Implementing standardized medication plans in ambulatory care – Are they correct and do patients follow their plan?

Christiane Eickhoff (✉ C.Eickhoff@abda.de)  
ABDA – Federal Union of German Associations of Pharmacists

Uta Müller  
ABDA – Federal Union of German Associations of Pharmacists

Sophie Thomas  
Leipzig University

Christian Schmidt  
Leipzig University

Lisa-Sophie Hartling  
Löwen-Apotheke Waldheim e.K

Sebastian Michael  
Löwen-Apotheke Waldheim e.K

Martin Schulz  
ABDA – Federal Union of German Associations of Pharmacists

Thilo Bertsche  
Leipzig University

Research Article

Keywords:

Posted Date: March 21st, 2023

DOI: https://doi.org/10.21203/rs.3.rs-2699749/v1

License: © This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Abstract

Purpose

The standardized medication plan (MP) is a document listing the patients’ entire medication, instructions for use, and indications in a nationally defined format. However, there is currently little data on its practical implementation, comprehensibility, and use at the patient level. We aimed to investigate under routine conditions (i) patients’ competencies in using the MP, (ii) completeness and correctness of the MP including handwritten modifications, and (iii) patients’ reasons for deviating from the MP.

Methods

We conducted face-to-face interviews with patients in community pharmacies. Data was analyzed with qualitative and quantitative methods.

Results

We enrolled 288 patients (median age: 76 years, range: 27–95) with n=2,779 medications actually taken and n=2,539 medications documented on the MPs. 38.5% of the patients used their MP regularly to prepare their medication and 73.3% used it to inform their physician. (i) Overall, patients’ orientation and understanding the MP was good. (ii) No MP was correct and complete. When taking only relevant aspects into account, i.e. active ingredient, strength, dosage, medication missing or listed but not taken, 79.2% (n=228) were incorrect or incomplete. With 25.8% of the total number of handwritten modifications (n=341) most often medications were added. (iii) Almost 60% of all patients deliberately deviated from their MP, “fear of adverse drug reactions” was the most frequently (n=50) mentioned reason.

Conclusion

The patients’ competence in understanding their MP was good. However, important information was often missing or incorrect; therefore, handwritten modifications were frequently added. Patients often deliberately deviated from their MP for various reasons.

Introduction

Medication errors can significantly jeopardize patient safety [1]. The causes often lie in an inadequately organized medication process. The reasons extend to the identification and resolution of drug-related problems including also inadequate communication across care interfaces. For this purpose, informing the patients on their medication by listing it on a (standardized) medication plan (MP) with all relevant information may prevent many of those problems and MPs have been identified as a relevant factor for patient safety [2,3]. Additionally, it was shown that further information, especially on handling, helps to improve patient knowledge about medication compared to control groups with only standard information [4,5]. MPs have therefore been used since many years and are often even created by the patients
themselves [6]. Such MPs, however, should include all relevant information in a structured manner to accomplish their task. For this reason, the legislator in Germany introduced a federal standardized MP in 2016 [7]. This standardized format includes information on the active ingredient, trade name, strength, dosage form, dosage regimen, administration information, and the medical indication of each medication listed (supplementary information). All ambulatory patients insured with the statutory health insurance system (SHI, consisting of nearly 100 funds covering 88% of the population i.e., approximately 73.3 million people) and taking at least three prescribed long-term medications are entitled to receive such a MP. This MP is issued by the general practitioner (GP) upon patients’ request. Electronic storage of the MP is optional in addition to the paper-based version that is printed out for the patient [7]. The MP can be updated by all physicians, hospitals and community pharmacists, if needed and requested by the patients, but neither the processes nor the responsibilities have been defined specifically.

