Pharmacist-led medication reconciliation and medication review practices at care transitions in primary care

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Dekan

"Not everything that can be counted counts, and not everything that counts can be counted. "

Albert Einstein

To my lovely family

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2. Abbreviations

ADE	Adverse Drug Event
ADR	Adverse Drug Reaction
AG	Aargau
ATC	Anatomical Therapeutic Chemical Classification System
BPMH	Best Possible Medication History
BPML	Best Possible Medication List
BSc	Bachelor of Science
CLEOde	Clinical, Economic, and Organizational (German language)
DRP	Drug-Related Problem
ECTS	European Credit Transfer System
eHealth	Electronic Health
EHR	Electronic Health Record
EKNZ	Ethics Committee of Northwest and Central Switzerland
EMILIA	Elektronischer MedikatIonspLan nach Spitalaustritt Im Kanton Aargau (electronic medication list after hospital discharge in the canton of Aargau)
ESCP	European Society of Clinical Pharmacy
FFS	Fee-For-Service
FIP	International Pharmaceutical Federation
GP	General Practitioner
GSASA	Schweizer Verein der Amts- und Spitalapotheker (Swiss Association for Public Health Administration and Hospital Pharmacists)
ICD-10	International Classification of Diseases, 10th Revision
INR	International Normalized Ratio
IT	Information Technology
IU	International Unit
MedTax	Medication Discrepancy Taxonomy
MeSH	Medical Subject Heading
MM	Mixed Models
MR	Medication Review

MRC	Medical Research Council (United Kingdom)
MSc	Master of Science
MUR	Medicines Use Review
NHS	National Health Service
OECD	Organisation for Economic Co-operation and Development
ONC	US Office of National Coordinator of Health Information Technology
OTC	Over-The-Counter
P4P	Pay-for-Performance
PCNE	Pharmaceutical Care Network Europe
PGEU	Pharmaceutical Group of the European Union
PharmDISC	Pharmacists' Documentation of Intervention in Seamless Care
PLCS	Pharmacist-led Cognitive Service
PMC	Polymedication Check
PRACTISE	PhaRmAcist-led CogniTIve Services in Europe
PRN	pro re nata (as needed)
Rx	Prescription
STeHAG	Stammgemeinschaft eHealth Aargau
UK	United Kingdom
US	United States
USA	United States of America
WHO	World Health Organization

3. Index

4. Summary

In recent years, the daily role of pharmacists has changed from that of a medication vendor and producer of extemporaneous formulations to providing a more patient- and care-focused practice through the introduction of pharmaceutical services. During this time, numerous pharmacist-led services have been introduced worldwide and the community pharmacists in Europe perform a variety of pharmacy services such as home care services, medication reviews, new medicine services, measurement and testing services (e.g. blood pressure, blood glucose), disease management services, medication administration services, and smoking cessation services. However, the level of implementation and remuneration of pharmacist-led cognitive services in primary care across Europe is lacking.

Each person takes medication, at some point in their lifetime, for the prevention or treatment of a disease and can, therefore, be affected by drug-related problems (DRPs). The inclusion of multiple health care professionals in the care of patients taking medications is a risk for the development of medication errors and the continuity of patient care. The performance of medication reconciliation and medication reviews is an important intervention to prevent medication errors and improve various health outcomes, by enabling the identification and resolution of DRPs and medication discrepancies. The occurrence of medication discrepancies is a common phenomenon at hospital admission (up to 67% of patients) and discharge (up to 80% of patients) because a hospital stay is associated with various changes in a patient's medications, which can trigger intentional and unintentional medication discrepancies. However, medication discrepancies can also arise in the outpatient setting at transitions between care homes, community pharmacies, primary care physicians, medical specialists, or even without any transitions if the patient takes the medication differently than prescribed. As the performance of medication reconciliation is laborious and resource-intensive, information technology (ranging from simple emails to specialized electronic tools) is used to facilitate medication reconciliation processes. To date, Swiss community pharmacies do not have medication reconciliation tools specifically developed to help community pharmacists to compare the best-possible medication history to admission, transfer, discharge orders and to resolve medication discrepancies. In addition, electronic health records (EHRs) are used to support medication reconciliation processes. The worldwide implementation of such EHRs has increased in recent years. Theoretical advantages and risks linked to EHRs are mainly

related to the management and storage functionalities of electronic health data (e.g. the ability to access, search, manipulate, transport, share, and preserve electronic data).

Goal

The goals of this thesis are to assess different aspects of pharmacist-led cognitive services in Europe with a focus on medication review procedures, to evaluate medication discrepancies and DRPs identified by systematic medication reconciliation in community pharmacies, and to develop an electronic medication reconciliation tool for community pharmacies. These goals were approached with four main projects:

Project A - Pharmacist-led cognitive services with a focus on medication review procedures across Europe

- Assessment of the implementation of pharmacist-led cognitive services performed in primary care across Europe and the associated remuneration models. [A-1]
- Description of the characterization of the different types of medication review services and projects available, the level of implementation and remuneration in community pharmacies, considering the Pharmaceutical Care Network Europe (PCNE) definition. [A-2]

Project B - Identification of medication discrepancies in community pharmacies

- Identification, characterization, and categorization of medication discrepancies occurring in adult community pharmacy customers with long-term polypharmacy use and to assess their potential clinical and economic impact. [B-1]
- Assessment of patients' awareness of generic medications in their therapy, perception of specific aspects, and attitudes towards generic medication and substitution. [B-2]
- Evaluation of medication discrepancies identified by pharmacy students in discharged patients in community pharmacies in Switzerland. [B-3]

Project C - Detection and resolution possibilities of DRPs in patients at hospital discharge in Swiss community pharmacies

- Investigation into whether DRPs identified on discharge prescriptions in a hospital's community pharmacy (with full access to the hospital's electronic health records) would be detectable in a community pharmacy by simple medication reviews based on the patient's medication history only, or if intermediate or advanced medication review with additional clinical and/or patient-specific information would be needed. [C-1]
- Investigation into whether the resolution of the DRPs that were deemed detectable by a simple medication review would require a consultation with the prescriber. [C-1]

Project D - Electronic health records and electronic medication reconciliation in Switzerland

- Examination of the acceptance and satisfaction of patients, community pharmacists, physicians and caregivers with the electronic medication plan. [D-1]
- Assessment of the number of discrepancies between the discharge prescription and the dispensed medicines in the community pharmacy. [D-1]
- Analysis of the number and type of interventions performed by the community pharmacists filling the hospital discharge prescription. [D-1]
- Development of an algorithm that enables the identification of medication discrepancies and medication duplications in community pharmacies. [D-2]
- Assessment of the feasibility of the electronic medication reconciliation tool by adding different case studies of three Anatomical Therapeutic Chemical (ATC) subgroups C01, C03 and C10 followed by a second feasibility assessment evaluating different case studies including all ATC groups. [D-2]
- Investigation of the safety, efficiency, effectiveness and satisfaction of the electronic medication reconciliation tool. [D-2]

Overview of the projects:

Project A

The first project aimed to obtain an overview of different pharmacist-led cognitive services **(Project A-1)** with a special focus on medication reviews **(Project A-2)** across Europe regarding availability, level of implementation and remuneration. An online survey including 21 different pharmacist-led cognitive services and the associated definitions of the services was developed and piloted by a multinational team. In the study, participants from 34 different European countries (ranging from one to three persons per country with working backgrounds in community pharmacy, pharmacy practice research, or health policy) completed the survey. In **Project A-1**, pharmacist-led cognitive services with the widest dissemination were the provision of medicines' information (94.1%), generic substitution (85.3%), provision of emergency oral contraception (70.6%) and point-of-care testing (67.7%). Focusing on medication reviews **(Project-A2)**, 55.9% of the countries provided at least one type of medication review (according to the definition and classification of Pharmaceutical Care Network Europe) as an implemented service or project. There was great heterogeneity in the availability, level of implementation and remuneration of investigated pharmacist-led cognitive services across Europe.

Project B

Project B-1 aimed to assess the frequency and types of medication discrepancies identified by pharmacy students comparing the best possible medication history (compiled during a type 2a medication review) with medication prescriptions in community pharmacies in Switzerland and the potential clinical and economic impact of the identified medication discrepancies. Overall, 116 patients (mean age 74 ± 10.3 years) with an average of 10.2 (± 4.2) medications were analysed and 317 discrepancies were identified. The most frequent discrepancy type was related to "strength and/or frequency and/or number of units of dosage form and/or the total daily dose". Although the majority of discrepancies were rated as inconsequential (55.2%) on patients' health conditions, the remainder had a potential moderate (43.2%) or severe impact (1.6%). Focusing on the economic impact, in 49.5% of the discrepancies, patients' medication cost less than the prescribed medication.

In **Project B-2** we focused on a specific type of medication discrepancy: medication substitution. **Project B-2** aimed at assessing patients' awareness of generic medications in their therapy, perception of specific aspects, and attitudes towards generic medication and substitution. Pharmacy students performed systematic interviews in adult patients with ≥4 medications, including ≥1 generic medication and ≥1 medication from the ATC main group C (cardiovascular system), prescribed for at least 3 months. A total of 136 patients (median age 74 years [49-91 years], 58.8% male) were interviewed by pharmacy students and they had an average of 9.9 ± 4.0 prescribed medications. More than a quarter (27.9%) of these patients were not aware of using at least one generic medication. Overall, 26.4% of the prescribed medications were eligible for medication substitution but were not substituted. Out of the 15 different medication aspects, the cost was the most commonly reported advantage of generic medications (n = 120) whereas the taste of generic medication was most frequently reported as a disadvantage (n = 42).

Project B-3 aimed to evaluate the medication discrepancies identified by pharmacy students in adult patients (with ≥4 medications taken for ≥3 months) discharged from the hospital whose discharge prescription was filled in their regular community pharmacy. They compared the medication of the discharge prescription to the patients' pre-admission medications compiled during the type 2a medication review. A total of 51 patients (74.1 ± 15.6 years) were included and the patients had an average of 13.5 ± 5.2 prescribed medications prior to hospital admission and 11.0 ± 4.5 medications on the discharge prescription. Overall, the pharmacy students identified 557 medication discrepancies and 98.0% of the patients had at least one medication omission or commission.

Project C

Project C-1 aimed to assess whether DRPs identified on discharge prescriptions in a hospital's community pharmacy (with full access to the hospital's electronic health records) would be detectable in a community pharmacy by simple medication reviews based on the patient's medication history only, or if intermediate or advanced medication review with additional clinical and/or patient-specific information would be needed. In addition, it was assessed whether the resolution of the DRPs that were deemed detectable by a simple medication review would require a consultation with the prescriber. Between June 1, 2016, and May 31,

2019, 6087 prescriptions were filled in the hospital community pharmacy by patients from the internal medicine unit. In total, 1876 DRPs were identified among 1352 different prescriptions, 23% (n = 438) were caused by reconciliation problems at hospital admission and 73% (n = 1367) by prescribing problems during the hospital stay or at discharge. Overall, 71.6% of DRPs led to a modification of the discharge prescription. The retrospective assessment showed that community pharmacists conducting simple medication reviews (based on discharge prescriptions and medication history only) would be able to detect 1115, whereas for the detection of the remaining DRPs, additional clinical and/or patient-specific information is needed. In 944 DRPs detectable by simple medication reviews, the pharmacist would need to consult the prescriber for their resolution.

Project D

In 2015, a federal law was passed by the Swiss Federal Parliament requiring the implementation of electronic health records in the Swiss health care system to enable cooperation and data sharing between different health care providers, with the intention of improving the quality of patient care and efficiency of the Swiss health care system. **Project D-1** aimed to assess the acceptance and satisfaction of patients, community pharmacists, physicians and caregivers with the electronic medication list, which is part of the electronic health record. Furthermore, this project aimed to investigate the number of discrepancies between the discharge prescription and the medication actually dispensed in the community pharmacy after hospital discharge, as well as the number and type of pharmaceutical interventions performed by the community pharmacists filling the hospital discharge prescriptions. During the pretest of the electronic medication list and the eHealth platform, the research team identified multiple problems and bugs by entering different fictional persons to the eHealth platform and by testing the electronic medication list application. The identified patient safety and usability problems and bugs were listed and transmitted to the provider for further improvement. Between July and November 2017, iterative rounds were needed to improve the eHealth platform and, in particular, the application for the electronic medication list. Afterwards, the research team decided to perform a pilot study recruiting patients during one month to assess the feasibility of the study design and to optimize the study processes. Unfortunately, the project was discontinued after

one year because the Swiss Post abandoned the provision of their electronic medication list application provided for the evaluation in the present project in 2018. Therefore, **Project D-1** reports the methods of the planned usability study and the methods and results of the performed pilot study.

Medication reconciliation is a labour- and resource-intensive activity, therefore **Project D-2** aimed to develop and evaluate an electronic medication reconciliation tool for community pharmacies supporting the identification of medication discrepancies and medication duplications. Initially, a set of requirements was compiled through a pragmatic literature search and an algorithm for the development of an electronic medication reconciliation tool was designed, based on different national and international coding systems. The feasibility testing and piloting of the first version of the electronic medication reconciliation tool showed that in 76.5% of the case studies the output of the electronic tool was confirmed by two pharmacists of the research team. The subsequent feasibility testing and evaluation of the electronic medication reconciliation tool will be performed beyond this thesis.

Conclusions

The following conclusions can be derived from the different projects in this thesis:

Project A – Pharmacist-led cognitive services with a focus on medication review procedures across Europe

- There was great heterogeneity in the availability, level of implementation and remuneration of investigated pharmacist-led cognitive services across Europe, with some countries standing out as early adopters, leading the way and serving as examples for other countries.
- The research team was aware that the definition of specific terms used in surveys across language and national borders is pivotal because the responders' personal perceptions (influenced by the language, culture, and daily practice) affect the responses and lead to insufficient comparability of responses across different regions and countries. The development of transnational surveys by an international team and piloting with multiple experts from different countries help to identify deficiencies in the survey regarding the definition and perception of central terms used in the survey.
- The inclusion of multiple individuals per country and the consensus-seeking process in a survey assessing country-specific information is a suitable method to ensure credible data.

Project B – Identification of medication discrepancies in community pharmacies

- Numerous medication discrepancies were identified by the performance of systematic medication reconciliation in patients with polypharmacy in community pharmacies in Switzerland. Community pharmacists should be encouraged to reconcile patients' medication systematically at each encounter to identify and resolve medication discrepancies impeding optimal medication therapy.
- Generic substitution is responsible for numerous medication discrepancies at care transitions. Health care professionals should be aware of these discrepancies and counter patients' lack of knowledge about their generic medications to avoid medication errors. Moreover, most of the aspects differing between brand name and generic medications were not relevant for the majority of the study patients. Therefore, health care professionals should not hesitate to recommend generic medication and

therefore strengthen efforts in achieving higher rates of generic substitution through patient counselling and shared decision making to decrease general health care costs.

Project C – Detection and resolution possibilities of DRPs in patients at hospital discharge in Swiss community pharmacies

- Systematic medication reconciliation and medication reviews of the hospital medication and patients' home medication are indispensable prior to hospital discharge to identify and resolve potential DRPs, to ensure an accurate medication prescription and to continue an optimal medication therapy after hospital discharge.
- The documentation of the intentional medication changes in the discharge prescription and patient medication list might help patients and all subsequent health care providers to identify and implement the intended medication changes after hospital discharge. Furthermore, this documentation might reduce the need for prescriber consultations by subsequent health care professionals, which saves the resources and time of all involved actors in the health care sector.
- The ability to identify DRPs is strongly influenced by the extent of different information sources available to pharmacists at hospital discharge. The vast majority of community pharmacists in Switzerland have no access to clinical patient information (e.g. diagnosis, laboratory values) and discharge summaries. Therefore, community pharmacists might not identify all DRPs in the patient's medication after hospital discharge. Moreover, community pharmacists' lack of clinical information limits plausibility checks of medication changes and medication appropriateness after discharge and triggers further consultations with the prescriber for clarification.
- The performance of simple medication reviews enable detection of approximately 60%, a majority of these DRPs would require contact with the prescriber for resolution. This is facilitated when the medication reconciliation and review activities take place in close collaboration with or at least in the vicinity of the prescriber, which might also have a positive effect on the communication and acceptance of the pharmacist's recommendations.

Project D – Electronic health records and electronic medication reconciliation in Switzerland

- A participatory action research approach with the integration of end-users with different working backgrounds (e.g. patients, physicians, pharmacists, nurses, physiotherapists) in all development phases might prevent problems with electronic health records and novel electronic medication applications. Furthermore, electronic health records need comprehensive evaluation prior to their introduction in the Swiss health care system to identify and resolve the safety and usability issues of this novel application.
- The development of an electronic tool supporting medication reconciliation needs close cooperation between the different actors of the development team and multiple interim evaluations to identify and subsequently overcome the safety and usability issues of the novel tool.

Outlook

According to the results and conclusions of this thesis, the recommendations for pharmacy practice and future research are:

Project A – Pharmacist-led cognitive services with a focus on medication review procedures across Europe

- The identification of facilitators for and barriers to the successful implementation of specific pharmacist-led cognitive services should be analysed in order to help further countries to initiate and implement specific cognitive services. This analysis should also include characteristics of the country-specific health care systems (accessibility of clinical and patient-specific information, legal barriers, and general health care structure).
- The repetition of the survey assessing the availability, implementation and remuneration of pharmacist-led cognitive services across Europe in the coming years will lead to an update and illustrate the progress of the pharmacist-led cognitive services in primary care across Europe.

Project B – Identification of medication discrepancies in community pharmacies

- The performance of systematic medication reconciliation **(Project B-1 and B-3)** in the community pharmacy led to the identification of numerous medication discrepancies between the patient's home medication and the medication prescriptions. In the daily community pharmacy practice, there are no specific tools (paper-based or electronic) supporting Swiss community pharmacists in the performance of systematic medication reconciliation. Therefore, the development and evaluation of such a tool (e.g. checklist, electronic application) supporting pharmacists in the performance of systematic medication reconciliations in community pharmacies is desirable for the future.

Project C – Detection and resolution possibilities of DRPs in patients at hospital discharge in Swiss community pharmacies

- The assessment of the relevance of the identified DRPs by an interdisciplinary team including hospital and community pharmacists, hospital physicians, and general practitioners would help to prioritize pharmaceutical interventions within the hospital and community pharmacy setting.
- The development of a checklist for the management of patients at hospital discharge (based on the results of **Project C-1**, the literature, and a Delphi survey) could support hospital and community pharmacists in the performance of systematic medication reconciliation and medication reviews in patients at hospital discharge.
- To date, the vast majority of the community pharmacies in Switzerland do not have routine access to clinical patient information (e.g. diagnoses, laboratory values) and they are therefore limited in their ability to identify DRPs. The implementation of the EHR in Switzerland helps to overcome this gap when patients share their EHR with community pharmacists. However, it should be taken into account that patients can restrict specific parts of their EHR (e.g. information regarding mental health) or the information is not up-to-date, which poses a risk for clinical decision making of health care professionals based on incomplete/incorrect information.

Project D – Electronic health records and electronic medication reconciliation in Switzerland

- The development, feasibility and evaluation are the initial phases of the Medical Research Council framework for the development of pharmacy practice interventions followed by the implementation of the intervention, which includes the dissemination, surveillance/monitoring, and the long-term follow-up of the intervention. The implementation of the electronic medication reconciliation tool in the routine practice of community pharmacy should not be neglected because a high implementation and dissemination is a precondition to enable as many patients as possible to benefit from this novel tool. Different facilitators and barriers should be considered for the implementation process of the medication reconciliation procedure in routine practice.

5. General introduction

5.1. Patient safety in health care

Patient safety is an important topic for the World Health Organization (WHO). In 2017, the WHO launched the third Global Patient Safety Challenge entitled "Medication Without Harm" because medication errors and unsafe medication practices can lead to patient harm and enormous costs for health care systems worldwide. [1]

> *"**Patient safety** is the absence of preventable harm to a patient during the process of health care and reduction of risk of unnecessary harm associated with health care to an acceptable minimum. An acceptable minimum refers to the collective notions of given current knowledge, resources available and the context in which care was delivered weighed against the risk of non-treatment or other treatment. Every point in the process of care-giving contains a certain degree of inherent unsafety."* - WHO [2]

Estimates show that four patients out of ten are harmed by safety lapses in the primary care setting and that the majority (up to 80%) of this harm can be prevented. [3] The global costs related to medication errors are estimated at $42 billion per annum. [1] Due to the fact that each individual will take medication, at some point in their lifetime, to prevent or treat a disease, the WHO aims to maximize the benefit of medication and prevent patients from medication harm. [1]

5.2. Pharmaceutical care and continuity of patient care

> *"**Pharmaceutical care** is the pharmacist's contribution to the care of individuals in order to optimize medicines use and improve health outcomes".* - Pharmaceutical Care Network Europe (PCNE) [4]

The improvement of health outcomes and the optimization of medicine use by the contribution of pharmacists are the aims of pharmaceutical care. [4] The outcomes defined by Hepler and Strand are "1) cure of a disease, 2) elimination or reduction of patient's symptomatology, 3) arresting or slowing of the disease process, 4) preventing a disease or symptomatology." [5] Pharmaceutical care is based on a network of different actors including the patient, pharmacist, and other health care providers aiming to formulate, implement, and supervise a therapeutic plan that produces specific patient-related therapeutic outcomes. [5] Figure 1 presents the pharmaceutical care process consisting of five different activities.

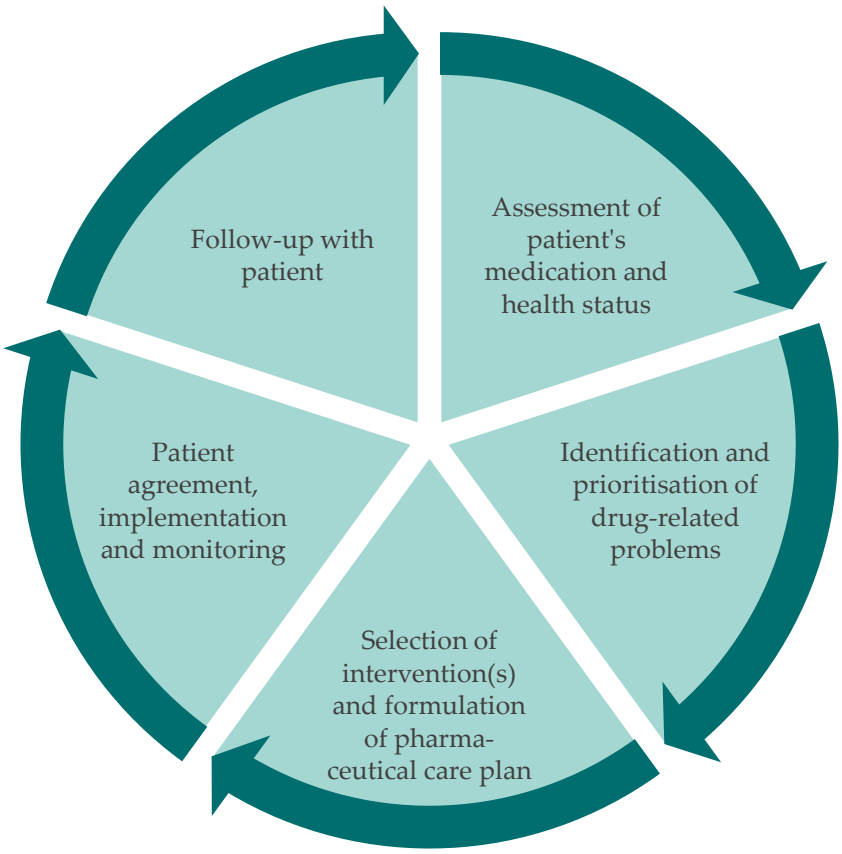


Figure 1: Pharmaceutical care process [6]

The risk of occurrence of errors can be increased by the inclusion of multiple individuals in patient care, as a result of service provision from different health care institutions (e.g. in primary, secondary, tertiary care), different levels within the same health care institution (e.g. intensive care unit, hospital ward), and different health care professionals (e.g. physicians, pharmacists, nurses). [7]

Continuity of patient care is *"health care provided on a continuing basis from the initial contact, following the patient through all phases of medical care"*. - Medical Subject Heading (MeSH) [8]

The continuity of patient care between different settings and levels within a single setting should be ensured, but the individual health care professionals often provide care to patients without knowledge of previous or subsequent medical treatment. [7, 9, 10]

In 2003, Coleman and Boult published a position statement with a set of five activities to ensure the coordination and continuity of patient care [7]:

(1) inclusion of patients and caregivers in the process of the design and execution of the transitional care plans
(2) bidirectional communication between health care professionals (sending and receiving of health information)
(3) promotion of high-quality transitional care by policymakers
(4) education of health care professionals in the provision of transitional care
(5) performance of research in the area of transitional care to improve processes.

Focusing on the effect of specific interventions targeting improvement in the continuity of patient care between different health care settings and providers, a systematic review strongly indicates that especially older people discharged from the hospital to home will benefit from interventions targeting the transition of care. [11] These interventions encompass health care profession-oriented interventions (education and training), organizational interventions (e.g. discharge protocols, standardized discharge letters, medication reconciliation, discharge planning, transfer nurses or coaches), and patient- and relative-oriented interventions (patient empowerment and family involvement). [11]

5.3. Drug-related problems, adverse drug events, adverse drug reactions, and medication errors

Patients who take medication risk developing drug-related problems (DRPs). Numerous patients are affected by DRPs because they are widely disseminated in various health care settings. [12-19]

> *"A **Drug-Related Problem** is an event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes."* - PCNE [20]

A randomized controlled trial in adult patients with polypharmacy (≥4 medicines) for a minimum of 3 months, obtaining a pharmacist-led medication review in community pharmacies in Switzerland, identified 258 DRPs (n = 218 patients, 1.18 DRPs per patient). [21] Overall, 58% of these DRPs were assessed as potential problems and 42% as actual problems. The two most frequent types of DRPs were lack of medication adherence to at least one

medication (26.7%) and insufficient patient knowledge enabling safe and effective medication use (19.4%). [21]

It is important to differentiate between different natures of DRPs: they can be preventable or non-preventable, potential or actual, caused by an idiopathic reaction to a correct medical intervention, or by an error. [22] Therefore, DRP is an umbrella term, including a wide range of problems associated with medication therapy, entailing adverse drug events (ADE), adverse drug reactions (ADR) and medication errors. [23]

Adverse drug event is *"any untoward medical occurrence that may present during treatment with a pharmaceutical product but which does not necessarily have a causal relationship with this treatment."* - Edwards I.R. and Biriell C. [24]

The symptom of dizziness in patients with concurrent medication therapy is an example of an ADE because dizziness can be triggered not only by the medication therapy, but also by various other factors (e.g. migraine, fluid and electrolyte disorders, alcohol intoxication or withdrawal, anaemia). [25, 26] The previous example shows that there is not necessarily causality between the symptom and medication therapy.

Adverse drug reaction is *"a response to a drug which is noxious and unintended, and which occurs at doses normally used in man for prophylaxis, diagnosis, or therapy of disease, or for the modification of physiological function."* - WHO [27]

ADRs are unintended events such as side effects or allergic reactions due to a medication therapy [28], for example, the occurrence of Stevens-Johnson syndrome due to an adequate dose of allopurinol.

Medication errors are *"Errors in prescribing, dispensing, or administering medication with the result that the patient fails to receive the correct drug or the indicated proper drug dosage."* - MeSH [29]

It is important to differentiate between medication errors leading to undesired and clinically significant patient responses and those medication errors that do not reach the patient because they are detected and corrected at an early stage. [30] In 2016, the WHO listed several domains and key factors associated with medication errors. The domains encompass health care professionals, patients, work environment, tasks, medications, computer systems, and the transitions between primary and secondary care. Some examples of key factors are the absence

of therapeutic training, the accuracy of patient records, the lack of resources, and the name/labelling/packaging of medications. [31] In addition, the WHO suggested potential solutions to reduce medication errors and increase patient safety such as medication reviews and medication reconciliation, computerized information systems, education of health care providers and patients, and complex interventions including more than one intervention to overcome these issues. [31]

The terminology of medication harm including the previously mentioned terms (DRPs, ADEs, ADRs, and medication errors) used in the literature is illustrated by various models and definitions; however, these models and definitions are inconsistent and a consensus regarding medication harm terminology is needed. [30]

5.4. Pharmacist-led cognitive services

*A **pharmacist-led cognitive service** is a service provided or supervised by the pharmacist, based on a standardized and structured procedure, to promote optimal health and medicine therapy that is not necessarily medicine/product related.* - adapted from Nutescu E.A. and Klotz R.S. [32]

The daily practice of pharmacists has changed from a vendor of medication and producer of extemporaneous formulations to more patient- and care-focused practice through the introduction of pharmaceutical services in recent years. [5] Since then, numerous pharmacist-led services have been introduced worldwide. [33-35] Community pharmacists in Europe perform a variety of services such as home care services, medication reviews, new medicine services, measurement and testing services (blood pressure, blood glucose, body weight, cholesterol), disease management services, medication administration services, and smoking cessation services. However, some of these services are rarely implemented across Europe. [36] A survey obtaining responses from 19 different European countries reported that medication dispensing, smoking cessation and medication waste management were the most widespread services. The authors of this survey concluded that legal frameworks and remuneration issues affect service availability in community pharmacies in these countries. [37] Chan and colleagues reported that the large-scale implementation of pharmacist-led cognitive services, which were developed in connection with health research studies, is restricted, due to a deficiency in service remuneration. [33] Nevertheless, most of the

previously reported studies provide limited information on the implementation rate and remuneration of these services, focusing rather on general availability.

5.5. Medication review

Medication review is a widely disseminated service among pharmacist-led cognitive services. [34, 35, 37-40] In 2011, Bulajeva and colleagues [39] investigated medication review practices in different settings (community setting, hospital setting, nursing home setting) across Europe by the performance of an online survey. Individuals from 25 different European countries participated in this study and 16 (64%) countries were reported to have established medication review procedures. [39] In these 16 European countries, they provided medication review procedures either in a single setting (n = 5) or in multiple settings (n = 11). Medication review procedures in the community setting existed in 13 different countries at that time. [39] Furthermore, the authors [39] distinguished between three different types of medication reviews performed in the community setting according to clinical comprehensiveness of the review, namely prescription review, adherence and compliance review, and clinical medication review. This medication review classification used by Bulajeva and colleagues [39] was adapted from Clyne et al. [41].

The performance of pharmacist-led medication reviews shows positive effects on the attainment of clinical biomarkers, number of medications prescribed, patient satisfaction, number of DRPs, patient knowledge about the medication, medication adherence, storage problems, number of unnecessary medications, and costs. [42, 43] Jokanovic and colleagues [38] observed similar results in different systematic reviews focusing on medication reviews performed specifically in the community setting. Nevertheless, the impact of medication reviews on hospitalization was inconsistent, and no effect on mortality was demonstrated by the performance of medication reviews in the community setting. [38] It is important to note, however, that hard outcomes such as hospitalization and mortality are frequently not the key focus of medication review studies. [38] Furthermore, these hard outcomes are influenced by multiple factors and medication review interventions are only one factor among others. [38] The variation of care delivery and patient selection between studies, assessing the effect of medication reviews in older people, might be other factors causing a lack of benefit in systematic reviews and meta-analysis. [43] Similarly, pharmacist-led medication reviews are

complex pharmaceutical interventions with various definitions, procedures, and aims, therefore the comparison of studies and outcomes investigating pharmacist-led medication review interventions is challenging. [38, 42, 43] In 2016, the PCNE presented a definition for the term "medication review" to contribute to a general understanding of this term.

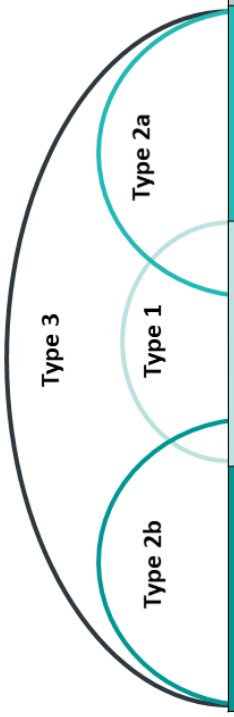
> *"**Medication review** is a structured evaluation of a patient's medicines with the aim of optimising medicines use and improving health outcomes. This entails detecting drug-related problems and recommending interventions."* - PCNE [44]

Additionally, the PCNE published a classification for the different levels and types of medication reviews based on the available information (Table 1). [44]

Table 1: PCNE classification of medication reviews with the according sources of information [44]

Type of medication review		**Available information**		
Type	**Level**	**Medication history**	**Patient interview**	**Clinical data**
Type 1	Simple	✓		
Type 2a	Intermediate	✓	✓	
Type 2b	Intermediate	✓		✓
Type 3	Advanced	✓	✓	✓

Depending on the degree of information available during the performance of medication reviews, different types of DRPs can be detected (Figure 2). [44]



Information available	Drug-related problems detectable by medication review
Patient interview	• Adherence → difficulty to use dosage form, irrational use • Incorrect instruction, need of drug information • Adverse drug reactions • Some aspects of effectiveness (e.g. pain)
Medication history	• Drug-drug interactions/duplications • Contraindications because of age/gender, inappropriate drugs (e.g. Beers Criteria) • Duration, dose, dosing time and dosing interval (indication for under-prescribing) • Drug cost • Derived indication → some contraindications • Adherence (partly)
Clinical patient information	• Untreated conditions → indication without drug • Validity of indications → drug without indication • Response to therapy → effectiveness • Drug doses against indication • Contraindications (against e.g. renal function, allergy) • Adverse drug reactions

Figure 2: Different types of medication review and the corresponding detectable DRPs (adapted from [45])

The initial step of each medication review is the comparison of medication information from different information sources, to get a complete and correct medication list for the critical evaluation of the medication therapy. Therefore, medication reconciliation is typically the first activity of each medication review. [44]

5.6. Medication reconciliation and medication discrepancies

Health care professionals should ensure that they have accurate information about the patient's current home medication at each encounter in patient care. [46] If this is not the case, they will base their clinical decisions on incorrect information, which may pose a risk for errors and consequently for patient safety. [47, 48] In the optimal situation, health care professionals would perform medication reconciliation at any patient transition to obtain an accurate and complete list of the patient's current home medication at any time (Figure 3). [49]

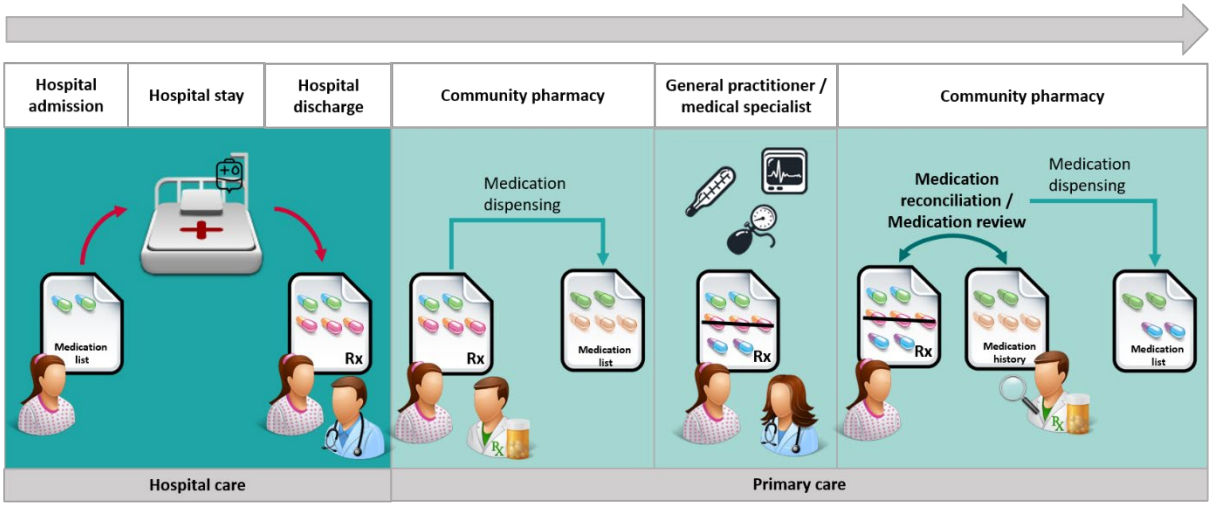


Figure 3: Care transitions between hospital and primary care settings - Medication reconciliation and medication discrepancies (Rx = prescription)

Different patient safety organizations worldwide support the performance of medication reconciliation [50-53], but no internationally accepted definition for the term "medication reconciliation" exists. Consequently, different definitions have been used by these organizations [50-53] and also in the literature [54]. Nevertheless, the core element of comparing medication information from different information sources to obtain an accurate and complete list of the medications a patient is taking was included in all definitions. In 2019, Penm and colleagues [55] published a consensus definition for "medication reconciliation" by performing a modified Delphi process including 24 international experts in the field of medication reconciliation from 16 different countries.

Medication reconciliation is *"the process of creating the most accurate list possible of all medications a patient is taking and comparing that list against the prescriber's orders. In addition, the patient's allergies, history of side effects from medications and medication aids are listed with the goal of providing correct medication to the patient at all transition points within the health care system."* - Penm J. et al. [55]

The medication reconciliation process encompasses three steps [51]:

- **Compilation of** an accurate and complete **best possible medication history** (BPMH) including medication name, dosage, route, and frequency based on at least two reliable sources of information (e.g. interview with patient/relatives, medication dispensing record, medication packaging, medication administration records of the referring health care facilities, community pharmacy records)
- **Reconciliation of medication**: Comparison of the BPMH to admission, transfer, discharge order, or creation of an admission order based on the BPMH. Identification and resolving of any differences and discrepancies.
- **Documentation and communication of** any subsequent medication changes to the patient/caregiver and to following health care providers.

Medication discrepancies are *"any differences in the prescribed drug, dose, route, or frequency noted among the sources of documentation"*. - Tjia J. et al. [56]

Medication discrepancies identified between different sources of information are either intentional or unintentional. A change in a patient's medication caused by an intentional decision of a prescriber by adding, modifying, or removing a medication, is called "intentional medication discrepancy". An "unintentional medication discrepancy" is when a prescriber unintentionally changes the patient's medication. [51] Unintentional medication discrepancies are medication errors, which can result in ADEs. [51]

Medication discrepancies are frequent at hospital admission (occurring in up to 67% of patients) [57] and discharge (up to 80% of patients) [58] because a hospital stay is associated with various changes in a patient's medications and might, therefore, lead to intentional and unintentional medication discrepancies in a patient's medication [59-61]. Several studies investigated the effect of medication reconciliation interventions at hospital transitions. [59, 62-67] A meta-analysis including 17 studies indicates that medication reconciliation programmes performed by pharmacists at hospital transitions reduce all-cause readmission, emergency department visits, and ADE-related hospital readmissions. [62] However, the impact of medication reconciliation on mortality is inconclusive. [62] Medication discrepancies can also arise in the outpatient setting, e.g., at transitions between care homes, community pharmacies, primary care physicians, medical specialists, or even without any transitions

when the patient is taking the medication differently than prescribed. [68-70] However, studies focusing on pharmacist-led medication reconciliation and medication discrepancies occurring in the outpatient setting are scarce. In the following, two examples of studies focusing on pharmacist-led medication reconciliation in outpatients are outlined. In the first study, pharmacy students performed medication reconciliation in patients waiting for their physician in a family medicine outpatient centre in the United States. [68] They identified 1783 medication discrepancies (an average of 3.2 medication discrepancies per patient) in 557 patients by comparing the electronic health records and the patient-reported medication regimens. [68] The second study analysed the number of medication discrepancies identified by clinical pharmacists comparing patients' home medications and the documentation of the primary care physician in 142 elderly patients. [69] Over 90% of the investigated patients had at least one medication discrepancy (an average of 2.8 medication discrepancies per patient). [69]

Focusing on the types of medication discrepancies, the omission of medication at care transitions is the most frequently occurring type reported in different systematic reviews. [57, 71, 72] Other commonly observed types of medication discrepancies are discrepancies in the dose or frequency of medication [57, 72-74], and the commission of a medication without indication [57, 74]. Medication duplication [49, 73, 74] and medication substitution [75, 76] are further causes for medication discrepancies although the latter may, for example, occur due to indicative or mandatory generic substitution in community pharmacies [77], or due to hospital formulary restrictions, which lead to the substitution of medication on admission, with a lack of switching back to the patient's home medication at hospital discharge. [78, 79] Medication substitution can lead to patient confusion and also duplication of medication intake at home. [79] Medication substitution is also a common practice in the Swiss health care system. [80] A medication reconciliation study performed in a Swiss hospital identified medication substitution as the most common type of medication discrepancy at discharge (49%), followed by the omission of a medication (26%). [75] In contrast, at hospital admission the most common type of medication discrepancy, in this study, was the omission of a medication (33%), followed by a discrepancy in the dose (25%). [75]

Another important aspect is the differentiation between medication reconciliation and medication review. [44, 55] Penm and colleagues, for example, recognised in their Delphi

study on the definition and identification of medication reconciliation concepts that some medication management experts believed that the review of patient's full medication with regard to appropriateness is also part of the medication reconciliation whereas others did not. [55] However, the international experts who defined the terms "medication review" [44] and "medication reconciliation" [55] concluded that medication reconciliation consists of obtaining the BPMH whereas medication review consists of reviewing the adequacy of all prescribed medication and identifying medication lacking in the patient's treatment. These two activities are therefore not the same but often occur simultaneously.

