y stage (%)	
1	22.5
2	9.0
3	26.1
4	35.1
5	7.2
Off-periods more than twice/week (%)	24.8
Decrease in drug effectiveness within the previous month (%)	35.6
PS-23 score (mean ± SD)	1.45 ± 0.40
PDQ-8 SI score (mean ± SD)	33.41 ± 20.77
EQ-5D IS score (mean ± SD)	0.62 ± 0.24
EQ-5D VAS score (mean ± SD)	49.39 ± 23.18
Total medications (n)	805
Medications per patient (n)	7.12 (range 2–16)
Total anti-Parkinsonian drugs (n)	319
Dopamine agonists	73
L-dopa (including Stalevo® [carbidopa, L-dopa, entacapone]	177
Amantadine	32
Monoamine oxidase B inhibitors	16
Catechol-O-methyl transferase inhibitors	15
Budipine	2
Anticholinergics	4

Data given as absolute frequencies and percentages or as mean ± SD. *H&Y* Hoehn and Yahr (estimated in the "on" phase, with medication), *PS-23* 23-item Parkinson's scale, *PDQ-8 SI* 8-item Parkinson's disease questionnaire summary index; *EQ-5D-IS* EQ-5D (EuroQol) index score, *EQ-5D VAS* EQ-5D (EuroQol) visual analogue scale

DRP-targeted interventions

The pharmacists proposed a total of 474 interventions for the 331 DRPs. The most common intervention was giving the patient special treatment advice (19.6%) (Fig. 2), followed by interventions associated with compliance problems (15.6%) and ADRs (11.6%).

DRP-targeted intervention outcomes

Pharmacists recorded the observed outcomes an average of 5.4 months after the initial DRP/intervention documentation. Intervention outcomes were recorded for 215 of the 331 DRPs. For 89 DRPs (27%), no outcome was observed within the study period and there was no data available for 27 (8%) that occurred in the patients who withdrew prematurely. Evaluation of the 215 documented outcomes using the modified PI-Doc classification showed there were 553 individual outcome results, i.e. 2.57 per observed

Table 3 Categorisation of 331 DRPs using PI-Doc

PI-doc	DRPs (n = 331)	Number	Percentage
A	*Inappropriate drug choice*	*41*	*12.4*
A1	Unsuitable drug for indication	9	2.7
A2	Physiological contraindication not considered	2	0.6
A3	Contraindication due to other disease not considered	9	2.7
A7	Wrong strength	2	0.6
A8	Inappropriate administration aids	18	5.4
A11	Drug out of the market	1	0.3
C	*Inappropriate drug use by the patient/ compliance problems*	*65*	*19.6*
C2	Handling problems	17	5.1
C3	Patient uses drug without an indication	3	0.9
C4	Patient does not use a recommended drug (primary non-compliance)	4	1.2
C5	Independent change of the recommended dose by the patient	3	0.9
C6	Unsuitable period of use	1	0.3
C7	Unsuitable time of application	33	10.0
C9	Insufficient knowledge about the correct storage of the drug	4	1.2
D	*Inappropriate dosage*	*52*	*15.7*
D3	Over-dosage (symptom: hallucinations)	7	2.1
D4	Under-dosage	32	9.7
D5	Unsuitable dosage intervals	13	3.9
W	*Drug-drug interaction*	*31*	*9.4*
W1	Reference to an interaction in the literature	22	6.7
W2	Symptoms of an interaction	9	2.7
U	*Adverse drug reaction*	*44*	*13.3*
U1	Patient's fear of adverse drug reactions	2	0.6
U2	Symptoms of an adverse drug reaction	41	12.4
U3	Stopping medication due to adverse drug reaction	1	0.3
S	*Other problems*	*98*	*29.6*
SP1	Patient's limited knowledge about the nature of the disease	1	0.3
SP3	Patient's dissatisfaction with current treatment	4	1.2
SP6	Patient does not receive a drug although an indication/symptom exists	87	26.3
SK1	Unclear or wrong package insert text	6	1.8

