



Counseling patients on correct drug handling in German community pharmacies: experiences and opinions of pharmaceutical staff

Pia Madeleine Schumacher¹ · Martina Patrizia Neininger¹ · Almuth Kaune¹ · Thilo Bertsche¹

Received: 16 July 2018 / Accepted: 15 November 2018 / Published online: 29 November 2018
© Springer Nature Switzerland AG 2018

Abstract

Background For a safe drug therapy, outpatients have to self-administer their medications correctly. However, these procedures are known as error-prone. In community pharmacies, the pharmaceutical staff has to recognize patients' counseling needs and to use adequate strategies to prevent possible handling errors. **Objective** Assessing the experiences and opinions of pharmaceutical staff on counseling patients on practical drug handling. **Setting** Community pharmacies in a German city and surrounding area. **Method** Descriptively evaluating a self-administered questionnaire to be completed by members of the pharmaceutical staff involved in patient counseling. **Main outcome measures** Estimated counseling needs of patients, current counseling strategies and limitations of counseling. **Results** 520 staff members of 119 pharmacies (59.8%, 199 invited) participated. The majority prioritized counseling on dosage over counseling on practical drug handling. Participants saw a particular need when medication was dispensed for the first time compared to repeated use (all medication types, each $p < 0.001$). The need and counseling strategy depended on the dosage form with a special focus on practical demonstration in bronchopulmonary (83.9%) and oral liquid formulations (54.3%). As one main limitation, they cited the refusal of patients to accept information on drug handling (34.4%). **Conclusion** Participants considered drug handling an important counseling topic. However, reduced awareness for handling errors made at repeated use and at administration of certain dosage forms may affect the safety and success of medication therapy. Additionally, patients' resistance to information may limit the intent on counseling. Still, it is important to verify patients' abilities to handle their medication as intended.

Keywords Community pharmacy · Counseling · Drug handling · Drug safety · Germany · Patient–provider communication

Impacts on practice

- Advice on the correct drug handling should increasingly be integrated into patient counseling in pharmacies.
- Previously neglected dosage forms and practical demonstration should be given greater consideration in counseling.

- Training concepts should be developed in order to optimize the self-confidence of employees in their counseling services and to ensure the quality of counseling.

Introduction

Self-administration was confirmed as a complex and error-prone step in the medication process [1, 2]. Autonomous manipulations due to swallowing problems [3], inappropriate tablet crushing [4], misinterpretation of measuring devices [1] and other incorrect preparation and administration strategies [5, 6] pose the risk of serious under- and overdosing and therapy failure [4, 7, 8]. Therefore, patients need an appropriate level of knowledge about dosage and dose regimen including the period of treatment, adverse drug reactions, proper storage [9, 10] as well as practical skills in drug administration. The pharmaceutical staff members in community pharmacies are easily accessible

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s11096-018-0757-y>) contains supplementary material, which is available to authorized users.

✉ Thilo Bertsche
thilo.bertsche@medizin.uni-leipzig.de

¹ Drug Safety Center and Dept. of Clinical Pharmacy, Leipzig University, Brüderstraße 32, 04103 Leipzig, Germany

health care professionals to provide this knowledge. In Germany, pharmaceutical staff allowed to provide advice on medicines includes the following professions: pharmacists, pharmaceutical engineers, and pharmaceutical technical assistants as well as persons in training to become one of these professions. Those are qualified to counsel patients on the use of prescription long-term and PRN medication (“pro re nata”, “as needed”) as well as OTC (“over-the-counter”, non-prescription) drugs. Current guidelines are inconsistent on counseling strategies for drug preparation and administration [11–14]. When information on drug preparation and administration is offered, mainly bronchopulmonary devices or dosage marks on measuring devices are described [13, 15].

Aim of the study

This pilot study aimed at gaining a first insight in the experiences and opinions of pharmaceutical staff on counseling drug handling as well as their way of counseling patients on that topic.

Ethics approval

As this study consisted of an anonymous self-administered questionnaire of pharmaceutical staff without any assessment of patient data, no ethical approval was required in Germany. The responsible Chamber of Pharmacists was informed about the study protocol in advance.

Method

Participants and setting

The survey was performed in community pharmacies in a large German city and the surrounding region (≤ 40 km) to cover urban and rural areas. Pharmacies were identified via telephone directory and online research, e.g. in Yellow Pages. In order to preserve the anonymity of the participants, at least three pharmacies had to be located in the same postal code area at the time of recruitment to be included in our survey. All eligible community pharmacies were contacted by phone and the head pharmacist was asked if the pharmacy’s staff agreed to participate. The survey was addressed to all members of the staff that are responsible for patient counseling on medication. Participation in the survey was voluntarily.