5.7. Electronic medication reconciliation

The performance of medication reconciliation is a laborious and resource-intensive procedure [81, 82] because the patient's entire medication information has to be compiled and verified from different information sources [82]. The median time reported for the performance of medication reconciliation at hospital admission is 15-24 minutes per patient. [59, 74, 83] In comparison, the medication reconciliation at hospital discharge needs an average of 18-28 minutes per patient. [75, 84] Kennelty and colleagues [85] interviewed 10 community pharmacists regarding facilitators and barriers when reconciling the medication of patients after hospital discharge. The community pharmacists reported that medication reconciliation is difficult and time-consuming. [85] The main factors affecting the medication reconciliation procedure on the organizational level are the resources of the pharmacy, the communication at hospital discharge, and the hospital resources. [85] Pharmacists indicated that the electronic transfer of information (e.g. electronic prescribing or electronic medication records) would simplify the medication reconciliation process. [85]

A scoping review focusing on the use of information technology (IT) in medication reconciliation reported that IT is used to facilitate medication reconciliation processes, ranging from simple emails to specialized electronic tools supporting the medication reconciliation process. [86] Focusing more on specialized medication reconciliation tools, a systematic review by Mekonnen and colleagues [71] evaluated the effectiveness of medication reconciliation procedures assisted by an electronic tool in reducing medication discrepancies at hospital care transition. The support of electronic tools in the medication reconciliation activities reduced the frequency of medications with unintentional discrepancies over all reconciled

medications. [71] In contrast, these tools only partially minimized other outcomes, namely the average number of medication discrepancies per patient and the proportion of patients with medication discrepancies at hospital transitions. [71] The authors mentioned that the absence of well-established studies prevented them from concluding the non-existence of an effect. [71] Focusing on the setting, multiple studies reported on electronic medication reconciliation efforts in the hospital setting [87-92] whereas studies in the outpatient setting are rare [46, 93]. Nonetheless, for the continuity of the patient's medication therapy after discharge, medication reconciliation needs to be maintained in the primary care setting. [93] Taking all this evidence together, there seems to be a need for a tool to assist community pharmacists in the performance of medication reconciliation thus improving the efficiency and accuracy of the medication reconciliation processes.

5.8. Electronic health records

Electronic health records (EHRs) are *"real-time, patient-centred records that provide immediate and secure information to authorized users. EHRs typically contain a patient's medical history, diagnoses and treatment, medications, allergies, immunizations, as well as radiology images and laboratory results."* - WHO [94]

The worldwide adoption of national electronic health record systems has increased in recent years. [94] The results of a worldwide survey on eHealth (Electronic Health) conducted by the WHO in 2015 showed that nearly half (n = 57, 47%) of the replying member states reported having established a national electronic health record system. [94]

Theoretical advantages and risks linked to EHRs are mainly related to the management and storage functionalities of electronic health data. These functionalities include "accessibility, legibility, searchability, manipulation, transportation, sharing, and preservation of electronic data". [95] In Switzerland, hospitals are required to adopt interoperable electronic health records by 2020 and nursing homes by 2022, although the adoption of these records by other health care providers (e.g. general practitioners, community pharmacists) is voluntary. [96] Swiss citizens need to authorize health care providers to enable access to their electronic health records and they are able to determine which data of their electronic health record will be shared with other health care professionals (e.g. only pharmaceutical records). [96]

5.9. Rationale and approach

The goals of this thesis are to assess different aspects of pharmacist-led cognitive services in Europe with a focus on medication review procedures, to evaluate medication discrepancies and drug-related problems identified by systematic medication reconciliation in community pharmacies, and to develop an electronic medication reconciliation tool for community pharmacies. These goals are approached with four main projects.

5.9.1. Project A - Pharmacist-led cognitive services with a focus on medication review procedures across Europe

The role of pharmacists moved from product-oriented towards patient-centred care practice and numerous pharmaceutical services have been introduced since the 1990s. **Project A-1** aimed to give an overview of the availability, implementation and remuneration of 21 different pharmacist-led cognitive services in primary care in Europe by the performance of an online survey. In 2016, PCNE presented a definition for the term "medication review" to contribute to a general understanding of this term. Therefore, the second part of the online survey (**Project A-2)** aimed to explore the availability, characteristics, level of implementation and remuneration of pharmacist-led medication review procedures across Europe, considering the definition and classification of PCNE.

5.9.2. Project B - Identification of medication discrepancies in community pharmacies

In performing medication reviews, pharmacists should base their evaluation on a complete and correct medication list. Therefore, the initial part of any medication review is medication reconciliation to obtain the BPMH. **Project B-1** and **Project B-3** aimed to assess the frequency and types of medication discrepancies identified by pharmacy students comparing the best possible medication history (compiled during a type 2a medication review in the community pharmacy) with medication prescriptions in community pharmacies in Switzerland. A frequent type of discrepancy between medication lists is the difference in the name of a medication caused by generic or therapeutic substitution. Medication substitution is a risk for confusion, non-adherence, and duplications. **Project B-2** aimed to assess patients' attitudes towards generic medications using a structured patient interview.

5.9.3. Project C - Detection and resolution possibilities of DRPs in patients at hospital discharge in Swiss community pharmacies

The medication therapy of a patient can undergo multiple changes during a hospital stay. These changes are a potential risk for the development of DRPs. Depending on the degree of information available to the pharmacists for the medication review, different types of DRPs are detectable. First, **Project C-1** aimed to assess whether DRPs identified on discharge prescriptions in a hospital's community pharmacy (with full access to the hospital's electronic health records) would be detectable in a community pharmacy by simple medication reviews based on the patient's medication history only, or if intermediate or advanced medication review with additional clinical and/or patient-specific information would be needed. Nonetheless, the identification of DRPs is only one part of the process. In addition, pharmacists need to clarify and resolve DRPs, either by themselves or in collaboration with the prescriber. Second, **Project C-1** aimed to evaluate whether the resolution of the DRPs that were deemed detectable by a simple medication review would require a consultation with the prescriber.

5.9.4. Project D - Electronic health records and electronic medication reconciliation in Switzerland

Medication reconciliation is a resource-intensive and time-consuming activity. The use of information technology (ranging from emails to specialized electronic medication reconciliation tools) might facilitate medication reconciliation activities. **Project D-1** aimed to evaluate the acceptance and satisfaction of patients, community pharmacists, physicians and caregivers at hospital discharge with the electronic medication plan as part of the newly developed electronic health record system in Switzerland. Furthermore, **Project D-1** aimed to assess the number of discrepancies between the discharge prescription and the dispensed medicines in the community pharmacy and to analyse the number and type of interventions performed by the community pharmacists filling the hospital discharge prescription. In **Project D-2,** the focus was put on medication reconciliation tools specifically developed to help health care professionals to compare the best-possible medication history to admission, transfer, discharge orders and to resolve medication discrepancies. In this project [D-2], the aim was to develop and evaluate an electronic medication reconciliation tool incorporated into community pharmacy software to facilitate the medication reconciliation process.

5.10. Project synopsis

Project A - Pharmacist-led cognitive services with a focus on medication review procedures across Europe	
A-1	**A survey to assess the availability, implementation rate and remuneration of pharmacist-led cognitive services in Europe** Publication (second author) in *Research in Social and Administrative Pharmacy.* 2020; 16.1:41-47 [97] • To review the implementation of pharmacist-led cognitive services performed in primary care across Europe and the associated remuneration models.
A-2	**Community pharmacist-led medication review procedures across Europe: Characterization, implementation and remuneration** Publication in *Research in Social and Administrative Pharmacy.* 2020; 16.8:1057-1066 [98] • To describe the characterization of the different types of medication review services and projects available, the level of implementation and remuneration in community pharmacies, considering the PCNE definition.
Project B - Identification of medication discrepancies in community pharmacies	
B-1	**Medication discrepancies in community pharmacies in Switzerland: identification, classification, and their potential clinical and economic impact** Publication in *Pharmacy*. 2020; 8.1:36 [99] • To identify, characterize, and categorize medication discrepancies occurring in adult community pharmacy customers with long-term polypharmacy use. • To assess the potential clinical and economic impact of the identified medication discrepancies.
B-2	**Attitudes of patients with polypharmacy towards generic medications in Switzerland** Project report • To assess patients' awareness of generic medications in their therapy, perception of specific aspects, and attitudes towards generic medication and substitution.
B-3	**Evaluation of medication discrepancies identified in patients after hospital discharge in the community pharmacy** Project report • To evaluate medication discrepancies identified by pharmacy students in discharged patients in community pharmacies in Switzerland.

Project C - Detection and resolution possibilities of DRPs in patients at hospital discharge in Swiss community pharmacies	
C-1	**Detection and resolution of drug-related problems at hospital discharge focusing on information availability – a retrospective analysis** Publication accepted by *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen* (13.08.2021) • To assess whether DRPs identified on discharge prescriptions in a hospital's community pharmacy (with full access to the hospital's electronic health records) would be detectable in a community pharmacy by simple medication reviews based on the patient's medication history only, or if intermediate or advanced medication review with additional clinical and/or patient-specific information would be needed. • To assess whether the resolution of the DRPs that were deemed detectable by a simple medication review would require a consultation with the prescriber.
Project D - Electronic health records and electronic medication reconciliation in Switzerland	
D-1	**Electronic medication plan after hospital discharge in the canton of Aargau (EMILIA)** Work report • To evaluate the acceptance and satisfaction of patients, community pharmacists, physicians and caregivers with the electronic medication plan. • To assess the number of discrepancies between the discharge prescription and the dispensed medicines in the community pharmacy. • To analyse the number and type of interventions performed by the community pharmacists filling the hospital discharge prescription.
D-2	**Development of an electronic medication reconciliation tool for community pharmacies** Work report • To design an algorithm that enables the identification of medication discrepancies and medication duplications in community pharmacies. • To assess the feasibility of the electronic medication reconciliation tool by adding different case studies of three ATC subgroups C01, C03 and C10 followed by a second feasibility assessment evaluating different case studies including all ATC groups. • To analyse the safety, efficiency, effectiveness and satisfaction of the electronic medication reconciliation tool.

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6. Project A

6.1. A survey to assess the availability, implementation rate and remuneration of pharmacist-led cognitive services throughout Europe [A-1]

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Abstract

Background: Pharmacist-led cognitive services (PLCS) are increasingly necessary in primary care as a response to patient-centered care. However, the implementation rate and remuneration models of PLCS are either absent or superficially described in the literature.

Objective: The aim of this study is to review the implementation of PLCS in primary care across Europe and explore the associated third-party paid remuneration models.

Methods: A cross-sectional study was conducted using an online survey sent to representatives of 44 European countries. The survey listed 21 PLCS and asked respondents to report the availability of the service, the rate of implementation and the existence of remuneration. To ensure credible data, data triangulation was sought using three representatives per country, representing backgrounds of community pharmacy, pharmacy practice research and health policy. Subsequently, data was validated, and consensus sought.

Results: Data were collected between November 2016 and October 2017 from 34 different countries across Europe (79%). Provision of medicines' information (94.1%), generic substitution (85.3%), provision of emergency oral contraception (70.6%) and point-of-care testing (67.7%) were the services reported as the most widely disseminated in European primary care. Medication review was the most disseminated among advanced services (55.9%). Medication review, adherence support and monitoring, prescription renewal, opioid substitution and travel medicine had the highest implementation rates reported. Half of the participating countries mentioned models of remuneration, predominantly based on a fee-for-service, with less frequent reports of pay-for-performance or mixed models of remuneration.

Conclusions: The availability of PLCS is increasing and varying in scope across Europe. There is wide variation in the implementation level of services across Europe and a lack of valid data. Remuneration of PLCS is also spreading but no clear pattern was found that relates service provision to payment.

Keywords: Community pharmacy services [MeSH]; Pharmaceutical services [MeSH]; Pharmaceutical care; Health care [MeSH]; Health services [MeSH]; Europe [MeSH]; Remuneration [MeSH]

Introduction

According to the World Health Organization (WHO), 70% of all deaths across the globe result from noncommunicable diseases, with 15 million deaths between the ages of 30 and 69 years registered every year. According to the global monitoring framework developed by the WHO, risk factors such as tobacco use, hypertension, uncontrolled diabetes, obesity, and underuse of drug therapy to prevent myocardial infraction and strokes, play a central role in these deaths and are factors conducive to risk minimization interventions by pharmacists, either by direct intervention for instance through smoking cessation programmes or by indirect interventions where multiprofessional collaboration is needed, where pharmacists engage in early detection programmes leading to physician referral for diagnosis of various asymptomatic diseases obtaining more favourable prognosis. [1]

Aligned with these problems, to act as partner for solutions, community pharmacists have been expanding their role and developing progressively more interventions in the field of medicines management, disease prevention and health promotion. Pharmacists, as part of the primary care team, work closely with the local community and their interventions have shown positive impact on various areas of public health. [2, 3] Under the umbrella term "pharmaceutical care" are all activities for which the pharmacist contributes to the care of individuals in order to optimise medicines use and improve health outcomes. [4] However, the number of services and actions included is subject to change and to interpretation. Pharmacist-led cognitive services (PLCS) are in the center of this transition and act as a pillar to develop new solutions for the delivery of better healthcare. [5, 6] The ultimate goal in delivering PLCS is to improve health outcomes and increase the value of healthcare that pharmacies and pharmacists are able to provide. [7]

PLCS is a service provided or supervised by the pharmacist, based on a standardized and structured procedure, to promote optimal health and medicine therapy that is not necessarily medicine/product related. [8] Different interpretations of this definition may arise, mostly in terms of which are the services falling into the scope of PLCS. A recent study has suggested that pharmacists' activities may be divided into four main categories: logistics, pharmacy management, quality assurance and cognitive pharmaceutical services. According to these authors, PLCS include 17 activities, which when analyzed seem to have in common the fact

that they all require pharmacotherapeutic knowledge to be performed, which perhaps is not so clear in the abovementioned definition. [9] The scope of practice of community pharmacists in Europe currently includes health promotion, smoking cessation, new medicines service, different types of medication review, among other new and more patient-centered activities. Many of these services are not universally available, meaning that the provision is only done in some specific countries or within a group of countries. There are specific services such as immunization that, although growing, are still scarcely implemented across Europe. [10]

Previous research on the availability of PLCS in Europe includes periodic policy reports issued by the Pharmaceutical Group of the European Union (PGEU), the International Pharmaceutical Federation (FIP) and similar organizations, but also scientific literature. A series of articles published in the Annals of Pharmacotherapy provided a good background on service availability in various countries in the world. [11] A literature review specifically for Europe followed [12] and led to an update of the Annals series based on field work by our group. [13] Our previous study obtained information from key opinion leaders in the represented countries to map out service provision, indicating a wide variation in the scope of practice of pharmacists. Some countries, such as Portugal stood out as having a wider scope of services available, whilst others had unique services such as pharmacists prescribing in England, Ireland and Northern Ireland. This same study also suggested that services classified as essential tend to be more widespread than advanced ones. [13] Various classifications exist for service levels, which vary in name but traditionally are grouped into three layers. We have adopted PGEU classification, grouping services into core, basic and advanced, as explained in the methods section. [14]

The model of practice and the implementation of services in primary care vary widely, mainly because of the legal framework and financial incentives for service provision. [12] Notwithstanding, the international trends suggest a progressive uptake of PLCS in Europe, particularly since 2010, confirming that pharmacists are motivated and capable to acquire and manage new responsibilities in health care systems. [14]

Two previous studies aimed to assess the implementation of pharmaceutical care and used a standardized scale with pharmacists' self-report based on the last patients served at the pharmacy. Scores obtained with the scale used enabled direct estimation of the provision of

pharmaceutical care, where higher scores indicated greater service provision and vice-versa. These studies yielded unexpected results with Ireland appearing as the highest scoring and Denmark as the lowest scoring country, but concluding provision of pharmaceutical care was still limited in Europe in 2006. [15] The replication of this study ten years later suggested improvements particularly in Denmark and Switzerland, aside with a wider country uptake of pharmaceutical care. Overall, this study suggested a slight improvement in the provision of pharmaceutical care across Europe. [16] However, all these studies focused on availability of services with very limited data on implementation rates.

Previous research has suggested that the viability of pharmacy services depends heavily on the remuneration models in place, because the pharmacy structure is a small to medium enterprise which must ensure return on its investments. [17] Implementing a new service has associated costs, which include the staff, the training and material resources, to name a few. [17, 18] To cover these costs, the services need to be charged and the payer may be the patient, the government or the health insurer. Remuneration occurs when the cost of the service, provided by the pharmacy (or pharmacist), is supported by the government or insurance companies, therefore excluding the out-of-pocket payments by the patient from this definition of remuneration. [19] Some of the most common forms of remuneration include the fee for service (FFS), pay-for performance (P4P) and mixed models (MM). FFS is a retrospective activity-based payment, where individual services provided, and patient contacts made foster billing. In P4P, payment results from the demonstration of a positive impact of service provision on objective indicators. MM result from the combination of the previous models. [20-22] Having a third-party payer may be seen as a form of recognition of the value of the service and may in theory lead to greater service uptake by patients and patient satisfaction. [23]

The FIP issued a report in 2017 describing the most common model relies on costs being supported by the community pharmacy or the patient, suggesting room for improvement. [24] Although there is published literature on the provision of PLCS in Europe, most do not result from a systematic survey or a robust methodology, tending to use information from one sole representative of the country, and fail to report the implementation stages and rates within the country (or report it in a limited way). Further, the remuneration models are either absent or superficially described. [13, 25] This study aims to fill in this gap.

The aim of the study is to survey the implementation of pharmacist-led cognitive services performed in primary care across Europe and the associated remuneration models. For the ease of understanding, the term "country" was selected for all geographic entities under scrutiny in this study, including the political regions such as Kosovo, England and Northern Ireland.

Methods

Study design and study period

A cross-sectional study was conducted between November 2016 and October 2017, using a questionnaire presented in detail in the Appendix I.I.I.. This study is part of a larger project with two separate sections. The results of the pharmacist-led cognitive services are presented here and the second part focusing on medication review will be published separately.

Sample selection

All countries listed by the United Nations to be part of the Europe (n = 44) were targeted. Collaboration established with the Pharmaceutical Care Network Europe (PCNE), the European Society of Clinical Pharmacy (ESCP), FIP, PGEU members' lists and further contacts from the project team led to the identification of a purposive sample of 141 participants. All members of these societies are pharmacists working in various settings of the profession, namely academia, hospital pharmacy, community pharmacy and health policy.

In each country, the survey was sent to a key representative, defined as a person with a background in community pharmacy, pharmacy practice research or health policy, which may be considered an expert in the area given his role description or contribution to these areas. This person acted as the gateway to the country and was the first contact providing the contact of two further participants in the other sectors of the profession he/she could not represent. The selection of three representatives aimed to ensure different and complimentary views of practice and enable data triangulation.

Development and content validity of the survey questions

A list of PCLS was gathered from a literature review and previous work [13], subsequently enriched with a search on official government websites, the PCNE Wiki - (http://europharm.pbworks.com/w/page/19341636/FrontPage) and arising links. Definitions for each retrieved PLCS were used to ensure homogeneous understanding of services explored [26] (Appendix I.I.II.).Whenever no MeSH term was available, the most robust and recently published study on that topic was chosen and its definition adopted. The concept of remuneration was restricted to third-party payers and defined so that out-of-pocket payments were not considered. [19, 27] For each service, three domains were explored: availability of the service, rate of implementation and existence of remuneration. Corresponding questions were tested for content, format and wording with five experts in pharmacy practice research. After corrections, eight experts in pharmacy practice research, further refined the subsequent version, resulting in the final version used, where questions were:

1. Do you have the service 'xy' available in community pharmacies in your country (performed or supervised by a pharmacist)?

2. What is approximate proportion of pharmacies providing the service (%)?

3. How much does the pharmacy receive for this service in Euro (€)?

The final survey used is available in Appendix I.I.I..

Data consolidation and consensus seeking procedure

In countries with three or two participants, re-sending the results to the participants with the requirement to deliver a revised version after consensus resulted in data triangulation. In countries with one participant, another person from the same country selected from the pool of the societies mentioned above received the results and asked for data confirmation. In addition, the consolidators had to address the possible reasons for discrepancies by a) stating if the given answer was an estimate or if it arose from a valid source; and b) by providing references or data sources (if available).

Results were considered "fully consolidated" if all or the majority of participants agreed on the results; "partially consolidated" if one participant agreed on the results, and "not

consolidated" if no participant answered the questions. In case of discordant answers, official documents publicly available were used to estimate the validity of the first results.

Data analysis

Data were collected using the online Findmind© tool, allowing extraction to Microsoft Excel 2016 to perform the descriptive analysis. Respondents categorized PLCS as an integral part of medicines dispensing (*e.g.* provision of information upon dispensing) or as independently provided. Independent provision was considered as a service that may be provided as an "add-on" to medicines dispensing, either simultaneously or on a different occasion (*e.g.* inhalation technique or adherence support), or as a service that is provided independently from medicines dispensing, even when no dispensing is occurring (*e.g.* smoking cessation).

Pharmaceutical care was listed as one of the possible PLCS in this survey, as it emerged from previous research. [13] However, in the course of data analysis an option was made for reporting pharmaceutical care separately and not as one of the PLCS, considering it is a concept that may comprise various PLCS.

Services provided independently were analyzed and clustered according to the PGEU classification (2010) [14] assuming their complexity and demands. This classification differentiates:

• Core Services: services provided by licensed pharmacies during pharmacy opening hours.

• Basic Services: may require separate consultation facilities and special training of pharmacy staff; may need to be available outside core pharmacy opening hours (*e.g.* during the night)

• Advanced Services: require separate consultation facilities in the pharmacy and accredited pharmacists to provide it.

Rates of implementation were categorized as low (1–33%), medium (34–66%) or high (67–100%).

Remuneration data are presented according to the remuneration models: Fee-for-service (FFS), Pay-for-performance (P4P) and Mixed models (MM). The rates of implementation reported for medication review refer to the type most widely implemented in the country, regardless of the type of review.

Results

The online survey was open between November 2016 and March 2017, data consolidation occurred between April and November 2017. Responses were obtained from 34 different countries across Europe (77.2% response rate), 15 with three participants (44%; Croatia, Estonia, Finland, Germany, Hungary, Iceland, Latvia, Luxemburg, Malta, Portugal, Slovakia, Slovenia, Spain, Switzerland, Turkey), 12 with two participants (35%; Albania, Belgium, Denmark, England, France, Ireland, Kosovo, Macedonia, Northern Ireland, Sweden, The Netherlands, Ukraine) and 7 with one participant (16%; Austria, Bulgaria, Georgia, Norway, Poland, Romania, Serbia), with a mean value of 2.2 participants per country. Ten validators in eight countries were additionally recruited.

The three areas of expertise were evenly distributed among all responders (33.9% community pharmacists; 33.7% pharmacy practice researchers; and 31.4% health policy makers). Full consolidation was achieved for 26 countries (76.4%; Albania, Austria, Belgium, Bulgaria, Croatia, Denmark, Finland, Germany, Hungary, Iceland, Ireland, Luxemburg, Macedonia, Malta, Northern Ireland, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Switzerland, The Netherlands, Turkey, Ukraine), partial consolidation for five countries (14.7%; England, Estonia, Kosovo, Latvia, Sweden) and no consolidation for three countries (8.8%; France, Georgia and Serbia) (Appendix I.I.III.).

Availability and rates of pharmacists-led cognitive services

All countries provide medicine dispensing (100%, n = 34). The five most commonly available services are provision of medicine information (94.1%, n = 32), generic substitution (85.3%, n = 29), provision of emergency oral contraception (70.6%, n = 24), point-of-care testing, such as cholesterol, glucose and blood pressure measurement (67.7%, n = 23) and assessment of the inhalation technique (64.7%; n = 22). The more seldom provided services are personalized medicine, such as the determination of the rate of metabolism of medicines (2.9%, n = 1), prescribing (5.9%, n = 2), administration of injectable medicines (5.9%, n = 2) and INR testing and/or management (5.9%, n = 2), (Figure 1). Fifteen countries (44.1%) selected the option pharmaceutical care (Albania, Austria, Belgium, Bulgaria, Croatia, Denmark, Finland, Germany, Hungary, Portugal, Spain, The Netherlands, Sweden and Ukraine). There were others however, reported not to provide pharmaceutical care, but when looking at the services

listed as provided, some services believed to fit into the scope of pharmaceutical care were found. These include for example Medicines use review in England; assessment of the inhalation technique in Iceland, Malta, Northern Ireland or Norway; adherence support and monitoring for Switzerland and France; to name a few.

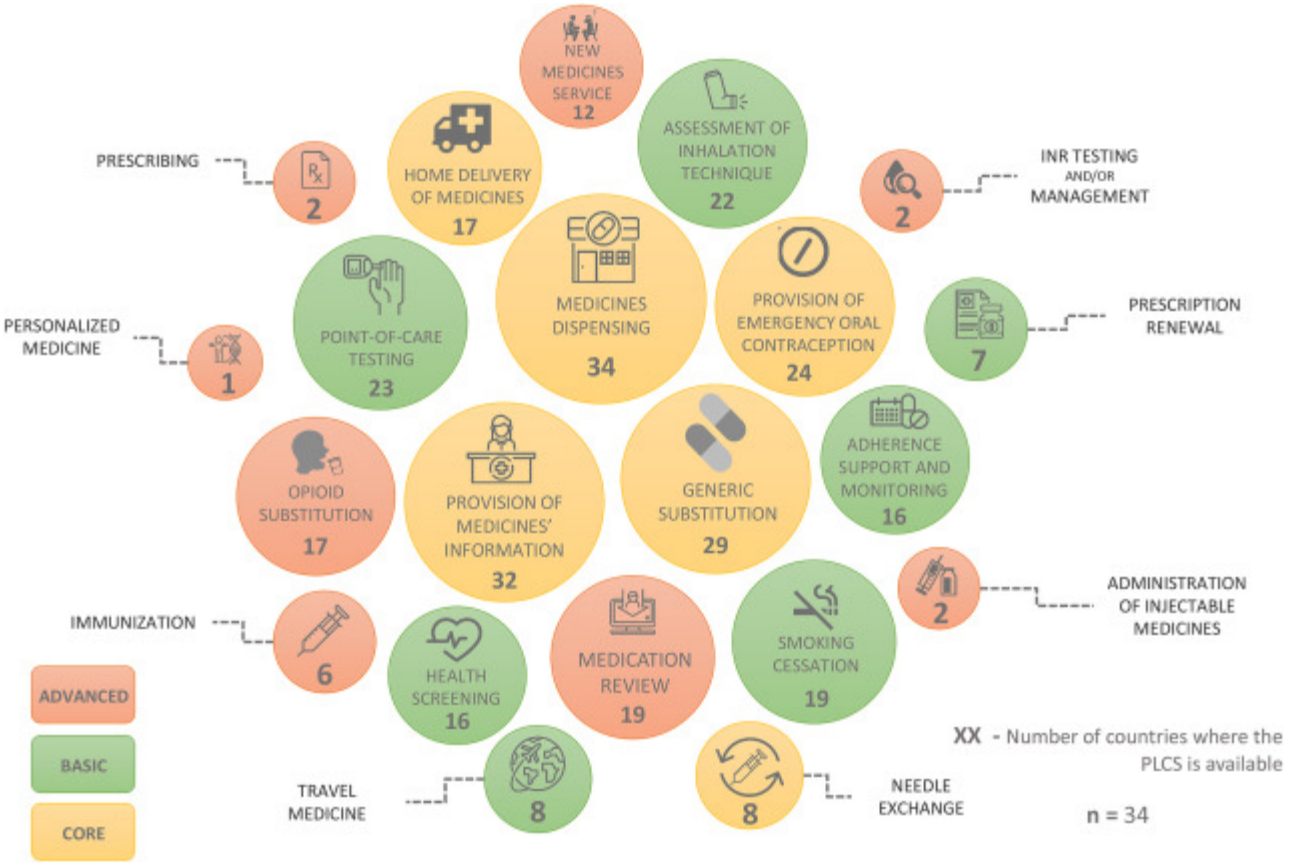

Figure 1. Availability and rates of Pharmacist-led cognitive services in community pharmacies in 34 European countries.

Several countries have a wider scope of services, namely 18 (85.7%) in England, 17 (81.0%) in Portugal, 15 (71.4%) in The Netherlands, 14 (66.7%) in Switzerland and Northern Ireland, and 13 (61.9%) in Austria, Belgium and Finland.

Countries reporting to provide fewer services were Poland (2 services; 9.5%), Kosovo and Macedonia (3 services; 14.3%), Turkey (4 services, 19.0%) and Romania and Latvia (5 services; 23.8%), (Figure 2).

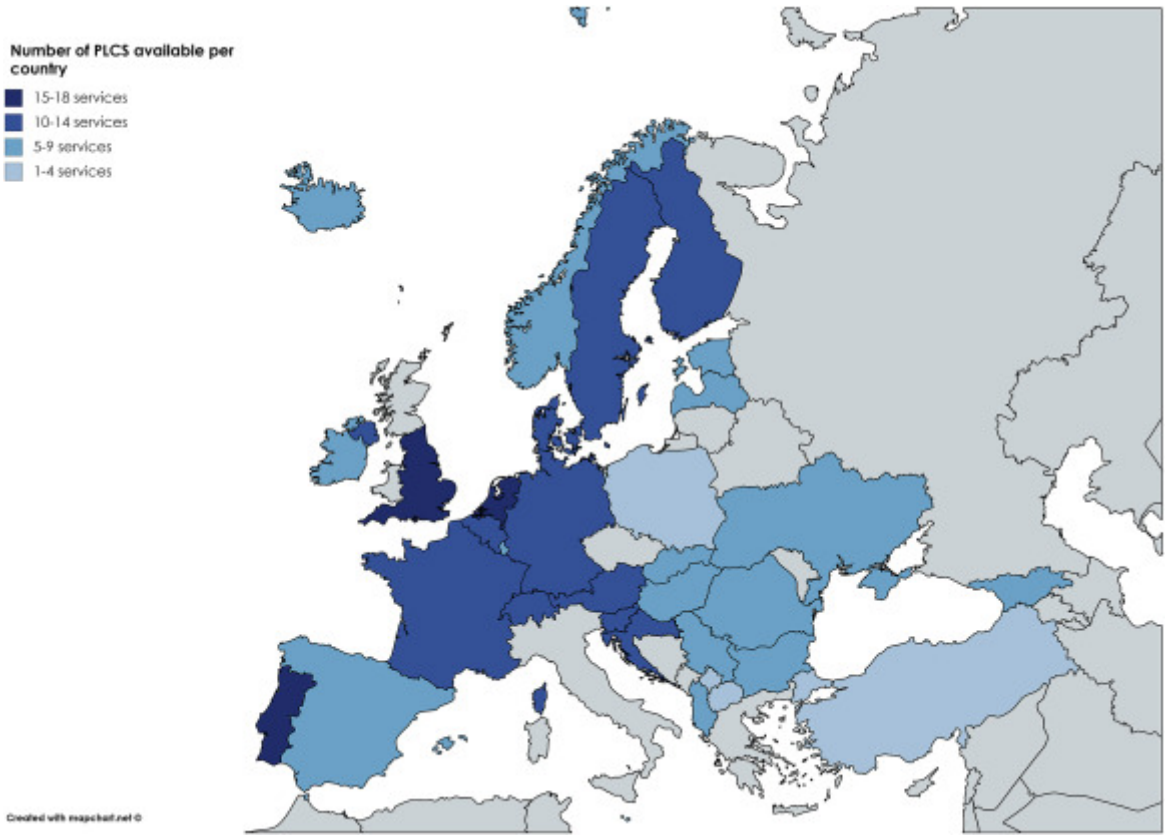

Figure 2. Number of Pharmacist-led cognitive services provided per each European country.

Generic substitution and provision of medicines' information are always provided as part of medicines dispensing. The services that are exclusively provided independently in all countries are administration of injectable medicines, immunization, INR testing and/or management, medication review, personalized medicine and prescribing.

From those services provided independently, the most commonly provided were medication review (55.9%, n = 19), health screening (41.2%, n = 14), smoking cessation (35.3%, n = 12), opioid substitution (32.4%; n = 11), home delivery of medicines and assessment of inhalation technique (29.4%, n = 10). Prescription renewal (8.8%, n = 3) was scarcely reported.

Implementation rate

Twenty-three countries reported the implementation rate of at least one independent PLCS (88.4% amongst the 26 having independent PLCS) (Appendix I.I.III.). We obtained rates of implementation for 60.9% of the services listed (81/133). Nearly half (49.4%; 40/81) indicated low levels of service implementation and high rates of implementation were reported by 41.9% (34/81) of the countries.

Medication review was the service more often mentioned as having high implementation rate (7 countries). Mentioned with high implementation rate in three countries were provision of emergency contraception, adherence support and monitoring, prescription renewal and opioid substitution.

Conversely, smoking cessation was the service more frequently mentioned as having low implementation rate (9 countries), followed by health screening (5 countries). Overall, regardless of the specific service, the countries where more services were reported as having high levels of implementation were Northern Ireland and England (5 services), followed by The Netherlands (4 services), Switzerland and Germany (3 services).

On the contrary, some countries consistently reported low levels of service implementation, namely Portugal (9 services), Croatia (6 services), Slovenia (5 services) and Finland (4 services).

Remuneration models

The majority of countries (70.6%) described a remuneration model for medicine dispensing with one of the following components: mark-up, regressive margin, fixed fee, margin + fixed fee or capitation fee. [27]

Twenty-one countries provided details about their remuneration models on the independent PLCS (80.8% out of the 26 having PLCS) (Appendix I.I.III.). Fourteen countries mentioned remuneration models for at least one PLCS, namely Austria, Belgium, Ireland, Luxembourg, Northern Ireland, Norway, Portugal, Slovenia, Spain, Switzerland, The Netherlands, Ukraine, England, and France. Countries with a wider range of remunerated services were Northern Ireland (n = 5; assessment of inhalation technique, smoking cessation, opioid substitution, immunization and prescribing); England (n = 4; adherence support and monitoring, new medicines service, immunization and medication review); Switzerland (n = 3; adherence support and monitoring, opioid substitution, medication review) and Belgium (n = 3; assessment of inhalation technique, adherence support and monitoring and new medicines service). A total of 24 remunerated PLCS were described.

In most countries, remuneration models were predominantly based on a FFS. Examples include the adherence support monitoring, where reported prices may vary between 13 and 120€ per session or 80€ per month; opioid substitution with a co-payment of 5€ per dispensed

item plus a monthly fee that varies from 30 to 100€ per month. Other services with lower remuneration values include the new medicines service, with a compensation of 20€ per service (England), immunization, charged at 10–15€ per vaccine administered (England, Ireland, Northern Ireland) and needle exchange change with a compensation of 2.4€ per exchange (Portugal).

Services with a mixed model of remuneration include smoking cessation in Northern Ireland. The only P4P model reported was in Slovenia for medication review.

Discussion

This study expands and updates the information on PLCS availability across Europe in 2016/2017. The main findings suggest that almost half of the investigated European countries (14/34; 41.1%) are providing at least 11 of the 21 PLCS listed. Many of these services have evidence of contributing to better patient outcomes, including health-related quality of life. [27, 28]

Compared to 2015 data from the PGEU [29], our study shows a clear progression in the number of countries providing PLCS in 2016/17. Even with differences in methodology between both surveys, the overall progression of PLCS remains. Thus, discrepancies between both surveys are mainly due to study design considerations more than to the national services provided. As an example, the definition of countries differed (*e.g.* UK in PGEU was one country; England and Northern Ireland were two countries in our study) or services were differently defined (*e.g.*, services provided in pharmacies by other healthcare professionals as in Iceland, Finland and The Netherlands would be excluded in our survey given our definition of a pharmacist-led service [8]). It is also important to recognize that PGEU is an organization with the main goal of advocating the role of the pharmacist and of community pharmacies; hence, pilot studies, such as the one currently running in France are included, whereas in our study we have also excluded pilots from the concept of "implemented".

Compared to previous work [13], there is an increased provision of some services namely smoking cessation, point-of-care testing, and immunization. As expected, 'core services' with a lower degree of complexity were observed more often. However, this rate is likely to be even higher because some core services such as generic substitution are not independent services in Albania, Austria, Bulgaria, Northern Ireland and England, but part of medicines dispensing.

New services are also emerging, namely personalized medicine. Despite not explored in this survey, the emergence of such services may result from an effort to respond to accessibility issues, in which patients would need to attend other healthcare facilities, sometimes distant from where they live.

In parallel, the least available services were often those considered more demanding, such as prescribing, administration of injectable medicines and personalized medicine. The reason is likely to be the additional training, investment in refurbishing or even accreditation of pharmacists and/or premises that are required for the implementation of these PLCS. Further, some of these services are forbidden by law in some countries such as Albania, Bulgaria, Macedonia, and Romania where strict regulations often impede pharmacists to further expand their scope of practice. [30] As an example provided by the respondents, it is still illegal to manage biological products (*e.g.* blood) in the community pharmacy in Romania and Ukraine, which hinders the implementation of various services. Some controversy was also reported by participants from Belgium and The Netherlands about touching patients, which is implicit in some activities such as point-of-care testing. Finally, the fact that some of these services are quite innovative leads to their slow diffusion, which is well characterized in pharmacy research and beyond. [31, 32]

The new definition of pharmaceutical care depicts a concept that comprises various services and is not a service in itself. [4] It can be assumed that some respondents were not confident with the new definition of pharmaceutical care. This problem has already been reported in a previous study, where self-reported provision of pharmaceutical care had led to controversial findings believed to result from terms used. [13] Unexpectedly, some respondents from countries with high number of implemented PLCS did not report on pharmaceutical care (*e.g.* England, Switzerland). Other countries know services named as "Pharmaceutical care program" and therefore 15/34 countries (44.1%) reported to provide pharmaceutical care. "Pharmaceutical care" was included in this survey to permit comparison between studies and this data is described in the results and available in Appendix I.I.III., whilst excluded from the counts reported in data analysis of PLCS. Nonetheless, it should be acknowledged that in the UK the word of such term is now out-of-use, which may explain the fact that it was not reported for this country. The use of correct terms in English speaking countries may even be considered more important since there might be less flexibility to assume similarities in terms

and concepts. In fact, data from the UK seems to be particularly problematic as this country tends to use unique terms. The same may have happened with medication review, which in the UK may be referred to as medicines use review (MUR), but in fact is a distinct service where focus is put on medication use by the patient, *i.e*, classified as an adherence service in European terms.

Although the rate of service provision has been increasing, the existence of remuneration or incentives is still scarce, which is a recognized barrier for the provision of PLCS. [33] The most commonly found remuneration model was the traditional fee-for-service payment model. Medication review in Slovenia is an exception, where a P4P model is used. Smoking cessation in Northern Ireland are illustrations of mixed economic models. However, it may be argued that population-based payments provide the strongest incentives to deliver high quality and efficient care. [34] The regular collection of patient outcome data is still suboptimal in pharmacy practice and essential to ensure services are worth paying for. [22, 35] More recently, new models have suggested combining elements from FFS and an additional payment in case of a positive outcome. [22]

United Kingdom (UK) and Switzerland are two countries that have been evolving towards implementing specific pharmaceutical care programs, where optimising medication use is an integral part. [36, 37] The successful implementation of MUR in the UK and "Polymedication check" in Switzerland, despite the divergent functioning of the healthcare systems, respectively Beveridge and Bismarck, suggests different remuneration solutions may exist for sustainable PLCS. In fact, in both these countries, respondents, confirming the previous assumption, did not select the option pharmaceutical care. However, it should also be stated that MUR are considered adherence services in European terms, whereas the polymedication check is a medication review service, both of which fall into the scope of pharmaceutical care, contributing to optimise medication use through distinct interventions.