The question arises on the quality of the standardized MP in routine care. It was reported that the medication documented on the MPs is not always correct with only 36% being in line with the medication presently taken [8]. This casts doubt on the consistent updating of the MP. Completeness of data, however, is a precondition for a MP to be useful. Another relevant factor for its use is to which extent patients understand the information on their MP and can consecutively implement it in their daily lives. Here, studies show that there are limitations in understanding: Less than 50% of the patients examined showed sufficient understanding of a standardized mock-up MP [9, 10]. Those problems in comprehensibility were correlated with higher age and lower educational level [9, 10].

Those previous studies have shown the challenges in in the practical implementation of the standardized MP. Furthermore, the actual handling of the patient's medications, has rarely been addressed. Another important aspect that, to our knowledge, has not yet been investigated is the reasons why patients deliberately deviated from their MP. We, therefore, aimed to investigate under routine conditions (i) patients’ competencies in using the MP, (ii) completeness and correctness of the MP including handwritten modifications, and (iii) patients’ reasons for deviating from the MP.

**Methods**

We conducted a cross-sectional survey enrolling patients with polymedication from May to October 2021 in community pharmacies in the German federal state Saxony.

**Patients**

As inclusion criteria were defined: ≥ 18 years old, living at home, possessing a standardized MP with ≥ 5 medications, understanding and speaking German, and written informed consent. Patients were excluded if they were cared for by a nursing service, or participated in the interprofessional medication management program *ARMIN* [11].
To include a convenience sample of at least 200 patients we aimed to invite 20 community pharmacies. The community pharmacies were approached by the Saxon Pharmacist Association (SAV). Patients were requested to participate in the study in two ways: They were approached by the pharmacy staff during regular visits in the pharmacy or contacted by phone. If patients were willing to participate and fulfilled the criteria, a meeting was scheduled in the pharmacy to conduct an interview. Patients were requested to bring their MP as well as their current medication including over-the-counter (OTC) drugs.

Data collection

The information sources to evaluate the MPs were: (a) the current medication patients brought along, (b) the practical demonstration of how patients prepared their medication ready for use by filling in weekly pill boxes according to the information given on the MP, (c) oral information of the patients, and (d) a file with the patients’ medication in the pharmacy.

The patient interviews were conducted by graduate pharmacists in the consulting rooms of the pharmacies. If patients were not able to visit their pharmacy, interviews were conducted in the patient’s home. The information given by the patients was documented on two paper-based questionnaires (available upon request from the corresponding author). Both questionnaires were assessed for face validity and a cognitive pretest was conducted with 4 patients (not enrolled in the main study) and resulted in wording clarification.

The first questionnaire consisted of 23 items on sociodemographic data, overall health condition, organization of the medication intake, medical aids used, handling problems with the medication, use of self-medication/OTC products, use of and opinions on the MP.

With the second questionnaire, the patients’ understanding of the MP was assessed in two steps/sections:

1. The patients’ orientation on the MP and understanding the ten structural elements: general information (patients name, GP’s name that issued the MP, date of issue, and QR-code, an element allowing health care professionals (HCPs) to scan the MP and process the information from the MP in their local software systems) as well as information on each medication listed on the MP (active ingredient, product name, dosage, instructions for administration, medical indication), and if applicable subheadings. Subheadings are optional elements on the MP inserted by a HCP in order to structure the listed medications into different sets, e.g. long-term medication vs. medication taken as needed.

2. Understanding the information provided for the individual patients’ medication displayed on the MP: This was assessed either by an oral explanation by the patient how the medication is administered (including dosage and if applicable instructions for use) or by a practical demonstration by filling the medication into compartments of a pill box (morning, noon, afternoon and at bedtime) for two consecutive days.
The completeness and correctness of the medication on the MPs was assessed by comparing the medication printed on the MP with the medication the patients brought along to the interview, the patient file in the pharmacy, and the oral information given by the patients. Additionally, patients were requested to report other reasons than incomplete or missing information for deviating from the MP.

Data analysis

All data were checked for plausibility. Statistical analysis was conducted using Excel™ 2019 for Windows and SPSS™, Version 25. Descriptive data is presented as sums, medians, means, and range. Associations between patients’ orientation on and understanding of MP versus patients’ age and educational degree were evaluated with the Kruskal Wallis test. Associations between age of the MP (days since print out) versus completeness and correctness of the MP was evaluated using the Mann-Whitney U test. A p-value of <.05 indicated statistical significance.