We aimed at including all members of the pharmaceutical staff involved in patient counseling. In Germany, those are pharmacists and pharmaceutical engineers

(academic) as well as pharmaceutical technical assistants (non-academic). The latter perform their duties under the supervision of pharmacists. Pharmaceutical engineers are a special profession that was trained at universities of applied science in the former German Democratic Republic (GDR). They work under the responsibility of pharmacists and may substitute pharmacists in the community pharmacy under certain conditions.

Self-administered questionnaire

An expert panel of pharmacists working in patient care research and pharmacists with longstanding working experience in community pharmacies systematically developed a self-administered questionnaire for pharmaceutical staff on patient counseling on drug handling. To confirm completeness and to increase comprehensibility and feasibility, the interview was pretested stepwise in three community pharmacies outside the recruiting area. Thereby received feedback was included in the final version of the document. Results of the pretests were not included in the final assessment.

The questionnaire contained four question categories, which included the following experiences and opinions of pharmaceutical staff: estimated relevance of counseling practical drug handling and counseling needs of patients (3 questions), limitations of in-depth counseling (1 question), estimated self-confidence in counseling patients (1 question), and current counseling procedure (1 question, see supplementary material). Patient counseling regarding OTC, long-term prescription and PRN rescue medication (i.e. for epileptic seizure or anaphylaxis), and different dosage forms (DF) was considered. In addition, the confidence of pharmacy staff in counseling on administration via feeding tube was investigated. Furthermore, sociodemographic data was elicited. For clarification, the self-administered questionnaire defined the term “drug handling” as “preparation (e.g. by using dosing devices) and procedure of administration of a medication”, differentiating it from topics such as dose regimen and period of treatment. To obtain the opinions and experiences of the participants, 4-point Likert scales and dichotomous response options were used. When appropriate, an additional free text area was provided. In one question, participants were asked to rank the importance of six counseling topics due to their estimated priority from 1 (highest) to 6 (lowest).

Sample size calculation

Considering a population of 123,235 members of the pharmaceutical staff in 2016 in Germany [16], a confidence

level of 99% ($t \approx 2.58$), an attribute level of 80% (estimated rate of participants regularly engaged in patient counseling) and a sampling error of 5%, a minimum of 425 participants was required according to Mayer et al. [17].

Data analysis

Calculations were performed using SPSS (Statistical Package for the Social Sciences, Version 24, IBM Corporation, Armonk, NY, USA) and Microsoft Excel (Version 2013, Microsoft Corporation, Redmond, Washington, USA). Frequencies are reported as numbers and percentages, continuous data and ranking results as median with first (25%) and third (75%) quartile (Q25/Q75). For comparison of the counseling need of patients at initial dispensing (new medication) and repeated supply (medication already used by patient), the Wilcoxon Test for dependent samples was

applied. To compare the self-confidence of academic and non-academic pharmaceutical staff, the Mann–Whitney-U test for independent samples was applied. A p value ≤ 0.05 indicated significance. Missing data (i.e., no answer given) is described as “not specified.”

Results

Characteristics of participants

Of 199 invited community pharmacies, 119 (59.8%) agreed to take part in the survey. The characteristics of the 520 participating members of the pharmaceutical staff are shown in Table 1. Of those, 86.3% of participants were female with a median age of 37 (29/46) years. Pharmacists and trainees made up for 40.2%, pharmaceutical engineers for 15.6%, and pharmaceutical technical assistants and trainees for 42.1% (2.1% not specified). The majority of participants (81.0%) worked most of the time at the counter for drug supply and patient counseling.

Table 1 Characteristics of participating pharmaceutical staff

Characteristics	Values
Number of participating pharmacies (n)	119
Number of participants (n)	520
Female [n (%)]	449 (86.3)
Male [n (%)]	63 (12.1)
Not specified [n (%)]	8 (1.5)
Median age (Q25/Q75) (years)	37 (29/46)
Not specified [n (%)]	26 (5.0)
Median working experience (Q25/Q75) [years]	13 (6/22)
Not specified [n (%)]	34 (6.5)
Pharmacists and trainees [n (%)]	209 (40.2)
Pharmaceutical engineers [n (%)]	81 (15.6)
Pharmaceutical technical assistants and trainees [n (%)]	219 (42.1)
Not specified [n (%)]	11 (2.1)
Working time engaged in patient counseling > 50% [n (%)]	421 (81.0)
Working time engaged in patient counseling < 50% [n (%)]	97 (18.7)
Not specified [n (%)]	2 (0.4)