In most of the remaining countries, medication review has varied formats, is either not remunerated or provided for free (*i.e.*, the pharmacy takes on the costs) or paid out of pocket (*i.e.*, patients support the cost). In both cases, unsustainability of such services is likely. [38]

The national variations of implementation rates reported by the experts suggest that data available within the countries are scarce or outdated. The remuneration values in Beveridge

models are generally legislated and available in published documents. In Bismarck models, variation is easier to understand as payments may vary by insurance companies, hence difficult to find. This study shows the difficulties of providing such numbers and estimations when data are missing, either because the experts ignore the numbers or because these data are perceived as highly sensitive.

Universal health coverage means that all people can use the promotive, preventive, curative, rehabilitative and palliative health services they need, of sufficient quality to be effective, while also ensuring that the use of these services does not expose the user to financial hardship. [39] If PLCS are considered as one of the necessary services, PLCS should be readily accessible to all the population (100%). However, data show few PLCS are available in 100% of pharmacies within each country.

Study limitations

Some limitations ought to be acknowledged. First, a list of 21 pharmacist-led cognitive services retrieved from literature review was used, but additional services may exist in national settings. Second, although standardized definitions for the description of each single service were used, interpretations may have occurred, especially due to translation issues (the survey was in English) or to the use of unique terms in some countries (MUR in the UK, a term eventually suggesting medication review rather than adherence service). Perhaps some descriptions on the content of services within the scope of pharmaceutical care should have been placed. Third, data triangulation with involvement of three participants from different backgrounds was aimed for, but in three countries answer from one person only was obtained. Thus, consolidation of the data could have led to different result with another validator and these results have the weakest evidence. Finally, the methodological option to use one key contact to identify three informants could lead to potential selection bias. Service fidelity was consciously not measured, although recognizing this feature to be important. [40] Nonetheless, they are valuable because they depict the difficult situation to obtain consolidated data in some countries, especially when data is not publicly available. Further research should carefully consider recruitment difficulties.

Strengths in the study also need acknowledgement. This is the first European survey on pharmaceutical services that describes new characteristics such as implementation rate and

remuneration of PLCS. Second, work was built on previous literature to enable comparison of data and ameliorated the recruitment procedure by using renowned pharmaceutical societies. Thus, the landscape of pharmaceutical services in Europe should be closer to practice. Third, revealing that some countries have no data on implementation levels can be of major interest to various stakeholders to improve monitoring systems. This project can be a foundation for future research in which knowledge on health care payment systems is increased. This study is important for pharmacists that perform their roles in the different areas, not only in community pharmacies and research, but also for policy makers that may have a significant and direct impact on the stakeholders and on the development of new policies and directives.

Conclusion

The availability of PLCS is increasing across Europe despite much variation in the implementation rates. Some countries are standing out as the early adopters, which can lead the path and serve as examples for other countries. Our findings also indicate that data on implementation are either not available or difficult to assess, suggesting that databases need improvement to better plan service provision. Remuneration of PLCS is spreading but no clear pattern found between service provision and payment.

Competing interests

The authors declare that they have no competing interests.

Authors contributions

FC and KH initiated this project and conceived the study. FC, KH, IBS, TI were involved in study and survey design. IBS and TI prepared the glossary with the PLCS definitions. TI, IS, UNM accessed and analyzed the retrieved data and prepared the data validation and consensus seeking procedure. IS prepared the draft of a first manuscript and then finalized by FC, subsequently revised in depth by TI and KH. MK, NH and UNM contributed to the discussion and reviewed the manuscript. IA contributed extensively to the final review of the manuscript and suggested additional analysis as those initially foreseen. FC, KH, TI, MK, NH, UNM and IA read and approved the final manuscript.

Ethics approval and consent to participate

The Ethical approval for this study was obtained from "Comissão de Ética Egas Moniz" on 26th October 2016 (Proc. Number 515).

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6.2. Community pharmacist-led medication review procedures across Europe: Characterization, implementation and remuneration [A-2]

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Abstract

Background: Pharmaceutical Care Network Europe (PCNE) proposed a definition and classification system (type 1, 2a, 2b, 3) for medication review in 2016. However, to date, a description of the implementation and remuneration of such procedures across Europe is lacking.

Objective: The aim of this study was to describe the medication review procedures and the level of implementation and remuneration in community pharmacies across Europe.

Methods: An online survey was developed to characterize medication review procedures (PCNE classification), level of implementation (considering regional or national) and remuneration by a third party. This survey was sent to a purposive sample of three individuals per country, with a working background in community pharmacy, pharmacy practice research, or health policy to ensure reliable data. Data triangulation was used and consensus sought between the responses.

Results: Data were received from 34 out of 44 targeted European countries (November 2016–October 2017) [response rate = 77%]. Overall, 55.9% of the countries provided at least one type of medication review as an implemented service or project. Type 1 medication review (based on the medication history) was provided in 13 countries, type 2a (medication history + patient interview) in 14, type 2b (medication history + clinical data) in two, and type 3 medication review (medication history + patient interview + clinical data) in four countries. Ten of the mentioned services or projects were remunerated by a third-party.

Conclusion: Substantial heterogeneity was observed across Europe in various aspects, including the procedures, implementation level and remuneration obtained. Type 1 and 2a medication review services seem to be more feasible to implement in the community pharmacy than type 2b and 3. A large number of medication review projects were ongoing in community pharmacies, which suggests that new medication review services could become implemented in the coming years.

Keywords: Medication review**;** Community pharmacy services**;** Primary health care**;** Service implementation**;** Remuneration**;** Europe

Introduction

The role of community pharmacists started to shift from product to patient oriented care since the introduction of pharmaceutical care by Hepler and Strand around 1990. [1] As a result, pharmacist-led cognitive services (PLCS), including medication review, were introduced. [2-6] PLCS are services provided or supervised by a pharmacist, which are based on a standardized and structured procedure, to promote optimal health and medicine therapy and are not necessarily product related. [7] A review of the literature shows that medication review (MR) is one of the most studied and discussed services among PLCS. [3, 8, 9] Numerous reviews and meta-analyses focus on the effectiveness and benefits of MR, whereas studies on the availability and the implementation of MR are scarce. [4, 5, 8-13] In 2011, Bulajeva and colleagues showed that pharmacists in approximately two thirds of 25 investigated European countries (n = 16, 64%) provided at least one type of MR in the community setting, nursing home or hospital setting. However, pharmacists in only seven of the 13 countries who provided MR in the community setting charged a payment for the MR procedure. [8] In 2017, the Pharmaceutical Group of European Union (PGEU) stated in their annual report that all community pharmacies in European countries provide chart review (by definition of PGEU, MR type 1) as part of the mandatory dispensing process. [5] In addition, 53% of 30 respondent countries stated to provide MR including structured interviews between pharmacists and patients (PGEU, MR type 2). [5] Both reports provide an overview of the availability of MR across Europe and point towards an increased recognition and importance of MR services. Clinically positive effects of pharmacist-led MR have been reported, with impacts on low-density lipoprotein, blood pressure and medication adherence. [11] Subgroup analysis of clinical MR (type 3) also demonstrated reduced hospitalizations, although with no impact on mortality. [3, 11] Studies have also successfully shown significant cost reduction as a result of decreased healthcare utilization and medication used. [3] Rose et al. investigated the presence of MR in the community pharmacy and in the hospital in an opportunistic sample of 12 different countries (Australia, Austria, Belgium, Bosnia-Herzegovina, Canada, Germany, Japan, Kosovo, Switzerland, the Netherlands, Thailand, USA). [14] Focusing on European countries portrayed in this study, only Austria, Switzerland, and the Netherlands affirmed to have MR available in the community pharmacy, while Belgium, Bosnia-Herzegovina, Germany (projects only), and Kosovo denied the availability of MR in community pharmacies.

[14] The absence of a clearly presented definition and classification of MR [14] makes a comparison between studies difficult. The published literature mostly lacks details on the variety of service models, definitions and the understanding of MR. [11, 13-17] This is an important aspect to explore as procedures associated with service delivery may also contribute to understand variability in studies and a possible failure in demonstrating the cost-effectiveness or even cost-benefit of the service.

Contributing to a more universal understanding of the service, Pharmaceutical Care Network Europe (PCNE) presented a definition for medication review (2016) stating: "Medication review is a structured evaluation of a patient's medicines with the aim of optimizing medicines use and improving health outcomes. This entails detecting drug related problems and recommending interventions." [18] PCNE also published a classification for MR according to the information sources available (access to medication history ± patient interview ± clinical data) (Table 1). The classification comprises three levels (simple, intermediate, advanced) of MR and four different types (1, 2a, 2b, 3). [18]

Table 1: PCNE classification of MR with the according sources of information. [18]

Characterization:		**Availability of information**		
Type	**Level**	**Medication history**	**Patient interview**	**Clinical data**
Type 1	**Simple**	✓		
Type 2a	**Intermediate**	✓	✓	
Type 2b	**Intermediate**	✓		✓
Type 3	**Advanced**	✓	✓	✓

This definition was complemented with additional specifications: medication review is a structured procedure or a method in patient care, in contrast to the prescription validation or counselling, [18] routinely performed in community pharmacies. The PCNE definition only describes the MR as a distinct activity ending with recommending possible interventions. However, all following activities (the interventions, follow-up) are part of the total MR service. Therefore, 'medication review service' is a broader concept than medication review alone, which as such can differ from country to country. [18]

Considering this background and the PCNE definition of MR, we believed the existing literature was insufficiently reflecting the current status of MR services across Europe. Therefore, we aimed at a detailed characterization of the different types of MR services and

projects available, the level of implementation and remuneration in community pharmacies, considering the PCNE definition.

Methods

Study design

Between November 2016 and October 2017, a cross-sectional study named PRACTISE (PhaRmAcist-led CogniTIve Services in Europe) was conducted using an online survey consisting of two parts. The part presented here investigated different aspects of MR services, the level of implementation and the remuneration of the service (Appendix I.I.IV.). Previous results from the overview of the 21 different pharmacist-led cognitive services have already been published. [6]

Sample

The list of all European countries according to the United Nations (n = 44) [19], complemented by Armenia, Kosovo, Northern Ireland, Wales, Scotland, Georgia, and Turkey were targeted by the research team. Please note that for better readability, the term "country" is used in this paper for all geographic entities (regions and countries).

For each country, one key representative was identified through the member lists of PCNE, the European Society of Clinical Pharmacy (ESCP), the International Pharmaceutical Federation (FIP), the PGEU and personal contacts from the project team members. The key representatives had either a working background in community pharmacy, pharmacy practice research or health policy. To enable data triangulation, they were asked to suggest two more individuals from their country with different backgrounds (community pharmacy, pharmacy practice research, and health policy) to complete the set for each country.

Participants were invited to the study by sending an email with an individual link to the online survey tool Findmind® (https://www.findmind.ch/) between November 2016 and October 2017, with a first reminder sent to the potential participants two weeks and a second reminder three weeks after the invitation. In case of lack of response, further potential participants suggested by key representatives were consecutively invited.

Design and content validity of the survey

To ensure uniform understanding of the term "medication review", the PCNE definition and the accompanying classification (Table 1) were provided in the introduction of the online survey. [18] The survey focused on the presence of any type of MR in the home country of the respondent, and the same questions were asked for each type of MR on the characterization of the MR (involved persons, initiation of the MR, source of information, patient eligibility criteria, issues addressed, possible clinical decisions taken, general practitioner (GP) involvement, pharmacist's accreditation), the level of implementation, different aspects of the execution, the service remuneration and relevant published literature.

Services were considered as remunerated, when payment was made by a third-party payer, *e.g*. the government or the health insurance to the pharmacy (or pharmacist), but payment out-of-pocket by the patient was excluded. [20] Besides local and national available implemented services, projects running as a campaign in community pharmacies (except pilot studies/pilot projects) were also considered.

The survey was based on the questionnaire from Bulajeva et al. [8] focusing on MR practices of the different types of MR defined by Clyne et al. [21] (prescription review, adherence and compliance review, clinical medication review) in the community setting, hospital setting, and nursing home setting in Europe. The present survey was restricted to the community pharmacy setting and adapted using comprehensive definitions, additional questions on the implementation level and remuneration of the service (Appendix I.I.IV.). This survey was then tested for content and face validity in a pilot study with 11 experts in the field of pharmaceutical care from seven different European countries.

In addition, illustrative examples of different MR types were presented as separate statements written by individuals from the respective country (Appendix I.I.V.).

Data consolidation and consensus seeking procedure for the results obtained

After data collection, preliminary analysis by comparing all responses within each country was performed by two researchers (TI & UNM) and discrepancies in responses within the countries were evaluated. A set of "preliminary consensus documents" were prepared containing the discrepant responses (including free text comments) of all participants of a

country and a suggestion to the country respondents. The free text was evaluated by two researchers (TI & UNM) and relevant information was added as specific information to the manuscript *e.g.* the different eligibility criteria and description of the accreditation procedure.

Subsequently, the documents were sent back to the participants for consolidation. In countries with a single participant, the document was sent to a different person from the same country who acted as a validator of the answers obtained from the single survey participant. In the countries with two or three responses, the country-specific preliminary consensus document was resent to the same participants, informing them of the discrepancies identified and requesting further reflection or justification of their answers. The goal was to obtain uniform responses for each country. In case of discrepancy between the answers, official and publicly available documents and published literature were used to validate and consolidate the results.

Data analysis

The Findmind® tool allowed data extraction to Microsoft Excel 2013 for descriptive analysis, performed independently by two researchers (TI & UNM). Three categorical levels were considered for the implementation level, which were defined by the PRACTISE study research team to stratify the quantitative responses obtained: low (1–33%); medium (34–66%); high (67–100%), as described elsewhere. [6]

Results

In 44 of the targeted countries, the research team identified at least one contact. In 34 of these, at least one individual completed the online survey (response rate: 77.3%) (Table 2). No response was received from Armenia, Belarus, Bosnia and Herzegovina, Czech Republic, Italy, Lithuania, Moldova, Russia, Scotland, and Wales. Three responses within a country were achieved from 15 countries, two responses from 12 countries and one response from 7 countries. For five of the seven countries with a single participant, independent validators for data consolidation were recruited, but no validator could be found for Serbia and Georgia. Furthermore, the two participants from France did not consolidate their discrepancies. The survey participants (n = 76) and validators (n = 8) had a working background in community pharmacy (n = 30; 35.7%), health policy (n = 28; 33.3%) or in pharmacy practice research (n = 26; 31.0%).

Table 2: Overview of the available MR services and projects.

Countries/ Regions	Type 1 MR (medication history)	Type 2a MR (medication history + patient interview)	Type 2b MR (medication history + clinical data)	Type 3 MR (medication history + patient interview +clinical data)
Austria [1]	✓°			✓
Belgium [1]		✓°		
Croatia [1]	✓°	✓		
Denmark [1]	✓°	✓°		
England [2]		✓	*	*
Finland [1]†	✓	✓	✓	✓
France [3]	✓	-	-	-
Germany [1]	✓°	✓°		✓°
Hungary [1]	✓°	✓°		
Northern Ireland [1]	✓	✓	✓	
Norway [1]	✓			
Portugal [1]		✓		
Slovakia [1]	✓°			
Slovenia [1]		✓	*	*
Spain [1]		✓		
Sweden [2]		✓		
Switzerland [1]	✓	✓		
The Netherlands [1]	✓			✓
Ukraine [1]	✓°	✓°		
No implemented MR service or project: Albania[1], Bulgaria[1], Estonia[2], Iceland[1], Ireland[1], Kosovo[2], Latvia[2], Luxembourg[1], Macedonia[1], Malta[1], Poland[1], Romania[1], Turkey[1], Georgia[3], and Serbia[3]				
[1] Full validation of data (all participants or majority); [2] Partial validation of data (one participant/validator); [3] No validation of data MR = medication review, GP = general practitioner ° ongoing project on MR (no implemented procedure); * MR performed outside of the community pharmacy (GP practices or healthcare centers); † BSc and MSc in pharmacy ; - no result				

Respondents from 19 out of the 34 countries, reported to provide at least one type of MR (55.9%), either as a national/local service or as a project. (Table 2). In 15 of the 34 countries MRs was not provided as a distinguished structured service or project to patients in community pharmacies (Table 2).

Detailed description of type 1 MR available in Europe

The survey resulted in 13 countries reporting the existence of type 1 MR based on the medication history. Type 1 MR service in Austria was on a project level and will be implemented nationally in 2019 (Table 3).

Table 3: Type 1 and type 2a MR services and projects – characterization, remuneration and implementation.

	Country	Characterization					Remuneration	Implementation
		Local/national service or project	Starting year	Medication history with prescription AND non-prescription medicines	Medication history AND comprehensive refill data	Initiation of the MR	Remuneration by the government or health insurance	Level of implementation
Type 1 MR (medication history)	**Austria**	Project	2016	Yes	Yes	caregiver, patient, computer software	-	Project
	Croatia	Project	2008	No	No	pharmacist, caregiver, patient	No	Project
	Denmark	Project	End of 1990	No	Yes	pharmacist	No	Project
	Finland†	National	2001	Yes	Yes	pharmacist, caregiver, patient	No	High
	France	Local	-	-	No	pharmacist	-	High
	Germany	Project	2014	Yes	Yes	-	Yes	Project
	Hungary	Project	2014	Yes	No	pharmacist, caregiver	No	Project
	Northern Ireland	National	-	-	-	-	No	-
	Norway	Local (specific pharmacy chain)	-	-	-	-	No	Low
	Slovakia	Project	2003	No	No	GP, patient	No	Project
	Switzerland	National	2001	Yes	Yes	pharmacist	Yes	High
	The Netherlands	National	1987	Yes	Yes	computer software	No	High
	Ukraine	Project	2005	No	No	pharmacist, GP, patient	No	Project
Type 2a (medication history + patient interview)	**Belgium**	Project	2016	Yes	Yes	pharmacist	Yes	Project
	Croatia	Local	2008	Yes	Yes	pharmacist, patient	No	Low
	Denmark	Project	2010	Yes	Yes	pharmacist, patient	No	Project
	England	National	2005	Yes	-	pharmacist, GP, patient, caregiver, computer software	Yes	High
	Finland†	National	2014	Yes	Yes	caregiver, patient	No	Low
	Germany	Project	2014	Yes	Yes	pharmacist, caregiver, patient	Yes	Project
	Hungary	Project	2014	Yes	No	pharmacist	No	Project
	Northern Ireland	National	2016	-	-	-	Yes	High
	Portugal	Local	1999	Yes	Yes	pharmacist, caregiver, patient	No	Low
	Slovenia	National	2014	Yes	No	pharmacist, GP, nurse, caregiver, patient	No	Low
	Spain	National	2016	No	Yes	pharmacist, caregiver, patient	No	-
	Sweden	National	2000	-	Yes	pharmacist, patient	No	High*
	Switzerland	National	2010	Yes	Yes	pharmacist, patient	Yes	Medium
	Ukraine	Project	2001	Yes	No	pharmacist, patient	No	Project

† BSc and MSc pharmacists, * offered by the majority of the community pharmacies, but actually carried out for a small number of patients, - no result
MR = medication review, GP = general practitioner
Level of implementation: low = 1-33%, medium = 34-66%, high = 67-100%

Implementation: Table 3 presents the implementation of the type 1 MR service.

Remuneration: Remuneration for type 1 MR existed in two of the 13 countries (Germany and Switzerland). In Switzerland, it was paid by the health insurance and in Germany by one specific insurer and the regional chamber of pharmacists. Community pharmacies in Switzerland received remuneration for the nationally implemented service based on a specific remuneration model where the pharmacy receives a specific fee for each prescription and an additional fee for each prescribed product (Appendix I.I.V. – Box 1). Pharmacies in Germany receive a fixed fee for type 1 MR in the ongoing project. Respondents of the remaining countries reported not getting remuneration for type 1 MR except for Austria and France where the reports were unclear to be able to conclude on this topic.

Workforce and setting: MR services or project could be performed by the pharmacists themselves or in collaboration with pharmacy technicians. In the majority of the countries, pharmacists themselves performed the type 1 MR service (10/13, 76.9%). No agreement among the respondents about the persons involved in the provision of MR was achieved in France and in Norway. In the Netherlands, in specific pharmacy chains, some activities such as interaction checks and medication reconciliation were transferred to specialized pharmacy technicians. In Finland, MR services were performed by pharmacists (Master's degree, with university education of 300 European Credit Transfer System (ECTS) credits), but also by those having a Bachelor's degree (3 years at university, 180 ECTS credits). [22]

Accreditation: No accreditation was reported as needed for provision of type 1 MR. Participants from Hungary stated to be working on an accreditation program for pharmacists to be implemented in the near future.

Initiation and eligibility criteria of MR: Different people could initiate a type 1 MR (general practitioner (GP), pharmacist, nurse, patient, and caregiver) as well as specific computer software, which served as trigger for a MR (Table 3). In Austria and the Netherlands, computer software triggers the pharmacist to perform a type 1 MR service in patients, using specific clinical rules. Eligibility criteria were only reported for type 1 MR service in Hungary, where a specific document for a patient's health profile is filled according to the national guidelines and topics identified. In five countries (France, Germany, Slovakia, Switzerland, and the Netherlands), the community pharmacy medication record is updated with the information

collected during the MR. In Germany, the information retrieved during the type 1 MR project, an official report form was used to document findings. The collected information could be shared with other health care professionals in France, whereas in the Netherlands this information could be shared through the national electronic patient record.

Information source: For the provision of type 1 MR three different sources of information could be used: prescription medication history, non-prescription medication history, and comprehensive refill data (detailed information related to all medication dispensed from the community pharmacy, *e.g.* date, time, and dispensed quantity). [23] In Austria, England, Finland, Germany, Switzerland, and the Netherlands the medication history for both prescription and non-prescription medication, as well as the comprehensive refill data, were available as an information source. In Croatia, Slovakia, and Ukraine only the medication history of prescription medication was available for type 1 MR.

Issues addressed during MR: "Drug-drug interactions" and "duplications (of therapeutic group or active ingredient)" are relevant issues in all 13 countries providing type 1 MR, whereas "treatment costs" and "treatment durations" were less often looked at (Appendix I.I.VI.). Some respondents reported further issues checked: *e.g.* "overuse of medication" (Switzerland), "drug-food interactions" and "pharmacogenetics" (the Netherlands).

Inter-professional collaboration: Different ways of information exchange between pharmacists and GPs after the MR was reported, including a report form on findings, an updated medication record, a medication action plan, or a case conference. German pharmacists involved in the current project stated to prepare a report on the findings and a medication action plan to be transferred to the GP. Ukrainian participants stated sending a report form with findings, an updated medication record and a medication action plan to the GP. In all countries the GP makes the clinical decision on solving the detected drug- and patient-related problems. The patient was also involved in clinical decision making in Denmark, Northern Ireland, and the Netherlands.

Detailed description of type 2a MR available in Europe

Type 2a MR service based on the medication history and the patient interview was present in 14 countries across Europe. (Table 2). Polymedication checks in Switzerland and MUR in England are both type 2a MR services focusing on medication use and adherence.

Implementation: Implementation of type 2a varied widely (Table 3). In Sweden it was reported that nearly all community pharmacies could offer type 2a MR services, but in fact, only few did.

Remuneration: In Belgium and in Germany remuneration is only available within specific projects. In all countries where remuneration exists, a fixed price for each performed service is provided ranging from 30 to 80 €. In England, remuneration was restricted to a maximum of 400 MURs per pharmacy a year (Appendix I.I.V. - Box 3).

Workforce and setting: Type 2a MR services were exclusively conducted by pharmacists (without the involvement of pharmacy technicians) in all countries. In Finland, individuals with a Bachelor's degree in pharmacy were involved.

Accreditation: Specific accreditation for service provision was required in Denmark, England, Germany, Hungary, Slovenia, and Spain. In Belgium, training and follow up on a voluntarily base was offered for the MR project. No specific accreditation existed in Croatia, Finland, Northern Ireland, Portugal, Switzerland, Sweden, and Ukraine.

Initiation and eligibility criteria of MR: In 10 of the 14 countries providing type 2a MR (71.4%), both the pharmacist and the patient could initiate the service (Table 3). After the completion of type 2a MR the medication record was updated with the information collected in half of the countries. Pharmacies in Belgium were reported to update the shared medication record linked with other community pharmacies when consent had been obtained from the patient. Six countries (Belgium, Denmark, England, Hungary, Slovenia, and Switzerland) reported using eligibility criteria for patient selection *e.g.* ≥5 medications, ≥65 years, on high risk medication, recently discharged from hospital, adherence issues, complex dosing regimen, elderly living with homecare or in a nursing home to name a few.

Information sources: Type 2a MR is based on a patient interview and the medication history with prescription and possibly non-prescription medication and/or comprehensive refill data.

All above mentioned information sources were used in Belgium, Croatia, Denmark, Finland, Germany, Portugal, and Switzerland. Only the history of prescription, non-prescription medications and the patient interview, but no comprehensive refill data, were reported to be available as informational basis in England, Hungary, Slovenia, and Ukraine. Medication history of prescription medication, comprehensive refill data and patient interview, but no information on non-prescription medication, were available in Spain.

Issues addressed during MR: In half of the countries "drug/treatment cost" is not looked at during the review. Conversely, "adverse drug reaction", "incorrect instructions", "need of drug information", "adherence", and "handling of medication" are issues discussed in all countries (Appendix I.I.VI.).

Inter-professional collaboration: In all countries, the pharmacists themselves, or together with the patient, decide if the GP receives a report on the findings or an updated medication record. In half of the countries the pharmacist provided a medication action plan to the GP, if necessary. In the Danish project, the pharmacist in collaboration with the patient decided upon the information exchange with the GP. A case conference with the GP was arranged in six countries when deemed necessary by the pharmacist. In all countries, the GP was involved in the final therapy decisions within their area of competence.

Special cases for type 2a MR: In addition to these services, the so-called medication review with follow up exists in Spain. This MR is similar to a type 2a MR, but additional information on specific clinical data measured in the community pharmacy or patient provided medical records are available. Moreover, the medication of the patients is evaluated over a period of time. [24-26]

Detailed description of type 2b MR available in Europe

Respondents from two out of the 34 countries reported to provide type 2b MR based on patients' medication history and clinical data (Finland and Northern Ireland) (Table 2). In Northern Ireland, type 2b MR was reported to be available on a local level, but no detailed description of the service was received. In Finland, this type of MR service was reported to differ from pharmacy to pharmacy.

Implementation and remuneration: Type 2b MR models in Finland were reported to have low implementation (1–33%) and no remuneration by a third party payer. (Table 4).

Table 4: Type 2b and type 3 services and projects – characterization, remuneration and implementation.

	Country	Characterization							Remuneration	Implementation
		Local/national service or project	**Starting year**	**Medication history with prescription AND non-prescription medicines**	**Medication history AND comprehensive refill data**	**Clinical conditions**	**Laboratory test results**	**Initiation of the MR**	**Remuneration by the government or health insurance**	**Level of implementation**
Type 2b# (medication history + clinical data)	**Finland†**	National	2012	Yes	Yes	Yes	Yes	pharmacist, GP, nurse	No	Low
Type 3 MR (medication history + patient interview + clinical data)	**Austria**	Local	2016	Yes	-	Yes**	Yes**	pharmacist, caregiver, patient, computer software	Yes	Low
	Finland†	National	2005	Yes	Yes	Yes	Yes	GP makes decision and pharmacist, patient caregiver, nurse can propose the MR	No	Low
	Germany	Project	2016	Yes	Yes	No***	No***	pharmacist, GP	Yes	Project
	The Netherlands	National	2010	No	Yes	Yes	Yes	pharmacist, GP, caregiver, patient, computer software	Yes	High

† BSc and MSc in pharmacy, # no detailed description available from Northern Ireland, ** clinical conditions and laboratory test results are provided by the patient, *** cooperation with GPs ,- no results
MR = medication review, GP = general practitioner
Level of implementation: low = 1-33%, medium = 34-66%, high = 67-100%

Workforce and setting: In Finland, type 2b MR was reported in different models depending on the setting and on the patient population (home care, outpatients, hospital) and was performed by individuals with a Bachelor's or Master's in pharmacy.

Accreditation: No precondition for accreditation was reported for Finland, although an optional training was offered.

Initiation and eligibility criteria of MR: In Finland, the initiation of type 2b MRs relied on pharmacists, GPs, or nurses (Table 4.)

Information sources: Information accessible to pharmacists in Finland depends on the service model used.

Issues addressed during MR: In Finland, all listed medication- and patient-related issues were covered during MR, except "drug/treatment costs" (Appendix I.I.VI.).

Inter-professional collaboration: The information exchange on the findings of the MR could be transferred to the GP. The information exchange with GPs was dependent on the pharmacist's opinion in Finland and the model of the service, but a case conference with the GP is always part of the service. No information about GP involvement was received for Northern Ireland.

Special case for type 2b MR: In Slovenia and in England, participants reported on the performance of type 2b MR services outside the community pharmacy in GP practices or healthcare centers, if patients could not attend the interview for the type 3 MR service.

Detailed description of type 3 MR available in Europe

Type 3 MR services based on patients' medication history, the patient interview and the clinical data were reported to be available in Austria, Finland, Germany, and the Netherlands (4/34, 11.1%). (Table 2).

Implementation and remuneration: The level of implementation and the remuneration of the type 3 MR services and projects are presented in Table 4.

Workforce and setting: In Austria and Finland, pharmacists were reported to provide MR independently, while in the Netherlands, pharmacy technicians were also part of the service delivery team (*e.g.* logistic support, data collection, medication reconciliation, implementation

of agreed outcomes). In the type 3 MR project in Germany, GPs were included in the review in alliance with pharmacists.

Accreditation: Type 3 MR service provision requires accreditation in Finland, and the Netherlands. The accreditation process in Finland includes a continuous education course with training lasting 1.5 years (35 ECTS credits). [27] There is no formal accreditation in the Netherlands, although insurance companies demand a specific certificate (obtained following approx. an eight-day course). Pharmacists participating in the project in Germany had to attend a short course (8 h). No specific accreditation or course was required for type 3 MR service in Austria.

Initiation and eligibility criteria of MR: In all countries the pharmacist or the GP decided on the need for a MR. In addition, patients, caregiver, or nurses could propose MR in Austria, Finland, and the Netherlands (Table 4). Eligibility criteria were mentioned in all countries. In Austria, patients aged over 65 years and taking ≥ five medications were eligible. In Finland, locally agreed eligibility criteria existed, but no national ones. Specific eligibility criteria was reported for the German project: adults insured with a specific company living at home, on ≥ five long-term medications, or with a specific need for the service (*e.g.* non-adherence); agreeing to choose one GP and one pharmacy to care for them continuously. In the Netherlands, the health insurance companies provide specific eligibility criteria, mostly based on age and ≥ five medications with additional criteria such as renal function, cardiovascular or neurological problems and frailty. (Appendix I.I.V. - Box 4).

Information sources: In Austria, pharmacists reported to have the medication history of prescription and non-prescription medication and access via the patients to laboratory data and clinical conditions. Pharmacists in Finland have access to the history of prescription and non-prescription medication, comprehensive refill data, information on patients' clinical conditions and the laboratory test results. In the Netherlands, pharmacists used comprehensive refill data, clinical conditions and laboratory test results. In addition, they use the list of over-the-counter (OTC) product sales or they are expected to interview patient about their use of OTC products. Pharmacists, who participated in the type 3 MR project in Germany had access to the medication history of prescription and non-prescription medication and comprehensive refill data for this MR review, but no access to laboratory test results and

clinical conditions. However, in this project pharmacists had a close cooperation with GPs focusing on the clinical information for the conduction of this type 3 MR.

Issues addressed during MR: Most of the proposed drug- and patient-related issues were focused in type 3 MR services; conversely, "drug/treatment costs" were irrelevant in Germany, whereas lifestyle issues were irrelevant in Austria and Germany (Appendix I.I.VI.).

Inter-professional collaboration: In Austria and Finland the GP was reported to be responsible for final clinical decision making. A triplet consisting of a GP, pharmacist and patient was involved in clinical decision making in Germany and the Netherlands.

Special cases for type 3 MR service: In Slovenia and England clinical pharmacists provide type 3 MR outside the community pharmacy.

In England, the National Health Service (NHS) started to integrate clinical pharmacists (background in hospital or community pharmacy) into GP practices. [28] If the patient is present in the GP practice, these pharmacists perform a type 3 MR service (based on the medication history + patient interview + clinical data), otherwise they perform a type 2b MR. Pharmacists performing the type 2b or type 3 MR in GP practices have to complete a formal training program and demonstrate their clinical competencies. Regarding the remuneration of this service, the NHS service description for clinical pharmacists in GP practices reported on an upfront payment once a year. These clinical pharmacists have access to the full medication history (including prescription/non-prescription medication and comprehensive refill data), laboratory test results and patients' clinical conditions. Moreover, they decide themselves if a GP should be informed about the results of the MR.

In Slovenia, a type 3 MR service was reported to be performed in healthcare centers by a clinical pharmacist (background in community or hospital pharmacy), when the patient cannot attend the interview for the type 3 MR service, they perform a type 2b MR service (see Appendix I.I.V. - Box 3). Only specialized pharmacists in clinical pharmacy (three-years post-graduate course set by the Slovene Chamber of Pharmacies) were allowed to perform this type of MR service. The eligibility criteria for patient selection was broadly written and patients were mainly referred to the pharmacist by the GP. These pharmacists have access to medication history of prescription medication and comprehensive refill data; clinical condition of the patient; laboratory data, but no information on non-prescription medication history. In

Slovenia, the GP was informed about the MR performed by a standard issued report, leading to an updated record and a medication action plan. A case conference with the GP was also organized, if deemed important.

Comparison of the survey responses by the three different working backgrounds and the results after data consolidation

In 12 of the 34 countries, responses from the three different working backgrounds (community pharmacy, pharmacy practice research and health policy) were obtained. Figure 1 presents and compares the responses to the survey question on the existence of each type of MR service according to the three working backgrounds (presented as continuous lines), illustrating the added value of considering complimentary perspectives and the data consolidation process. This figure also highlights the number of MR types reported after the data consolidation process (presented as a dotted line).

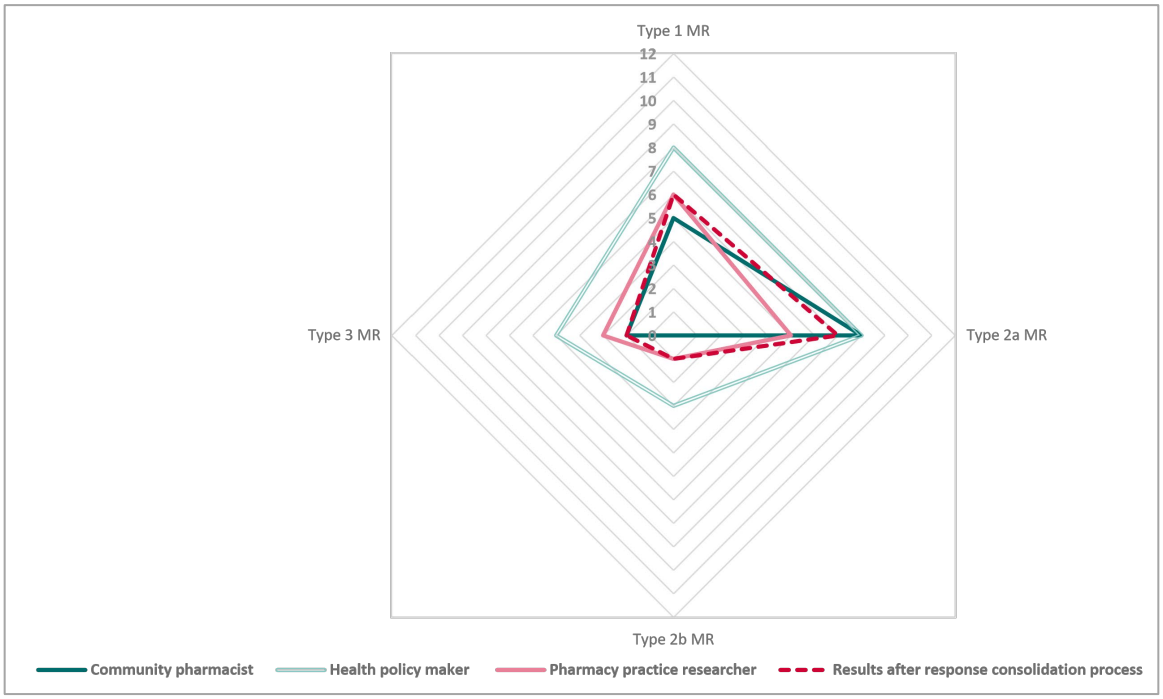

Figure 1. Comparison of survey responses by the three different working backgrounds and after data consolidation, n = 12 (Croatia, Estonia, Finland, Germany, Hungary, Iceland, Malta, Portugal, Slovakia, Slovenia, Switzerland, Turkey).

Discussion

The present study investigated the characteristics of the different MR services and projects, the implementation and the remuneration in European community pharmacies. In 19 of the 34 participating countries, at least one type of MR service was provided in community pharmacy, either as a project or as an implemented service. Implementation variability suggests that reporting the existence of a service in a country does not therefore automatically mean the service is regularly provided to the country's population. In our study, type 2a MR service was the most widespread, followed by type 1, type 3, and type 2b. Comparing these results to the results from Bulajeva et al., [8] where 13 of the 25 countries provided at least one type of MR in the community setting, a minor increase in the proportion of countries could be observed over 5 years. Nevertheless, different classifications of the MR type were adopted in these two studies and a distinct set of countries, which is likely to influence the results. [8] Besides the reported 20 locally or nationally implemented MR services, 13 projects on MR are currently ongoing in the investigated European countries, suggesting potential expansion of MR services across Europe.

The results of this survey are not only an upgrade of a prior survey conducted in 2011 by Bulajeva et al., [8] but provide an additional focus on service implementation and remuneration, while using comprehensive definitions based on the PCNE classification of MR (type 1, 2a, 2b, 3). It is important to say that the participants in this survey received clear information on different types of MR and the difference between "prescription validation and counselling" versus "medication review", same as the difference between "medication review" as a standalone activity, versus the "medication review service" based on the activity of MR including other activities.

Type 1 MR service was provided in 38.2% of the participating countries, whereas the PGEU stated that type 1 MR is provided by 100% of the European pharmacies as this is part of the routine dispensing process. [5] This discrepancy can be explained mainly by the different definitions adopted. In the present survey, it was clearly stated that type 1 MR is not equal to the ad hoc prescription validation and counselling during the dispensing of prescribed medication and that the major difference relies in the structured procedure of a MR in contrast to ex tempore counselling. [18]

Type 2a MR is the most prevalent service according to our results with 41.2% of the countries reporting to offer type 2a MR services in their countries, either as an implemented service or ongoing project, in line with the survey from Bulajeva et al. [8] This suggests that the MR using the medication history and a patient interview as sources of information is more feasible to perform in the community pharmacy.

Type 2b and type 3 MR are less prevalent in European community pharmacies. These services may however be available on different levels and in different settings (*e.g.* hospitals or general practices). [10, 28] The provision of such services implies a comprehensive appraisal of clinical data. In Slovenia and England, clinical pharmacists perform MR type 2b and 3 within GP practices or in healthcare centers where clinical conditions and laboratory test results are available, while in the Netherlands and Finland the community pharmacies have access to the clinical information. These services are only available for few patients and the performance of these services is limited to specifically trained pharmacists in these countries. Training in clinical and other skills was identified as a facilitator for service implementation. [29] In the future, e-health initiatives might ease the access to clinical data for all healthcare providers and thereby also facilitate provision of type 2b and 3 MR services in the community pharmacy setting. [29, 30]

Implementation of MR services still poses a major challenge. In countries with medium or high implementation such as the Netherlands, England, Finland and Switzerland, the services were nationally initiated a few years ago, which indicates that large-scale implementation is time consuming. Moreover, the level of implementation of the service could be influenced by different factors: *e.g.* service reimbursement [29] or commissioning, the time span since service initiation, local or nation wide initiative, training and education. The majority of the MR services with medium or high implementation were remunerated by the government or health insurance. A study focusing on clinical MR in cardiovascular patients in the Netherlands concluded that lack of reimbursement and high time demands to perform the MR were the main reasons for service unsustainability. [31] Our data suggests reimbursement may be partly accountable for facilitated implementation. The Netherlands has a high level of implementation of MR services (~100% for type 1 and type 3 MR services), because Dutch pharmacies are obliged to provide type 1 MRs and the inspectorate also monitors the performance of type 3 MR. Previous Dutch studies have also shown that MR reduces drug-

related problems and hence improve the quality of drug therapy [32, 33], factors that may also lead to higher service uptake. MRs have also proven to improve blood pressure control, low-density lipoprotein, medication adherence, and contribute to reduced healthcare costs. [11] This evidence of impact on outcomes is likely to influence stakeholders' perspectives and willingness to cooperate and contribute to wider dissemination. [11] Behavior change in proactive service provision is likely to be feasible, but challenges at different levels (personal, team, institution, wider environment) need to be overcome. [34]

Remuneration for MR services is available in 10 out of the 19 countries, where respondents reported to provide MR by a third-party payer. Comparing remuneration with other pharmacist-led cognitive services, MR services were the most frequently remunerated. [6] Looking into details in the current study reveals that only 15.4% (2/13) of the provided type 1 MR services were remunerated, compared to 35.7% (5/14) in type 2a, and 75.0% (3/4) in type 3 MR services, whereas the type 2b MR in Finland is not remunerated by a third-party payer. This difference is plausible since human and financial resources needed to perform a type 3 MR review are far higher than those for type 1 MR. Community pharmacies offering MR services without remuneration might provide the service at their own cost or require the patient to bare the cost. This situation and the low rates of remuneration of structured pharmacy services are unsatisfactory and call for action.