Other reasons for deviating from the MP than missing or incorrect information on the MPs for not taking their medication as stated were analyzed with a conceptual, deductive content analysis [12]. Data was first analyzed by one researcher not involved in the interviews and in the following steps: sorting, paraphrasing, generalizing, and finally reducing the phrases to categories. The initial categories were discussed with two other investigators and adapting the system to nine categories. The data was then analyzed separately by two investigators. Deviations were discussed until consensus was reached.

Results

Patient characteristics and medication plan use

Characteristics of the 288 patients enrolled by 21 community pharmacies are shown in Table 1. Patients had a median age of 76 years and 57.6% were female. Whereas a median number of 8 medications were recorded on the MP, a median number of 9 medications were actually taken by the patients, however.

For 78 patients (27.1%) all information sources including drug packages and results from the practical demonstration were available. 116 patients (40.3%) were not willing to participate in the practical demonstration filling pill boxes, and for 94 patients (32.6%) only the MP and the patient himself were available for information. For the majority of these patients (n=86, 91.5%) a file with the patients’ medication was available in the pharmacies additionally, however. Since these groups did not differ significantly in all relevant variables, it was decided not to differentiate them in the analyses (data not shown).

Most often (n=211; 73.3%) patients used the MP to inform their physician on their medication. Furthermore, the MP was used for hospital admissions (n=190; 66.0%), taking it along when travelling (n=142; 49.3%), and when visiting the pharmacy (n=6; 2.1%). While most patients (n=242; 84.0%) indicated to purchase self-medication/OTC products in the pharmacy, only 50.3% (n=145) informed their
physician on the use of non-prescription/OTC drugs. 38.5% of the patients used their MP regularly to prepare their medication.

**Patients’ orientation and understanding regarding the standardized medication plan**

Up to 99.7% (n=287) correct patients’ answers were found in the patients’ orientation on the MP for the different structural elements (Figure 1A). The subheadings were the only optional structural elements purposely inserted on the MP by a HCP if needed and existed on 38 MPs; of these 35.7% (n=10) were indicated by the patients.

Concerning the comprehensibility of the structural elements of the MP (Figure 1B), the results were comparably with up to 97.5% (n=281) of correct patients’ answers, with the two categories subheadings as well as the QR code least understood with 39.3% (n=15) and 27.4% (n=79).

A moderate correlation of the patients’ orientation on the MP as well as the understanding of the structural elements was found with age (r=-0.46) and education (r=0.45; each p<0.01). No significant association was found with gender, number of medications on the MP or taken, or the living situation.

**Completeness and correctness of the medication plan including handwritten modifications**

Altogether, 2,539 medications were printed on the MP and 2,779 medications were actually taken by the enrolled 288 patients. During the interviews, 70 patients (24.3%) indicated altogether 102 medications listed on the MP that were not taken any more and 122 patients (42.4%) stated to take additional medications (n=264) not listed on the MPs. On the MPs of 44 patients (15.3%) medications (n=88) had been added by hand. Table 2 summarizes all evaluated aspects. None of the evaluated MPs were fully complete and correct. When only taking the most relevant aspects into account (i.e. active ingredient, strength, dosage, medication missing or listed but not taken any more), 79.2% (n=228) of the patients had an incorrect or incomplete MP. None of those aspects were associated with the age of the MPs since it had been printed out.

Table 3 provides an overview on the therapeutic indications with cardiovascular medication being the most frequent drug class. Drug classes where medication was relatively often documented on the MP but not taken any more were analgesics (8.2%, n=19) and antacids (11.2%; n=15). Medications missing on the MPs were relatively often related to self-medication, most frequently eye drops (47.9%), followed by minerals (42.4%), vitamins (31.0%), analgesics (21.6%), and antidepressants/hypnotics/sedatives (20.5%).