Experiences in patient counseling on appropriate drug handling: general aspects

To classify “drug handling” (consisting of “preparation” and “procedure of administration of a medication”) compared to other relevant counseling topics on drug use, participants were asked to rank those from 1 to 6 (1 = “highest priority” to 6 = “lowest priority”). Of 520 participants, 466 (89.6%, 54 gave no answers) prioritized the counseling topics as follows: Dosage and dose regimen [median 1 (1/1)], procedure of administration [median 3 (2/4)], preparation of medication [median 3 (2/4)], period of treatment, if limited [median 3 (2/4)], possible adverse drug events [median 5 (5/6)], storage of medication [median 6 (5/6)].

The participants considered patient counseling on drug handling as quite or highly important in nearly all types of medication and especially the first time that the medication

Table 2 Importance of counseling on drug handling according to the type of medication and supply

Type of medication/supply	Not important n (%)	Less important n (%)	Quite important n (%)	Highly important n (%)	Not specified n (%)
OTC initial dispensing	0/520 (0.0)	1/520 (0.2)	58/520 (11.2)	456/520 (87.7)	5/520 (1.0)
OTC repeated supply	5/520 (1.0)	181/520 (34.8)	300/513 (57.7)	23/520 (4.4)	11/520 (2.1)
PM initial dispensing	0/520 (0.0)	4/520 (0.8)	29/520 (5.6)	475/520 (91.3)	12/520 (2.3)
PM repeated supply	10/520 (1.9)	258/520 (49.6)	222/520 (42.7)	23/520 (4.4)	7/520 (1.3)
PRN initial dispensing	0/520 (0.0)	1/520 (0.2)	10/520 (1.9)	505/520 (97.1)	4/520 (0.8)
PRN repeated supply	1/520 (0.2)	69/520 (13.3)	303/520 (58.3)	144/520 (27.7)	3/520 (0.6)

The rounding of values may result in total amounts deviating from 100.0%

OTC over the counter, PM prescription long term medication, PRN pro re nata medication (rescue medication)

was dispensed to the patient (Table 2). For repeated supply of OTC and prescription long-term medication, they gave counseling lower importance than they did for PRN rescue medication (each $p < 0.001$). For all types of medication, the importance of counseling was rated significantly lower for repeated supply than for initial dispensing (each $p < 0.001$).

Experiences in patient counseling on appropriate drug handling: dosage forms

Participants considered that especially DF for bronchopulmonary administration require a comprehensive patient counseling when they are dispensed for the first time (Table 3).

A vast majority of participants expressed feeling “very confident” in offering comprehensive patient counseling on drug handling for oral solid and liquid DF, and for nasal DF. Participants were less confident when it came to rectal DF. The smallest number of participants described themselves as “very confident” when counseling the use of bronchopulmonary devices or the administration of drugs via feeding tube (Table 4).

Academic pharmaceutical staff felt more confident than non-academic pharmaceutical staff when counseling on oral solid DF ($p = 0.033$), oral liquid DF ($p = 0.011$), rectal DF ($p = 0.018$), and the administration

of medication via feeding tube ($p = 0.009$). For nasal and bronchopulmonary DF, both groups felt equally confident (n.s.).

Procedure and limitations of patient counseling in drug handling

For all DF, most participants stated that they offered verbal counseling on correct drug handling at initial supply (Fig. 1). They used different counseling techniques depending on the supplied DF. A practical demonstration of correct drug handling with dosing or administration devices from the original packaging or nonworking devices was stated to be used for oral liquid and bronchopulmonary DF. Additional information provided in the free text areas was the use of pictograms for the handling of liquids and tablets, or provide information about videos on the internet for the use of bronchopulmonary devices. In case of prescribed tablet splitting, some participants named the recommendation of a tablet splitter and stated to demonstrate the splitting process with this device.