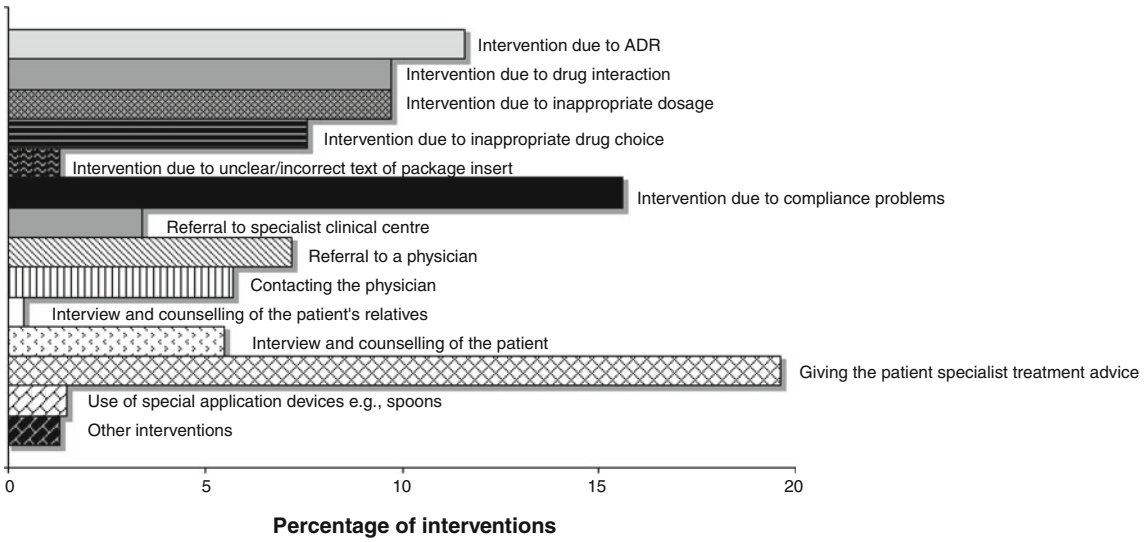

Fig. 2 Pharmacist interventions (n = 474) for DRPs (n = 331)

Table 4 Individual outcome results of 215 DRPs using PI-doc

PI-doc	Results (n = 553)	Number	Percentage
EG	*Improving the health status of the patient*	*89*	*16.1*
EG1	Patient reports relief of symptoms	82	14.8
EG2	Doctor reports improvement in symptoms	7	1.3
ES	*Improving the patient's safety*	*223*	*40.3*
ES1	Patient has improved knowledge of disease	50	9.0
ES2	Patient has improved knowledge of general medication	44	8.0
ES3	Patient has improved knowledge of drug administration	40	7.2
ES4	Patient has improved knowledge of how to store medication	4	0.7
ES5	Prevention of undesired/harmful drug effects	38	6.9
ES6	Prevention of unsuitable/harmful drug combinations	23	4.2
ES7	Improvement in compliance	7	1.3
ES8	Change in treatment by doctor/specialist after contact with doctor recommended by pharmacist	6	1.1
ES9	Change in treatment after contact with clinic recommended by pharmacist	5	0.9
ES10	Misdiagnosis by doctor/specialist discovered after suspicion reported by pharmacist	6	1.1
ET	*Drug regimen adjustment*	*241*	*43.6*
ET1	Prescription adjusted according to package insert	140	25.3
ET2	Appropriate drug prescribed by doctor for existing indication	14	2.5
ET3	Appropriate over-the-counter drug purchased by patient for existing indication	36	6.5
ET4	Appropriate basic treatment initiated by doctor	10	1.8
ET5	Compliance with guidelines achieved	13	2.4
ET6	Medication increased patient's satisfaction	28	5.1

intervention outcome (Table 4). Adjustments of the drug regimen accounted for the highest percentage of individual results (241 cases), followed by improvement in the patient's safety (223 cases) and improvement in health status (89 cases).

Amongst the 241 cases in which the drug regimen was adjusted, 140 (25.3%) involved the prescription being adjusted according to the patient information leaflet. The most common adjustment concerned the time of day at which the medication was taken (n = 24; 17.1%). This was

followed by consideration of interactions (n = 19; 13.6%), increased dosage (n = 18; 12.9%), reduced dosage (n = 14; 10.0%) and consideration of ADRs (n = 14; 10.0%). Other adjustments involved changes in the interval between doses (n = 12; 8.6%), changes in formulation (n = 10; 7.1%), consideration of contraindications (n = 10; 7.1%), consideration of age (n = 9; 6.4%) and use of special application devices (n = 5; 3.6%).

Four patients were identified as being misdiagnosed with Parkinson's disease and subsequently discontinued anti-Parkinsonian treatment. These misdiagnoses were corrected by the physicians into restless leg syndrome, hypertensive encephalopathy, essential tremor (in a patient who had been mistakenly treated for Parkinson's disease for 25 years) and pathological cerebral contraction. There were a further two patients who received additional diagnoses due to the pharmacist's closer collaboration with the patient's physician. In one case, a diagnosis of cardiac insufficiency led to an adjustment in the medication regimen, whilst in the other, a diagnosis of Parkinson's disease plus encephalitis resulting from borreliosis led to discontinuation from the study.

Discussion

The results from this study show that community pharmacists identified a wide array of DRPs within the primary care of Parkinsonian patients. Almost half of the recorded DRPs were related to anti-Parkinsonian medications (1.3 per patient over 8 months). This is almost as many as were identified in a previous study of Parkinson's disease forum users (approximately 1.5/patient over 1 year) [16]. When comparing findings from the forum research with pharmacists' records on DRPs, it is evident that inappropriate dosage and compliance problems are common in both cases. Comparison of data provided by forum users and pharmacy customers, however, might be limited due to differences in patient characteristics and the reporting methods by consumers versus health care professionals. Selection bias also cannot be excluded in either study.

Poor compliance can be partially explained by the nature of Parkinson's disease. As the condition progresses, multiple symptoms result in a highly complex clinical picture and the drug regimens become more complicated than in other disease areas [15]. Inadequate timing of doses may be the consequence, and erratic drug-taking has been shown to be common in Parkinson's disease [32].