N=341 handwritten modifications (described in Table 4), related to 156 medications (6.1% of all medications on the MP) were observed on 99 MPs (34.4%). Most frequent handwritten modification was a medication added (n=88).

Most of the 99 MP with handwritten modifications were amended by the patients themselves (n=83; 83.8%), but also by the GP (n=12; 12.1%), and in some cases either by the pharmacist (n=1; 1.0%), jointly
by patient and GP (n=2; 2.0%), or patient and pharmacist (n=1; 1.0%). The median age of MPs with handwritten amendments (189 days) differed significantly from MP without any handwritten amendments (46 days; p<0.001). No associations were found between any of the aspects concerning correctness and completeness of the MP (Table 2) and age of the MP in days since the MP has been printed.

Patients’ reasons for deliberately deviating from the medication plan

169 patients (58.6%) indicated other reasons than missing or incorrect information on the MPs for not taking their medication as stated on the MP. This affected 309 medications (12.2%) of all medications printed on the MPs (n=2.539). Most often these were deviations from the individual dose (n=89; 28.8%), the number of doses (n=88; 28.5%), administration time (n=62; 20.1%), intake with respect to meals (n=39; 12.6%), and duration of intake (n=31; 10.0%).

The top five medications with the relatively most frequent intentional deviations from the MP were: Parkinson disease medication (ATC-Code: N04) with 25.6% (n=10), antacids (A02) with 21.1% (n=28), antidepressants/hypnotics/sedatives (N05/N06) with 17.3% (n=22), analgesics (N02) with 14.7% (n=34), and thyroid hormones (H03) with 14.0% (n=14).

Of the 169 patients that reported deliberate deviations from their MP, 117 reported a total of 151 explanations and reasons for their deviations which were assessed in a qualitative analysis. The results of this analysis with its themes, frequencies, and patient quotes is summarized in Table 5. The most frequent reason for patients’ intentional deviations from the MP was fear of side effects which accounted for 33.1% of all reasons.

Discussion

For the first time, patients’ orientation and understanding regarding their own MP was assessed. Patients were well orientated on their MPs and the structural elements were understood by most patients. In contrast, the content of the MPs was insufficient with none of the evaluated 288 MPs being complete and correct. Our findings show that the current process of developing complete and correct MPs which are updated as needed are insufficient and potentially misleading.

To further identify potential for improvement, the patients’ reasons for deliberate deviations from the MP were investigated for the first time: More than half of the patients deliberately deviated from their MP; reasons were most often fear of side effects as well as insufficient effectiveness.

Patients’ orientation and understanding regarding the medication plan format

A particularly important criterion for the usability of the MP is the competence of patients to find their way around it. Patients indicated the structural elements of their own MPs and additionally explained the respective meanings. Most structural elements of the MP were identified and explained correctly by more than 90% of the patients, among them were such important information as the dosage. Just above 80%
of the patients understood where instructions for administration could be found. However, the patients knew little about the QR code, allowing HCPs to scan the MP and process the information into their software systems.

Of particular interest is a comparison with the data of Botermann et al. [13]: This study assessed the comprehensibility of a mock-up MP in the standardized format according to law presenting six different drug schedules. As in our study, patients were asked to identify the information on the plan and comparably good results were obtained for the orientation on the MP. This lead to the conclusion that patients are in general competent in finding relevant information on their MP. Nevertheless, not all patients found their way around on the MP and a significant although moderate correlation was found between the “Evaluation Tool to test the handling of the Medication Plan” (ET-MP) score with the level of education (r=0.45) and age (r=-0.46) [14]. Our findings support the recommendation that HCPs have to take into consideration that a MP alone is not sufficient for all their patients and additional interventions to ensure the correct administration of the medication might be needed.

**Completeness and correctness of the medication plan**

Of the 288 MPs evaluated none was correct and if taking only the most relevant aspects for patient safety into account, only 21% were correct.