Eligibility criteria exist in several countries, especially for types 2a, 2b and type 3 MR service (*e.g.* ≥ 5 medications, ≥ 65 years, living in a homecare or nursing home, high risk medication, recent hospital discharge etc.). These criteria are similar to those previously reported in the literature. [20, 35-38] However, a large number of countries have no specific criteria for patient selection and pharmacists themselves take the decision to select patients based on a perceived clinical need.

Data triangulation was used to collect representative information from different stakeholders. Even if this comprehensive approach was only partially successful, complete data in 12 countries revealed interesting heterogeneity among responses. These experiences should be respected when other pan-European surveys are planned.

Strengths and limitations

The present survey completed in October 2017 included participants with different backgrounds (community pharmacy, pharmacy practice research or in health policy) aiming to increase data credibility. Nonetheless, the strategy used to reach further participants through a key representative could potentially lead to selection bias. It should be noted, however, that our study reflects the situation in 2016–2017 and may have changed between then and the date of this publication. The process of data consolidation was very time consuming and leading to a delay in making final results available.

It is essential to consider that MR is a complex pharmaceutical intervention with different types of MR and variable issues to be addressed, strongly dependent on multiple factors such as legal frameworks and the context, where the service is provided within the countries. [39] Theses differences represent a challenge when trying to standardize concepts. Even though the multinational research team had a wide network across Europe, not all European countries were reached, despite intense attempts. Consequently, there is still some uncertainty regarding the responses, especially from Georgia, Serbia and France. The type 1 MR service based on the medication history was difficult to distinguish from daily community pharmacy practice, particularly in two countries (England, Sweden), despite having stated that type 1 MR service is more than just the daily dispensing and counselling routine. Because fees for national services may be confidential data in some countries, it was avoided to report country specific fees for MR services.

Conclusion

Our overview of the provided community pharmacist-led MR services in Europe in 2016 and 2017 presents detailed information on specific service characteristics and enables an insight into a wide pattern of MR services available in Europe. There is large heterogeneity across Europe in all aspects, the characteristics of the services, the implementation and the remuneration. Moreover, complexity of the MR type seems to be associated with remuneration. Types 1 and 2a MR services were more frequently provided, suggesting they may be more feasible to implement in community pharmacy. Although no major development over the last few years could be observed, the large number of ongoing projects on MRs in community pharmacies suggests that new MR services could become implemented in Europe

in the coming years. The comprehensive information provided in this paper could help researchers, representative associations and policy makers to reengineer current services or to establish new ones.

Ethics approval

The Ethical approval for the PRACTISE study was obtained from "Comissão de Ética Egas Moniz" on October 26, 2016 (Proc. Number 515).

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7. Project B

7.1. Medication discrepancies in community pharmacies in Switzerland: identification, classification, and their potential clinical and economic impact [B-1]

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Abstract

Background: Transitions of care are high-risk situations for the manifestation of medication discrepancies and, therefore, present threats for potential patient harm. Medication discrepancies can occur at any transition within the healthcare system.

Methods: Fifth-year pharmacy students assessed a best possible medication list (BPML) during a medication review (based on medication history and patient interview) in community pharmacies. They documented all discrepancies between the BPML and the latest medication prescription. Discrepancies were classified using the medication discrepancy taxonomy (MedTax) classification system and were assessed for their potential clinical and economic impact.

Results: Overall, 116 patients with a mean age and medication prescription of 74 (± 10.3) years and 10.2 (± 4.2), respectively, were analyzed. Of the 317 discrepancies identified, the most frequent type was related to strength and/or frequency and/or number of units of dosage form and/or the total daily dose. Although, the majority of discrepancies were rated as inconsequential (55.2%) on health conditions, the remainder posed a potential moderate (43.2%) or severe impact (1.6%). In 49.5% of the discrepancies, the patients' medication cost less than the prescribed.

Conclusion: Community pharmacies are at a favorable place to identify discrepancies and to counsel patients. To improve patient care, they should systematically perform medication reconciliation whenever prescriptions are renewed or added.

Keywords: medication discrepancy; medication reconciliation; medication review; community pharmacy; pharmaceutical care

Introduction

Transitions of care, especially hospital admission and discharge, are high-risk situations for the manifestation of medication discrepancies and therefore relevant origins for potential patient harm. [1-3] Medication discrepancy is defined as "any differences in the prescribed medication, dose, route, or frequency noted among the sources of documentation." [4] An intentional medication discrepancy is when prescribers intentionally decide to add, modify, or remove a patient's medication. [5] Unintentional discrepancies occur when prescribers unintentionally add, change, or remove medications from the medication list. [5] The latter type of medication discrepancies can lead to adverse drug events. [5]

At hospital admission, the number of medication discrepancies per patient ranges from 3.0 to 9.8 [6-8], whereas at hospital discharge, the average ranges from 0.6 to 4.0 [9-11] discrepancies per patient. Pharmacists play a pivotal role in the medication reconciliation process, because they are able to detect and resolve medication discrepancies. [3] Medication reconciliation as defined by the Medical Subject Headings (MeSH) is a "formal process of obtaining a complete and accurate list of each patient's current home medications including name, dosage, frequency, and route of administration, and comparing admission, transfer, and/or discharge medication orders to that list. The reconciliation is done to avoid medication errors." Multiple studies focusing on medication reconciliation at hospital transitions were published. [2, 3, 12, 13] The meta-analysis by Mekonnen and colleagues [2] indicated a reduction in emergency department visits and hospital readmission in patients with a pharmacist-led medication reconciliation procedure at hospital transitions. However, medication discrepancies can also occur outside of hospital admission and discharge at any transition in the healthcare system, e.g., at transitions from medical specialists, general practitioners, community pharmacies, and nursing homes, or even without any transition. [14-16]

The aim of this study was to identify, characterize, and categorize medication discrepancies occurring in adult community pharmacy customers with long-term polypharmacy use and to assess their potential clinical and economic impact.

Materials and Methods

The study presented here was part of a larger cross-sectional observational study across Swiss community pharmacies with three different investigated topics: (1) medication management (investigation of patients' organization strategies with their polypharmacy in daily life), (2) attitudes towards generic medication, and (3) medication discrepancies between current patient medication and the latest medication prescription filled in the community pharmacy in patients with polypharmacy (≥4 medications) for long-term use (>3 months). In this study, we analyzed part (3) on medication discrepancies. All patients and community pharmacies gave written informed consent for study participation. The study was conducted in accordance with the Declaration of Helsinki, and was approved by the Northwest and Central Switzerland ethics committee (EKNZ 2016-02143) and registered on ClinicalTrials.gov (NCT03321058).

Setting and Recruitment

Two consecutive cohorts of 5th year pharmacy students of the University of Basel, working in Swiss community pharmacies during their internship, served as recruiters for this study. The number of patients included in this study was given by the number of students in the two student cohorts. Each student attended one medication review in the community pharmacy and performed a medication reconciliation (Figure 1). For this medication review, students selected a regular patient from the community pharmacy in accordance with the inclusion and exclusion criteria. Eligibility criteria were adult patient (≥18 years) with ≥4 medications for a minimum of 3 months, including ≥1 medication from the Anatomical Therapeutic Chemical (ATC) group cardiovascular system (C01–C10), and ≥1 generic medication. Exclusion criteria were managing their medication with professional support from pharmacies, home care services, or nursing homes. These inclusion and exclusion criteria were used to investigate the medication management, the attitudes towards generic medication, and for the assessment of medication discrepancies.

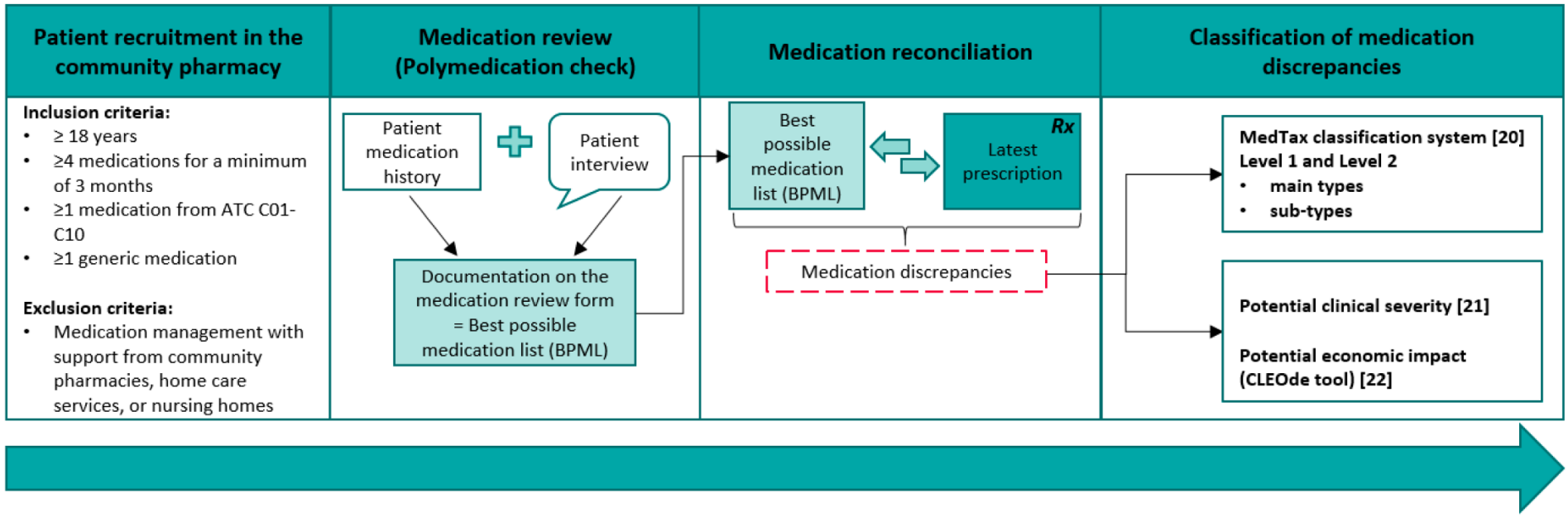

Figure 1. Study flowchart, ATC = Anatomical Therapeutic Chemical; BPML = best possible medication list; Rx = medication prescription; MedTax = medication discrepancy taxonomy [20]; CLEOde tool = evaluation of the potential CLinical, Economic, and Organizational relevance of pharmacists' interventions, German version. [22]

Medication Review

The pharmacist-led medication reviews, called "Polymedication Checks" (PMC) in Switzerland [17], were performed by the supervisors of the students, but in presence of the students. According to the classification of the Pharmaceutical Care Network Europe [18], the PMC is a type 2a medication review based on a routinely collected patient medication history and an additional patient interview. [17] The documentation of dispensed medication in patient medication histories are required for all patients filling prescriptions in community pharmacies in Switzerland. Medication name, strength, dosage, time of administration, and indication are documented on the standardized medication review form. The PMC focuses on medication use, patient knowledge, and medication adherence, and results in a list of the patient's current home medication. The PMC is an implemented and remunerated cognitive community pharmacy service in Switzerland. [19] Pharmacy students were trained to perform medication reviews during lectures and workshops at the university. Prior to the start of the study, all students additionally received a verbal introduction and a written manual for performing medication reviews.

Medication Reconciliation

The list of the patient's prescribed home medication assessed during the PMC (based on the patient medication history + patient interview) was used as best possible medication list (BPML) in this study (Figure 1). The students then transferred this BPML to a separate, standardized medication reconciliation form with two columns: one for the BPML and the other for the medication according to the latest medication prescription available in the community pharmacy (Appendix I.II.I.). They compared each medication and marked any discrepancy. In case of a discrepancy (intentional or unintentional), they added a description and/or potential explanation of the discrepancy as free text.

Data Handling

The medication review form, the patient's medication history with the comprehensive refill data for a period of 12-months, and the medication reconciliation form were pseudonymized and sent to the study site, where the results were entered into a database. The ATC codes were amended to all active ingredients involved in a medication discrepancy. Subsequently, all discrepancies were categorized with medication discrepancy taxonomy (MedTax) [20], a

validated classification system for medication discrepancies. This taxonomy is hierarchical and consists of two levels (1 "medication mismatched", 2 "medication partially matched"), with 12 main types and 28 sub-types. [20] For level 1 "medication mismatched", the active substance of the medication was either present on the BPML or on the latest medication prescription. In contrast, in level 2 "medication partially matched", the active substance was identical on BPML and the latest medication prescription.

The plausibility of the discrepancies reported by the students were checked using their free text comments, the medication review form, and the 12-months medication history. This plausibility check and the categorization of the medication discrepancies were independently performed by two researchers (T.L.I.-I., M.B.T.P.) and subsequently discussed in a meeting. In case of disagreement, a third person (K.E.H.) joined the discussion.

Potential Clinical Severity and Economic Impact of the Identified Medication Discrepancies

Three clinical pharmacists with working experience in hospital pharmacies and community pharmacies (V.A., D.S., T.L.I.-I.) assessed the potential clinical severity and economic impact of all medication discrepancies. Any disagreement among the three pharmacists were individually re-evaluated. In case of further disagreement, the majority decided. They evaluated the potential direct or indirect clinical impact of each medication discrepancy on the patient's medical conditions using three different severity classes: "unlikely" (Class 1), "moderate" (Class 2), or "potentially severe" (Class 3), as adapted from Cornish and colleagues. [21] The discrepancy, hence, either leads to a potential positive or potential negative effect on the patient's health condition in context of the entire medication.

The potential economic impact of the medication discrepancy was assessed using the economic dimension of the tool CLEOde (CLinical, Economic, and Organizational), a validated tool for the assessment of the potential relevance of pharmacists' interventions. [22] In this study, the economic dimension of CLEOde was defined as immediate impact of medication discrepancies on the medication costs (levels: increase, null, decrease) from a healthcare system's perspective by comparing the medication of the BPML and the latest medication prescription.

Statistical Analysis

Demographic patient data, number of medications and related ATC codes, number of generic medications, and frequency and characteristics of medication discrepancies were analyzed. Data were descriptively quantified and analyzed using IBM® SPSS® Statistics Version 25 (IBM Corp., Armonk, NY, USA). The inter-rater reliability for the assessment of the potential clinical and economic impact of the medication discrepancies was analyzed using Fleiss' Kappa [23] from IBM® SPSS® and interpreted according to Landis and Koch [24].

Results

A total of 149 pharmacy students attended medication reviews during their practical training in the community pharmacy between January and August 2017 in Switzerland. Six community pharmacies and two patients denied study participation; three patients did not meet the inclusion criteria, while six were excluded by the research team due to missing or invaluable data (e.g., inconsistent information). Sixteen patients were excluded, because they obtained their prescribed medications in the physician's practice or filled the prescriptions in another community pharmacy. Therefore, the medication history in the participating community pharmacy was inadequate for the BPML. In total, 116 medication reconciliation forms originating from 96 different community pharmacies were included for analysis (20 community pharmacies with two students). The mean age of the patients was 74 (± 10.3) years (range 49 to 91 years). Gender was male for 56.9% (66/116) of the patients. Overall, 79.3% of the study patients were ≥65 years old. Patients had, on average, 10.2 ± 4.2 medications (range 4 to 26) on the BPML, including at least one medication from the ATC group C (cardiovascular) and at least one generic medication.

Medication Discrepancies—Frequency of Main Types

In total, the students identified 317 medication discrepancies in 116 patients, with a mean of 2.7 ± 2.3 discrepancies per patient (range 0–11). In 82.8% (96/116) of all patients, at least one medication discrepancy was detected. A total of 1180 prescribed medications were listed on 116 different medication review forms. Of the 317 medication discrepancies, one-third (34.1%) were medications from the ATC group C for the cardiovascular system, while 25.2% medications were from the ATC group A for the alimentary tract and metabolism, and 13.9% from the group N for the nervous system (Table 1).

Table 1: Frequency of the ATC main group causing medication discrepancies (n = 317).

ATC Group	**Contents**	**Number (%)**
A	Alimentary Tract and Metabolism	80 (25.2)
B	Blood and Blood Forming Organs	25 (7.9)
C	Cardiovascular System	108 (34.1)
D	Dermatologicals	6 (1.9)
G	Genito Urinary System and Sex Hormones	3 (0.9)
H	Systemic Hormonal Preparations, Excl. Sex Hormones and Insulines	7 (2.2)
J	Antiinfectives for Systemic Use	1 (0.3)
L	Antineoplastic and Immunomodulating Agents	3 (0.9)
M	Musculo-Skeletal System	24 (7.6)
N	Nervous System	44 (13.9)
P	Antiparasitic Products, Insecticides, and Repellents	2 (0.6)
R	Respiratory System	11 (3.5)
S	Sensory Organs	3 (0.9)
V	Various	0 (0.0)

Table 2 shows the two levels of the MedTax classification system [20] with the according 12 main types of medication discrepancies. Over 90% (n = 299) of the discrepancies were categorized as level 2 “medication partially mismatched”.

Table 2: Classification of medication discrepancies using the MedTax classification system [20]—main types (n = 317)

Levels and Main Types	Number (%)
1.Medication mismatched	**18 (5.7)**
1.1 Medication omission	0 (0.0)
1.2 Medication commission (or addition)	2 (0.6)
1.3 Medication duplication	1 (0.3)
1.4 Therapeutic class substitution (medication change within a medication class)	12 (3.8)
1.5 Allergy or intolerance*	0 (0.0)
1.6 Other	3 (0.9)
2.Medication partially matched	**299 (94.3)**
2.1 Discrepancy in the name of medication	43 (13.6)
2.2 Discrepancy in the strength and/or frequency and/or number of units of dosage form and/or total daily dose	134 (42.3)
2.3 Discrepancy in the dosage form/route of administration	0 (0.0)
2.4 Discrepancy in the time of medication administration	35 (11.0)
2.5 Discrepancy in the duration or length of the therapy	0 (0.0)
2.6 Other	87 (27.4)

* Allergies and intolerances were not assessed during the medication review.

The most frequently identified main type of medication discrepancy (42.3%) was "2.2 discrepancy in the strength and/or frequency and/or number of units of dosage form and/or total daily dose". The main type "2.6 other" was the second most often identified type of discrepancy (e.g., stop of a medication by the physician with knowledge of the patient, but without transfer of this information to the community pharmacy). An additional, frequently observed discrepancy (13.6%) was "2.1 discrepancy in the name of medication" caused by different medication names (brand to generic name, generic to brand name, and generic to generic name).

Medication Discrepancies—Frequency of Sub-Types

Level 2 "medication partially mismatched" discrepancies (categories 2.1–2.4) were further specified to different sub-types according to the MedTax [20] classification system (Table 3). The most frequent sub-type in the category "2.2 discrepancy in the strength and/or frequency and/or number of units of dosage form and/or total daily dose" was "2.2.7 same strength but unclear or wrong frequency" caused by the prescription of an on-demand regimen (pro re nata; PRN), but the patient took the medication on a regular basis or vice versa. One reason for the discrepancy in the sub-type "2.4 discrepancy in the time of medication administration"

was that medication was administered at different times through the day to improve adherence or effectiveness of a medication.

Table 3: Classification of medication discrepancies using the MedTax classification system [20] focussing on partially matched medication (n = 299) and their classification in the sub-types (n = 212 sub-types).

Main Types and Sub-Types	**Number (%)**
2.1. Discrepancy in the name of medication	**43 (13.6)**
2.1.1. Unclear or wrong name (brand name or generic name)	-
2.1.2. Omission of brand name	-
2.1.3. Omission of generic name	-
2.1.4 Different brand name but same generic name	43 (13.6)
2.2. Discrepancy in the strength and/or frequency and/or number of units of dosage form and/or total daily dose	**134 (42.3)**
2.2.1. Unclear or wrong strength	-
2.2.2. Omission of strength	-
2.2.3. Different strength and different total daily dose	8 (2.5)
2.2.4. Different strength but same total daily dose	4 (1.3)
2.2.5. Omission of unit of strength	-
2.2.6. Different or wrong unit of strength	-
2.2.7. Same strength but unclear or wrong frequency	40 (12.6)
2.2.8. Same strength but omission of frequency	29 (9.1)
2.2.9. Same strength but different frequency and omission of the number of units	-
2.2.10. Same strength and same frequency but omission of the number of units	-
2.2.11. Same strength and same number of units but different frequency and different total daily dose	21 (6.6)
2.2.12. Same strength but different frequency and different number of units and different total daily dose	9 (2.8)
2.2.13. Same strength but different frequency and different number of units but same total daily dose	4 (1.3)
2.2.14. Same strength and same frequency but different number of units and different total daily dose	19 (6.0)
2.3 Discrepancy in the dosage form / route of administration	**0 (0.0)**
2.3.1. Unclear or wrong dosage form	-
2.3.2. Unclear or wrong route of administration	-
2.3.3. Omission of dosage form	-
2.3.4. Omission of route of administration	-
2.3.5. Different dosage form but same route of administration	-
2.3.6. Different dosage form and different route of administration	-
2.3.7. Same dosage form but different route of administration	-
2.4. Discrepancy in the time of medication administration	**35 (11.0)**
2.4.1. Omission of the time of administration	3 (0.9)
2.4.2. Different time of administration through the day	25 (7.9)
2.4.3. Discrepancy in the medication administration with respect to food/meal	7 (2.2)
2.5. Discrepancy in the duration or length of therapy	**0 (0.0)**
2.6. Other	**87 (27.4)**

Potential Clinical Severity of the Medication Discrepancies and Economic Impact

The potential clinical severity of the medication discrepancies and the economic impact are presented in Table 4. Three clinical pharmacists assessed and categorized the potential clinical severity and economic impact of the medication discrepancies. Fleiss' kappa coefficient was moderate for the rating of the potential clinical severity ($\kappa = 0.478$, $p < 0.0005$) and substantial for the potential economic impact ($\kappa = 0.637$, $p < 0.0005$). Over half (55.2%) of the identified medication discrepancies were considered as unlikely to have a clinical effect on the patient's health condition (Class 1), whereas 1.6% were rated to have a potentially severe impact on the patient's health condition (Class 3), either in a positive or negative sense. The following five medication discrepancies were rated as a potentially severe clinical impact: 1) a patient accidentally took rivaroxaban 20 mg twice daily instead of once daily as prescribed by the physician; 2) unclear dose of methotrexate; 3) stop of methotrexate; 4) use of indacaterol for acute congested bronchi; and 5) an intentional change in the dosing of a rapid-acting insulin (from 11 IU to 30–50 IU per day).

Table 4: Type of medication discrepancy, its potential clinical severity, and economic impact (n = 317) indicated with numbers (%).

Medication Discrepancy		**Potential Clinical Severity** [a]			**Potential Economic Impact** [b]		
Type	**No. (%)**	**Class 1***	**Class 2***	**Class 3***	**Increase in Cost**	**Null**	**Decrease in Cost**
1.1 Medication omission	-	-	-	-	-	-	-
1.2 Medication commission	2 (0.6)	-	2 (0.6)	-	2 (0.6)	-	-
1.3 Medication duplication	1 (0.3)	-	1 (0.3)	-	1 (0.3)	-	-
1.4 Therapeutic class substitution	12 (3.8)	2 (0.6)	10 (3.2)	-	3 (0.9)	1 (0.3)	8 (2.5)
1.5 Allergy or intolerance*	-	-	-	-	-	-	-
1.6 Other (mismatched)	3 (0.9)	1 (0.3)	2 (0.6)	-	3 (0.9)	-	-
2.1 Discrepancy in the name of the medication	43 (13.6)	42 (13.2)	1 (0.3)	-	3 (0.9)	23 (7.3)	17 (5.4)
2.2 Discrepancy in the strength and/or frequency and/or number of units of dosage form and/or total daily dose	134 (42.3)	60 (18.9)	71 (22.4)	3 (0.9)	29 (9.1)	43 (13.6)	62 (19.6)
2.3 Discrepancy in the dosage form/route of administration	-	-	-	-	-	-	-
2.4 Discrepancy in the time of medication administration	35 (11.0)	31 (9.8)	4 (1.3)	-	-	35 (11.0)	-
2.5 Discrepancy in the duration or length of therapy	-	-	-	-	-	-	-
2.6 Other (partially matched)	87 (27.4)	39 (12.3)	46 (14.5)	2 (0.6)	8 (2.5)	9 (2.8)	70 (22.1)
Total	317 (100.0)	175 (55.2)	137 (43.2)	5 (1.6)	49 (15.5)	111 (35.0)	157 (49.5)

[a] Classification adapted from Cornish et al. [21]. [b] Classification adapted from Stämpfli et al. [22]. Class 1 = unlikely to have an effect, Class 2 = potential moderate effect, Class 3 = potential severe effect. * Allergies and intolerances were not assessed during the medication review.

In 157 of the 317 medication discrepancies (49.5%), the difference between the prescription and the current patient medication led to a decrease in medication therapy costs (e.g., reduction of the dose or frequency, stop of a medication, generic substitution). In contrast, 49 (15.5%) of the medication discrepancies caused an increase in costs (e.g., increase in the total daily dose, therapeutic class substitution, regular intake of an as-needed medication).

Discussion

In this study, pharmacy students performed medication reconciliation in community pharmacies in patients with polypharmacy for long-term use, based on a BPML compiled through a type 2a medication review in Swiss community pharmacies. The population consisted of elderly patients (mean age 74 years) with an average of 10.2 medications at the time of the medication review. In total, 317 medication discrepancies were detected between the BPML and the latest prescription of the 116 patients (2.7 medication discrepancies/patient), and 82.8% of patients had a minimum of one medication discrepancy. Some of the identified discrepancies were intentional changes by the patient (e.g., different intake time during the day) and some were unintentional discrepancies (e.g., mix-up or overdose of a product). Our finding of 2.7 discrepancies per patient is consistent with two other studies performed in the primary care setting. [14, 15] Rose and colleagues [15] compared patient reported medication lists assessed during a home visit to physician records and they identified at least one medication discrepancy in 94.4% of the patients. They found 2.8 ± 2.4 medication discrepancies per patient. [15] This average number of discrepancies was slightly lower than the results from Andrus and colleagues [14] with 3.2 discrepancies per patient, investigating the actual patient medication with the electronic health record in an outpatient family clinic in the United States.

Types of Medication Discrepancies

The three types of discrepancies that occurred most frequently in our study were (1) discrepancy in the strength/frequency/number of units/total daily dose, (2) discrepancy in the name of the medication, and (3) other. These types of discrepancies belong to level 2 of the MedTax classification system (partially mismatched medications). [20] In this level, the active ingredient of the medication with a discrepancy was identical on both lists. It is not surprising that only few discrepancies (5.7%) in our study were discrepancies within level 1 “medication mismatched”, because the start or stop of medications leading to commission or omission are

in the responsibility of the physician in Switzerland. In contrast, studies performed at hospital admissions or discharges revealed medication mismatches, such as omission, commission, and therapeutic class substitution, more frequently. [10, 11, 25, 26] The omission of a medication was the most frequently reported discrepancy after hospital admission or discharge. [11, 21, 25, 26] Similarly, Almanasreh and colleagues [27] identified omission as the most frequent type of discrepancy in their systematic review focusing on the medication reconciliation process and medication discrepancy classification. However, it should be considered that the lack of a standardized classification system led to various pragmatically developed classifications for medication discrepancies. This heterogeneity in turn makes comparisons of different studies difficult. [27]

The sub-type of medication discrepancy that occurred most frequently in our study was a difference in the name of the medication. This included differences between brand and generic names, as well as between two products from different generics manufacturers. Even though the active ingredient remains unchanged, any generic substitution may lead to a change in the primary packaging, the appearance of the blister and the shape, as well as the size or color of the dosage form. These differences are important issues for patients, because they may lead to confusion, non-adherence [28], and a perceived altered effect of the medication. [29] Sufficient information by pharmacists or physicians about the generic substitution may reduce the patient's feeling of insecurity [28] or dissatisfaction [30]. Community pharmacists in Switzerland are allowed to substitute the prescribed medication by a product from another manufacturer, unless the prescriber restricts it. [31] To avoid patients' concerns, confusion, and potential non-adherence, pharmacists might dispense the medication known by the patient even though another medication product was prescribed by the physician. This substitution results in an intentional discrepancy.

Another frequent sub-type was medication with the same strength, but unclear or wrong frequency of administration. An example of this type of discrepancy was that patients often took their medication on a demand regimen (PRN medication) rather than on a scheduled regimen as prescribed by the physician, or vice versa. The failure of the patients to comply with the prescribed dosing regimen is well known and is, therefore, a frequent reason for discrepancies observed in ambulatory care. [14] Some of the medication discrepancies occurred due to intentional changes by the patients themselves (e.g., change of the intake time)

or by the physicians (e.g., verbal instructions to patients to change dose, or to intentionally stop a medication). According to annotations by the pharmacists and the pharmacy students in the medication review forms, a frequently reported discrepancy was an intentional stop of a medication by the physician with the knowledge of the patient, but without the transfer of this information to the community pharmacy. Subsequently, patients reported this intentional stop to the community pharmacist during the medication review. The lack of communication between community pharmacists and physicians create issues with care transitions and was identified as a potential risk for patient safety. [32, 33] Eggink and colleagues [34] reported that a clinical pharmacist-led discharge service consisting of a medication review, verbal and written information for the patient, and a discharge list with additional information related to medication, decreased the number of prescription errors and medication discrepancies in patients with heart failure. Furthermore, in a survey in the UK, 89% of general practitioners and 76% of community pharmacists wished to have additional information, such as discontinuation of a medication. [35] This lack of information within the community pharmacy about intentional or unintentional medication discontinuation or dose regimen changes are a risk for patients and needs time to be solved by healthcare professionals in primary care [36]. A pragmatic pharmacist-led in-hospital service consisting of medication reconciliation, addition of information regarding therapy changes (new, stop, change in dose), and check of the prescription for formal mistakes reduced clinically significant pharmaceutical interventions. Moreover, pharmacists' satisfaction with the quality of the discharge prescription were significantly higher in the group with the in-hospital service. [37] The performance of a systematic medication reconciliation as part of a medication review in community pharmacies is also a chance to update the community pharmacy patient records and the patient's home medication list. A Dutch study reported poor documentation of medication changes after hospital discharge in the patient records in the community pharmacy, which could lead to a negative effect on the continuity of care. [38]

Potential Clinical Severity and Economic Impact

Focusing on the potential clinical effects of the detected medication discrepancies, only 1.6% of the medication discrepancies were rated as having a potentially severe effect and 43.2% were assessed as having a potentially moderate clinical effect on patients' health conditions. Over half (55.2%) of the medication discrepancies were rated to be unlikely to have an effect.

This pattern of potential severity is consistent with the results from studies by Cornish et al. [21] and Becerra-Camargo et al. [25] investigating unintentional medication discrepancies at hospital discharge and admission, respectively. Although the potentially clinically severe discrepancies accounted for a small proportion of the discrepancies in these studies, all kinds of medication discrepancies have a potential risk for adverse drug events and should, therefore, be identified and resolved. Pharmacist-led interventions consisting of a systematic medication reconciliation and periodic medication reviews could help to identify, address, and resolve these unfavorable medication discrepancies, and could, therefore, reduce drug-related problems. Focusing on the economic effect of medication reconciliation, Kennelty et al. [39] identified barriers and facilitators of medication reconciliation after discharge by interviewing 10 community pharmacists. They reported that reduced costs due to a decrease of unnecessary healthcare utilization by preventing medication errors were benefits of medication reconciliation after discharge. Our study analyzed the potential immediate economic impact of medication discrepancies on the current medication therapy costs. In approximately 50% (n = 157) of the discrepancies, the medication therapy costs were lower than the therapy initially prescribed by the physician. This result is mainly based on discontinued medications, dose reductions, or generic medication substitutions, which all lower the immediate and actual drug use costs.

Strengths and Limitations

This study was performed under real-world conditions in various community pharmacies across Switzerland. The PMC demonstrated to be a useful tool to compile a BPML and identify intentional and unintentional changes in patients' medication in the community pharmacy. We acknowledge few limitations. First, the uncontrolled patient recruitment and the inclusion criteria (including >1 medication from the ATC group cardiovascular system and >1 generic medication) poses a selection bias, which may influence the frequency of medication discrepancies and medication classes and limits the generalizability of these results. Nevertheless, the pattern of medication classes is comparable to previous studies. [21, 25, 40, 41] Second, the clinical and economic impacts were retrospectively assessed based on the aggregated information and short descriptions handed in by the students. We deemed the aggregated information (PMC, medication history over 12 months, medication reconciliation form) and short descriptions as correct and sufficient to allow a retrospective

evaluation of the medication discrepancies. Moreover, we had a good inter-rater reliability for the potential clinical severity (moderate) and economic impact (substantial). Third, the assessment of the absolute costs was generated by, e.g., missed doses, and did not include therapeutic failure or clinical outcomes.

Conclusions

Medication reconciliation processes in community pharmacies lead to the identification of numerous medication discrepancies between the patients' current home medication and the latest medication prescription. Most discrepancies were classified as partially mismatched medication, whilst omission, duplication, and commission accounted for less than 10% of all discrepancies, which is typical for the ambulatory setting. The results of this study show that within the healthcare system, community pharmacies are favorably placed to perform medication reconciliation and to counsel patients on discrepancies. To improve patient care, community pharmacists should systematically perform medication reconciliation prior to a medication review and whenever prescriptions are renewed or added.

Author Contributions

Conceptualization, T.L.I.-I., M.B.T.P., V.A., and K.E.H.; data curation, T.L.I.-I.; formal analysis, T.L.I.-I. and M.B.T.P.; investigation, T.L.I.-I., M.B.T.P., D.S., and V.A.; methodology, T.L.I.-I., M.B.T.P., V.A., E.A., R.M., T.F.C., and K.E.H.; project administration, T.L.I.-I.; resources, T.L.I.-I. and M.B.T.P.; supervision, K.E.H.; validation, T.L.I.-I., M.B.T.P., D.S., and V.A.; visualization, T.L.I.-I.; writing—original draft, T.L.I.-I.; writing—review & editing, T.L.I.-I., D.S., V.A., E.A., R.M., T.F.C., and K.E.H. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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7.2. Attitudes of patients with polypharmacy towards generic medications in Switzerland [B-2]

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Project report

Adapted from the poster presented at the 47th European Society of Clinical Pharmacy (ESCP) symposium; Belfast, Northern Ireland 24.-26. October 2018.

Introduction

Generic substitution is one approach to reduce increasing costs in health care systems. In addition, cost savings, medication safety and patients' adherence are important aspects to be considered in the discussion of generic substitution. [1, 2] In Switzerland, the generic substitution of medications is not mandatory, neither by dispensing physicians nor by community pharmacists. However, pharmacists are allowed and encouraged to substitute brand name medications; they receive a small compensation of lost margin, which is given once the generic medication is dispensed for the first time. [3]

Aim: Assessment of patients' awareness of generic medications in their therapy, perception of specific aspects, and attitudes towards generic medication and substitution.

Methods

Fifth-year pharmacy students, working in community pharmacies during their internship, attended one type 2a medication review (based on medication history + patient interview) and performed a structured interview with the patients about their knowledge of and attitudes towards generic medication and substitution (4 items) (Appendix I.II.II.). The patient inclusion criteria were: age ≥18 years, with ≥4 medications, including ≥1 generic medication and ≥1 medication from the ATC main group C (cardiovascular system), prescribed for at least 3 months. After the community pharmacists finished the medication reviews, the pharmacy students interviewed community pharmacists regarding their opinions on generic substitution (2 items). Furthermore, the students analysed all prescribed medications listed in the medication review form in regard to reimbursement.

Results

A total of 136 patients were recruited for this study (median age 74 years [range 49-91 years], 58.8% male) and interviewed by pharmacy students. The patients had an average of 9.9 ± 4.0 prescribed medications at the time of the medication review. More than a quarter (27.9%) of these patients were not aware that they were using at least one generic medication. Three-quarters (75.7%) of the patients would prefer a generic if a new medication were to be prescribed by their physician. Nearly three-quarters (73.6%) of the prescribed medications were either brand name products protected by patents/with no generic medications available,

or generic medications; 26.4% were eligible for medication substitution but were not substituted. (Figure 1)

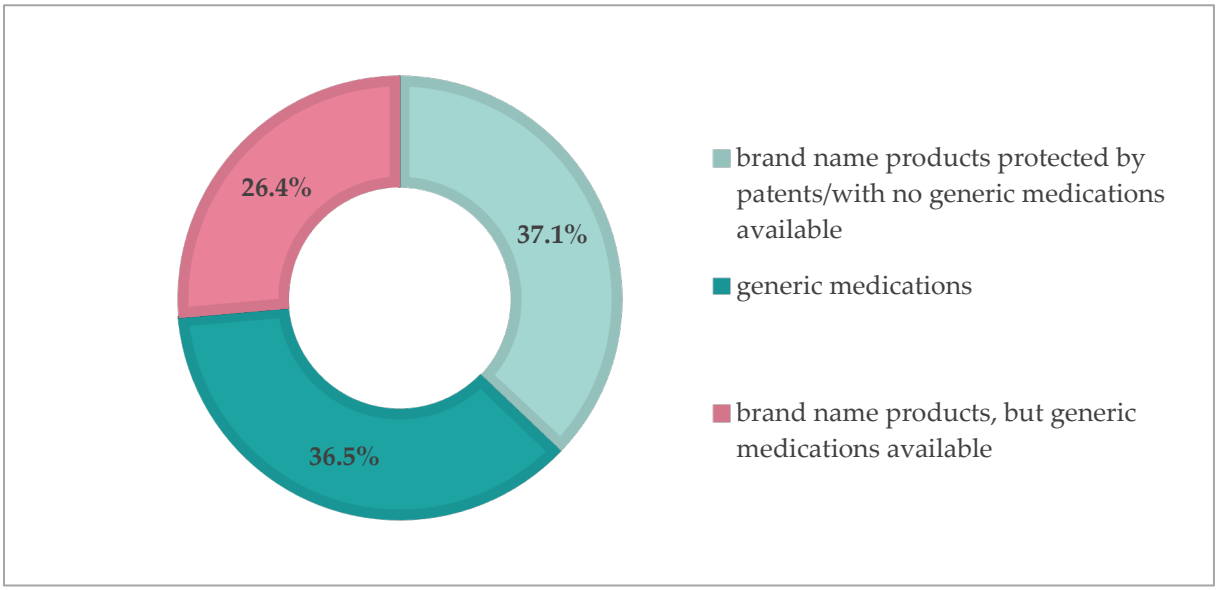

Figure 1: Percentages of substituted and non-substituted medications

Patients were asked to think about their current generic medication/s and list the benefits compared to brand name medications (multiple answers possible). The following aspects were named by the patients: cost (n = 92); effect (n = 6); tolerability (n = 3); on stock in community pharmacy (n = 2); quality (n = 2), formulation (galenic form), splitting, no animal testing, design of the packaging (each n = 1). Afterwards, the pharmacy students listed 15 specific medication aspects and patients were asked to rate these aspects, as an advantage, disadvantage or not relevant to them (Figure 2). The cost aspect was the most commonly reported advantage of generic medications (n = 120) and the taste of generic medication was most frequently reported as a disadvantage (n = 42).