Finally, participants were asked to judge different scenarios based on their experiences to identify limitations to comprehensive patient counseling (Table 5). The main obstacle they mentioned was patients’ refusal to accept information about correct drug handling of the supplied DF. As a reason

Table 3 Need of counseling according to the type of dosage form

Types of dosage forms	No need n (%)	Little need n (%)	Greater need n (%)	Especially great need n (%)	Not specified n (%)
Oral solid DF	1/520 (0.2)	142/520 (27.3)	252/520 (48.5)	122/520 (23.5)	3/520 (0.6)
Oral liquid DF	1/520 (0.2)	57/520 (11.0)	273/520 (52.5)	186/520 (35.8)	3/520 (0.6)
Bronchopulmonary DF	0/520 (0.0)	1/520 (0.2)	52/520 (10.0)	462/520 (88.8)	5/520 (1.0)
Nasal DF	4/520 (0.8)	141/520 (27.1)	270/520 (51.9)	95/520 (18.3)	10/520 (1.9)
Rectal DF	3/520 (0.6)	67/520 (12.9)	249/520 (47.9)	197/520 (37.9)	4/520 (0.8)

The rounding of values may result in total amounts deviating from 100.0%

DF dosage form

Table 4 Self-confidence regarding patient counseling on drug handling for different types of dosage forms or way of administration

Types of dosage forms/way of administration	Not confident n (%)	Hardly confident n (%)	Rather confident n (%)	Very confident n (%)	Not specified n (%)
Oral solid DF	0/520 (0.0)	0/520 (0.0)	83/520 (16.0)	434/520 (83.4)	3/520 (0.6)
Oral liquid DF	0/520 (0.0)	0/520 (0.0)	129/520 (24.8)	387/520 (74.4)	4/520 (0.8)
Bronchopulmonary DF	1/520 (0.2)	51/520 (9.8)	347/520 (66.7)	115/520 (22.1)	6/520 (1.2)
Nasal DF	0/520 (0.0)	4/520 (0.8)	122/520 (23.4)	389/520 (74.8)	5/520 (1.0)
Rectal DF	1/520 (0.2)	26/520 (5.0)	205/520 (39.4)	281/520 (54.0)	7/520 (1.4)
Administration of drugs via feeding tube	186/520 (35.7)	262/520 (50.3)	58/520 (11.2)	7/520 (1.4)	7/520 (1.4)