This is in line with other studies showing that MPs have deficiencies with respect to its content: Waltering et al. [15] demonstrated that dosage was missing in 35% of medications, while indication was missing in 95% and intake recommendation was missing in 97%. Dormann et al. [8] showed that only 36% of the medication documented on the MPs was in line with the medications presently taken by the patients and Müller et al. [16] reported 166 medication discrepancies for 774 listed medications.

Investigating pharmacists performing medication reviews, 75% specifically looked at ‘correct dosage’ [17]. One of the least reviewed criteria was ‘effectiveness of medication’ with 16 %. Interestingly, in the same survey, 41% of pharmacists would appreciate further administration instructions. These data can optimally be communicated via a MP.

Missing or incorrect information on the MPs might explain the high prevalence of handwritten modifications. Since we did not see an increase in deviations in terms of completeness and correctness with increasing time since the MP had been printed out, one may doubt that these MPs were complete and correct at the time of issue. One approach to obtain a complete overview on the medication is a brown bag-review as done, for example, in the German interprofessional medication management program ARMIN [11]. In this program, GPs and pharmacists jointly not only compiled the information on the entire patients’ medication starting with a brown bag-review in the community pharmacy, but also agreed on a structured process and defined responsibilities on how to regularly update the MP when changes of the medication occur. Two other studies evaluating the implementation of the MP resulted in similar findings and jointly published their recommendations for the implementation of MPs [18]. In
addition; the MP has to be implemented in a telematic infrastructure in order to update all data electronically.

**Patients’ reasons for deviating from the medication plan**

More than half of the patients indicated to deliberately deviate from their MP. This seems to be particularly important, since obviously not all deviations are due to knowledge deficits, but patients also deliberately disregard GP's recommendations. Clinicians should have this in mind when handing out MPs and address this topic during patient counselling. Fear of side effects as well as symptoms that persist or increase are both justified concerns in need of careful management by a HCP since patients might otherwise not adhere to their therapy. Adjustment to the daily routine is another reason that was given frequently, potentially improving medication adherence and outcomes [19].

Only if the extent and the reasons for deliberate deviations are known, HCPs may find solutions together with the patient, i.e. shared decision making. Interestingly, communication problems with HCPs was another reason often mentioned by patients for deviating from the MP.

**Limitations**

This study has limitations: first, the study was performed only in 21 pharmacies in one federal state. Statements on generalizability should, therefore, be made with caution. Second, not all patients invited were willing to participate. It can be assumed that the study cohort represents better-informed patients. Therefore, the true results are likely to be worse. Third, at the time of our study, the medication management project *ARMIN* was implemented in Saxony (and Thuringia). We cannot fully exclude that the patients in our study, although not enrolled in *ARMIN*, still benefited from the general increase in knowledge and optimization of processes in the participating pharmacies, also with regard to the quality of the MPs.

**Conclusions**

Although the standardized MPs in primary care are comprehensible to the patients, they are neither complete nor correct. Therefore, a structured process with defined responsibilities on generating and updating MPs is needed. This should be a joint task for all HCPs, in particular GPs, medical specialists, and pharmacists. Furthermore, a telematic infrastructure is needed in order to update the MPs electronically in routine care.

Additionally, the patients perspective with his or her knowledge, beliefs, and limitations as potential reasons for non-adherence needs to be known and taken into account. This is a precondition for understanding the patients’ agenda. However, tools are needed to effectively screen for such deliberate deviations in routine care. In this context, further research should focus on targeted and effective interventions.
Declarations

ACKNOWLEDGEMENTS

We would like to thank all pharmacists involved, especially Claudia Sehmisch (“Albert Schweitzer” Pharmacy, Leipzig) and Heike Senf (“Sonnen” Pharmacy, Leipzig) for their active support in planning and implementing this study.

The project was funded in part by grants from the ABDA – Federal Union of German Associations of Pharmacists, Berlin, and the Saxon Pharmacists Association (SAV), Leipzig.

Ethical Approval

The study was approved by the local ethics committee of the Leipzig University (127/20-ek from May 4th, 2020).