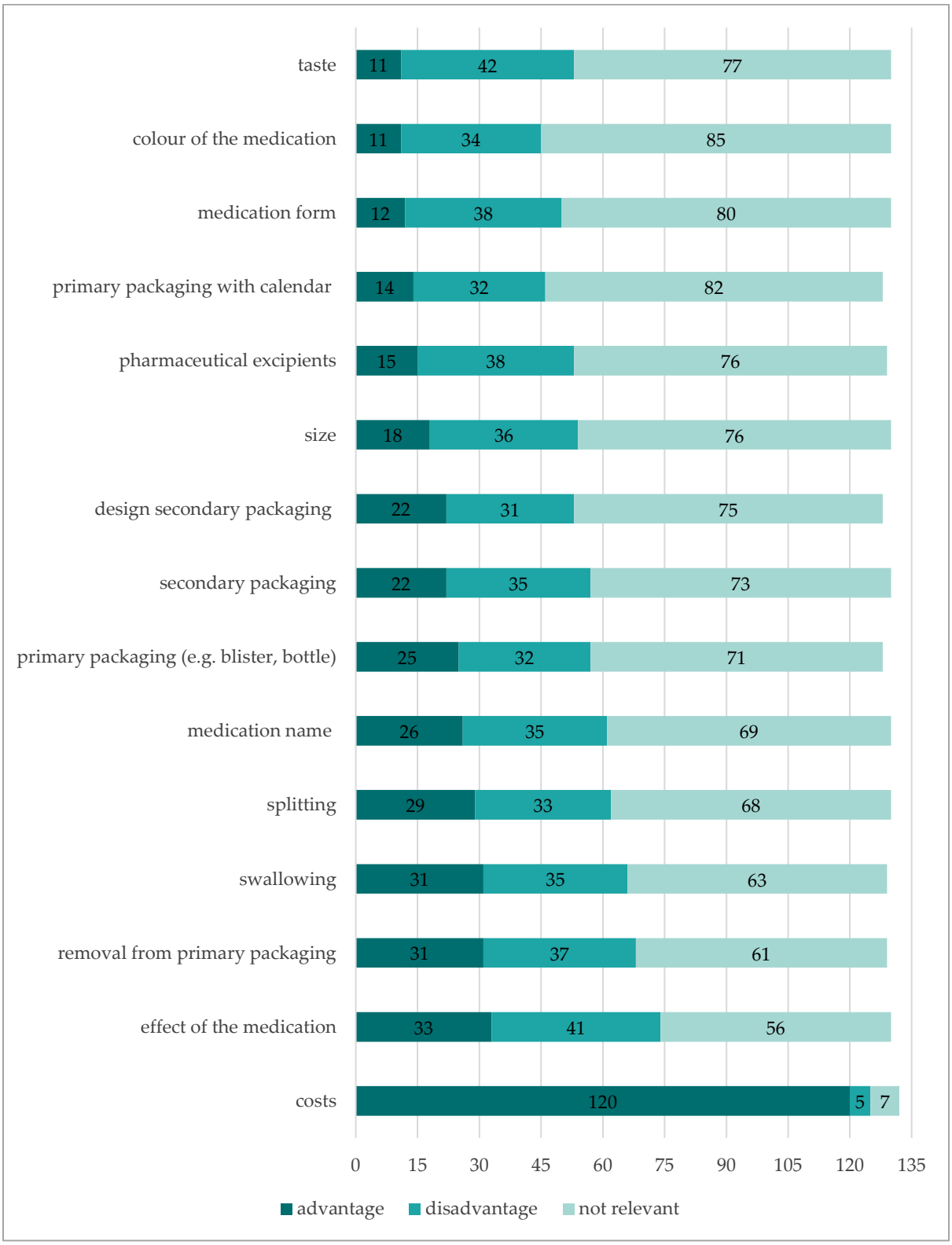

Figure 2: Patients' perceptions of different medication aspects (n= 136, multiple answers possible)

In 14.7% of the medication reviews, the community pharmacists recommended substituting additional medication. Reasons for not recommending additional generic medications were: all medications were already substituted (29.4%), the patient did not want further generic medication/s (30.9%), generic substitution is a risk for non-adherence (2.9%), other reasons

(14.0%), and 31 (22.8%) pharmacists did not answer the question. Furthermore, the community pharmacists were asked whether the patients' responses regarding generic medication and substation influenced their behaviour regarding generic medication and substitution. The majority (n = 98, 72.1%) reported that the responses of the patients did not influence their behaviour, 25.7% (n = 35) would recommend generic medications even more; one pharmacist even less (0.7%), and two pharmacists (1.5%) did not answer the question.

Discussion and Conclusion

In a setting without mandatory generic substitution, there is potential for extended generic medication substitution. In addition, the well-known benefits of cost-saving, generic substitution involves additional aspects that are important for patients either as advantages or disadvantages. Health care professionals should improve the patients' lack of knowledge about their medication and strengthen efforts in achieving higher rates of generic substitution through shared decision making to decrease general health care costs.

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7.3. Evaluation of medication discrepancies identified in patients after hospital discharge in the community pharmacy [B-3]

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Project report

Adapted from the poster presented at the 48th European Society of Clinical Pharmacy (ESCP) symposium; Ljubljana, Slovenia 23-25. October 2019.

Introduction

Medication discrepancies at care transitions are frequent and pose a high risk for patient safety. [1] Pharmacy-led medication reconciliation is a well-studied approach to decrease the number of medication discrepancies at hospital transitions (admission/discharge). [2] However, knowledge about the frequency and patterns of medication discrepancies identified in patients after hospital discharge in Switzerland is lacking.

Aim: Evaluation of medication discrepancies identified by pharmacy students in discharged patients in community pharmacies in Switzerland.

Methods

A cross-sectional study with pharmacy students from the University of Basel, Switzerland was conducted between April and August of 2018. During their internship in Swiss community pharmacies, students attended one type 2a medication review (based on patient's medication history and a patient interview). Adult patients discharged from hospital with a discharge prescription and with a history of ≥4 medications taken for a minimum of three months were eligible for the study. During the medication review, the community pharmacists compiled a list of patients' pre-admission medications. The students compared this list to the hospital discharge prescriptions and all discrepancies (intentional and unintentional) were documented as free text (Appendix I.II.III.). Two researchers independently classified these discrepancies using MedTax [3], a validated classification system for medication discrepancies consisting of two different levels (medication mismatched/medication partially matched) and 12 types. The frequency and types of discrepancies and the active substance (ATC classification system) causing these discrepancies were analysed.

Results

A total of 51 patients were included for analysis with a mean age of 74.1 ± 15.6 years [range 19-98 years] and 54.9% were male. The study patients had an average of 13.5 ± 5.2 prescribed medications prior to hospital admission and 11.0 ± 4.5 medications on the discharge prescription. Overall, the pharmacy students identified 557 medication discrepancies. Figure 1 presents the types and frequencies of the identified medication discrepancies according to the MedTax [3].

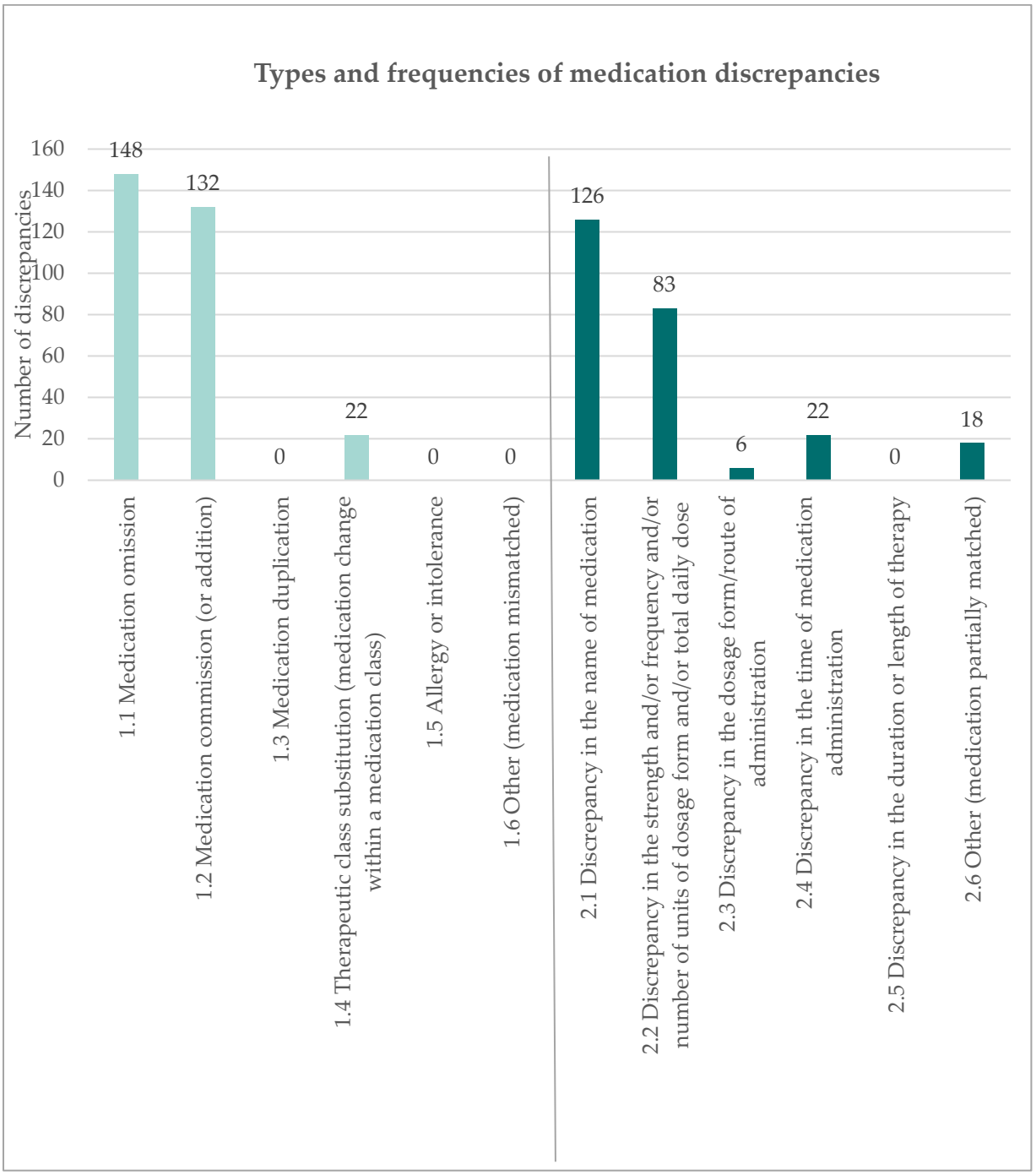

Figure 1: Types and frequencies of medication discrepancies according to MedTax [3] classification system ■ *medication mismatched,* ■ *medication partially matched; (n=557)*

In total, 54.2% (n = 302) of the discrepancies were classified as "medication mismatched" and 45.8% (n = 255) as "medication partially matched" (Figure 1). In 98.0% of the patients, at least one medication omission or commission was identified. Of the 557 identified medication discrepancies, 29% were medications from the ATC C (cardiovascular system), followed by 26% of medications from the ATC A (alimentary tract and metabolism) and 16% from the ATC N (nervous system) (Figure 2).

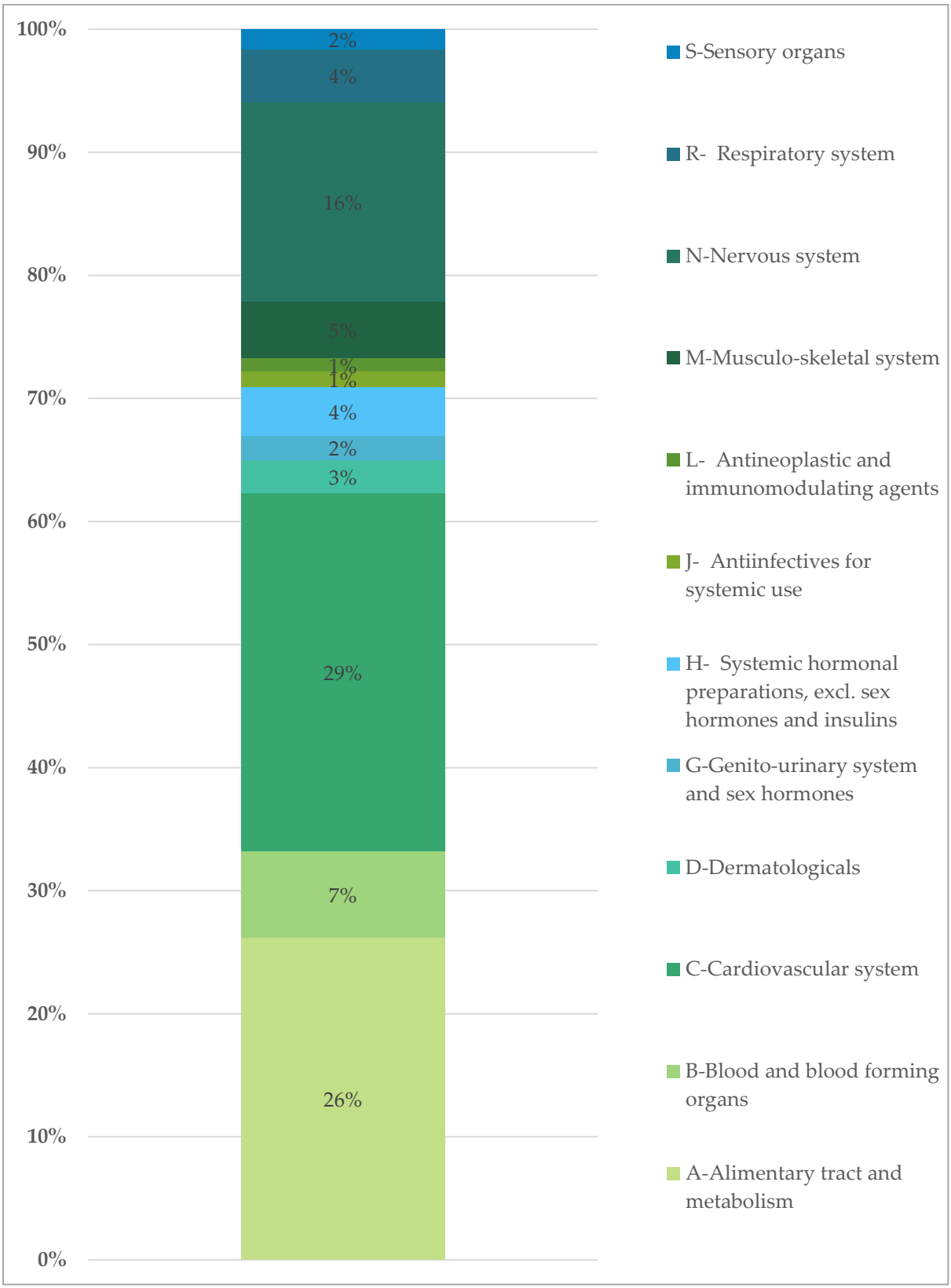

Figure 2: Active substances causing the medication discrepancies according to the Anatomical Therapeutic Chemical (ATC) classification main groups (1st level), (n=557)

Discussion and Conclusion

Medication omission or commission were the most frequent types of medication discrepancies in adults discharged from hospital and 98% of the patients were affected by such a medication discrepancy. Cardiovascular medications caused the highest number of medication discrepancies. For optimal counselling and safety after hospital discharge, the identification of all medication changes in the community pharmacy is relevant for patients and the care team, irrespective of intentional or unintentional discrepancies. Therefore, the implementation of systematic medication reconciliation procedures in community pharmacies is essential following hospital discharge.

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8. Project C

8.1. Detection and resolution of drug-related problems at hospital discharge focusing on information availability – a retrospective analysis [C-1]

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Abstract

Background: Hospital stays are often associated with medication changes, which may lead to drug-related problems (DRPs). Medication reconciliation and medication reviews are strategies to detect and resolve DRPs.

Methods: A descriptive cohort study was conducted, using DRPs collected during routine pharmacist-led medication reconciliation and medication reviews in the hospital's community pharmacy at discharge (cantonal hospital Zug, Switzerland). In a simulation experiment, we retrospectively analysed the detection and resolution possibilities of these DRPs and their dependency on different information sources.

Results: Overall, 6087 prescriptions were filled in the hospital's community pharmacy (June 2016 - May 2019). Among 1352 prescriptions (with ≥1 documented DRP) a total of 1876 DRPs were detected. The retrospective assessment showed that 1115 DRPs could be detected by performing simple medication reviews (based on the discharge prescription and the medication history), whereas in the remaining cases, additional clinical and/or patient-specific information would have been needed. In 944 (84.7%) DRPs detectable by simple medication reviews, the pharmacist would need to consult the prescriber for resolution.

Conclusion: The detection of DRPs is strongly influenced by the information available. These results support models with pre-discharge medication reconciliation and pharmacist-led medication review procedures enabling both, comprehensive detection and facilitated resolution of DRPs.

Keywords: drug-related problems, hospital discharge, medication reconciliation, medication review, community pharmacy, information availability

Introduction

A hospital stay is commonly associated with multiple medication changes (e.g. initiation or discontinuation, dose adjustment, generic/therapeutic substitution), which may lead to drug-related problems (DRPs). [1-3] The Pharmaceutical Care Network Europe (PCNE) defines a DRP as an "event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes". [4] A systematic review showed that the median prevalence of drug-related hospital readmission was over 20%, and almost 70% of these readmissions were considered preventable. [5] In recent years, healthcare professionals have developed and evaluated various interventions to detect and resolve potential DRPs at hospital discharge, thus avoiding adverse drug events (ADEs). [1, 6-8] Medication reconciliation and medication reviews are two options to detect and resolve DRPs at transitions of care. [9-13] According to the World Health Organisation, different healthcare professionals are able to perform medication reconciliation (e.g. physicians, pharmacists, nurses, technicians), but ideally pharmacists should be involved in obtaining or validating the complete and accurate medication list of the patients and comparing this list with medication orders. [14] Pharmacist-led medication reconciliation leads to a significantly reduced number of ADE-related hospital readmissions and emergency department visits. [15] Conducting medication reviews at transitions within or between different healthcare settings showed positive effects on the number of DRPs. [16, 17] Based on available information sources, PCNE defined simple, intermediate and advanced medication reviews (Table 1). The detection of DRPs is directly linked to the types and sources of information available for medication reviews. [18, 19] Nonetheless, studies indicate that community pharmacies in several European countries do not have routine access to clinical patient information. [20-22] In Switzerland, the majority of community pharmacies are able to perform simple and intermediate medication reviews based on the patient's medication history and patient interviews, but have no access to clinical data. [23, 22] For the resolution of some detected DRPs, pharmacists might need to contact the prescriber for further clarification. [24] At present, conducting systematic pharmacist-led medication reconciliation and medication reviews at transitions of care, and especially at hospital discharge, is not routine practice in the Swiss healthcare system. Therefore, the question emerges on the extent of DRPs that can be identified and solved in the traditional

setting of a community pharmacy without a direct link to hospitals and on the added value of a dedicated service from a discharge pharmacy.

Table 1: PCNE classification of medication reviews [19].

		Medication history	Patient interview	Clinical information
Simple	Type 1	✓		
Intermediate	Type 2a	✓	✓	
Intermediate	Type 2b	✓		✓
Advanced	Type 3	✓	✓	✓

Aims of the study

This study aimed at assessing whether DRPs identified on discharge prescriptions in a hospital's community pharmacy (with full access to the hospital's electronic health records) would be detectable in a community pharmacy by simple medication reviews based on the patient's medication history only, or if intermediate or advanced medication review with additional clinical and/or patient-specific information would be needed. In addition, it was assessed whether the resolution of the DRPs that were deemed detectable by a simple medication review would require a consultation with the prescriber.

Methods

Study design and setting

This was a simulation experiment based on data from a retrospective, single-centre, descriptive cohort study using routinely collected data from inpatients discharged from the internal medicine unit (n = 65 beds) of the cantonal hospital of Zug, Switzerland between June 1, 2016 and May 31, 2019. The study was approved by the ethics committee of Northwest and Central Switzerland (EKNZ: 2018-01462; 30.08.2018). Patients were included for analysis if they were 18 years or older and filled their discharge prescription in the community pharmacy located within the hospital and with full access to the hospital's electronic health records (called hereafter hospital's community pharmacy). All results were analysed based on single hospital stays because an individual patient could have several hospital stays during the study

period. The results reported here are part of a bigger study focusing on the influence of pharmacist-led interventions on the number of DRPs at discharge, which will be published separately. This study focused on DRPs identified in patients filling their discharge prescription in the hospital's community pharmacy (Figure 1). The cantonal hospital Zug routinely offers pharmacist-led medication reconciliation and medication reviews to patients at hospital discharge according to the hospital internal Standard Operating Procedure (SOP). If patients agree, the discharge prescription is transmitted to the hospital's community pharmacy. Based on eight risk factors (≥5 medications prescribed, patient ≥65 years of age, lack of information on therapy duration, prescription of anti-infective therapy, antiepileptic medication, oral anticoagulant, antiplatelet therapy, ≥1 discrepancy between patient's home medication and the discharge prescription), the hospital's community pharmacists stratify the prescriptions into the different levels of risk for DRPs. According to these risk levels, they perform different types of medication reviews: low = 0-1 risk factor (simple medication review), intermediate = 2 risk factors (intermediate medication review), and high = ≥3 risk factors (advanced medication review). In all risk groups, the pharmacists contact the prescriber if the detected DRPs require a clinical decision regarding the patient's treatment. DRPs leading to minor therapy changes (e.g. optimisation of the intake time, generic substitution) or educating patients about their medications do not require contact with the prescriber.

DRPs detected during medication reconciliation and medication reviews at discharge are documented and classified by the hospital's community pharmacists of the cantonal hospital Zug using an adapted version of the GSASA (Swiss Society of Public Health Administration and Hospital Pharmacists) classification tool [25], which was originally developed for the documentation of clinical pharmacists' activities during the patient's hospital stay (detected problems, causes, performed interventions, and outcomes of the intervention). It was adapted by the hospital's community pharmacists to the discharge situation by adding categories for DRPs caused by medication reconciliation issues. The classification tool used to categorise the DRPs in this study consisted of four main categories, thirteen subcategories, and five categories to document the outcomes of the pharmaceutical interventions (Appendix I.III.I).

Detection and resolution of DRPs

In a simulation experiment, two members of the research team (A.P.H. and T.L.I.-I.), independently assessed for every documented DRP, if it could have been detected by

performing simple medication reviews (based on the discharge prescription and the patient's medication history), or only by conducting intermediate/advanced medication reviews based on the discharge prescription, the patient's medication history, clinical information, and/or patient-specific information (Figure 1). In addition, they assessed whether a direct consultation with the prescriber was necessary for the resolution of the DRPs, which were classified as detectable by simple medication reviews. Differences between the two assessors were resolved by discussion and, if necessary, a third member of the research team (H.S.) was consulted.

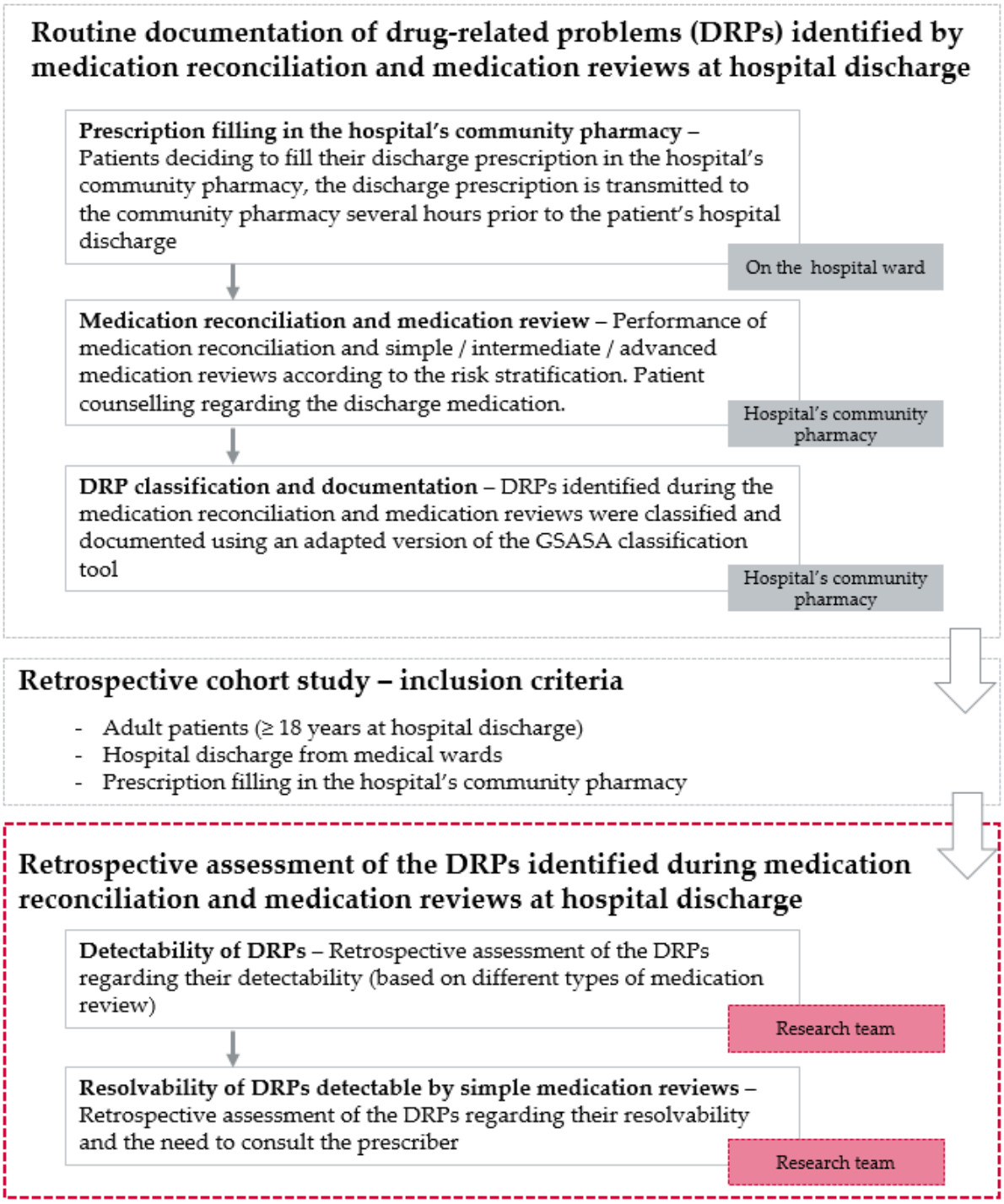

Figure 1: Hospital discharge process at the cantonal hospital Zug and study overview. (DRP = drug-related problem, GSASA = Swiss Society of Public Health Administration and Hospital Pharmacists)

Data collection and variables

Data sources for patients' demographic information and medication at admission and discharge were extracted from the hospital's electronic health records. The International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) codes of the patient's diagnoses at hospital discharge were provided by the hospital's clearing

office. The information on prescription filling was extracted from the hospital's community pharmacy software. For each patient, the number of Elixhauser comorbidities [26, 27] was calculated using the ICD-10 codes of all recorded diagnoses to measure patient comorbidity. The research team retrospectively identified and documented all medication names and codes of the Anatomical Therapeutic Chemical (ATC) Classification System associated with the DRPs. The different sources of information were linked in the database using unique encrypted identifiers. The research team validated each variable in the database and the output tables prior to the analysis (Appendix I.III.II).

Statistical analysis

Statistical analyses were performed using IBM® SPSS® Statistics Version 25 (IBM Corp., Armonk, New York, USA). We considered all inpatient stays with ≥1 DRP at hospital discharge for analysis. Descriptive statistics were used for the baseline characteristics, the documented DRPs, the ATC codes of medications associated with DRPs and the assessment of the detection and resolution of DRPs. Numeric variables were summarised using median and interquartile range (IQR), for categorical variables, frequencies were calculated.

Results

Between June 1, 2016 and May 31, 2019, the discharge prescriptions of 6087 inpatient stays in the medical unit were filled in the hospital's community pharmacy, 15 prescriptions were excluded due to inconclusive documentation of DRPs. Overall, prescriptions from 6072 inpatient stays (4545 individual patients) were used for the analysis.

Table 2 presents the baseline characteristics of all inpatient stays with ≥1 documented DRP at hospital discharge (n = 1352 inpatient stays, 22.3%). In 77.7% (n = 4720) of inpatient stays, the hospital's community pharmacist did not document any DRPs (Appendix I.III.III).

Table 2: Baseline characteristics of the inpatient stays with ≥1 documented DRP at hospital discharge (n = 1352).

Determinants	**Values**
Female, n (%)	674 (49.9%)
Age at discharge (in years), median (IQR)	79 (70-85)
Emergency admission, n (%)	1245 (92.1%)
Length of hospital stay (in days), median (IQR)	5.3 (3.2-8.1)
Medication	
Number of medications recorded at admission, median (IQR)	7 (5-10)
Number of medications prescribed at discharge, median (IQR)	9 (6-12)
Clinical status	
Elixhauser comorbidity score[26, 27], median (IQR)	3 (2-4)
Specific Elixhauser comorbidities† [26, 27], n (%)	
- Hypertension (uncomplicated and complicated)	826 (61.1%)
- Renal failure	469 (34.7%)
- Cardiac arrhythmias	435 (32.2%)
- Diabetes (uncomplicated and complicated)	326 (24.1%)
- Fluid and electrolyte disorders	306 (22.6%)
- Congestive heart failure	300 (22.2%)
- Chronic pulmonary disease	202 (14.9%)
- Valvular disease	131 (9.7%)
- Depression	118 (8.7%)
- Solid tumour without metastasis	116 (8.6%)
- Other neurological disorders	112 (8.3%
- Hypothyroidism	103 (7.6%)
Number of ICD-10 diagnoses at hospital discharge, median (IQR)	8 (5-10)

IQR=interquartile range, † Twelve most frequent comorbidities

A total of 1876 DRPs (n = 6072 inpatient stays, an average of 0.31 DRPs per inpatient stay) were detected by the hospital's community pharmacists during medication reconciliation and medication reviews in patients filling their discharge prescription (Table 3). The majority of the detected DRPs were classified into the main category "prescribing problem during the hospital stay or at discharge" (n = 1367, 72.9%) followed by DRPs caused by a "medication reconciliation problem at hospital admission" (n = 438, 23.3%), (Table 3). The most frequently detected sub-categories of DRPs were "missing/inappropriate dosage" (n = 409, 21.8%), followed by "omission of a medication" (n = 184, 9.8%), "untreated indication" (n = 182, 9.7%) and "medication not indicated or duplication" (n = 182, 9.7%).

Table 3: Number and categories of DRPs detected at hospital discharge by the hospital's community pharmacist (n = 1876) and the number of DRPs leading to a modification in the discharge prescription.

Main category and sub-category	**Frequency of DRPs**	**Frequency of DRPs leading to modifications in the discharge prescription**
	Number	**Number (%)**
1) Medication reconciliation problem at hospital admission	**438**	**319 (72.8%)**
1.1 Incorrect medication recorded	114	100
1.2 Omission of a medication	184	105
1.3 Incorrect strength/dose recorded	140	114
2) Prescribing problem during the hospital stay or at discharge	**1367**	**1012 (74.0%)**
2.1 Incorrect or lack of substitution back to patient's home medication	136	127
2.2 No restart of medication that was paused during the hospital stay	58	52
2.3 Missing/inappropriate dosage	409	304
2.4 Missing/inappropriate therapy duration	135	121
2.5 Medication not indicated or duplication	182	116
2.6 Untreated indication	182	144
2.7 No concordance with guideline or contraindication	46	22
2.8 Interaction	98	67
2.9 Adverse effect	29	14
2.10 Medication not suitable or of limited suitability	72	34
Missing subcategory	20	11
3) Incomplete patient documentation	**56**	**5 (8.9%)**
4) Other	**15**	**8 (53.3%)**
Total	**1876**	**1344 (71.6%)**

Table 3 shows that 71.6% (n = 1344) of the detected DRPs led to a modification of the original discharge prescription. In 10.9% (n = 204) of cases, the prescriber was informed about the DRP, but the result of the intervention was not followed up. In 6.8% (n = 128) of cases, a recommendation concerning medication was made to the patients' general practitioner in the hospital discharge letter. Additionally, in 6.5% (n = 122) of cases, the pharmaceutical interventions triggered by the DRPs were not accepted by the prescribing physician, and in 3.6% (n = 67) of cases, the patient was directly informed by the hospital's community pharmacist about the DRP because no prescriber approval and/or notification was deemed necessary.

The ten most frequent ATC subgroups associated with the detected DRPs were: proton pump inhibitors (n = 136), HMG-CoA-reductase inhibitors (n = 135), direct factor Xa inhibitors (n = 105), calcium, combinations with vitamin D and/or other drugs (n = 94), selective beta-blocking agents (n = 92), ACE inhibitors (n = 91), platelet aggregation inhibitors excluding heparin (n = 80), angiotensin II receptor blockers (n = 77), sulphonamides (n = 75), and dihydropyridine derivatives (n = 66). Illustrative examples of DRPs detected at hospital discharge are shown in Appendix I.III.I.

Detection and resolution of DRPs

In a simulation experiment, two members of the research team retrospectively assessed detectability and resolvability of 1852 DRPs (98.7%), 24 DRPs were excluded due to inconclusive documentation. Figure 2 shows that community pharmacists conducting simple medication reviews (based on discharge prescriptions and medication history only) would be able to detect 1115 out of the 1852 DRPs (60.2%), whereas for the detection of the remaining DRPs (n = 737, 39.8%), additional clinical and/or patient-specific information is needed.

Focusing on the 1115 DRPs, which are detectable by simple medication reviews, Figure 3 shows that 944 (84.7%) DRPs would require a consultation with the prescriber for the resolution of the problem. Examples for DRPs detectable by simple medication reviews and resolvable without prescriber consultation (n = 171) are inadequate medication intake time or suboptimal frequency, intake of fluoroquinolone/bisphosphonate/levothyroxine with polyvalent cations, or incorrect/lack of generic substitution in accordance with the patient's home medications. In contrast, DRPs detectable by simple medication reviews requiring contact with the prescriber for resolution (n = 944) include, e.g., prescription of multiple medications associated with QT-interval prolongation, missing/inappropriate therapy duration of antibiotics/antifungals, or untraceable changes in the patient's medication (e.g. discontinuation of medications for chronic conditions), because these DRPs require clarification and/or a clinical decision regarding the patient's treatment.

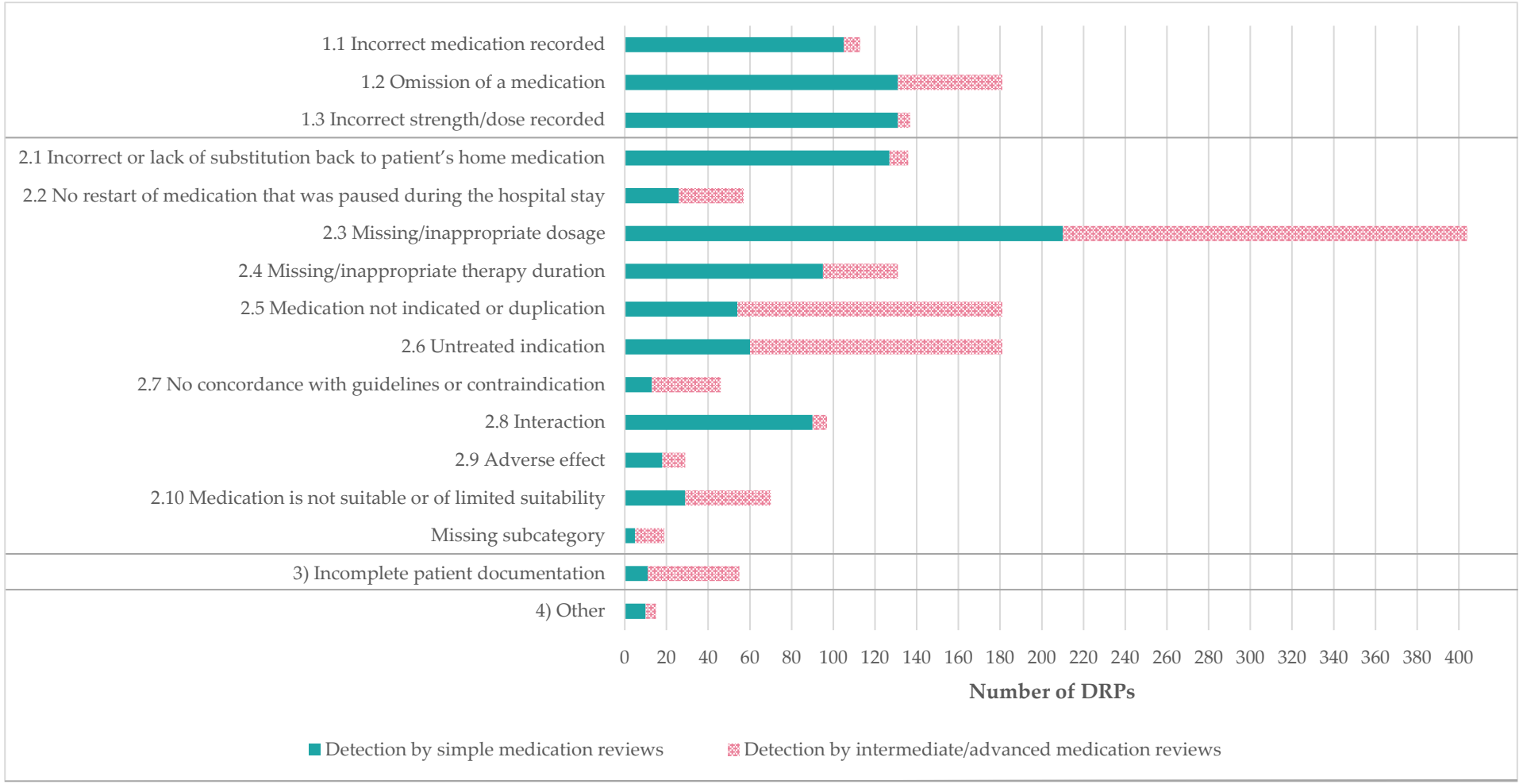

Figure 2: Detection of DRPs in a simulation experiment by performing either simple or intermediate/advanced medication reviews at hospital discharge (n = 1852 DRPs).

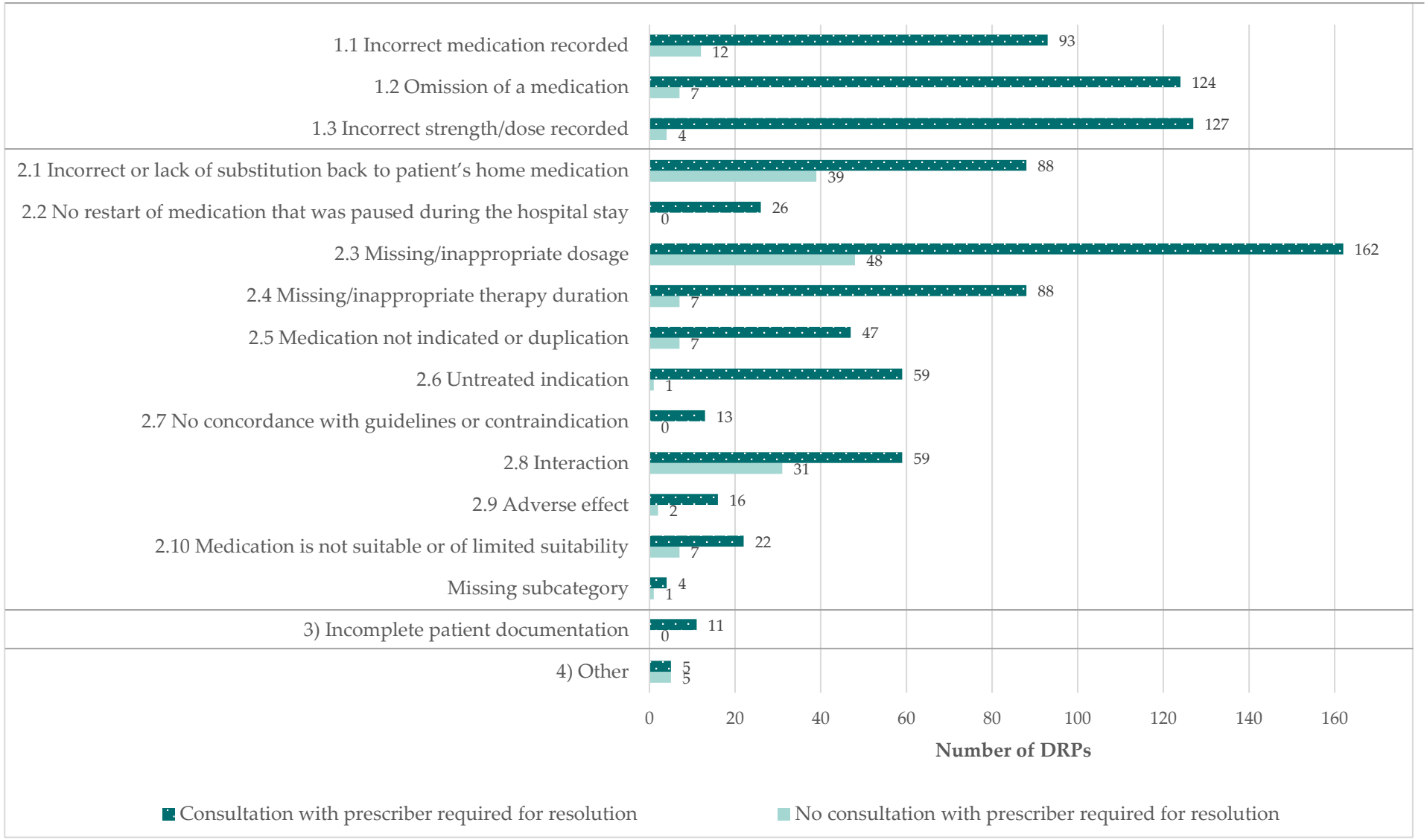

Figure 3: Resolution of DRPs detected in a simulated experiment by simple medication reviews with or without the consultation of the prescriber (n = 1115).