DF dosage form

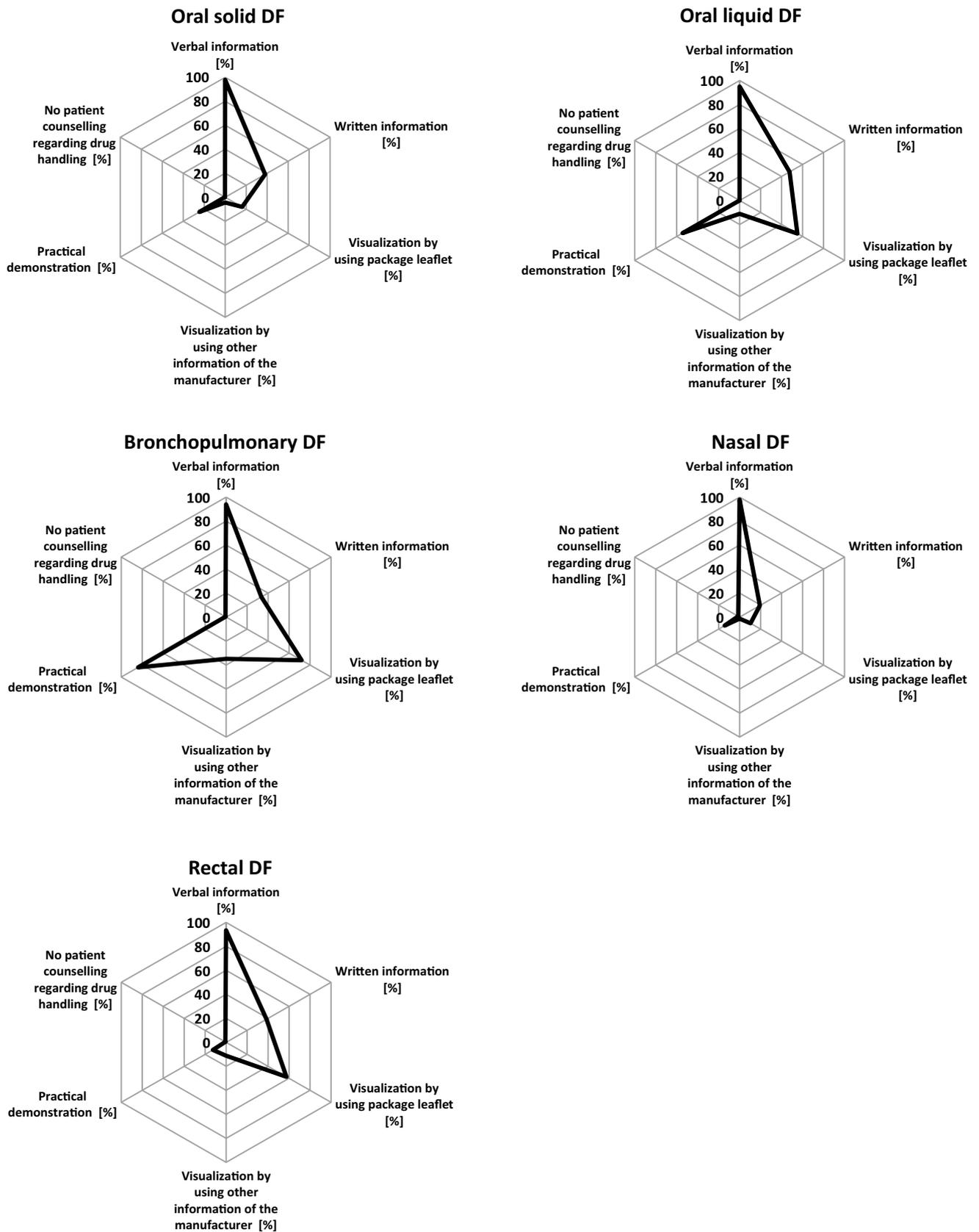


Fig. 1 Procedure of patient counseling for different dosage (DF) forms regarding practical drug handling when dispensed for the first time, multiple answers possible. Percentages relate to participants who have yet performed counseling regarding the particular dosage form

Table 5 Reasons for limited patient counseling regarding drug handling

Scenario	Do not agree n (%)	Hardly agree n (%)	Rather agree n (%)	Strongly agree n (%)	Not specified n (%)
Patient refuses the offer to be informed	20/520 (3.8)	99/520 (19.0)	212/520 (40.8)	179/520 (34.4)	10/520 (1.9)
More than one medication supplied at the same time	125/520 (24.0)	187/520 (36.0)	164/520 (31.5)	28/520 (5.4)	16/520 (3.1)
Patient does not ask for information	220/520 (42.3)	186/520 (35.8)	76/520 (14.6)	16/520 (3.1)	22/520 (4.2)
Patient states to be already informed by physician or at the hospital	12/520 (2.3)	81/520 (15.6)	320/520 (61.5)	98/520 (18.8)	9/520 (1.7)
Lack of available placebo devices in the pharmacy	134/520 (25.8)	214/520 (41.2)	127/520 (24.4)	24/520 (4.6)	21/520 (4.0)
No limitations, comprehensive patient counseling always fully performed	29/520 (5.6)	149/520 (28.7)	222/520 (42.7)	54/520 (10.4)	66/520 (12.6)

The rounding of values may result in total amounts deviating from 100.0%

for rejection, some participants stated that patients were often in a hurry and therefore not prepared to listen. Additionally, they mentioned that patients already felt confident in the practical handling of drugs and, therefore, would not take any further advice.

Discussion

For instructions on correct medication use, members of pharmaceutical staff in community pharmacies are easily accessible sources of information. The participating pharmaceutical staff stated in this survey that drug handling is an important topic in counseling outpatients but that counseling dosage and dose regimen is by far more important. Regardless of the type of medication, they estimated the counseling at initial dispensing to be more important than at repeated supply. They saw an especially great need for bronchopulmonary DF, but not so much for oral solid or liquid DF. However, they felt less confident in patient counseling on bronchopulmonary DF than for counseling on oral solids and liquids. They felt least confident when counseling the correct preparation and administration of medication via feeding tubes. They described most counseling interviews as solely verbal. Especially for bronchopulmonary DF and oral liquid DF, most participants claimed to demonstrate the handling procedure during patient counseling. They noted that the main limitation for comprehensive counseling was patients' refusal to accept information on drug handling.

To perform adequate patient counseling when dispensing a medication for the first time, participants assumed dosage and dose regimen to be the most important information for correct drug use. This is in line with literature reporting that community pharmacies relay information on dosage at first supply [9]. However, participants were also aware that, especially for newly dispensed medication, patients have to be instructed on how to prepare and administer it safely.