Consent to Participate

Written informed consent was obtained from all participating patients.

Consent to Publish

Not applicable.

Competing interests

The author declare to have no conflict of interest in regard to this study.

Authors’ contributions

CE, UM, SM, MS, and TB developed the study protocol and developed the interview. ST, LSH, and CS performed the study on-site in the pharmacies, evaluated the results, and summarized them. CE, SM, and TB supervised and monitored the study implementation. CE and TB supervised and monitored the statistical analysis. CE and TB drafted the first version of the manuscript. All authors critically revised the manuscript.

Funding

This project was supported by the ABDA – Federal Union of German Associations of Pharmacists, Berlin, and the SAV – State Association of Pharmacists - Saxony, Leipzig, Germany.

Availability of data and materials

The data can be requested for scientific questions from the corresponding author.
References


Tables

Table 1 Patients’ characteristics (N=288)
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Median (range) or n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>76 (27–95)</td>
</tr>
<tr>
<td>Female</td>
<td>166 (57.6)</td>
</tr>
<tr>
<td>Living alone</td>
<td>110 (38.2)</td>
</tr>
<tr>
<td>Highest degree of professional educational</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>9 (3.1)</td>
</tr>
<tr>
<td>Vocational training</td>
<td>203 (70.5)</td>
</tr>
<tr>
<td>Master craftsman</td>
<td>10 (3.5)</td>
</tr>
<tr>
<td>University degree</td>
<td>66 (22.9)</td>
</tr>
<tr>
<td>Number of medications on the MP</td>
<td>8 (1–19)</td>
</tr>
<tr>
<td>Number of medications taken by the patient</td>
<td>9 (3–19)</td>
</tr>
<tr>
<td>Age of the MP (days since the MP was issued for the patient)</td>
<td>73 (0–1660)</td>
</tr>
</tbody>
</table>

*MP medication plan*

Table 2 Completeness and correctness of the medication plans (N=288 patients with altogether 2,539 medications printed on the MPs)
<table>
<thead>
<tr>
<th>Aspect</th>
<th>Missing or not correct</th>
<th>Discrepancies related to total number of drugs on all MPs</th>
<th>Discrepancies per MP</th>
<th>MPs affected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>%</td>
<td>n (min-max)</td>
</tr>
<tr>
<td>Active ingredient</td>
<td>Not correct (but same drug class)</td>
<td>31</td>
<td>1.2</td>
<td>0-3</td>
</tr>
<tr>
<td>Strength</td>
<td>Not correct</td>
<td>53</td>
<td>2.1</td>
<td>0-11</td>
</tr>
<tr>
<td>Dosage&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Not correct</td>
<td>124</td>
<td>4.9</td>
<td>0-5</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>47</td>
<td>1.9</td>
<td>0-5</td>
</tr>
<tr>
<td>Relevant instructions for administration</td>
<td>Not correct</td>
<td>28</td>
<td>1.1</td>
<td>0-4</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>220</td>
<td>81.2&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0-4</td>
</tr>
<tr>
<td>Indication</td>
<td>Missing</td>
<td>1,840</td>
<td>72.5</td>
<td>0-19</td>
</tr>
<tr>
<td>Medication</td>
<td>Listed on the MP but not taken any more</td>
<td>102</td>
<td>4.0</td>
<td>0-6</td>
</tr>
<tr>
<td></td>
<td>Medication added by hand</td>
<td>88</td>
<td>3.5</td>
<td>0-8</td>
</tr>
<tr>
<td></td>
<td>Missing&lt;sup&gt;3&lt;/sup&gt;</td>
<td>264</td>
<td>10.4</td>
<td>0-8</td>
</tr>
<tr>
<td>Product name</td>
<td>Not correct</td>
<td>1,127</td>
<td>47.8</td>
<td>0-8</td>
</tr>
</tbody>
</table>

<sup>1</sup> Dosage: number of daily doses and administration time.