Discussion

This study aimed to assess the influence of the availability of different information sources on the detectability of DRPs, and whether resolving the DRPs detected by simple medication review would require a consultation with the prescriber or not. Our findings suggest that pharmacists without access to clinical and/or patient-specific information can only detect a part of the DRPs at hospital discharge. For many cases, additional clinical and/or patient-specific information is needed. The access to patient-specific information collected during a patient interview helps to detect adherence issues, medication use problems, knowledge gaps, and adverse drug reactions. [18] Since patients are often present when prescriptions are filled, they might be a reasonable source of information for the identification of DRPs after hospital discharge in the community pharmacy. Conversely, for the detection of, for example, incorrect dosing according to organ dysfunction, a medication without documented indication, or a diagnosis without treatment, pharmacists need access to clinical patient information. [18] However, in some European countries and in most community pharmacies in Switzerland, clinical patient information is not routinely accessible by pharmacists. [20-22] Therefore, the access to hospital discharge summaries, including clinical patient information, could be beneficial for the detection of DRPs by community pharmacists, reduce the risk for undetected DRPs [28] and would enable the dispensing of appropriate medication after hospital discharge [29]. As reported by Geurts and colleagues, discharge summaries were only sent to the patients' general practitioners, not to community pharmacies [29], which is also common practice in Switzerland. The implementation of shared electronic patient records accessible by all involved healthcare providers might be a valuable option to increase the quality of patient care. [30] Efforts regarding the development and implementation of the national electronic health record in Switzerland are ongoing. [31] Taking all of this into consideration, both the access to patient-specific information, as well as clinical patient information, is desirable in community pharmacies to enable comprehensive detection of DRPs in patients after hospital discharge.

Nonetheless, the detection of DRPs is only the first step of the process. Pharmacists need to clarify and resolve DRPs, either by themselves or in collaboration with the prescriber. We found the majority of DRPs detectable by simple medication reviews would require a consultation with the prescriber for their resolution. One study from the Netherlands analysed

100 hospital discharges in the community pharmacy and investigated the medication discrepancies between discharge documents and documentation in community pharmacy software for discharged patients, and the number of discharges causing contact with the physician. [29] In 69% of the investigated hospital discharges, the community pharmacists needed to contact a hospital physician to discuss identified problems. [29] These results show that community pharmacists frequently contact prescribers to discuss DRPs in patients discharged from the hospital. Additionally, it should be taken into account that each contact with the prescriber leads to an interruption of workflow [32], which is time-consuming for both community pharmacists and physicians [12, 33]. The collaborative preparation of discharge prescriptions by physicians and pharmacists within the hospital could lead to a reduction in the number of DRPs in patients discharged from the hospital, which would increase medication safety as well as save time.

In addition, the results of the present study confirm previous findings indicating the frequent occurrence of DRPs at hospital discharge. Over 70% (n = 1367) of the detected DRPs were caused by prescribing problems during the hospital stay or at hospital discharge. In contrast, 23% (n = 438) of the DRPs were caused by a medication reconciliation problem at hospital admission. The most frequent DRP sub-category within this main category was the omission of a medication that the patient was taking prior to hospitalisation, followed by the recording of incorrect medication doses or strengths. Previous national and international studies performing medication reconciliation at hospital admission showed a similar pattern of DRPs. [34-37] The persistence of these DRPs from admission throughout the hospital stay and at discharge may lead to further reconciliation errors at subsequent transitions of care. [35] Hence, the detection of DRPs at an early stage might reduce the overall risk for reconciliation errors [35] and clinical decisions based on inaccurate medication histories. [38, 39] Therefore, a systematic pharmacist-led medication reconciliation process at hospital admission constitutes a valuable opportunity to reduce these types of DRPs. [40, 41] So far, this is not common practice upon hospital admission in Switzerland.

Strengths and limitations

The strengths of this study were its large sample size and the use of routinely collected data, which was not influenced by a highly controlled and artificial study environment.

However, the limitations of this study should be taken into account when interpreting the results. We analysed data from a single site. Nevertheless, this hospital's community pharmacy was performing comprehensive patient discharge management, which is not routinely established in Swiss hospitals so far and might be an example for other institutions. The risk stratification including eight different risk factors could influence the pattern of the DRPs, but the comparison of the DRPs detected in our study was similar to other national and international studies. [34-37] Furthermore, the analysis of routinely collected real-life data might result in a slight underestimation of DRPs, because in daily practice minor problems and interventions might not have been comprehensively documented in the hospital's community pharmacy. Several pharmacists performed medication reconciliation and medication reviews, which might lead to heterogeneity in the detection and classification of the DRPs. Additionally, this was a retrospective assessment of DRP detection and resolution possibilities based on a simulation experiment, performed by two members of the research team not working at the study site.

Conclusion

The ability to detect DRPs is strongly influenced by the extent of information available to the pharmacists. While simple medication reviews enable the detection of approximately 60% of all DRPs identified by pharmacists at discharge, a majority of these DRPs would require a consultation with the prescriber for resolution. These results support the added value of a dedicated service from a discharge pharmacy or models with pre-discharge medication reconciliation and pharmacist-led medication review procedures enabling both, comprehensive detection and facilitated resolution of DRPs through easy access to clinical data and contacts to the prescribers. However, with regard to the community pharmacy setting, we advocate full access to hospital health records and efficient communication channels between healthcare professionals to reduce inadequate post-hospital medication therapies, save resources by reducing consultations between pharmacists and prescribers, which might ultimately improve patient safety and clinical outcomes.

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9. Project D

9.1. Electronic medication list after hospital discharge in the canton of Aargau – Usability study [D-1]

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Work report

Introduction

Hospital discharge is an important transition in patients' care because changes in medication regimen occur frequently during the admission, hospital stay, and at discharge. [1-4] Dose adjustments, discontinuation of a medication or initiation of new medication are some examples of such medication changes. [1] As a consequence, medication discrepancies can cause drug-related problems (DRPs), especially in patients with insufficient knowledge about their medication. [3, 5, 6] Medication reconciliation might help to avoid medication discrepancies and subsequent DRPs after hospital discharge. A systematic review reported that pharmacist-led medication reconciliation interventions are able to reduce the risk of unfavourable effects after hospital discharge and to avoid emergency department visits, ADE-related hospital revisits and all-cause readmissions. [7] In addition, the community pharmacist is frequently the first health care professional visited by the patient after hospital discharge. [8, 9] Therefore, community pharmacists play a pivotal role in patient care after hospital discharge through identifying and resolving medication discrepancies, and improving patients' knowledge about their medication by patient counselling. [3] A Cochrane review determining the effectiveness of written health information together with verbal information at discharge from an acute hospital to home concluded that the combination of written and verbal health information at hospital discharge appears to increase knowledge and satisfaction. [10] In Switzerland, hospital physicians prepare written discharge documents such as discharge reports for general practitioners, discharge prescriptions for patients and in some cases discharge medication lists with an overview of the patient's medication. [11] However, limited data exist about patient's transitions in the Swiss health care system from hospital discharge to primary care, the types and frequencies of medication discrepancies and other types of DRPs experienced, and about the strategies used to overcome difficulties.

Hospital discharge processes might be improved by the implementation of electronic health records (EHR) including, for example, medication lists and additional health information. [12] In 2015, a federal law was passed by the Swiss Federal Parliament and came into effect in 2017, which requires the implementation of EHRs in the Swiss health care system to enable the cooperation and data sharing between different health care providers, intending to improve the quality of patient care and efficiency of the Swiss health care system. The EHR systems are organized and encouraged by so-called "communities", which are private legal bodies built

around specific groups of populations (e.g. cantonal or regional cooperation). Hospitals had to be ready to offer EHRs to patients by the year 2020, followed by specific health care institutions (e.g. nursing homes) two years later (2022). Contrasting this, in primary care the implementation of the EHR is voluntary for both health care providers (e.g. general practitioners, community pharmacies) and patients. [13] Regarding the implementation of EHRs, experience from other countries reveals different concerns such as privacy and security issues [14], financial aspects [15, 16], usability, education and technical support [16-18], user acceptance [16], and service continuity in case of downtimes [19].

Against this background, in 2018 the canton of Aargau founded "Stammgemeinschaft eHealth Aargau" (SteHAG), a local network incorporating all health care providers (individuals and institutions) with the aim of preparing the implementation of an eHealth platform with the EHR in that region. [20] The electronic prescribing of medications and the compilation of an electronic medication list are essential elements of the EHR. The SteHAG planned to pilot the electronic medication list integrated into the EHR in collaboration with the cantonal hospital in Baden and the surrounding health care professionals in primary care. However, at that time, neither standards nor validated instruments for electronic medication existed in Switzerland although they were under development. A few pilot projects assessing different aspects of the EHR were performed in different regions of Switzerland. [12] Thus, STeHAG approached the Pharmaceutical Care Research Group of the University of Basel, intending to evaluate the electronic medication list as part of the EHR in a usability study. They expected to gather valuable information about the satisfaction and acceptance of patients, health care professionals, and stakeholders with the electronic medication list in terms of the implementation of the EHR. The project was named EMILIA (**e**lektronischer **M**edikat**i**onsp**l**an nach Spitalaustritt **i**m Kanton **A**argau), an acronym for "electronic medication list after hospital discharge in the canton of Aargau".

The aims of the project were to evaluate:

- the acceptance and satisfaction of patients, community pharmacists, physicians and caregivers with the electronic medication list and the eHealth platform.
- the number of discrepancies between the discharge prescription and the dispensed medication in the community pharmacy.

- the number and type of pharmaceutical interventions performed by the community pharmacists filling the hospital discharge prescriptions.

Unfortunately, the project was discontinued after one year because in 2018 the Swiss Post abandoned the provision of their electronic medication list application used for the evaluation in the present project. Therefore, we herein report the methods of the planned usability study and the methods and results of the performed pilot study.

Methods

Usability study

The study was designed as a prospective, observational single centre study (Figure 1) and conducted at the cantonal hospital in Baden (canton Aargau) and the community pharmacies of the regional community pharmacy association (Der Aargauische Apothekerverband). The study was approved by the ethics committee of Northwest and Central Switzerland (EKNZ 2017-01250).

Study design

Patients from the internal medicine wards of the cantonal hospital in Baden (AG) were screened for inclusion and exclusion criteria (Table 1) during their hospital stay by clinical pharmacists (Figure 1, T1). The screening for inclusion and exclusion criteria consisted of two consecutive parts: First, screening at the hospital pharmacy using hospital health records with the criteria for age (≥18 years), insurance status, patients in isolation, and discharge on weekends. Second, screening on the internal medicine wards during patient visits with the criteria: ≥1 medication for chronic use; sufficient language, hearing and speaking skills; no cognitive impairment or hindering ability; no discharge to another institution; prescription filling in a community pharmacy participating in the study; knowledge of basic computer skills (patient or caregiver); and informed consent.

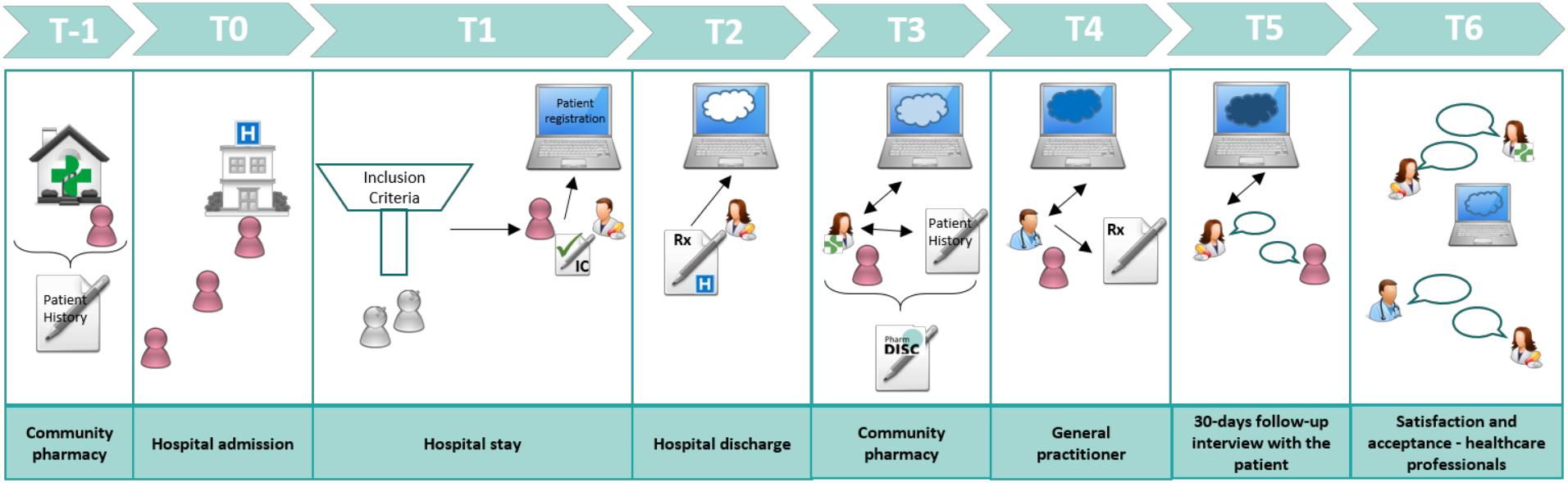

Figure 1:Study overview and the outcome measurements at different points in time (T-1 = patient medication history in the community pharmacy prior to hospital admission, T0 = hospital admission, T1 = patient screening, T2 = hospital discharge, T3 = prescription filling in community pharmacy, T4 = general practitioner visit, T5 = follow-up patient interview 30 days post-discharge, T6 = interview with health care professionals and IC = informed consent, Rx = prescription, pharmDISC = Pharmacists' Documentation of Interventions in Seamless Care

Table 1: Inclusion and exclusion criteria

Inclusion criteria: • Patient ≥18 years of age • Internal medicine wards • Standard or semi-private insurance • Chronic medication (>1 medication) prior to hospital admission or new medication (>1 medication for a minimum of 3 months) at discharge • Patient or caregiver needs basic computer skills • Plan to fill the discharge prescription in a study-participating community pharmacy • Discharge during weekdays
Exclusion criteria: • Insufficient language, hearing or speaking skills • Cognitive impairment or hindering ability • Isolated patients, due to infectious diseases • Discharge to another institution (hospital, nursing home, assisted living, rehabilitation clinic) • Patients without medication at discharge or without discharge prescription • No informed consent

After informed consent was received, patients were registered on the eHealth platform provided by Post E-Health at the bedside. The login procedure and the different features of the EHR and the electronic medication list were explained to the patients. At the same time, the patients received a study identification card with a name, date of birth and patient number for identification in the community pharmacy (Figure 1, T1). The pre-registered community pharmacy was informed about the study participation of the included patient by fax and the patient's general practitioner was asked for study participation by email.

At the day of hospital discharge, the clinical pharmacists recorded the medication of the hospital discharge prescription on the electronic medication list of the EHR. In addition, the patient received the regular paper-based hospital discharge prescription and medication list from the cantonal hospital in Baden (Figure 1, T2).

After hospital discharge, patients went to their regular community pharmacy (Figure 1, T3) to fill the hospital discharge prescription. At least one employee per community pharmacy was trained to adapt the medication list in the EHR, and to identify and document drug-related problems. This person validated and filled the discharge prescription. All pharmacist-led interventions performed during the prescription filling and patient counselling were documented in the outcome sheet (Appendix I.IV.I.) using PharmDISC, a validated

intervention-oriented classification system for pharmaceutical interventions. [21] In parallel, the EHR was updated with the actual dispensed medication (e.g. after generic medication substitution, optimization of medication regimen). The updated electronic medication list with the actual dispensed medication was printed and handed over to the patient.

In the next step, all discrepancies between the hospital discharge prescription and the actual dispensed medication were assessed and documented by the community pharmacy employees in the outcome sheet. At the subsequent GP visit, the eHealth platform with the EHR was available for consultation and/or for the update of the electronic medication list by the general practitioner (Figure 1, T4).

Thirty days post-discharge (Figure 1, T5), a member of the researcher team contacted the patient by phone to perform a structured patient interview (Appendix I.IV.II.). The interview consisted of six different sections:

- demographic information and the living situation,
- pharmaceutical aspects such as the current home medication and community pharmacy visits,
- planned and unplanned physician visits, hospital readmissions,
- patient's general use of media,
- use, satisfaction and acceptance with the eHealth platform and the electronic medication list,
- attitudes towards eHealth and the EHR.

The questionnaire had 21 main questions and 16 additional in-depth questions. The answers to the questions were indicated as open-ended, multiple-choice, or Likert-scale. At the end of the study, the healthcare professionals and stakeholders were interviewed to assess satisfaction and acceptance with the electronic medication list as part of the EHR and the eHealth platform (Figure 1, T6).

For this usability study, a number of 100 participating patients was aimed for in order to collect a broad range of feedback from patients, involved health care professionals and stakeholders on their satisfaction with and acceptance of the new electronic medication list as part of the EHR and eHealth platform. As 28 community pharmacies from Baden and its surroundings were interested in participating in the study, a reasonable sample of patients was needed.

Outcomes

The **primary outcome** of this study was the acceptance and satisfaction of the electronic medication list as part of the EHR and the eHealth platform among involved health care professionals, stakeholders and patients (Figure 1, T6).

The **secondary outcomes** were the assessment of the numbers and types of medication discrepancies at different points in time prior to the hospital admission, hospital discharge and 30 days post-discharge (Figure 1): between the hospital discharge prescription (T2) and patient medication history prior to hospital admission (T-1); the medication discrepancies between the hospital discharge prescription (T2) and the dispensed medication in the community pharmacy (T3); and dispensed medication (T3) in the community pharmacy and the patient's home medication 30 days post-discharge (T5). Furthermore, we evaluated the pharmaceutical interventions performed during the prescription filling/patient counselling in the community pharmacy and assessed planned and unplanned physician visits, hospital re-admissions (within 30 days of hospital discharge).

Pretests of the eHealth platform and the electronic medication list

The research team performed various tests for a better understanding of the eHealth platform and the electronic medication list as part of the EHR and the preparation of the training material for community pharmacists, pharmacy technicians, physicians and patients. All processes of the usability study were tested by entering different fictional persons into the eHealth platform and EHR provided by the Swiss Post (e.g. registration procedure, log in, add medication to the electronic medication list, change medication or regimens, print the electronic medication list). All problems and bugs encountered during these pretests were documented with screenshots and detailed descriptions of the problems. The lists containing these problems were consecutively handed over to STeHAG and Swiss Post for incorporating adaptions to the eHealth platform.

Methods pilot study

The research team decided to perform a pilot study recruiting patients during one month to assess the feasibility of the study design and to optimize the study processes. Subsequently and based on this pilot study, the study team and the STeHAG planned to adjust the eHealth

platform and in particular the application for the electronic medication list with the intention to run the usability study with 100 patients according to the initial aims of the collaboration.

For the pilot study, we used the previously described study procedure (Figure 1). Before the start of the pilot study, we decided to restrict the patient birth year to 1940 to identify a high number of patients with basic computer skills during the one-month pilot study. Each weekday morning, the clinical pharmacist screened the hospital records to identify internal medicine ward patients eligible for study inclusion. Eligible patients were further screened by using the information reported in the hospital health record for age, insurance status, and isolation due to infectious diseases. For the second part of the screening, the clinical pharmacist visited the previously identified patients on the internal medicine wards. Two time slots a day were deemed as appropriate for the screening on the wards: in the morning prior to the start of ward rounds and in the afternoon prior to official visiting hours.

Results

Pretest of the eHealth platform and the electronic medication list

The research team identified multiple problems and bugs during the test sessions by entering different fictional persons to the eHealth platform and by testing the electronic medication list application. The identified patient safety and usability problems and bugs were listed and transmitted to the STeHAG and the Swiss Post for further improvement. Between July and November 2017, iterative rounds were needed to improve the eHealth platform and, in particular, the application for the electronic medication list (Appendix I.IV.III.). However, numerous problems and bugs could not be resolved until the start of the pilot study in December 2017.

Pilot study

Even though some problems and bugs were not fixed by the Swiss Post (e.g. generic substitution not linked to dose regimen, translation of English terms into German, representation of half-tablets, differentiation between upper and lower case letters) the research team decided to run the pilot study from 1st to 31st of December 2017. Overall, 11 community pharmacies in Baden and its surroundings participated in this pilot study.

Recruitment:

During the pilot study, 165 patients (mean age 60.7 ± 12.3 years) were screened for study inclusion (Figure 2). After the screening, using the patient health records and the patient visit to the internal medicine wards, eight patients signed the informed consent for study participation (4.8%). The mean age of the eight participating patients (two female) was 66.1 ± 6.7 years at study inclusion. Six patients had standard insurance and two semi-private insurance. The average hospital stay was 5.3 ± 3.5 days [range 2-12 days].

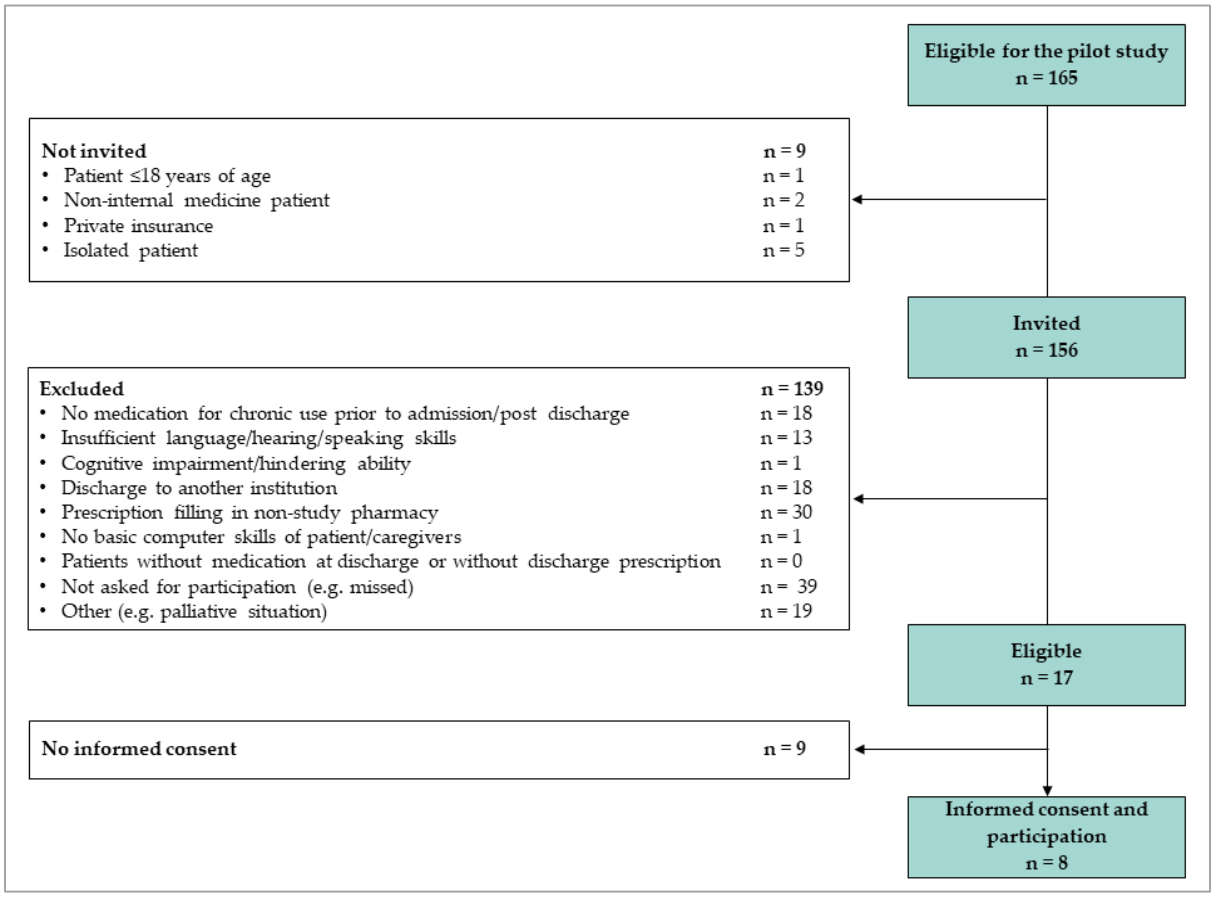

Figure 2: Flowchart of the screening process in the pilot study with the reasons and frequencies for study exclusion.

After receiving the patient's informed consent, each patient was registered on the eHealth platform by manually entering patient information (first name, last name, date of birth, address, cell phone number). In seven patients, the registration was successful. In one patient, the registration procedure failed the first time, but the registration was successful in a second attempt.

Hospital discharge:

At the day of the patient's hospital discharge, the information contained in the hospital discharge prescription, including all medications and dose regimen listed on the discharge prescription, was entered into the electronic medication list by the clinical pharmacist (n = 8 patients). The clinical pharmacists were able to enter the medication lists of all patients prior to hospital discharge. On average, patients had 10.4 ± 4.8 [range 4-19] medications listed on the discharge prescription.

Community pharmacy:

After hospital discharge, it was planned that patients would fill their prescriptions in the assigned community pharmacy; however, one patient visited the community pharmacy but did not fill the discharge prescription. In two cases, the community pharmacies were not able to log in to the eHealth platform, therefore the electronic medication list could not be updated according to the dispensed medications. Out of the remaining five patients, the full documentation was returned to the study site in only two cases; no documentation was received from the other three patients.

General practitioner:

The patient's general practitioner was invited by email to participate in the study on the day of the patient's study inclusion. One general practitioner responded to this email invitation and asked additional questions about the project and the involved stakeholders, but decided not to participate in the pilot study.

Patient interview:

Thirty days after hospital discharge, the research team phoned the patient to conduct the follow-up interview. The interview was performed in six out of the eight study patients because two patients were re-hospitalized prior to the follow-up interview. The mean duration of the patient interviews was 18.7 minutes [range 11-32 minutes]. Two patients reported during the patient interview that they had logged in to the eHealth platform at least once and a third patient failed to log in.

Discussion

This usability study aimed to obtain an insight into the acceptance and satisfaction of patients, involved health care professionals and stakeholders with the electronic medication list and the eHealth platform. Furthermore, we aimed to identify the frequency of medication discrepancies between the hospital discharge prescription and the dispensed medication and the number and type of pharmaceutical interventions performed by community pharmacists during the prescription filling.

Hereafter, we will discuss the shortcomings of this project, exploring potential reasons and proposing solutions for further studies.

Pretest of the eHealth platform and the electronic medication list

Prior to the start of the usability study, the research team tested the eHealth platform and the electronic medication list as part of the EHR. This testing showed multiple problems and bugs with this eHealth platform, in particular with the electronic medication list application; some of these problems might even pose a safety risk for patients because of missing or erroneous information on the patient's medication list (e.g. medication substitution not linked to dose regimen; no information on the exact units per dose because only ml, drops, tablets, small/large spoon and sachet could be specified but no strength for insulin or other biologics, topical applications, suppositories etc.; wrong display of umlauts and half a tablet). These problems impeded the start of the planned usability study. Usability is an essential factor in the design and development of EHR and influences the adoption and reasonable use of EHRs. [22] Health care professionals cannot gain the potential benefits of features and functions of the EHRs in the absence of usable systems. [22]

The US Office of the National Coordinator for Health Information Technology (ONC) established detailed standards, implementation specifications and certification criteria for EHR technology to support the achievement of reasonable use by eligible professionals and hospitals, including, for example, interoperability, data accessibility and exchange, privacy and security capabilities, and usability aspects. [23] In Switzerland, regional eHealth communities providing EHRs are required to be certified by external authorities to ensure compliance with organizational, legal, financial and technical standards. [12] Certification of the first EHR communities in Switzerland was expected for 2018. [12]

Coming back to the usability aspect, ONC also realized the importance of the usability of EHR and required the employment of a user-centred design process in the development of certified EHRs. [24] A user-centred design taking into consideration the needs of EHR end-users in each phase of the development has been reported to be a crucial element to enhance the implementation of the EHR and improve safety. [24, 25] In the current study, even though health professionals were involved in the development of the eHealth platform and EHR, including the electronic medication list provided by the Swiss Post, the aforementioned rules apparently had not been respected and resulted in unsatisfactory usability and even safety issues, when used for the electronic medication list and electronic medication dispensing processes. These problems required significant and multiple adaptions to allow a pilot study with real patients.

Pilot study

Recruitment:

During the one-month pilot study, 165 patients were screened for study inclusion and 4.8% of the patients gave informed consent for study participation. Reasons for this low rate were the high number of patients filling their prescription in community pharmacies not participating in the pilot study and patients who could not be asked for study participation because they were outside the room during screening on the internal medicine wards, were sleeping, or had already been discharged. To overcome these barriers, the number of community pharmacies participating in the usability study should be increased and the time slot and/or the number of clinical pharmacists screening on the medical wards should be expanded. Furthermore, over 20% of the screened patients either had no medication for chronic use after hospital discharge, or were discharged to another institution after the hospital stay. The study by Brühwiler and colleagues [26] with the same exclusion criteria (no medication for chronic use after discharge and discharge to another institution) showed a similar pattern.

Moreover, patient registration on the eHealth platform at the bedside was very time-consuming because of the manual entry of all patient information (name, first name, date of birth, address). The use of the demographic information saved on Swiss health insurance cards for automated registration of the patient on the eHealth platform would speed up this process.

Hospital discharge:

The clinical pharmacists were able to enter all information of the hospital discharge prescription to the electronic medication list prior to the patient's hospital discharge. Consequently, there was no time lag between the patient discharge and the prescription filling in the community pharmacy.

Community pharmacy:

The prescription filling in the community pharmacy after hospital discharge was expected to be the most critical phase of the study because community pharmacy employees had to complete multiple tasks (log in to the eHealth platform, update and print the medication list, identify medication discrepancies, and document interventions). Additionally, the community pharmacy employees were aware of the persistent problems and bugs of the eHealth platform and electronic medication list. During the pilot study, only two full sets of study documentation were received from the community pharmacies for further analysis. Therefore, the tasks performed in the community pharmacies would need in-depth analysis and subsequent adaption of the study design together with additional education of the community pharmacy employees. However, due to the termination of the entire project, the research team neither performed interviews with the employees of the community pharmacies, nor made further analysis of the study processes among the different partners (hospital, community pharmacies, and general practitioners).

General practitioner:

During the pilot study, the general practitioner of one patient responded to the study invitation to obtain further information about the study itself and the involved stakeholders. However, he decided not to participate in the pilot study. A potential reason for this low general practitioner response rate might be that joining to EHR communities and the provision of EHRs is voluntary for health care professionals in the primary care setting (e.g. general practitioners, community pharmacists, and physiotherapists). [27] De Pietro and Francetic concluded in their publication about eHealth in Switzerland that the development of health information exchange networks was hindered by fragmented health care provision in Switzerland, with various actors and the crucial role played by the general practitioner, that are not obliged to adopt the EHRs. [12]

Patient interview:

The patient interview was based on an interview guide; patient answers were recorded as tick boxes or free text. Collecting information for questions about the current medication, with the assessment of all medications and dose regimens, was laborious because for each medication patients had to report the name, manufacturer, strength, and dose regimen, and the researcher had to document all the information by hand. To enhance this assessment in a further study, an electronic tool connected to the catalogue of medications available in Switzerland (hospINDEX [28]) is recommended.

After the one-month pilot study, the research team was informed that the Swiss Post decided to terminate the use of the application for the electronic medication list. Therefore, the research team was forced to abandon this project and together with STeHAG all stakeholders were informed about this.

Conclusion

The multiple unexpected problems and bugs identified in the electronic medication list and eHealth platform prior to the start of the study led to a significant delay of the entire project. The main reasons were deficits of the electronic medication list application chosen by STeHAG and their partner Post E-Health, which posed insurmountable challenges. As a lesson learned, the results of this study show that novel health care applications need comprehensive evaluation prior to the start of the study including real patients to identify and resolve safety and usability issues. Furthermore, a participatory action research approach with the integration of end-users with different working backgrounds in each development phase of the application could have prevented most problems with the eHealth platform and the electronic medication application available for this project.

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9.2. Development and evaluation of an electronic medication reconciliation tool for community pharmacies [D-2]

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Work report

Introduction

The transfer of medication information between health care settings poses a risk for the occurrence of drug-related problems and errors caused by medication discrepancies and different types of medication duplications. [1-3] A medication discrepancy is an unexplained variation among medication lists in patients at the transition of care [4, 5] whereas the prescription of two or more medications from the same therapeutic class is defined as medication duplication. [1] Various interventions aiming to improve patient safety at care transitions have been developed and evaluated in systematic reviews in recent years. [6-10] A prominent intervention reported in these systematic reviews was the performance of medication reconciliation. [6-10] Medication reconciliation is "the formal process of obtaining a complete and accurate list of patient's current home medication including name, dosage, frequency, and route of administration, and comparing admission, transfer, and/or discharge medication orders to that list. The reconciliation is done to avoid medication errors." [11] The reconciliation of medications might help to improve a patient's safety by avoiding harm from prescription and non-prescription medicines or even adverse drug events (ADE) at the transition of care. [12, 13] Multiple studies have shown that pharmacists are able to detect medication discrepancies in patients by performing medication reconciliation and thereby reduce ADE-related hospital readmission and emergency department visits. [9] Medication discrepancies could also arise in the outpatient setting, for example at transitions between care homes, community pharmacies, primary care physicians, medical specialists, or even without any transitions when the patient is taking the medication differently than prescribed. [14-16] Moving to the situation in Switzerland, between 2014 and 2017 the Swiss patient safety foundation conducted a pilot project called "progress! Sichere Medikation an Schnittstellen" focusing on systematic medication reconciliation hospital admission. [17] The study aimed to obtain insights from different hospital settings regarding their experiences with medication reconciliation at hospital admission in order to support further hospitals in the implementation of systematic medication reconciliation procedures. [17] The results of this pilot project led to the assertion by the Swiss patient safety foundation that systematic medication reconciliation is essential at hospital admission and discharge. [17] Moreover, this pilot project indicated that medication reconciliation could be performed successfully by doctors, pharmacists, nurses and pharmacy technicians. In all participating hospitals, the

medication reconciliation was documented manually and mainly paper-based. [17] The performance of medication reconciliation by comparing different sources of information needed between 30 and 60 minutes in patients with multimorbidity. [17] The median time needed for the performance of medication reconciliation at either hospital admission or discharge ranged from 15 to 28 minutes per patient. [13, 18-21]

In recent years, the health care sector has started to incorporate information technology (IT) into the medication reconciliation process, ranging from simple emails to specialized electronic medication reconciliation tools, facilitating the medication reconciliation processes. [22, 23] A positive aspect of the use of IT in health care, reported by Bassi and colleagues [22], was the integration and interoperability of IT, simplifying the transfer of information. IT might also decrease transcription effort and time required by health care professionals during the assessment and recording of a patient's medication information. [22]

Focusing more on specialized medication reconciliation tools, a systematic review by Mekonnen and colleagues [23] evaluated the effectiveness of medication reconciliation procedures assisted by an electronic tool in reducing medication discrepancies at hospital care transition. The support of electronic tools in medication reconciliation activities reduced the frequency of medications with unintentional discrepancies over all reconciled medications. [23] In contrast, these tools only partially minimized other outcomes, namely the average number of medication discrepancies per patient and the proportion of patients with medication discrepancies at hospital transitions. [23] The authors mentioned that the absence of well-established studies prevented them from concluding the non-existence of an effect. [23] Focusing on the setting, multiple studies reported on electronic medication reconciliation efforts in the hospital setting [24-29] whereas studies in the outpatient setting are rare [30, 31]. Nonetheless, for the continuity of the patient's medication therapy after discharge, medication reconciliation needs to be maintained in the primary care setting. [31] Taking this together, an electronic tool supporting the detection of discrepancies between medication lists and medication duplication within a single medication list in an individual patient would reduce the workload, improve quality and facilitate a systematic medication reconciliation process.

Goal, approach and aims

The goal of this project was to develop and evaluate an electronic medication reconciliation tool for community pharmacies supporting the identification of medication discrepancies and medication duplications, and improving patient care.

To achieve this goal, the idea of developing an electronic medication reconciliation tool to automate some processes of medication reconciliation procedure was submitted to Ofac (www.ofac.ch), a company dedicated to the development of IT support for community pharmacies and specialised in the clearing of dispensed medicines to health insurances. Thereafter a close collaboration with the company was established leading to a formal agreement on a research plan with three phases and related aims:

- Development phase: to design an algorithm enabling the identification of medication discrepancies and medication duplications in community pharmacies based on a set of requirements identified by a pragmatic literature search.
- Feasibility and piloting phase: to assess the feasibility of the electronic medication reconciliation tool by testing different case studies of ATC subgroups C01, C03 and C10 followed by a second feasibility assessment evaluating different case studies including all ATC groups.
- Evaluation phase: to analyse the safety, efficiency, effectiveness of the electronic medication reconciliation tool and the end-users' satisfaction with the tool.

In the present work report, we describe the results of the first part of the feasibility/piloting phase and the methods for the subsequent feasibility/piloting phase and, finally, the evaluation phase. The development phase is not reported in this work report, due to contract restrictions between Ofac and the Pharmaceutical Care Research Group. (Additional information regarding the development phase is available upon request from the author.)

Methods

For the present project, we decided to follow the framework for the development of pharmacy practice intervention published by the Medical Research Council (MRC) [32, 33], which consists of four different phases: 1) development, 2) feasibility and piloting, 3) evaluation, and 4) implementation phase (Figure 1). As indicated by the arrows in Figure 1, the development,

feasibility/piloting and evaluation phases might not follow a linear sequence but could need additional loops until the implementation of the intervention. The present project focused on the development, feasibility/piloting and the evaluation of the electronic medication reconciliation tool for community pharmacies in Switzerland.

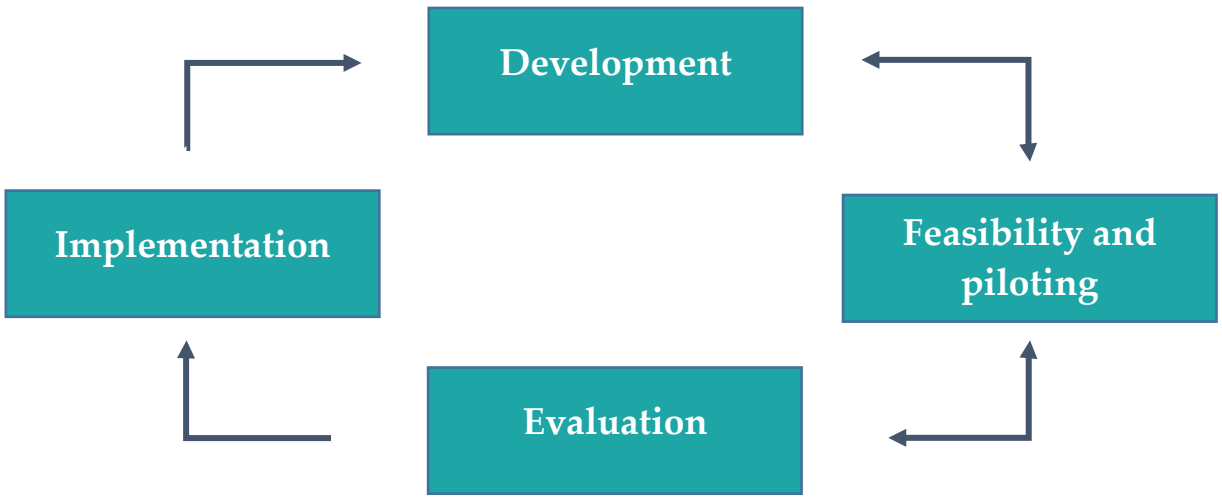

Figure 1: Framework for the development of pharmacy practice interventions [32]

Feasibility and piloting – Case studies with the ATC therapeutic subgroups C01, C03, C10

For the assessment of the feasibility of the electronic medication reconciliation tool, we followed an agile development process with iterative rounds of interim evaluations. [34] The initial piloting and feasibility testing of the electronic medication reconciliation tool used a total of 43 case studies with fictitious patients based on the set of requirements having a medication history in the community pharmacy and filling the new prescription. The electronic medication reconciliation tool analysed the medication information from two sources (medication history and new prescription) and generated the output of the analysis. The case studies were developed by two pharmacists of the research team (D.N., T.L.I.-I.) based on the different types of DRPs listed in the set of requirements and included medication from ATC subgroups C01 (cardiac therapy), C03 (diuretics), and C10 (lipid modifying agents). The research team decided to use these specific medication classes (ATC subgroups C01, C03, C10) for a first evaluation of the electronic medication reconciliation tool because of the large variety of products in these classes regarding strength, dosage, frequency, formulation (galenic form), combination products, and quantities. The IT specialists entered these case studies into the test database of the community pharmacy software. The medication

discrepancies identified by the electronic medication reconciliation tool were compared to the list of medication discrepancies detected by two pharmacists of the research team (D.N., T.L.I.-I.). Inconsistencies between discrepancy information generated by the electronic medication reconciliation tool and the two pharmacists of the research team were analysed, documented and transmitted to the IT specialists for further improvement of the electronic medication reconciliation tool.