Furthermore, and in contrast to the opinion of most participants, handling errors can occur even when a patient has been taking a medication for a long time. Even health care professionals, who prepare and administer drugs every day, have been found to commit severe handling errors [18–20]. Such errors occur due to habit or convenience and may creep into routine drug handling. The pharmaceutical staff should check these routines in the counseling interview, particularly when the patient before has used the medication before. A comprehensive insight on handling techniques could be gained by inviting patients to describe or demonstrate the way that they prepare and take their medication. Pharmaceutical staff should be encouraged to regularly perform standardized assessments of handling procedures, e.g. within medication reviews. These should be based on detailed instructions and tools, such as comprehensive checklists of steps for correct drug handling.

This study focused on the counseling for different types of DF. For bronchopulmonary DF, participants estimated an especially high need for counseling. This is consistent with findings in the literature that describe the complexity of medication handling in this area [21–23]. The educational and professional press emphasizes the importance of the safe use of bronchopulmonary DF. Fewer participants estimated a high need for counseling on the correct handling of solid and liquid oral medication. Additionally, they felt considerably more confident counseling patients in this field compared to bronchopulmonary DF.

For liquid medication, the lower estimated need for counseling could be misleading since the dosing of liquid preparations has to be explained for the great variety of dosing devices [1, 24]. These devices can even diverge between generic preparations of different brands and drug regulatory authorities have already released warnings on errors due to misunderstandings of dosing marks [25, 26]. Suspensions that are not shaken before being taken cause serious under- or overdosing [18–20]. For solid oral DF, patients

reported having problems swallowing and therefore often split or crush their medication without informing their physician or pharmacist [2, 3], which may not be adequate or even dangerous. For rectal and nasal DF, few participants noted a great need for counseling. Severe errors, such as unintended loss of drug or omission of opening tube lid, occurred in administering rectal tubes at both initial and repeated use [5]. In addition, various ways of administering nasal medication were identified that resulted in different effectiveness [27, 28] underlining the necessity of counseling. These discrepancies in the opinions of pharmaceutical staff to the findings of current literature emphasize the need for standardized means of identifying possible handling errors by patients taking different DF. Therefore, guidelines should mention the possible handling errors that must be considered in the use of the particular DF or administration type when a medication is being dispensed for the first or repeated time. They should provide material for a standardized documentation and evaluation. Additionally, regular and evidence based trainings to inform pharmaceutical staff of possible errors in drug handling are necessary to ensure up-to-date patient counseling.

To provide comprehensive counseling, pharmaceutical staff must be confident in counseling patients on practical drug handling of the different DF or administration techniques. Otherwise, they might avoid the subject in the counseling interview, depriving patients of information [29]. As the results showed, participants were least confident in the drug administration via feeding tubes. Since those processes are known to be especially error-prone and can have serious consequences, comprehensive counseling is necessary [30]. To overcome staff's insecurities, regular self-study or in-house team trainings could be offered. Because this survey found that academic pharmaceutical staff felt more confident than non-academic staff, pharmacists should take responsibility for these trainings. To ensure a consistent counseling quality teaching, staff members should obtain information on the correct drug handling of the different kind of DF, for instance, from databases, teach-the-teacher trainings or standardized counseling tools. Also, an enhanced inclusion of detailed instructions into the respective guidelines should be considered consistently.

The findings of this study show that demonstration was a counseling technique performed mainly for bronchopulmonary and oral liquid DF, while solely verbal or written information was preferred for other types of DF. Still, practical demonstration in patient counseling could easily be extended to other DF. In this way, patients' insecurities or errors in medication administration can be identified, thereby enabling the staff member to intervene [5].

Even though pharmaceutical staff is aware of the importance of counseling on drug handling, a patient's rejection of counseling can impede safe medication administration.

Patients may not be aware of many drug-handling errors that can occur. Therefore, they do not see the relevance to discuss their routines or cannot report their problems [5]. Furthermore, they may not be able see the consequences of incorrect drug handling. Therefore, it is important to call attention to the most common and severe administration problems if the patient rejects counseling. However, patients in community pharmacies are also customers whose wishes and expectations of customer service have to be respected. Additionally, pharmacies could hold campaign days, to increase awareness for the necessity of correct drug handling.

Limitations

- All results were based exclusively on participants' self-reports.
- We used a purely descriptive approach. However, we have chosen this method to obtain a broad acceptance of pharmaceutical staff to participate in this study.
- A validation of the questionnaire was not performed, which may limit the accuracy of the results. However, it was pretested several times to ensure completeness and to consider possible remarks of the test persons in the final document.
- This survey was conducted in the region of one German city as a pilot project, which may limit the generalizability of the results. However, the ratio of participating pharmacists accorded in comparison to general statistics of the Federal Union of German Associations of Pharmacists in 2016: 38.0 to 47.2 years, 79.8% female to 72.6% female and 37.3% compared to 40.7% of pharmaceutical staff [16].