<sup>2</sup> Related only to medications where instructions for administration was considered relevant: L-thyroxine, iron compounds, pantoprazole, omeprazole, esmoprazole, alendronic acid, risedronic acid, lercanidipine, methotrexate.

<sup>3</sup> Medication missing altogether on the MP (neither printed nor added by hand).

*MP* medication plan

**Table 3** Therapeutic indications of medications (2,779 medications taken by the patients)
<table>
<thead>
<tr>
<th>Therapeutic indication (ATC-Code 2nd level)</th>
<th>Medication taken by the patient (n=2,779)</th>
<th>Medications documented on MPs but not taken any more (n=102)</th>
<th>Medications missing on MPs (n=349)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Cardiovascular medication (C01-C09)</td>
<td>912</td>
<td>32.8</td>
<td>17</td>
</tr>
<tr>
<td>Antidiabetics (A10)</td>
<td>249</td>
<td>9.0</td>
<td>4</td>
</tr>
<tr>
<td>Analgesics (N02)</td>
<td>232</td>
<td>8.3</td>
<td>19</td>
</tr>
<tr>
<td>Antithrombotic agents (B01)</td>
<td>197</td>
<td>7.1</td>
<td>4</td>
</tr>
<tr>
<td>Statins (C10)</td>
<td>177</td>
<td>6.4</td>
<td>4</td>
</tr>
<tr>
<td>Vitamins (A11)</td>
<td>155</td>
<td>5.6</td>
<td>4</td>
</tr>
<tr>
<td>Antacids (A02)</td>
<td>134</td>
<td>4.8</td>
<td>15</td>
</tr>
<tr>
<td>Antidepressants/hypnotics/sedatives (N05/N06)</td>
<td>127</td>
<td>4.6</td>
<td>5</td>
</tr>
<tr>
<td>Antiasthmatics (R03)</td>
<td>104</td>
<td>3.7</td>
<td>6</td>
</tr>
<tr>
<td>Minerals (A12)</td>
<td>66</td>
<td>2.4</td>
<td>3</td>
</tr>
<tr>
<td>Eye drops (S01)</td>
<td>48</td>
<td>1.7</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>378</td>
<td>13.6</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,779</strong></td>
<td><strong>100.0</strong></td>
<td><strong>102</strong></td>
</tr>
</tbody>
</table>

1 Please note that this value does not correspond to “medication missing” in Table 2, as the value is based on a different total: 2,779 medications taken by the patients in Table 3 and 2,539 medications printed on the MPs in Table 2.

2 Percentage related to the total number of the respective medications of this therapeutic indication; ATC-Code Anatomical Therapeutic Chemical code.

*MP* medication plan

Table 4 Type of handwritten modifications (N=288 medication plans)
<table>
<thead>
<tr>
<th>Modified aspects</th>
<th>Handwritten modifications (n=241)</th>
<th>MPs with handwritten modifications (n=99)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Medication added</td>
<td>88</td>
<td>25.8</td>
</tr>
<tr>
<td>Indication added</td>
<td>77</td>
<td>22.6</td>
</tr>
<tr>
<td>Instruction for administration added</td>
<td>46</td>
<td>13.5</td>
</tr>
<tr>
<td>Dosage corrected</td>
<td>45</td>
<td>13.2</td>
</tr>
<tr>
<td>Medication deleted</td>
<td>40</td>
<td>11.7</td>
</tr>
<tr>
<td>Medication corrected&lt;sup&gt;1&lt;/sup&gt;</td>
<td>29</td>
<td>8.5</td>
</tr>
<tr>
<td>Dosage added</td>
<td>11</td>
<td>3.2</td>
</tr>
<tr>
<td>Remark on therapy or physicians’ appointment</td>
<td>3</td>
<td>0.9</td>
</tr>
<tr>
<td>Instruction for administration corrected</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>341</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

<sup>1</sup> Medication changed with respect to strength, name, or active ingredient.