In addition, anti-Parkinsonian agents are associated with side effects, especially psychosis, motor fluctuations, and dyskinesias [33, 34]. The pharmacists' identification of ADRs (13.3% ADRs out of 331 DRPs) and ADR-related interventions (11.6%) was low when compared with forum research (64.2% of DRPs) and a previous non-indication specific study on community pharmacist services in which almost half of interventions were aimed at preventing ADRs [35]. It seems that prescribing physicians in our study were generally concerned about prevention of dosage-related dopaminergic ADRs [33, 34]. This was also reflected by a comparatively high percentage of underdosage amongst the DRPs. It is not clear, however, whether these were unintentional or whether the physician chose to deviate from the recommended dosage. In addition, the physicians appeared to focus on amelioration of traditional cardinal motor symptoms. The highest percentage of DRPs was due to a lack of medication despite the presence of symptoms, especially non-motor symptoms. These results are in line with current literature showing that non-motor symptoms of Parkinson's disease continue to remain underestimated in clinical practice [36].

Pharmacists' collaboration with physicians and special clinical centres accounted for 16.3% of interventions, suggesting that the contribution of community pharmacists is particularly important in identifying and improving patients' unmet medical needs. This is supported by another study showing that 'need for additional drug' was identified significantly more often through face-to-face interviews between patients and pharmacists than by routine examinations by the prescribing physician [28].

Although patient interviews have become part of established pharmacy practice [5], a high number of DRPs recorded in our study were proactively identified by pharmacists who had an increased awareness of problems due to using a checklist of common DRPs. These findings are in line with previous studies showing that proactive intervention by community pharmacists leads to modification of prescription errors [35, 37]. One practical recommendation that emerges from this study is that pharmacists who provide primary care should be given the opportunity to qualify in "pharmaceutical care service". The use of the checklist of common DRPs significantly increased the awareness of problems in Parkinson's disease and should be implemented in standardized pharmaceutical services for other chronic disorders.

Importantly, in our study, four patients were identified who had been misdiagnosed with Parkinson's disease and subsequently received a different medication regime. In two other cases, additional diagnoses were made following close collaboration between pharmacists and physicians. These cases provide the first evidence that pharmaceutical care services in local pharmacies can make a valuable contribution to the health outcome of Parkinson's disease patients.

One of the methodological limitations of our study was the selection of patients by the pharmacists, who may have recruited those patients who are more prone to DRPs

(selection bias). In addition, although the patients were the primary source of information, the pharmacists assessed the outcome of their interventions themselves. Consequently, pharmacist-recorded outcomes of DRP-targeted interventions need to be seen in the light of interviewer and reporting bias, and can only reveal tendencies for the effectiveness of pharmaceutical care services rather than evidence. In addition, pharmacists were free to document more than one individual outcome result for each intervention, so conclusions about the quality of a single intervention cannot be drawn.

The clinical significance of DRPs assessed by an independent panel utilising explicit criteria might have been a more appropriate outcome measure. There is no officially recognised classification system for the significance of DRPs. The first quality-related classification of DRPs was developed by a team consisting of a specialist in pharmacotherapeutics as well as clinical pharmacists [28]. However, there are no strict guidelines for this classification and the assessment depends on the experience of the physician. Hence, evaluations should be conducted by at least three health care professionals, as in the current study. The expert panel assessed almost 40% of DRPs as being of minor clinical significance. This is in clear contrast to a previous study [28], which indicated that DRPs identified by hospital pharmacists might be of greater clinical significance (only 10% were considered of little clinical importance). It must be considered though that the type of DRP differs markedly between different patient groups, and that a valid comparison of the clinical value of services offered by community and hospital pharmacists cannot be made [38].

Future research on pharmaceutical management in local pharmacies should focus on the identification of DRPs and the effects of pharmaceutical interventions on patient outcomes among different patient groups or indications. In addition, the German model will need to be compared with that in other countries worldwide in order to develop strategies aimed at improving pharmaceutical services for patients with chronic diseases on an international basis.

Conclusion

Our study generates new information on Parkinson's disease patients' individual problems identified in a community setting. The community pharmacists identified a considerable number of DRPs that covered a wide spectrum of conditions, almost half of which were related to anti-Parkinsonian medication. The findings indicate that structured pharmaceutical care processes by community pharmacists have a high potential to provide a valuable contribution to the health care of these patients.

Acknowledgments The authors would also like to thank: the 32 study pharmacists for participation in the study; the 32 neurologists for participation in a survey on DRPs and unmet medical needs in Parkinson's disease; and the members of the expert panel for the assessment of the clinical significance of DRPs and the seriousness and unexpectedness of adverse events; and Jane Irons and Mark Hickery for their assistance in editing the final manuscript.

Funding The study was supported by an unrestricted grant from Solvay Pharmaceuticals GmbH, Hanover, Germany.

Conflicts of interests None of the authors has any declarable conflict of interest.

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