Conclusion

We found that pharmaceutical staff ranked the importance of providing drug information on correct handling procedures lower than other information such as on dosage and dose regimen. Especially, when the patient had already used the medication before or when certain DF, such as oral solids, were provided, participants stated a relatively low estimated relevance to counsel patients on drug handling. Many participants saw the lack of interest of patients in counseling as a limitation of their counseling activities. Additionally, they did not always feel confident in counseling on drug handling. These findings should be considered in future attempts to optimize counseling quality.

Acknowledgements We thank Anne Diessler, pharmacy student, for the support in the development and pretest of the self-administered questionnaire as well as for the support in development of the recruiting strategy. Also, we thank André Drechsler, Grit Lux and Barbara

Kubainska, pharmacy students, for their support in the recruitment, distribution and recollection process of the questionnaire and the data entry. We thank all participating members of pharmaceutical staff.

Funding The project received third party funding by the Lesmüller Stiftung, Munich, Germany, and the Förderinitiative Pharmazeutische Betreuung, Berlin, Germany.

Conflicts of interest The authors declare that they have no conflicts of interests.

References

1. Yin HS, Mendelsohn AL, Wolf MS, Parker RM, Fierman A, van Schaik L, et al. Parents' medication administration errors. Role of dosing instruments and health literacy. *Arch Pediatr Adolesc Med.* 2010;164:181–6.
2. Quinzler R, Gasse C, Schneider A, Kaufmann-Kolle P, Szecsenyi J, Haefeli WE. The frequency of inappropriate tablet splitting in primary care. *Eur J Clin Pharmacol.* 2006;62:1065–73.
3. Schiele JT, Quinzler R, Klimm H-D, Pruszydlo MG, Haefeli WE. Difficulties swallowing solid oral dosage forms in a general practice population: prevalence, causes, and relationship to dosage forms. *Eur J Clin Pharmacol.* 2013;69:937–48.
4. Cornish P. "Avoid the crush": hazards of medication administration in patients with dysphagia or a feeding tube. *CMAJ.* 2005;172:871–2.
5. Kaune A, Schumacher PM, Hoppe SC, Syrbe S, Bernhard MK, Frontini R, et al. Administration of anticonvulsive rescue medication in children—discrepancies between parents' self-reports and limited practical performance. *Eur J Pediatr.* 2016;175:1139–46.
6. Molimard M, Raheison C, Lignot S, Depont F, Aboulefath A, Moore N. Assessment of handling of inhaler devices in real life: an observational study in 3811 patients in primary care. *J Aerosol Med.* 2003;16:249–54.
7. Hatley RHM, Parker J, Pritchard JN, von Hollen D. Variability in delivered dose from pressurized metered-dose inhaler formulations due to a delay between shake and fire. *J Aerosol Med Pulm Drug Deliv.* 2017;30:71–9.
8. Melani AS, Bonavia M, Cilenti V, Cinti C, Lodi M, Martucci P, et al. Inhaler mishandling remains common in real life and is associated with reduced disease control. *Respir Med.* 2011;105:930–8.
9. Puspitasari HP, Aslani P, Krass I. A review of counseling practices on prescription medicines in community pharmacies. *Res Soc Adm Pharm.* 2009;5:197–210.
10. Buring SM, Kirby J, Conrad WF. A structured approach for teaching students to counsel self-care patients. *Am J Pharm Educ.* 2007;71:1–7.
11. ABDA. Leitlinie der Bundesapothekerkammer zur Qualitätssicherung, Information und Beratung des Patienten bei der Abgabe von Arzneimitteln – Erst- und Wiederholungsverordnung. 2016. https://www.abda.de/fileadmin/assets/Praktische_Hilfen/Leitlinien/Rezeptbelieferung/LL_Info_Beratung_Rezept.pdf. Accessed 7 Jul 2018.
12. ABDA. Leitlinie der Bundesapothekerkammer zur Qualitätssicherung, Information und Beratung des Patienten bei der Abgabe von Arzneimitteln – Selbstmedikation. 2016. https://www.abda.de/fileadmin/assets/Praktische_Hilfen/Leitlinien/Selbstmedikation/LL_Info_Beratung_SM.pdf. Accessed 7 Jul 2018.