*MP* medication plan

**Table 5** Patients’ concerns and reasons for deviating from the medication plan (n=151 concerns and reasons reported by n=117 patients)
<table>
<thead>
<tr>
<th>No</th>
<th>Themes</th>
<th>Description</th>
<th>Frequencies (n)</th>
<th>Quotations (patient code)</th>
</tr>
</thead>
</table>
| 1  | Fear of side-effects                                                 | Patient reduces or does not take the medication because he/she fears side-effects.                                                      | 50              | Patient often did not take his statin because he is in fear of side-effects (CS-A02-P07).  
The patient reduced the evening dose of ... to prevent hypoglycemia during the night (CS-A02-P16). |
| 2  | Insufficient communication between patient and physician / pharmacist | All drug-related problems with regard to insufficient or inadequate communication between the patient and health care professionals e.g., patient lacks knowledge. | 37              | Patient continued to take the medication although the physician wanted him to stop. This was either not sufficiently communicated or understood by the patient (CS-A01-P04).  
Patient did not rinse her mouth after the use of an inhaled corticosteroid, because this was not communicated to the patient (CS-A03-P02). |
| 3  | Symptoms increased or persisted                                      | Symptoms were not sufficiently treated by the drug or dosage given on the medication plan.                                             | 28              | Patient took one pill at night instead of half of the pill because the sleep-inducing effect was not sufficient (CS-A02-P05). |
| 4  | Medication schedule adapted to daily routine                         | The patient adapts the medication schedule to the daily routine without consulting the GP.                                            | 20              | Patient sometimes forgot the pill at noon and therefore decided to take it straightaway in the morning (CS-A01-P09).  
L-thyroxine was taken before breakfast together with the other medication because it was more convenient (CS-A03-P05). |
| 5  | Non-adherence due to forgetfulness                                   | Patient does not always take the medication because he/she forgets about the medication or is not well organized.                   | 19              | Patient forgot to take the medication (CS-A01-P05).  
The patient sometimes unintentionally took the medication too often (CS-A03-P08). |
<table>
<thead>
<tr>
<th>No</th>
<th>Themes</th>
<th>Description</th>
<th>Frequencies (n)</th>
<th>Quotations (patient code)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>No or less need for medication</td>
<td>Medication is discontinued or reduced because it is not needed any more</td>
<td>18</td>
<td>Antihypertensive drug was stopped by the patient after the blood pressure normalized without consulting the GP (CS-A01-P20). Patient questioned the need for Parkinson disease medication because of unclear symptoms. Patient did not trust the GP’s diagnosis and the lab results (CS-A04-P03).</td>
</tr>
<tr>
<td>7</td>
<td>Drug therapy changed by the patient</td>
<td>Patient changes the drug therapy himself/herself with the aim to optimize it on the basis of own believes or information.</td>
<td>14</td>
<td>Patient read in the package insert that the medication should be started with a lower dosage and wanted to take it accordingly although the GP prescribed a higher dosage. Patient was not willing to inform the GP about his decision (ST-A01-P25).</td>
</tr>
<tr>
<td>8</td>
<td>Insufficient communication between the prescribing physicians</td>
<td>All drug-related problems with regard to insufficient or inadequate communication between the GP and the specialist.</td>
<td>2</td>
<td>Pulmologist criticized the cardiologist’s medication. This pressured the patient who then agreed to reduce the dosage to half (CS-A01-P08).</td>
</tr>
<tr>
<td>9</td>
<td>Limited financial resources</td>
<td>Patient does not get or take the optimal drug therapy due to limited financial resources.</td>
<td>1</td>
<td>Tilidine was taken on demand if needed against headache. This medication was still available in the household and new headache medication would again cost money.</td>
</tr>
</tbody>
</table>

*GP* general practitioner

**Figures**
Figure 1

(A) Patients’ orientation on the MP. (B) Comprehensibility of the structural elements of the MP (n=288 MPs; *percentage relates to the number of MPs with subheadings (n=38); MP medication plan)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.
• EickhoffSupplement.docx