Results

Feasibility and piloting – Case studies with the ATC therapeutic subgroups C01, C03, C10

The development engineers from Ofac started to program the electronic medication reconciliation tool based on the set of requirements and the two algorithms. Furthermore, they integrated additional tasks based on an internal medication information database to overcome the medication discrepancies and medication duplications that could not be discriminated and depicted by the national and international coding systems used in the two algorithms.

In the first version of the electronic medication reconciliation tool, the development engineers integrated the functions of comparing two different medication lists, specifically the discrimination of the active ingredient, strength, formulation, package size, and posology. The identification of duplication within the medication list, switch between single-ingredient products and combination products, and switch between brand names and generic names were not integrated into the first version of the electronic medication reconciliation tool at that point of the project. Nevertheless, we started to perform an initial feasibility testing with this first version of the electronic medication reconciliation tool. The feasibility of the tool was tested by evaluating 34 out of the 43 different cases studies (nine case studies were not available for the evaluation; the list with the nine lacking case studies was sent to Ofac to identify the problem). In 26 out of the 34 case studies (76.5%), the two pharmacists of the research team confirmed results generated by the software (Appendix I.IV.IV.). Table 1 presents the eight case studies with inconsistencies between the pharmacists' perceptions and the information generated by the electronic medication reconciliation tool.

Table 1: Feasibility testing of the first version of the electronic medication reconciliation tool - results generated by the software, but not confirmed by the research team (red letters = disagreement)

	Medication history			**New prescription**			**Level of agreement between the electronic medication reconciliation tool and two pharmacists of the research team**					**Comment pharmacists**
Case No.	Medication	ATC and active ingredient	Posology	Medication	ATC / active ingredient	Posology	Active ingredient	Strength	Formulation	Package size	Posology	
1.	ESIDREX cpr 25 mg 100 pce	C03AA03 Hydro-chlorothiazide	0.5-0-0-0	COMILORID Mepha mite cpr 2.5/25 30 pce	C03EA01 Hydro-chlorothiazide avec diurétiques antikaliurétiques	1-0-0-0	ATC 2					
	AMIODAR cpr 200 mg 60 pce	C01BD01 Amiodarone	1-0-0-0	AMIODAR cpr 200 mg 60 pce	C01BD01 Amiodarone	0-0-0-1	GTIN				different	
			-	CORDARONE cpr 200 mg 60 pce	C01BD01 Amiodarone	1-0-0-0	Start					Lack of comparison of Cordarone in the new prescription and Amiodar in the medication history (Match ATC 5).
2.	EZETROL cpr 10 mg 98 pce	C10AX09 Ézétimibe	1 tablet per day	CRESTOR cpr pell 5 mg 100 pce	C10AA07 Rosuvastatine	1-0-0-0	ATC 3					Lack of comparison of Crestor in the new prescription and Simvasine in the medication history. (Match ATC4)
	SIMVASINE Spirig HC cpr pell 20 mg 98 pce	C10AA01 Simvastatine	0-0-1-0	SIMVASINE Spirig HC cpr pell 20 mg 28 pce	C10AA01 Simvastatine	0-0-1-0	ATC 5		identic	different	different	The posology of the new prescription and the medication history is identic and not different
3.	ALDACTONE cpr pell 50 mg 50 pce	C03DA01 Spironolactone	1-0-0-0			-	Stop					Lack of comparison of Aldactone in the medication history and Torem in the new prescription. (Match ATC2)
	LASIX cpr 40 mg 12 pce	C03CA01 Furosémide	1-0-0-0	TOREM cpr 5 mg 20 pce	C03CA04 Torasémide	1-0-0-0	ATC 4					

4.	ESIDREX cpr 25 mg bte 100 pce	C03AA03 Hydro-chlorothiazide	1-0-0-0			-	Stop					Lack of comparison of Esidrex in the medication history and Torem/Eplerenon in the new prescription. (Match ATC 2)
	DIGOXINE Juvisé cpr 0.25 mg 100 pce	C01AA05 Digoxine	1-0-0-0			-	Stop					Lack of comparison of the Digoxin 0.25 mg in the medication history with Digoxin 0.125 mg in the new prescription. (Match ATC5)
	TOREM cpr 5 mg 20 pce	C03CA04 Torasémide	1-0-0-0	TOREM cpr 5 mg 20 pce	C03CA04 Torasémide	1-0-1-0	GTIN				different	
	EPLERENONE Spirig HC cpr pell 50 mg 100 pce	C03DA04 Éplérénone	-	EPLERENONE Spirig HC cpr pell 50 mg 100 pce	C03DA04 Éplérénone	1-0-0-0	GTIN				different	
	DIGOXINE Juvisé cpr 0.125 mg 100 pce	C01AA05 Digoxine	-	DIGOXINE Juvisé cpr 0.125 mg 100 pce	C01AA05 Digoxine	0-0-0-1	GTIN				different	
5.	NITRODERM TTS 10 mg/24h 30 pce	C01DA02 Trinitrate de glycéryle, nitroglycérine	1 patch for 12 hours	NITROGLYC Streuli caps croquer 0.8 mg blist 30 pce	C01DA02 Trinitrate de glycéryle, nitroglycérine	-	ATC 5	different	different	identic	different	
	COMILORID Mepha cpr 5/50 20 pce	C03EA01 Hydro-chlorothiazide avec diurétiques anti-kaliurétiques	1 capsule per day	COMILORID Mepha mite cpr 2.5/25 30 pce	C03EA01 Hydro-chlorothiazide avec diurétiques antikaliurétiques	1 capsule per day	ATC 5	different	identic	identic	identic	
	QUANTALAN poudre s sucre 50sach 4g	C10AC01 Colestyramine	1-1-1-1	QUANTALAN poudre s sucre 50sach 4g	C10AC01 Colestyramine	1-1-1-0	ATC 5	identic	identic	identic	identic	Difference in the posology and not identic posology.
			-	PRAVASTATINE Sandoz cpr 20 mg 100 pce	C10AA03 Pravastatine	0-0-1-0	Start					Lack of comparison of the Pravastatin in the new prescription with Quantalan in the medication history. (Match ATC 3)

6.	INEGY cpr 10/20 mg 98 pce	C10BA02 Simvastatine et ézétimibe	0-0-0-1	INEGY cpr 10/20 mg 98 pce	C10BA02 Simvastatine et ézétimibe	0-0-0-1	ATC 5				different	No difference in the posology.
			-	SIMVASTATINE Helvepharm cpr pell 40 mg 98 pce	C10AA01 Simvastatine	0-0-0-1	Start					Lack of comparison of the Simvastatin in the new prescription with Ingegy in the medication history. (Match ATC 2)
			-	EZETROL cpr 10 mg 98 pce	C10AX09 Ézétimibe	1 table per day	Start					Lack of comparison of the Ezetrol in the new prescription with Inegy in the medication history. (Match ATC 2)
7.	INDAPAMID Spirig HC cpr pell ret 1.5 mg 30 pce	C03BA11 Indapamide	1 tablet per day	INDAPAMIDE Mepha caps 90 pce	C03BA11 Indapamide	1 tablet per day	ATC5	different	different	different	identic	
			-	METOLAZONE Galepharm cpr 5 mg 20 pce	C03BA08 Métolazone	1-0-0-0	Start					Lack of comparison of the Metolazone in the new prescription with Indapamid in the medication history. (Match ATC 4)
			-	ALDACTONE cpr pell 50 mg 50 pce	C03DA01 Spironolactone	0-0-0-1	Start					Lack of comparison of the Aldactone in the new prescription with Indapamid in the medication history. (Match ATC 2)
8.	PROCORALAN cpr pell 7.5 mg 56 pce	C01EB17 Ivabradine	1-0-1-0	IVABRADINE Sandoz cpr pell 7.5 mg 112 pce	C01EB17 Ivabradine	0-1-0-1	ATC5	identic	different	different	different	Formulation is identic.
	JINARC cpr 30 mg 28 pce	C03XA01 Tolvaptan	2 tablets per day with an interval of 8 hours	JINARC cpr 45 mg/15 mg 56 pce	C03XA01 Tolvaptan	1 tablet with 45 mg, after 8 hours 1 tablet with 15 mg	ATC5	different	different	different	different	Formulation is identic.
	FUROSEMIDE Zentiva cpr 40 mg 12 pce	C03CA01 Furosémide	0.5-0-0.5-0	FUROSEMIDE Zentiva cpr 40 mg 12 pce	C03CA01 Furosémide	1-0-0-0	ATC 5	identic	identic	identic	different	

Discussion

The research team based the project on the MRC framework (Development, Feasibility and piloting, Evaluation, Implementation) for the development of pharmacist-led services. [32, 33] During the development and feasibility/piloting phases of the electronic medication reconciliation tool multiple loops between the research team and the project partner from Ofac were needed for the design of the first version of the electronic medication reconciliation tool.

Feasibility and piloting

The first feasibility study focusing on the comparison of the active substance, strength, formulation (galenic form), package size, and posology in 41 different case studies (from the ATC subgroups C01, C03, C10) showed that the algorithm identified the majority of discrepancies. However, the results suggest that the software did not compare all medications from the medication history to all medications of a new prescription. Accordingly, the most frequent inconsistency was the erroneously identified start or stop of a medication, instead of generic or therapeutic substitution. A second problem was the identification of discrepancies in the posology of the medication. The algorithm identified a discrepancy in the posology of two medications, even though they were identic. In contrast, in one case the posology was rated as identic, although there was a discrepancy. Furthermore, in two medications, the algorithm identified different medication formulations, even if they were identic. The IT specialists need to identify the cause of these faults.

Conclusion

The exchange between the IT specialist and the research team during the development and feasibility/piloting phase is essential. Furthermore, iterative rounds of design and feasibility testing are necessary for the development of an electronic medication reconciliation tool.

Outlook

Following, the research team describes the next process steps for the feasibility/piloting and evaluation phase of the electronic medication reconciliation tool.

In the next step, the IT specialists need to improve the electronic medication reconciliation tool by solving the issues identified in the first feasibility testing and to include the functions to

identify duplication within the medication list, and switch between single-ingredient products and combination products, switch between brand names and generic names. For the second feasibility testing, the same case studies could be used for the first feasibility testing to track the progress of the electronic medication reconciliation tool.

Graphical user interface

After feasibility testing, the visual design of the electronic medication reconciliation tool for the end-users should be defined. Based on the literature, the research team identified important issues for the visual illustration of the medication lists, for the so-called graphical user interface of the electronic medication reconciliation tool. The medications of the two medication lists (medication history and new prescription) should be grouped according to therapeutic classes for example by the 14 main ATC groups. [31, 35] In addition, in these main groups the medication should be ordered according to the 5th level of the ATC code. Identical medications should be displayed at the same height, as illustrated in Table 2.

Table 2: Example graphical user interface for two medication lists

ATC Code	**Patient's medication history (prescribed and non-prescribed)**	**ATC Code**	**New prescription**
A02AD02	Riopan Gel Forte 1600 mg, 10 Beutel 10 mL		
A02BC02	Pantozol Control Filmtabl 20, 14 Stk	A02BC02	Pantoprazol Mepha Filmtabletten 40 mg
		B01AC04	Clopidogrel Mepha Lactab 75 mg
		B01AC06	Aspirin Cardio 100 mg Filmtabletten
		C03DA01	Aldactone Filmtabletten 25 mg
		C07AB07	Bilol Filmtabletten 5 mg
		C08CA01	Amlodipin Sandoz eco Tabl 10 mg
C09CA06	Candesartan Helvepharm 16 mg, 100 Stk	C09DA06	Candesartan HCT Helvepharm 16/12.5 mg Tabl
C10AA03	Pravastatin Helvepharm Tabl 40 mg, 100 Stk	C10AA0	Atorvastatin Helvepharm Filmtabletten 40 mg
C10AA03	Pravastatin Helvepharm Tabl 40 mg, 30 Stk		
		D02AE01	Excipial U Lipolotio Harnstoff Lot 40 mg
		G01AF02	Canesten Crème Tube 20 g
H03AA01	Euthyrox 100 Tabl 0.1 mg, 100 Stk		
M01AE01	Algifor-L forte Filmtabl 400 mg, 10 Stk		
R01AA07	Nasenspray NEO Spirig HC 0.1%		
R01AC03	Allergodil Saisonal Nasenspray 5 mL		
S01GX02	Livostin Gtt Opht 0.5 mg/ml, 4 mL		

Evaluation phase

For the evaluation phase, the research team planned to test the usability of the electronic medication reconciliation tool by assessing the safety, efficiency, and effectiveness of the electronic medication reconciliation tool and end-users' satisfaction with the tool. [36-39]

Different approaches for the assessment usability were compiled in an evaluation plan (Table 3).

Table 3: Electronic medication reconciliation tool – evaluation plan

	Evaluation	**Procedure**	**Included health care professionals**
Safety	The frequency of medication discrepancies identified through paper-based medication reconciliation by pharmacists and pharmacists supported by the electronic medication reconciliation tool	Comparison of the number of medication discrepancies identified in three case studies (including medication history and a prescription) through paper-based medication reconciliation by pharmacists and three case studies (including medication history and a prescription) identified by pharmacists supported by the electronic medication reconciliation tool.	10 pharmacists
Efficiency	The time needed to perform a paper-based medication reconciliation by pharmacists and pharmacists supported by the electronic medication reconciliation tool [38, 40]	Comparison of the time needed to perform a paper-based medication reconciliation by pharmacists and pharmacists supported by the electronic medication reconciliation tool [38, 40]	10 pharmacists
Effectiveness	Assessment of the reliability	Identification of specific types of medication discrepancies by using multiple case studies (n = 85 different medication discrepancies)	2 pharmacists
Effectiveness	Assessment of the completeness and correctness of the electronic medication reconciliation tool [37]	Expert panel assessment of the completeness and correctness of medication discrepancies identified by the eMedRec tool in real-life cases (n=45 patients [37]).	2 pharmacists/ 2 physicians
Satisfaction	The satisfaction of health care professionals with the electronic medication reconciliation tool [38]	Using a questionnaire for the assessment of the user satisfaction (e.g. System Usability Questionnaire – SUS) [41] / Computer System Usability Questionnaire - CSUQ / Post-Study System Usability Questionnaire – PSSUQ [42])	10 pharmacists

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10. General discussion

The goals of this thesis were to assess different aspects of pharmacist-led cognitive services in Europe with a focus on medication review procedures, to evaluate medication discrepancies and drug-related problems identified by systematic medication reconciliation in community pharmacies, and to develop an electronic medication reconciliation tool for community pharmacies.

10.1. Project A – Pharmacist-led cognitive services with a focus on medication review procedures across Europe

Pharmacist-led cognitive services contribute to patient care by ensuring the medication supply, the appropriate and rational medication use, and by optimizing health prevention. [1, 2] Previous studies investigated the availability of different pharmacist-led cognitive services in Europe [1, 3], but details on the level of implementation and remuneration of these services have not yet been investigated. **Project A** was based on an online survey assessing the availability, implementation and remuneration of 21 different pharmacist-led cognitive services **(Project A-1)** and different aspects of medication review services **(Project A-2)** including practitioners in the field of pharmaceutical care (working background either in community pharmacy, pharmacy practice research, or health policy). To ensure a uniform understanding of the different pharmacist-led cognitive services investigated in this project, we retrieved and added a definition to each of the services in the online survey. Van Mil and Henman published an article about the importance of defining terms in pharmaceutical care and pharmacy practice research, to ensure readers' understanding of the specific aspects and activities reported in research studies. [4] The difference in the connotation of a term might be caused by language, cultural differences or by differences in professional practices across regions and countries. [4] Consequently, the definition of terms in cross-national surveys is of utmost importance to obtain comparable results.

The results from **Project A-1** showed a heterogenic availability, implementation and remuneration pattern in the 21 investigated pharmacist-led cognitive services across Europe. Most of the core services (medication dispensing, provision of mediation information, generic substitution, provision of emergency contraception, and home delivery of medication) were available in at least 50% of the investigated countries. In contrast, the majority of the advanced

services (INR testing/management, administration of injectable medicines, prescribing, personalized medicine, new medicines service, and immunization) were provided in less than 40% of the investigated countries. Similar results regarding the advanced pharmacist-led services were reported by Martins and colleagues [1], assessing the availability of services in European community pharmacies in 2013: administration of injectable medicines, immunization, and prescribing. Hence, there was not a significant change in the number of countries providing these advanced services in community pharmacies across Europe over time. Multiple studies reported on facilitators for and barriers to the implementation of pharmacist-led cognitive services and a commonly reported barrier for service implementation was the remuneration. [2, 5-9] However, our results did not show a clear correlation between implementation level and remuneration of pharmacist-led cognitive services.

In **Project A-2,** we aimed to describe the availability, level of implementation and remuneration of medication reviews (based on the definition and classification of PCNE [10]) in community pharmacies across Europe and the characteristics of these medication review procedures. Our results demonstrate a large heterogeneity in the availability, implementation, remuneration and the investigated characteristics of the medication review services, highlighting country-specific variations.

The availability of the different types of medication reviews seems to be associated with their complexity. The type 1 medication review (based on the medication history) was the most prevalent type, followed by type 2a (based on the medication history and patient interview); type 2b and type 3, including clinical patient information, were rarely provided in the community pharmacies across Europe. In addition to the different sources of information [10-12], pharmacists need different skills [11] for the performance of the different types of medication reviews. Access to information in community pharmacies and education vary across countries [1, 13-15], which might facilitate or hinder the provision and implementation of different types of medication reviews. The lack of communication skills, clinical and communication education, management skills, time, view of professional development and the lack of reimbursement were considered as important barriers to the implementation of pharmaceutical care in community pharmacy practice in Europe. [16]

Even though we did not investigate the reasons for these heterogenic patterns in **Project A**, the differences in European health care systems and legal frameworks [1] might be additional and important factors influencing the provision, implementation and remuneration of pharmacist-led cognitive services across Europe.

In summary **(Project–A)**, countries providing a wide range of pharmacist-led cognitive services might serve as role models for late adopters; only in countries providing pharmacist-led cognitive services in primary care will patients be able to benefit from these services in everyday lives.

10.2. Project B – Identification of medication discrepancies in community pharmacies

With **Project B** we aimed to evaluate medication discrepancies identified by the performance of systematic pharmacist-led medication reconciliation in community pharmacies. Moreover, we focused on generic substitution, a specific type of medication discrepancies, and patients' attitudes towards the generic substitution.

In **Project B-1** and **Project B-3** pharmacy students working in community pharmacies during their internship performed systematic medication reconciliation in adult patients with polypharmacy (≥4 medications) by comparing the best possible medication list to prescriptions and documenting any intentional or unintentional medication discrepancies. The students identified 317 medication discrepancies (n = 116 patients) in **Project B-1** by comparing the BPML to the latest medication prescription available in the community pharmacy. In **Project B-3** they compared the hospital discharge prescription to the patient's home medication prior to hospital admission and identified 557 medication discrepancies (n = 51 patients). All the medication discrepancies identified in **Project B-1 and B-3** were caused by intentional or unintentional changes of the medication regimen by the patients themselves or by health care professionals. The majority of the identified medication discrepancies in **Project B-1** were considered inconsequential on the patient's health conditions. However, all kinds of medication discrepancies have potential risks for adverse drug events and should, therefore, be identified and resolved. The results of **Project B-1 and B-3** and further international studies [17-19] indicate that pharmacy students working in primary or secondary care during their

internship might be a valuable resource for the performance of systematic medication reconciliation and the identification and resolution of medication discrepancies.

Moving to predicting factors for unintentional medication discrepancies, a systematic review by Hias and colleagues identified a set of predictors for unintentional medication discrepancies in pre-admission medications. [20] The age of the patient and the number of pre-admission medications were the most frequently reported variables with a statistically significant association to unintentional medication discrepancies at admission. [20] As these unintentional medication discrepancies could remain until the patient's discharge into the primary care setting, these predictors might also be relevant for the primary care setting. Focusing on the population in Switzerland, the number of patients receiving ≥5 prescribed medications was 16.7% in the overall population and 41.2% in the elderly population (>65 years). [21] Furthermore, the federal statistical office reported that the proportion of elderly (≥65 years) inhabitants in Switzerland will increase from 1.64 million in the year 2020 to 2.67 million in 2050. [22] Subsequently, the performance of systematic medication reconciliation in elderly patients with polypharmacy might be a pivotal activity in the care of patients.

In **Project B-2** we investigated the patient's perspective regarding the generic substitution and generic medications (n = 136). The costs aspect of generic medications was most commonly rated as an advantage (n = 120) during the patient interview whereas the taste of generic medication was the aspect most commonly rated as a disadvantage (n = 42). The fact that 11 out of the 15 different aspects were rated as "not relevant" by ≥50% of the study patients is surprising because previous studies reported that changes (e.g. in the name, package appearance and size) can be confusing for patients [23-25]. In addition, we analysed 136 medication lists complied during medication reviews in community pharmacies regarding their reimbursement categories (brand name products protected by patents/with no generic medications available; brand name products, but generic medication available; generic medication). Overall, 36.5% of the listed medications were generics whereas 26.4% of the medications might be substituted by a generic medication thus the potential for cost reduction was not fully exploited in the study population. Comparing these results to other Organisation for Economic Co-operation and Development (OECD) countries, Switzerland has a small proportion of generic medication use whereas generics accounted for over 80% of the volume of medications sold, for example in the UK, Chile, Germany and New Zealand. [26]

10.3. Project C – Detection and resolution possibilities of DRPs in patients at hospital discharge in Swiss community pharmacies

Project C-1 presents the results of a retrospective analysis of DRPs identified in a community pharmacy located within the hospital by performing medication reconciliation and medication reviews in patients at hospital discharge. The results show that the majority of the identified DRPs were caused by prescribing problems during the hospital stay or at hospital discharge (72.9%), followed by DRPs caused by a medication reconciliation problem at hospital admission (23.3%). Focusing on the DRPs at hospital admission, the collection of a complete and correct pre-admission medication list is pivotal because the subsequent therapy is often based on this information. Errors caused by incomplete or incorrect information in the admission medication list can persist beyond the hospital stay and should, therefore, be identified and corrected at an early stage. [27] Consequently, a systematic pharmacist-led medication reconciliation process at the patient's admission to the hospital is one possibility to reduce these types of DRPs. [28, 29]

The hospital stay is associated with multiple dose adjustments, therapeutic and generic substitutions [30-32], as well as the initiation and discontinuation of medications as a result of altered medical patient conditions or new diagnosis [33-36]. Hence, it is not surprising that missing/inappropriate dosage, incorrect/lack of substitution back to home medication, and the medication not indicated or duplication were amongst the most frequently detected DRP sub-types of the category "prescribing problems during the hospital stay or at discharge". The generic or therapeutic substitution of patient's home medication to restricted hospital formularies is common practice nationally and internationally. [37-39] Nevertheless, medication substitution is also a frequent source of DRPs at hospital discharge, due to an incorrect or a lack of transfer back to the patient's home medication upon hospital discharge, which might lead, for example, to patient confusion, medication duplication, and non-adherence. [23] Taking all of this into consideration, the provision of detailed information on the intentional changes in a patient's medication regimen during the hospital stay is pivotal for all subsequent health care professionals (e.g. general practitioners, community pharmacists) to ensure the continuity of patient care after hospital discharge in primary care. [35, 40-44] A focus group discussion and online survey including Swiss community pharmacists aimed to identify the current problems facing community pharmacists regarding

patients after hospital discharge and to assess the need for information by the evaluation of information availability and usefulness. [45] Community pharmacists expressed a strong desire to obtain detailed information following patient discharge about the changes made to patients' medication during the hospital stay; however, this was usually not communicated to the community pharmacists. [45] In addition, discharged patients should also be aware of all changes made to their medication therapy during the hospital stay [46], as well as the diagnosis, names and purposes of their medications, and common side effects of the discharge medications [47], to enable the continuation of an effective medication treatment after hospital discharge.

Furthermore, we aimed to assess whether these DRPs would be detectable by performing different types of medication reviews. Our findings suggest that pharmacists without access to clinical and/or patient-specific information could detect 1115 DRPs (60.2%) at hospital discharge, whereas in the remaining cases (n = 737; 39.8%) additional clinical information or patient-specific information would be needed.; however, previous studies have indicated that numerous community pharmacies in Europe and also in most regions in Switzerland do not have routine access to clinical patient information. [13, 15, 16] The implementation of the electronic health records in Switzerland, accessible by community pharmacists, physicians and hospitals soon [48], might enable the performance of advanced medication reviews in community pharmacies to decrease errors and therefore increase patient safety.

The pharmacists in the hospital's community pharmacy documented the outcomes of the pharmaceutical interventions triggered by these DRPs. In 71.6% (n = 1344) of DRPs, the pharmaceutical interventions led to a modification of the patient's discharge prescription and 6.5% (n = 122) of the pharmaceutical interventions triggered by the DRPs were not accepted by the prescriber. These results indicate the importance of comprehensive pharmacist-led hospital discharge management, including systematic medication reconciliation and medication reviews. Previous studies showed acceptance rates of pharmacists' recommendations to be lower than 50% at hospital care transitions. [49, 50] Potential reasons suggested by the authors for the comparatively low acceptance rates were that pharmacists were not part of the hospital team [49] and that pharmacists worked outside the hospital in the community pharmacy setting and were therefore limited in their ability to communicate with the hospital physician [50]. In contrast, studies assessing the acceptance rate of

recommendations made by pharmacists during interprofessional ward rounds or by pharmacists working within the hospital was over 95%. [51-54]

The clinical relevance of the identified DRPs and the clinical outcomes of the pharmaceutical interventions were not assessed in **Project C-1**. A systematic review and meta-analysis by Lussier and colleagues [55] evaluated the impact of involving community pharmacists in the transition of care on 30-day readmission. They showed that studies with the more active community pharmacist involvement (e.g. receiving medication list and performing medication reconciliation/management) in the transition of care, similar to the community pharmacy in **Project C-1**, showed positive effects on the 30-day readmissions (relative risk, 0.55; 95% CI 0.32-0.95; I^2 = 88%). In contrast, studies with a passive community pharmacist involvement (e.g. only receiving medication list) showed fewer positive effects (relative risk, 1.02; 95% CI 0.80-1.31; I^2 = 0%). The authors of this systematic review and meta-analysis concluded that the inclusion of community pharmacists can have a positive effect on patients' care transitions, but the evidence was limited due to the imprecision and heterogeneity of the included studies. [55]

10.4. Project D – Electronic health records and electronic medication reconciliation in Switzerland

Project D focused on the development and/or evaluation of different electronic tools supporting pharmacists at care transitions.

A federal law was passed by the Swiss Federal Parliament and came into effect in 2017, requiring hospitals to implement EHR in Switzerland to enable cooperation and data sharing between different health care providers, and intending to improve the quality of patient care and efficiency of the Swiss health care system. [56] In **Project D-1** we aimed to evaluate the acceptance and satisfaction of different health care professionals, patients, and caregivers with the electronic medication list, which is a specific part of the EHR and the eHealth platform. The multiple unexpected problems and bugs identified in the electronic medication list prior to the start of the study led to a significant delay of this project and insurmountable challenges. Ultimately, the entire project had to be discontinued because the Swiss Post abandoned the electronic medication list application provided to the research team for evaluation. **Project D-1** indicates the importance of the user-centred design in the development of an EHR towards

improved overall usability. [57] Usability is an essential factor influencing the adoption and reasonable use of EHRs. [58] Health care professionals cannot gain the potential benefits of features and functions of the EHRs in the absence of usable systems. [58]

Moving from the evaluation of the Swiss EHR to the development of an electronic medication reconciliation tool for community pharmacists: Medication reconciliation is a laborious and resource-intensive activity. [59, 60] Furthermore, the reconciliation of complex medication histories is a cognitively demanding task for health care professionals. [61, 62] The use of IT might facilitate the performance of medication reconciliation. [61, 63, 64] A systematic review and meta-analysis aimed to assess the available electronic medication reconciliation tools and their effect on unintentional medication discrepancies occurring in hospitals. [65] The review identified a total of 12 different electronic medication reconciliation tools. [65] An electronic medication reconciliation tool is "a computerized tool to help support the medication reconciliation processes. They are used to compare BPMH to orders and identify discrepancies by displaying medication lists and providing options to select whether to hold, continue, change or discontinue medications. Electronic medication reconciliation tools may be linked to computerized provider order entry so that orders can be made, modified or discontinued taking into account medication reconciliation". [66] To date, no electronic medication reconciliation tools integrated into the community pharmacy software exist in Switzerland. For that reason, we aimed to develop an electronic medication reconciliation tool for community pharmacies supporting the identification of medication discrepancies and medication duplication and improving patient care **[Project D-2]**. The development of the electronic medication reconciliation tool was based on a set of requirements identified by a pragmatic literature search and an algorithm designed by the research team. In the first version of the electronic medication reconciliation tool, the development engineer integrated the functions comparing two different medication lists, specifically the discrimination of the active ingredient, strength, formulation, package size, and posology. The identification of duplication within the medication list, switch between single-ingredient products and combination products, and switch between the brand names and generic names were not integrated into the first version of the electronic medication reconciliation tool at that point of the project. The feasibility study of this first version of the electronic medication reconciliation tool including 34 different cases led to the successful detection of the majority of the

medication discrepancies. The documentation of the evaluation of this feasibility study was handed over to the development engineer for further improvement of the electronic medication reconciliation tool. To speed up the next steps in the development and evaluation of the electronic medication reconciliation tool, the subsequent steps and procedures were listed in the work report. For the evaluation of the electronic medication reconciliation tool, the research team compiled an evaluation plan to test the usability by assessing the safety, efficiency, effectiveness of the electronic medication reconciliation tool, and the end-user satisfaction. [67-70] Unfortunately, the development of the tool by the engineers was affected by multiple delays. Therefore, the further development and evaluation of the electronic medication reconciliation tool will be executed beyond this thesis.

10.5. Limitations

The limitations of the individual projects were discussed in the previous sections. The overall limitations of this thesis were:

- The majority of researchers involved in the development, conduction, evaluation, interpretation and supervision of the Projects A-D in this thesis were pharmacists. Therefore, the results might be influenced by a pharmacist's point of view. Furthermore, one researcher was involved in the entire process of the studies ranging from development, conduction, evaluation, and interpretation, which might lead to observer bias.
- In Project B, there was no differentiation between intentional and unintentional medication discrepancies because of the lack of direct contact with the prescriber regarding the identified medication discrepancies.
- Study patients in Projects B-D were recruited in the German-speaking part of Switzerland. This limits the generalizability of these results to other language regions and countries.

11. Conclusions

The research presented in this thesis shows different aspects of medication review and medication reconciliation practice in primary care and the importance of medication reconciliation in community pharmacies at care transitions. The following conclusions can be derived from the different projects in this thesis:

11.1. Project A – Pharmacist-led cognitive services with a focus on medication review procedures across Europe

- Great heterogeneity in the availability, level of implementation and remuneration of the investigated pharmacist-led cognitive services across Europe was observed in **Project A**. Some countries stand out as the early pharmacist-led cognitive service adopters, leading the way and serving as examples for other countries aiming to implement pharmacist-led cognitive services in primary care.
- The research team was aware that the definition of specific terms used in surveys across language and national borders is pivotal because the responders' personal perceptions (influenced by the language, culture, and daily practice) affect the responses and lead to insufficient comparability of responses across different regions or countries. The development of transnational surveys by an international team and piloting with multiple experts from different countries help to identify deficiencies in the survey regarding the definition and perception of central terms used in the survey.
- The inclusion of multiple individuals per country and the consensus-seeking process in a survey assessing country-specific information is a suitable method to ensure credible data.

11.2. Project B – Identification of medication discrepancies in community pharmacies

- The performance of systematic medication reconciliation in patients with polypharmacy in Swiss community pharmacies led to the identification of numerous medication discrepancies. Community pharmacists should be encouraged to reconcile the patient's medication systematically at each encounter to identify and resolve medication discrepancies impeding optimal medication therapy.

- Generic substitution is responsible for numerous medication discrepancies at care transitions. Health care professionals should be aware of these discrepancies and improve patients' lack of knowledge about their generic medications to avoid medication errors. Moreover, most of the aspects differing between brand name and generic medications were not relevant for the majority of the study patients. Therefore, health care professionals should not hesitate to recommend generic medication and therefore strengthen efforts in achieving higher rates of generic substitution through patient counselling and shared decision making to decrease general health care costs.

11.3. Project C – Detection and resolution possibilities of DRPs in patients at hospital discharge in Swiss community pharmacies

- Systematic medication reconciliation and medication reviews are indispensable prior to hospital discharge to identify and solve potential DRPs, to ensure an accurate medication prescription and to continue an optimal medication therapy after hospital discharge.
- The documentation of the intentional medication changes in the discharge prescription and patient medication list might help patients and all subsequent health care providers to identify and implement the intended medication changes after discharge. Furthermore, this documentation might reduce the need for prescriber consultations by subsequent health care professionals, which saves the resources and time of all involved actors in the health care sector.
- The ability to identify DRPs is strongly influenced by the extent of different information sources available to pharmacists at hospital discharge. So far, the vast majority of community pharmacies in Switzerland have no access to clinical patient information (e.g. diagnosis, laboratory values) and discharge summaries. Therefore, community pharmacists might be limited in the identification of drug-related problems in the patient's medication after hospital discharge. Moreover, community pharmacists' lack of clinical information limits plausibility checks of medication changes and medication appropriateness after discharge and triggers further consultations with the prescriber for clarification.
- For the majority of the identified DRPs at discharge, the pharmacist might need to contact the prescriber for the resolution of the problem. This is facilitated when the

medication reconciliation and review activities take place in close collaboration with or at least in the vicinity to the prescriber, which might also have a positive effect on the communication and acceptance of the pharmacist's recommendations.

11.4. Project D – Electronic health records and electronic medication reconciliation in Switzerland

- A participatory action research approach with the integration of end-users with different working backgrounds (e.g. physicians, pharmacists, nurses, physiotherapists) and patients in all development phases might prevent problems with electronic health records and novel electronic medication applications. Furthermore, electronic health records need comprehensive evaluation prior to their introduction in the Swiss health care system to identify and resolve the safety and usability issues of this novel application.
- The development of an electronic tool supporting medication reconciliation needs close cooperation between the different actors of the development team and multiple interim evaluations to identify and subsequently overcome the safety and usability issues of the novel tool.

12. Outlook

According to the results and conclusions of this thesis, the recommendations for pharmacy practice and future research are:

12.1. Project A – Pharmacist-led cognitive services with a focus on medication review procedures across Europe

- The identification of facilitators for and barriers to the successful implementation of specific pharmacist-led cognitive services should be analysed in order to help further countries to initiate and implement specific services. This analysis should also include characteristics of the country-specific health care systems (accessibility of clinical and patient-specific information, legal barriers, and general health care structure).
- The repetition of the survey assessing the availability, implementation and remuneration of pharmacist-led cognitive services across Europe in the coming years will lead to an update and illustrate the progress of the pharmacist-led cognitive services in primary care across Europe.

12.2. Project B – Identification of medication discrepancies in community pharmacies

- The performance of systematic medication reconciliation (Project B-1 and B-3) in the community pharmacy led to the identification of numerous medication discrepancies between the patient's home medication and the medication prescriptions. In the daily community pharmacy practice, there are no specific tools (paper-based or electronic) supporting community pharmacists in the performance of systematic medication reconciliation. Therefore, the development and evaluation of such a tool (e.g. checklist, electronic application) supporting pharmacists in the performance of systematic medication reconciliations in community pharmacies is desirable for the future.

12.3. Project C – Detection and resolution possibilities of DRPs in patients at hospital discharge in Swiss community pharmacies

- The assessment of the relevance of the identified DRPs by an interdisciplinary team including hospital and community pharmacists, hospital physicians, and general practitioners would help to prioritize the pharmaceutical interventions within the hospital and community pharmacy setting.
- The development of a checklist for the management of patients at hospital discharge (based on the results of **Project C-1**, the literature, and a Delphi survey) could support hospital and community pharmacists in the performance of systematic medication reconciliation and medication reviews in patients at hospital discharge.
- To date, the vast majority of the community pharmacies in Switzerland do not have routine access to clinical patient information (e.g. diagnoses, laboratory values) and they are therefore limited in their ability to identify DRPs. The implementation of the EHR in Switzerland will help to overcome this gap when patients share their EHR with community pharmacists. However, it should be taken into account that patients can restrict specific parts of their EHR (e.g. information regarding mental health) or the information is not up-to-date which poses a risk for clinical decision making of health care professionals based on incomplete/incorrect information.

12.4. Project D – Electronic health records and electronic medication reconciliation in Switzerland

- The development, feasibility and evaluation are the initial phases of the MRC framework for the development of pharmacy practice interventions followed by the implementation of the intervention, which includes the dissemination, surveillance/monitoring, and the long-term follow-up of the intervention. [71] The implementation of the electronic medication reconciliation tool in the routine practice of community pharmacy should not be neglected because a high implementation and dissemination is a precondition to enable as many patients as possible to benefit from this novel tool. Different facilitators and barriers should be considered for the implementation process of the medication reconciliation procedure in routine practice. [72, 73]

13. References

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I. Appendix

The following appendix is limited to the main documents used within the different projects. For further information, please send a request to the author.

I.I. Project A

I.I.I. PhaRmAcist-led CogniTIve Services in Europe – survey [A-1]

The online survey is available upon request or https://doi.org/10.1016/j.sapharm.2019.02.002.

I.I.II. Definitions for the retrieved pharmacist-led cognitive services [A-1]

List of the 21 Pharmacist-led Cognitive Services and according definitions

PHARMACIST-LED COGNITIVE SERVICE
Service provided or supervised by the pharmacist, based on a standardized and structured procedure, for the purpose of promoting optimal health and drug therapy and is not necessarily drug-product related.
Adapted from: Roberts, A. S., Benrimoj, S. I. C., Chen, T. F., & Williams, K. A. (2006). Implementing cognitive services in community pharmacy: a review of facilitators used in practice change. *The Internacional Journal of Pharmacy Practice*, 163–170. http://doi.org/10.1211/ijpp.14.3.0002

PHARMACEUTICAL CARE
Pharmaceutical Care is the pharmacist's contribution to the care of individuals in order to optimize medicines use and improve health outcomes. The term medication therapy management can be vowed as synonym.

Adapted from: Hersberger, K. E., Griese-Mammen, N., Cordina, M., Tully, M. P., Foulon, V., Rossing, C., & Mil, F. J. W. van. (2013). Position Paper on the definition of Pharmaceutical Care 2013. *Pharmaceutical Care Network Europe*.

IMPLEMENTATION
An effort specifically designed to get best practise findings and related products into routine and sustained use through appropriate change/uptake/adoption interventions.
Adapted from: Curran GM et al. Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. Med Care 2012;50(3):217-26. doi: 10.1097/MLR.0b013e3182408812 [published Online First: 2012/02/09]

REMUNERATION
Remuneration of services is considered when a payment is made by the government (National Health Service) or the insurer to the pharmacy (or pharmacist) for the provided service.
Adapted from: Houle, S. K. D., Grindrod, K. A., Chatterley, T., & Tsuyuki, R. T. (2014). Paying pharmacists for patient care: A systematic review of remunerated pharmacy clinical care services. *Can Pharm J (Ott)*, *147*(4), 209–232. http://doi.org/10.1177/1715163514536678

CORE SERVICES

MEDICINES DISPENSING
The preparation, packaging, labelling record keeping, and transfer of a drug to a patient or an intermediary, who is responsible for administration of the drug.

Adapted from: Medical dictionary. (n.d.). Drug dispensing | definition of drug dispensing by Medical dictionary. Retrieved April 9, 2018, from http://medical-dictionary.thefreedictionary.com/drug+dispensing

GENERIC SUBSTITUTION
Practise of substituting a pharmaceutical (trade name or generic name) by a pharmaceutical containing the same active ingredients.