13. ASHP. Guidelines on pharmacist-conducted patient education and counseling. *Am J Health-Syst Pharm.* 1997;54:431–4.
14. Pharmaceutical Society of Australia. Professional practice standards V5. 2017. <https://www.psa.org.au/wp-content/uploa>
[ds/2018/08/Professional-Practice-Standards-v5.pdf](https://www.psa.org.au/wp-content/uploa). Accessed 25 Nov 2018.
15. Pharmaceutical Services Negotiating Committee UK. Medicines use review—suggested questions. 2012. http://archive.psn.org.uk/data/files/PharmacyContract/Contract_changes_2011/Medicines_Use_Review_Exemplar_Interview_Schedule_Jan_2012.pdf. Accessed 7 Jul 2018.
16. ABDA. German pharmacies: figures, data, facts 2017. 2017. https://www.abda.de/fileadmin/assets/ZDF/ZDF_2017/ABDA_ZDF_2017_Brosch_english.pdf. Accessed 17 Oct 2018.
17. Mayer HO. Interview und schriftliche Befragung. Grundlagen und Methoden empirischer Sozialforschung. 6th ed. München: Oldenbourg; 2013.
18. Bertsche T, Bertsche A, Krieg E-M, Kunz N, Bergmann K, Hanke G, et al. Prospective pilot intervention study to prevent medication errors in drugs administered to children by mouth or gastric tube: a programme for nurses, physicians and parents. *Qual Saf Health Care.* 2010;19:e26.
19. Niemann D, Bertsche A, Meyrath D, Oelsner S, Ewen AL, Pickardt B, et al. Drug handling in a paediatric intensive care unit—can errors be prevented by a three-step intervention? *Klin Padiatr.* 2014;226:62–7.
20. Niemann D, Bertsche A, Meyrath D, Koepf ED, Traiser C, Seebald K, et al. A prospective three-step intervention study to prevent medication errors in drug handling in paediatric care. *J Clin Nurs.* 2015;24:101–14.
21. Neining MP, Kaune A, Bertsche A, Rink J, Musiol J, Frontini R, et al. How to improve prescription of inhaled salbutamol by providing standardised feedback on administration: a controlled intervention pilot study with follow-up. *BMC Health Serv Res.* 2015;15:40.
22. Bousquet J, Mantzouranis E, Cruz AA, Ait-Khaled N, Baena-Cagnani CE, Bleecker ER, et al. Uniform definition of asthma severity, control, and exacerbations: document presented for the World Health Organization Consultation on Severe Asthma. *J Allergy Clin Immunol.* 2010;126:926–38.
23. The Inhaler Error Steering Committee, Price D, Bosnic-Anticevich S, Briggs A, Chrystyn H, Rand C, et al. Inhaler competence in asthma: Common errors, barriers to use and recommended solutions. *Respir Med.* 2013;107:37–46.
24. Yin HS, Parker RM, Sanders LM, Dreyer BP, Mendelsohn AL, Bailey S, et al. Liquid medication errors and dosing tools: a randomized controlled experiment. *Pediatrics.* 2016;138:e20160357.
25. Bundesinstitut für Arzneimittel und Medizinprodukte. Rote Hand Brief: Levetiracetam-haltige Darreichungsformen der 100 mg/ml Lösung zum Einnehmen: Sicherheitshinweise zum Risiko einer Überdosierung durch Medikationsfehler. 2016. <https://www.bfarm.de/SharedDocs/Risikoinformationen/Pharmakovigilanz/DE/RHB/2016/rhb-levetiracetam.pdf>. Accessed 14 Jun 2018.
26. European Medicines Agency. EMA recommends measures to ensure safe use of Keppra oral solution. 2016. <https://www.ema.europa.eu/en/news/ema-recommends-measures-ensure-safe-use-keppra-oral-solution>. Accessed 25 Nov 2018.
27. Karagama YG, Rashid M, Lancaster JL, Karkanevatos A, Williams RS. Intranasal delivery of drugs to eustachian tube orifice. *J Laryngol Otol.* 2011;125:934–9.
28. Karagama YG, Lancaster JL, Karkanevatos A, O'Sullivan G. Delivery of nasal drops to the middle meatus: which is the best head position? *Rhinology.* 2001;39:226–9 (abstract).
29. McCroskey JC, McCroskey LL. Self-report as an approach to measuring communication competence. *Commun Res Rep.* 1988;5:108–13.
30. Williams NT. Medication administration through enteral feeding tubes. *Am J Health Syst Pharm.* 2008;65:2347–57.