Adapted from: The Pharmaceutical Pricing and Reimbursement Information (PPRI) network, & (WHO), W. H. O. (2013). *Glossary of Pharmaceutical Terms*.

VERBAL/ WRITTEN PROVISION OF MEDICINES' INFORMATION
The pharmacist provides written/verbal information on medicines that enhance the quality of patient care, improve patient outcomes, and ensure the prudent use of resources.

1

Adapted from: Ghaibi, S., Ipema, H., & Gabay, M. (2015). *ASHP Guidelines on the Pharmacist's Role in Providing Drug Information*. *American Journal of Health-System Pharmacy* (Vol. 72). Retrieved from http://www.ajhp.org/cgi/doi/10.2146/sp150002

PROVISION OF EMERGENCY ORAL CONTRACEPTION

To officially advise someone to use a treatment (a medicine, therapy, etc.) under specific protocol and/or for specific list of medicines.

Adapted from: WHO. (2018). WHO | Emergency contraception.

HOME DELIVERY OF MEDICINES

Service consists of having medicines (including prescriptions) delivered to patients' home by pharmacy staff.

Adapted from: HAP Michigan. (n.d.). Prescription Home Delivery | Health Insurance | HAP Michigan. Retrieved April 9, 2018, from https://www.hap.org/prescription-drug/home-delivery

NEEDLE EXCHANGE

Organized services for exchange of sterile needles and syringes used for injections as a potential means of reducing the transmission of infectious diseases.

Adapted from: MeSH. (1994). Needle exchange program.

BASIC SERVICES

ASSESSMENT OF INHALATION TECHNIQUE

Healthcare professionals ensure people with asthma or COPD receive specific training and assessment in inhaler technique.

Adapted from: NICE - National Institute for Health and Care. (n.d.). Asthma | Guidance and guidelines | NICE. Retrieved April 9, 2018, from https://www.nice.org.uk/guidance/qs25

ADHERENCE SUPPORT AND MONITORING

The Service may include the establishment of an enabling strategy (e.g. reminder system or simplification of the complexity of treatment), whenever appropriate. Service where the pharmacist checks the extent to which a person's behaviour – taking medication (including timing, dosage and frequency) – corresponds with agreed recommendations from a health care provider. This may be achieved using different methods (e.g. questionnaires, prescription refill pill count, etc).

Adapted from: Fenerty, S. D., West, C., Davis, S. A., Kaplan, S. G., & Feldman, S. R. (2012). The effect of reminder systems on patients' adherence to treatment. *Patient Preference and Adherence*, *6*, 127–135. http://doi.org/10.2147/PPA.S26314

SMOKING CESSATION

Individual behavioural counselling involving scheduled face-to-face meetings. Typically, it involves multiple session and it can be combined with pharmacotherapy. Brief interventions for smoking cessation typically delivered in less than 10 minutes are excluded.

Adapted from: NICE - National Institute for Health and Care. (2013). Nice Guidance.

HEALTH SCREENING

Health screening is the process of identifying healthy people who may be at increased risk of disease or condition.

Adapted from: NHS. (n.d.). NHS population screening explained. Retrieved April 9, 2018, from https://www.gov.uk/guidance/nhs-population-screening-explained

TRAVEL MEDICINE

Patient- and trip-related information are gathered to assess the traveller's health risks. People are counselled about food- and water-borne diseases, insect-borne diseases, sexual transmitted diseases, and diseases related to animal bites in the travel destination(s). Additionally, information about vaccines that may be needed to protect travellers against different diseases is provided. Moreover, specific information about the treatment of their chronic diseases during the trip are provided.

Adapted from: Jackson, A. B., Humphries, T. L., Nelson, K. M., & Helling, D. K. (2004). Clinical Pharmacy Travel Medicine Services : A New Frontier, *38*. http://doi.org/10.1345/aph.1E193

PRESCRIPTION RENEWAL

Service where the pharmacy/pharmacist assists in the renewal of a prescription for chronic medication. This can be done manually (phone calls, fax) or automated.

Adapted from: Company, E. S. H. (n.d.). Ordering online. Retrieved April 9, 2018, from https://www.express-scripts.com/medco/consumer/helpcenter/help_article.jsp?faq=HelpCenter_Refill-Prescription#A

POINT OF CARE TESTING

Patient diagnoses or patients monitoring of disease condition in the ambulatory setting or at bedside. The results of care are timely and allow rapid treatment to the patient and treatment monitoring.

Adapted from: MeSH. (2015). Point-of-care Testing.

ADVANCED SERVICES

OPIOID SUBSTITUTION

A comprehensive treatment program that involves individualised supply for illicit drug users with a replacement drug, a prescribed medicine (e.g. methadone, buprenorphine), which is usually administered orally in a supervised clinical setting.

Adapted from: Kermode, M., Crofts, N., Kumar, M. S., & Dorabjee, J. (2011). Opioid substitution therapy in resource-poor settings. *Bulletin of the World Health Organization*, *89*(4), 243–243. http://doi.org/10.2471/BLT.11.08685

NEW MEDICINES SERVICE

This Service will provide support to people who are newly prescribed a medicine to manage a long-term condition, which generally help them to appropriately improve their medication adherence.

Adapted from: PSNC, NHS Employers, Blueprint, T., Commission, R., Care, H., Report, R., … Gesundheit Österreich GmbH - GÖG. (2013). *Service specification – New Medicine Service (NMS)*. *European Journal of Hospital Pharmacy* (Vol. 21). Retrieved from http://ejhp.bmj.com/lookup/doi/10.1136/ejhpharm-2014-000527

IMMUNIZATION

The process of inducing immunity to an infectious agent by administrating a vaccine by any of the following routes: intravenous (IV); intramuscular (IM); subcutaneous (SC); Oral.

Adapted from: Pharmacy Guild of Australia. (2014). *Guidelines for Conducting Pharmacist Initiated and Administered Vaccination Service within a New South Wales Community*

http://dx.doi.org/10.1016/j.sapharm.2016.01.005

ADMINISTRATION OF INJECTABLE MEDICINES

The act of administering injectable medication by any of the following routes: intravenous (IV); intramuscular (IM); subcutaneous (SC).

Adapted from: Pharmacy Guild of Australia. (2014). *Guidelines for Conducting Pharmacist Initiated and Administered Vaccination Service within a New South Wales Community Pharmacy Environment*. Elsevier Ltd. Retrieved from http://dx.doi.org/10.1016/j.sapharm.2016.01.005

PERSONALISED MEDICINE

Clinical, therapeutic and diagnostic approaches to optima disease management based on individual variations in a patient's genetic profile. The main aim of this service is to determine the rate of metabolism of medicines so that the therapy may be adapted accordingly.

Adapted from: Velez, G., Roybal, C. N., Colgan, D., Tsang, S. H., Bassuk, A. G., & Mahajan, V. B. (2016). Precision Medicine. *JAMA Ophthalmology*, 1–7. http://doi.org/10.1001/jamaophthalmol.2015.5934

PRESCRIBING

To officially advise someone to use a treatment (a medicine, therapy, etc.) under specific protocol and/or for specific list of medicines.

Adapted from: Merriam-Webster. (n.d.). Prescription Drug | Definition of Prescription Drug by Merriam-Webster. Retrieved April 9, 2018, from https://www.merriam-webster.com/dictionary/prescription drug

INR TESTING AND/OR MONITORING

Service that uses the international normalized ratio (INR) to monitor blood coagulation (INR testing). Based on the results pharmacists may advise patients on the need to adapt the dose of oral anticoagulants. (INR management).

Adapted from: Mayo Clinic. (n.d.). Prothrombin time test - About - Mayo Clinic. Retrieved April 9, 2018, from https://www.mayoclinic.org/tests-procedures/prothrombin-time/about/pac-20384661

MEDICATION REVIEW

Medication Review is a structured evaluation of a patient's medicines with the aim of optimising medicines use and improving health outcomes. This entails detecting drug related problems and recommending interventions.

Adapted from: Pharmaceutical Care Network Europe. (2016). *Position Paper on the PCNE definition of Medication Review 2016*.

I.I.III. Pharmacist-led cognitive services in primary care across Europe – Provision, level of implementation and remuneration model [A-1]

Cognitive Pharmaceutical Services available in primary care across Europe - Provision (Level of implementation - Remuneration model)

Countries/ Regions	Generic substitution	Provision of information on medicines	Provision of emergency oral contraception	Home delivery of medicines	Needle exchange
Albania[1]	No	Yes	Yes	No	No
Austria[1]	No	Yes	Yes	Yes	No
Belgium	Yes	Yes	Yes	No	Yes
Bulgaria[1]	No	Yes	Yes	No	No
Croatia[1]	Yes	Yes	Yes	No	No
Denmark[1]	Yes	Yes	No	Yes	No
Finland[1]	Yes	Yes	Yes	Yes[a] (✗ - No)	No
Germany[1]	Yes	Yes	Yes[a] (High - No)	Yes[a] (High - No)	No
Hungary[1]	Yes	Yes	No	Yes	No
Iceland[1]	Yes	Yes	Yes	Yes	No
Ireland[1]	Yes	Yes	Yes[a] (✗ - ✗)	No	Yes[a] (Low - FFS)
Luxembourg[1]	Yes	Yes	Yes	No	No
Macedonia[1]	Yes	Yes	No	No	No
Malta[1]	Yes	Yes	Yes	Yes[a] (✗ - ✗)	No
Northern Ireland[1]	No	Yes	Yes[a] (✗ - ✗)	Yes[a] (High - No)	Yes[a] (Low - ✗)
Norway[1]	Yes	Yes	No	No	Yes[a] (✗ - ✗)
Poland[1]	Yes	No	No	No	No
Portugal[1]	Yes	Yes	Yes	Yes[a] (Low - No)	Yes[a] (Medium - FFS)
Romania[1]	Yes	Yes	No	No	No
Slovakia[1]	Yes	Yes	Yes	No	No
Slovenia[1]	Yes	Yes	Yes[a] (High - No)	Yes[a] (Low - No)	No
Spain[1]	Yes	Yes	No	No	Yes[a] (Low - No)
Switzerland[1]	Yes	Yes	Yes[a] (High- No)	Yes	No
The Netherlands[1]	Yes	Yes	Yes	Yes	Yes
Turkey [1]	Yes	Yes	No	Yes[a] (✗ - ✗)	No
Ukraine	Yes	Yes	Yes	Yes[a] (Medium - FFS)	No
England[2]	No	Yes	Yes[a] (✗ - ✗)	Yes[a] (✗ - No)	Yes[a] (✗ - ✗)
Estonia[2]	Yes	Yes	No	No	No
Kosovo[2]	Yes	Yes	No	No	No
Latvia[2]	Yes	No	Yes	No	No
Sweden[2]	Yes	Yes	Yes	No	No
France[3]	Yes	Yes	Yes[a] (✗ - FFS)	Yes	No
Georgia[3]	Yes	Yes	Yes	No	No
Serbia[3]	Yes	Yes	Yes	Yes[a] (✗ - ✗)	No

[1] Full validation of Data (all participants or majority)
[2] Partial validation of Data (one participant)
[3] No validation of Data (no participants)
[a] Provided as an independent service; ✗ - No data provided; **No** – No Remuneration (0€); **P4P** – Pay for Performance; **FFS** – Fee-for-service; **MM** - Mixed Model
Project = considered to be an independent PLCS, but limited in time, hence not described as a standard service

(Continued)

Countries/ Regions	Assessment of inhalation technique	Adherence support and monitoring	Smoking cessation	Health screening	Travel medicine	Prescription renewal	Point-of-care testing
Albania[1]	Yes	No	Yes	No	No	No	Yes
Austria[1]	Yes	Yes[a] (High - FFS)	Yes	Yes[a] (✗ - ✗)	Yes[a] (High - No)	No	Yes
Belgium	Yes[a] (High - FFS)	Yes[a] (✗ - FFS)	Yes[a] (Low- ✗)	No	No	Yes	Yes
Bulgaria[1]	Yes	No	Yes	No	No	No	Yes
Croatia[1]	Yes[a] (Low - ✗)	Yes[a] (Low- ✗)	Yes[a] (Low-No)	Yes[a] (Low - No)	No	No	Yes
Denmark[1]	Yes[a] (✗ - ✗)	Yes	Yes[a] (Low- ✗)	No	No	No	No
Finland[1]	Yes[a] (Low - No)	Yes[a] (Low-No)	Yes[a] (Low-No)	Yes[a] (Low - No)	No	Yes[a] (High - No)	Yes
Germany[1]	Yes[a] (✗ - ✗)	Yes[a] (✗ - ✗)	No	No	Yes[a] (✗ - ✗)	No	Yes[a] (High - ✗)
Hungary[1]	No	Yes	No	Yes[a] (Low - No)	No	No	No
Iceland[1]	Yes	No	Yes	No	No	No	Yes
Ireland[1]	No	No	No	No	No	No	Yes[a] (✗ - ✗)
Luxembourg[1]	Yes	No	No	No	Yes	No	Yes
Macedonia[1]	No	No	No	No	No	No	No
Malta[1]	Yes	Yes	No	No	No	No	Yes
Northern Ireland[1]	Yes[a] (✗ - FFS)	No	Yes[a] (High-MM)	Yes[a] (✗ - ✗)	No	Yes[a] (High - No)	Yes[a] (✗ - ✗)
Norway[1]	Yes[a] (High - FFS)	Yes	No	Yes[a] (✗ - ✗)	No	No	No
Poland[1]	No	No	No	No	No	No	No
Portugal[1]	Yes[a] (Low - No)	Yes[a] (Low-No)	Yes[a] (Low-No)	Yes[a] (Medium - No)	Yes[a] (Low - No)	No	Yes[a] (High - No)
Romania[1]	Yes	No	Yes	No	No	No	No
Slovakia[1]	No	No	Yes[a] (✗ - ✗)	No	No	No	Yes
Slovenia[1]	Yes[a] (Low - No)	Yes[a] (High-No)	Yes[a] (Low-No)	Yes[a] (Low - No)	No	Yes	No
Spain[1]	No	No	Yes[a] (Low- No)	No	No	No	No
Switzerland[1]	Yes	Yes[a] (Medium-FFS)	No	Yes[a] (✗ - No)	Yes[a] (✗ - No)	Yes	Yes[a] (✗ - ✗)
The Netherlands[1]	Yes	Yes	Yes	No	Yes[a] (High - No)	Yes[a] (High - No)	Yes
Turkey [1]	No	No	No	No	No	No	No
Ukraine	No	No	Yes[a] (Low-No)	Yes[a] (High - No)	No	No	Yes
England[2]	Yes[a] (✗ - ✗)	Yes[a] (High-FFS)	Yes[a] (✗ - ✗)	Yes[a] (✗ - ✗)	Yes[a] (✗ - ✗)	Yes	Yes[a] (✗ - ✗)
Estonia[2]	Yes	No	No	Yes[a] (Low - No)	No	No	No
Kosovo[2]	No	No	No	No	No	No	No
Latvia[2]	No	No	No	Yes	No	No	Yes
Sweden[2]	Yes	Yes	No	Yes[a] (✗ - ✗)	No	No	Yes
France[3]	No	Yes	Yes	Yes	Yes	No	Yes[a] (✗ - ✗)
Georgia[3]	No	No	No	No	No	No	Yes
Serbia[3]	Yes	No	Yes[a] (Low-No)	Yes[a] (✗ - No)	No	No	Yes

[1] Full validation of Data (all participants or majority)
[2] Partial validation of Data (one participant)
[3] No validation of Data (no participants)
[a] Provided as an independent service; ✗ - No data provided; **No** – No Remuneration (0€); **P4P** – Pay for Performance; **FFS** – Fee-for-service; **MM** - Mixed Model
Project = considered to be an independent PLCS, but limited in time, hence not described as a standard service

(Continued)

Countries/Regions	Opioid substitution	New medicines service	Immunisation	Administration of injectable medicines	Personalised medicine	Prescribing	INR testing and/or management	Medication review	Pharmaceutical Care*
Albania[1]	No	Yes	No	No	No	No	No	No	Yes
Austria[1]	Yes	Yes	No	No	No	No	No	Yes[a] (Low - FFS)	Yes
Belgium[1]	Yes[a] (✗ - ✗)	Yes[a] (Low-FFS)	No	No	No	No	No	Yes[a] (project)	Yes
Bulgaria[1]	No	Yes	No	No	No	No	No	No	Yes
Croatia[1]	No	Yes[a] (Low- ✗)	No	No	No	No	No	Yes[a] (Low - No)	Yes
Denmark[1]	Yes[a] (✗ - ✗)	Yes	Yes[a] (Low- No)	No	No	No	No	Yes[a] (project)	Yes
Finland[1]	Yes	No	No	No	No	No	No	Yes[a] (High - No)	Yes
Germany[1]	Yes[a] (✗ - ✗)	No	No	No	Yes[a] (✗ - ✗)	No	No	Yes[a] (project)	Yes
Hungary[1]	No	No	No	No	No	No	No	Yes[a] (project)	Yes
Iceland[1]	No	No	No	No	No	No	No	No	No
Ireland[1]	Yes (Medium-FFS)	No	Yes[a] (Med-FFS)	Yes[a] (✗ - No)	No	No	No	No	No
Luxembourg[1]	Yes (High-FFS)	No	No	No	No	No	No	No	No
Macedonia[1]	No	No	No	No	No	No	No	No	No
Malta[1]	No	No	No	No	No	No	No	No	No
Northern Ireland[1]	Yes	No	Yes[a] (Low-FFS)	No	No	Yes[a] (High-FFS)	No	Yes[a] (High - FFS)	No
Norway[1]	Yes	No	No	No	No	No	No	Yes[a] (✗ - No)	No
Poland[1]	No	No	No	No	No	No	No	No	No
Portugal[1]	No	Yes[a] (Low-No)	Yes[a] (High-No)	Yes[a] (Low - No)	No	No	Yes[a] (Low - No)	Yes[a] (Low - No)	Yes
Romania[1]	No	No	No	No	No	No	No	No	No
Slovakia[1]	No	No	No	No	No	No	No	Yes[a] (project)	No
Slovenia[1]	Yes	No	No	No	No	No	No	Yes[a] (Low - P4P)	Yes
Spain[1]	Yes[a] (Low-FFS)	No	No	No	No	No	No	Yes[a] (✗ -No)	Yes
Switzerland[1]	Yes[a] (High-FFS)	No	Yes[a] (Med-No)	No	No	No	No	Yes[a] (High - FFS)	No
The Netherlands[1]	Yes[a] (✗ - ✗)	Yes[a] (High-FFS)	No	No	No	No	No	Yes[a] (High - FFS)	Yes
Turkey [1]	No	No	No	No	No	No	No	No	No
Ukraine[1]	No	No	No	No	No	No	No	Yes[a] (project)	Yes
England[2]	Yes[a] (High - ✗)	Yes[a] (High-FFS)	Yes[a] (High-FFS)	No	No	Yes[a] (✗ - ✗)	Yes[a] (✗ - ✗)	Yes[a] (High - FFS)	No
Estonia[2]	No	Yes	No	No	No	No	No	No	No
Kosovo[2]	No	No	No	No	No	No	No	No	No
Latvia[2]	No	No	No	No	No	No	No	No	No
Sweden[2]	Yes[a] (✗ - ✗)	Yes	No	No	No	No	No	Yes[a] (High - No)	Yes
France[3]	Yes	Yes[a] (✗ - ✗)	No	No	No	No	No	Yes[a] (High - ✗)	No
Georgia[3]	Yes[a] (Low-No)	No	No	No	No	No	No	No	No
Serbia[3]	No	No	No	No	No	No	No	No	No

[1] Full validation of data (all participants or majority)
[2] Partial validation of data (one participant)
[3] No validation of data (no participants)

Provision (Implementation - Remuneration); [a] Provided as an independent service; ✗ - No data provided; **No** – No Remuneration (0€); **P4P** – Pay for Performance; **FFS** – Fee-for-service
Project = considered to be an independent PLCS, but limited in time, hence not described as a standard service
* Pharmaceutical care is listed in the table for easier understanding of manuscript but it is not considered in the overall counts or in the service categorisation because it is considered a concept encompassing various services

I.I.IV. PhaRmAcist-led CogniTIve Services in Europe – survey [A-2]

The online survey is available upon request or https://doi.org/10.1016/j.sapharm.2019.11.002.

I.I.V. Illustrative examples of different types of MR (Switzerland, England, Slovenia, the Netherlands) [A-2]

Additional file 3: Illustrative examples of different types of MR (Switzerland, England, Slovenia, the Netherlands)

Box 1: type 1 MR service – an example from Switzerland

In 2001, a new remuneration model for community pharmacies was introduced in Switzerland, away from margins depending on the price of the medication to a performance-based remuneration. This was the initiation of the type 1 MR service in Switzerland. This type 1 MR is performed in all patients filling a prescription or getting a prescription medication dispensed in one of the community pharmacies registered with the Swiss Pharmacy Association (83.3% of all Swiss Pharmacies).

Aim: To compare all prescriptions or prescription medication with patient's medication history (prescription +/- non-prescription medication) for abuse and hording, contraindications, drug interactions and dosage, risk factors, selection of optimized package size, possibility of repeat dispensing.

Who: All community pharmacists counsel patients about their prescription medication.

Where: In the community pharmacy.

When: Whenever the community pharmacy dispenses a prescription medication to a patient, without any eligibility criteria.

How: The type 1 MR in Switzerland consist of two parts:

- Drug-delivery check: Inconsistencies and contraindication are focused by pharmacists within a prescription. If illegibility or questions about the dosage occur, the pharmacist contacts the treating physician. In addition, the pharmacist suggests alternative options to the treating physicians in case of interactions in the prescription and informs the patient about possible risks and adverse reactions of the prescribed medication.

- Treatment check: Pharmacist compares the medication on the prescription with patients' medication history (list of prescription +/- non-prescription medication).

Remuneration: Community pharmacies are remunerated by the health insurance companies for the type 1 MR. The remuneration consists of a fix fee per prescription (approx. 3 €), plus a fee for each drug item on the prescription (approx. 4 €).

Box 2: type 2a MR service– an example from England

Aim: The service aims to primarily support patients in their medication adherence. It does this by identifying drug-related problems, educating patients about their medication and resolving any potential

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barriers to medication taking. A secondary objective is to reduce medication waste by promoting optimized repeat prescription management by patients.

Who: The community pharmacist can offer a MUR for all regular patients (receiving at least 3 months of prescriptions dispensed at the same pharmacy) or can provide one if a pharmaceutical need is identified (the service is then described as the Prescription Intervention Service). The pharmacist must undergo accreditation in order to be able to undertake MURs, and the pharmacy premises also needs to be declared as suitable for providing the service.

Where: Community pharmacies; however, special permission can be requested *(NHS England's approval)* to provide a MUR to a specific patient off-site (such as the patients' home) or via telephone.

When: In order to be eligible for a MUR, patients must take a minimum of two regular medications for a long term condition (or one medication if it is considered high risk). In addition, 70% of the MURs that a community pharmacy provides must be targeted at specific patient groups; patients taking high risk medication, patients recently discharged from hospital, respiratory or cardiovascular disease or those at risk of developing cardiovascular disease.

How: Community pharmacist uses the patient's medication record and a verbal patient medication history to identify pharmaceutical care needs. Where these can be addressed within the consultation this is done so, where an action needs to be taken by the prescriber, the community pharmacist highlights this on the patient's behalf. The prescriber is then responsible for making any decisions about any changes to therapy. A record of the consultation is kept within the pharmacy.

Remuneration: The pharmacy is remunerated 30 € for each completed MUR. Each pharmacy can provide a maximum of 400 MURs each year. This service is funded by the National Health Service.

Box 3: The type 3 MR service – an example from Slovenia

In 2016, a type 3 MR service named pharmacotherapy review was implemented and granted remuneration at the primary care level. This MR service was developed as type 3 MR, but in certain cases, when the patient is not able to attend the patient interview, a type 2b MR would be performed.

Aim: The service is primarily intended for the GPs' to help and consult them with optimizing patient's therapy.

Who: The GP refers the patients' medical documentation to a clinical pharmacist for MR. Clinical pharmacist is a Master of Pharmacy with a license, who finished 3-year post-graduate specialization course in clinical pharmacy and is certified to provide the service in practice by Slovene Chamber of Pharmacies.

Where: Primary care (ambulatory setting, nursing homes)

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When: Whenever a GP recognizes the need for consultation with the clinical pharmacist. No specific eligibility criteria apply. Typically, the reasons for referral are the optimization of therapy due to polypharmacy, vital parameters or adverse drug events.

How: The clinical pharmacist reviews patient's medical documentation and writes the pharmacotherapy review report with recommendations. The report is sent back to a GP, who considers the recommendations and makes clinical decisions about patient's therapy. The clinical pharmacist is available for further explanations or follow up if needed and upon GP's request.

Remuneration: The service is financed by the National Health Insurance Institute, who assures an annual flat rate of 41.000€ per team, which involves one clinical pharmacist. This corresponds to a 32€ per MR gross (based on one full time equivalent), of which 85% goes to a clinical pharmacist (27€ gross). The actual payment is per performance. Clinical pharmacist is paid per hour and should perform 6 reviews in 8h.

Box 4: type 3 MR service – an example from the Netherlands

MR by pharmacists has already been introduced in the Netherlands around 1990.

In 2013, the Dutch Pharmacy Association (KNMP) issued a guideline about the process around MR, based on a national consensus report. This guideline is currently used by the pharmacists, payers, and inspectorate.

Aim: To optimize the existing pharmacotherapy of a patient, in order to prevent worsening of disease or adverse events of treatment. MR should also help to adjust treatment to the patient's wishes and improve self-management.

Who: Pharmacist, patient and GP together. Pharmacist has the lead. Patient or his representative must be involved. The payers require that all pharmacists who conduct reviews must have followed an accredited MR training (but there is no official special accreditation for the pharmacist). There are bi-annual updates for these trainings.

Where: In the pharmacy plus patient interview possibly at the patients' home. Results of the review are discussed with the treating GP, usually in the GP office.

When: According to the official pharmacist' guideline, a review is conducted once a year if a patient is 65 or older, and using ≥ 5 medications. Additionally, one or more of the following criteria should be met: living in nursing home or home for the elderly, a decreased kidney function (eGFR <50 ml/min), decreased cognition, increased risk of falls, signals of decreased adherence to treatment. In the national multidisciplinary guideline, there is an additional criterion that the patient has had an unexpected hospital admission. The advised frequency (once a year) depends also on the stability of the patient. Additional diseases or hospital discharge of a patient may be a reason for a renewed MR. Based on the

3

above criteria, an average Dutch pharmacy (serving a population of 10.000 with mainly prescription medication) has around 550 patients that should have a MR. Additional local criteria may be used to select patients that are most in need.

How: A stepwise approach is advised, called the STRIP method (Systematic Tool to Reduce Inappropriate Prescribing). Because most patients go to the same pharmacy in the Netherlands, the pharmacists will have the prescription medication data from his patients at his fingertips. The STRIP method consists of the following steps: Pharmacotherapeutic anamnesis, pharmacotherapeutic analysis, preparing a pharmaceutical care plan & discussing the plan with the physician, discussing the pharmaceutical care plan and proposed treatment changes with the patient, follow-up with the patient and medical staff/physicians involved. There is a requirement to document the steps and the review result in the pharmacy.

Remuneration: Between 20 and 70 €, depending on the contract established with an insurance company. Pharmacists will only be contracted if they can prove that they followed a MR training.

Official Indicator: The number of MR according to the guideline is an important indicator in the Dutch Pharmacy Quality System. Additionally, the Inspectorate of the Ministry of Health checks that the annual number of reviews performed is above a certain limit (now in 2018, approx. 100 reviews annually).

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I.I.VI. Medication- and patient-related issues during medication reviews [A-2]

Additional file 2: Medication- and patient-related issues during MR

Type 1 MR	Austria°	Croatia°	Denmark °	Finland†	France	Germany °	Hungary°	Northern Ireland	Norway	Slovakia°	Switzerland	The Netherlands	Ukraine °
Contraindications because of age / gender or derived indication	Yes	Yes	Yes	No	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Appropriateness of drug choice	-	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes
Appropriateness of drug dose	-	Yes	Yes	Yes	-	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Appropriateness of dosing time/interval	-	Yes	Yes	Yes	-	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Drug-drug interactions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Duplication	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Drug/treatment costs	No	No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Poor adherence (partly)	-	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Treatment duration	-	Yes	Yes	No	-	No	No	Yes	-	Yes	Yes	Yes	Yes

[0] ongoing project on MR (no standard procedure)
† Individuals with a BSc or MSc in pharmacy
- no results

1

(Continued)

Type 2a MR	Belgium °	Croatia	Denmark °	England	Finland†	Germany °	Hungary	Northern Ireland	Portugal	Slovenia	Spain	Sweden	Switzerland	Ukraine
Adverse drug reactions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Some aspects of effectiveness	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contraindications age/gender	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Appropriateness of drug choice	Yes	-	Yes	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Appropriateness of drug dose	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Appropriateness of drug form	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Irrational drug use	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Incorrect instructions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Need of drug information	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Appropriateness of dosing time/interval	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Drug-drug interactions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Appropriateness of treatment duration	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Duplication	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Drug/treatment costs	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes	No	Yes
Adherence	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Patient dissatisfaction with the therapy	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Swallowing difficulties	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Handling of medication	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adherence aid	Yes	Yes	Yes	Yes	No	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Allergies	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	-	-		Yes
Lifestyle	Yes	Yes	-	Yes	No	No	Yes	Yes	Yes	Yes	Yes	-	Yes	Yes

° ongoing project on MR (no standard procedure)
† Individuals with a BSc or MSc in pharmacy
- no result

2

(Continued)

#Type 2b MR	Finland †
Effectiveness of treatment	Yes
Untreated conditions	Yes
Unnecessary drug treatment	Yes
Adverse drug reactions	Yes
Contraindication	Yes
Appropriateness of drug choice	Yes
Appropriateness of drug dose against indication	Yes
Appropriateness of treatment duration	Yes
Appropriateness of dosing time/interval	Yes
Drug-drug interactions	Yes
Duplication	Yes
Drug, treatment costs	No
Adherence (partly)	Yes
Adherence aid	No
Allergies	Yes

no detailed description available from Northern Ireland, † Individuals with a BSc or MSc in pharmacy

3

(Continued)

Type 3 MR	Austria	Finland†	Germany °	The Netherlands
Effectiveness of treatment	Yes	Yes	Yes	Yes
Untreated conditions	Yes	Yes	Yes	Yes
Unnecessary drug treatment	Yes	Yes	Yes	Yes
Adverse drug reactions	Yes	Yes	Yes	Yes
Contraindications	Yes	Yes	Yes	Yes
Appropriateness of drug choice	Yes	Yes	Yes	Yes
Appropriateness of drug dose	Yes	Yes	Yes	Yes
Appropriateness of drug form	Yes	Yes	Yes	Yes
Irrational drug use	Yes	Yes	Yes	Yes
Incorrect instructions	Yes	Yes	Yes	Yes
Need of drug information	Yes	Yes	Yes	Yes
Appropriateness of treatment duration	Yes	Yes	Yes	No
Appropriateness of dosing time/interval	Yes	Yes	Yes	No
Drug-drug interactions	Yes	Yes	Yes	Yes
Duplication	Yes	Yes	Yes	Yes
Drug/treatment costs	-	Yes	No	Yes
Adherence	Yes	Yes	Yes	Yes
Patient dissatisfaction with the therapy	Yes	Yes	No	Yes
Swallowing difficulties	Yes	Yes	No	Yes
Handling of medication	Yes	Yes	Yes	Yes
Adherence aid	Yes	Yes	No	Yes
Allergies	Yes	Yes	No	Yes
Lifestyle	No	Yes	No	Yes

° ongoing project on MR (no standard procedure)
† Individuals with a BSc or MSc in pharmacy
- no result

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I.II. Project B

I.II.I. Medication reconciliation form (generic medication) [B-1]

Medication Reconciliation			**Matrikelnummer StudentIn:**			
1) Aktuelle Medikation mit Name, Stärke und galenischer Form	**Dosierung pro Tag (x-x-x-x)**	**2) Letzte vom Arzt verordnete Medikation mit Name und Stärke (Datum der Verordnung)**	**Dosierung pro Tag (x-x-x-x)**	**3) Gibt es Unterschiede zwischen Kolonne 1) und 2)?**	**4) Begründung**	**5) Selbstbehalt?** O = Medikament mit 20% Selbstbehalt G = Medikament mit 10% Selbstbehalt
Beispiel: *Aspirin cardio Filmtabletten 100 mg*	*0-0-1-0*	*Aspirin cardio Filmtabletten 100 mg (17.9.16)*	*1-0-0-0*	☒ Ja ☐ Nein	*Beispiel: Einnahmezeitpunkt wurde vom Patienten geändert, da Patient alle anderen Medikamente jeweils am Abend einnimmt.*	*G*
A)				☐ Ja ☐ Nein	A)	
B)				☐ Ja ☐ Nein	B)	
C)				☐ Ja ☐ Nein	C)	
D)				☐ Ja ☐ Nein	D)	
E)				☐ Ja ☐ Nein	E)	
F)				☐ Ja ☐ Nein	F)	
G)				☐ Ja ☐ Nein	G)	
H)				☐ Ja ☐ Nein	H)	

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Version: V1.0 Seite 1/2
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			Matrikelnummer StudentIn:			
1) Aktuelle Medikation mit Name, Stärke und galenischer Form	**Dosierung pro Tag (x-x-x-x)**	**2) Letzte vom Arzt verordnete Medikation mit Name und Stärke (Datum der Verordnung)**	**Dosierung pro Tag (x-x-x-x)**	**3) Gibt es Unterschiede zwischen Kolonne 1) und 2)?**	**4) Begründung**	**5) Selbstbehalt?** O = Medikament mit 20% Selbstbehalt G = Medikament mit 10% Selbstbehalt
I)				☐ Ja ☐ Nein	I)	
J)				☐ Ja ☐ Nein	J)	
K)				☐ Ja ☐ Nein	K)	
L)				☐ Ja ☐ Nein	L)	
M)				☐ Ja ☐ Nein	M)	
N)				☐ Ja ☐ Nein	N)	
O)				☐ Ja ☐ Nein	O)	
P)				☐ Ja ☐ Nein	P)	
Q)				☐ Ja ☐ Nein	Q)	

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I.II.II. Interview guide - Attitudes of patients with polypharmacy towards generic medications [B-2]

Universität Basel

Departement
Pharmazeutische Wissenschaften

DEPARTMENT OF PHARMACEUTICAL SCIENCES

PMC Interviewguide: ‚Polymedikations-Check und Medikamenten-Organisation im Alltag'

Matrikelnummer StudentIn _____ **Start (Uhrzeit)** _____

Fragen an den Patienten:

1. Fragen zu System/Technik der Medikamenten-Organisation	**Antwort des Patienten:**	**Besteht Beratungsbedarf?** Falls ja, bitte auf „Issues und Interventionen - Drug Use Profile, Medication Reconciliation und Polymedikations-Check" dokumentieren.
Bitte denken Sie an all Ihre Medikamente, die vom Arzt verordnet sind.		
a) Haben Sie ein System/ eine Technik, das/die Ihnen hilft, an die Einnahme Ihrer Medikamente zu denken? (Mehrere Antworten möglich.)	☐ Wochendosiersystem→ **weiter bei b)** ☐ Tagesdosiersystem→ **weiter bei c)** ☐ Wecker → **weiter bei g)** ☐ App →**weiter bei g)** ☐ Andere _____ ☐ Kein/e System/Technik → **weiter bei Frage n)**	☐ Ja ☐ Nein
b) Falls Wochendosiersystem: Welches? (Fotos zeigen) (Mehrere Antworten möglich.) → **danach weiter bei d)**	☐ Medi-7® (A) ☐ Selbstgemacht (B) ☐ Dosett® (C) ☐ Anabox® (D) ☐ Medidos® (E) ☐ Anabox®1x7 (F) ☐ Andere: _____	☐ Ja ☐ Nein
c) Falls Tagesdosiersystem: Welches? (Fotos zeigen) (Mehrere Antworten möglich.)	☐ Unterteilte Dose (A) ☐ Selbstgemacht (B) ☐ Pillendose (C) ☐ Anabox® 1 Tag (D) ☐ Schieber (E) ☐ Andere:_____	☐ Ja ☐ Nein
d) Wer befüllt das Medikamentendosier-System (MDS) mit Medikamenten?	☐ Patient selbst ☐ Familienangehörige ☐ Nachbar ☐ Andere_____	☐ Ja ☐ Nein
e) Haben Sie Medikamente, welche Sie regelmässig anwenden und welche Sie nicht ins MDS füllen können? (z.B. Augentropfen, Pflaster, Salben, Inhalatoren)	☐ Ja ☐ Nein Falls **ja**, welche? ☐ Augentropfen ☐ Zäpfchen ☐ andere Tropfen ☐ Salbe/Creme ☐ Brausetabletten ☐ Pflaster ☐ Spritze/Pen ☐ Inhalator/Dosieraerosol ☐ _____	☐ Ja ☐ Nein
f) Wie organisieren Sie diese Medikamente, welche nicht im MDS sind?	☐ in Originalpackung ☐ _____	☐ Ja ☐ Nein
g) Was machen Sie mit Medikamenten, welche Sie nur bei Bedarf einnehmen?	☐ in Originalpackung ☐ in Extradose ☐ in MDS belassen, bis sie genommen werden ☐ Anderes_____	☐ Ja ☐ Nein

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h) Haben Sie Schwierigkeiten bei der Entnahme der Medikamente aus dem MDS?	☐ Ja ☐ Nein Falls **ja**, welche? ☐ Dose klemmt/lässt sich nicht öffnen ☐ Medikamente kleben in Dose ☐ Medikamente fallen runter ☐ _____ Falls **ja**, wie oft? ☐ 1x im Monat ☐ 1x alle 2 Wochen ☐ 1x pro Woche ☐ mehr als 1x pro Woche ☐ jeden Tag	☐ Ja ☐ Nein
i) Was machen Sie mit Ihrem MDS, wenn Sie auf Reisen gehen?	☐ gefüllt mitnehmen ☐ leer mitnehmen + Medikamente ☐ nicht mitnehmen ☐ _____	☐ Ja ☐ Nein
j) Was veranlasste Sie dazu dieses System/ diese Technik zu benutzen? (Mehrere Antworten möglich.)	☐ viele Medikamente ☐ wurde empfohlen ☐ Medikamente vergessen ☐ Andere_____	☐ Ja ☐ Nein
k) Falls dieses System/ diese Technik empfohlen wurde: Von wem?	☐ Arzt ☐ Familienangehörige ☐ Apotheker ☐ Spital ☐ Andere_____	☐ Ja ☐ Nein
l) Wen haben Sie über das Benutzen dieses Systems/dieser Technik informiert?	☐ Angehörige ☐ Arzt ☐ Apotheker ☐ Andere _____	☐ Ja ☐ Nein
m) Als wie hilfreich empfinden Sie Ihr System/ Ihre Technik auf einer Skala von 1 bis 10? Wobei 1 nicht hilfreich und 10 sehr hilfreich entspricht.	Wert: _____	☐ Ja ☐ Nein
n) Denken Sie an die letzten 4 Wochen zurück: Können Sie sich erinnern, dass Sie Ihre Medikamente manchmal nicht eingenommen haben?	☐ Ja ☐ Nein Falls ja, können Sie mir sagen, wie oft das passiert ist? (Nur eine Antwort möglich) ☐ 1x im Monat ☐ 1x alle 2 Wochen ☐ 1x pro Woche ☐ mehr als 1x pro Woche ☐ jeden Tag	☐ Ja ☐ Nein
o) Haben Sie Schluckbeschwerden bei der Einnahme Ihrer Medikamente?	☐ Ja ☐ Nein Falls **ja**, bei welchen Ihrer Medikamente (Name, Dosis)? _____	☐ Ja ☐ Nein
p) Wie verändern Sie die Form Ihrer Medikamente, um die Einnahme zu vereinfachen?	☐ gar nicht ☐ mörsern ☐ mit dem Messer teilen ☐ auflösen ☐ mit einem Tablettenteiler teilen	☐ Ja ☐ Nein

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2. Fragen zu Generika	Antwort des Patienten:	Besteht Beratungsbedarf?
Bitte denken Sie an all Ihre Medikamente, die vom Arzt verordnet sind.		
q) Ist Ihnen bewusst, dass mind. 1 Ihrer verordneten Medikamente ein Generikum ist?	☐ Ja ☐ Nein **(→ Generika zeigen)** Falls **ja**, welches/welche? _____	☐ Ja ☐ Nein
Bitte denken Sie nun ausschliesslich an Ihr/e Generikum/a.		
r) Welches ist ein Vorteil Ihres/Ihrer Generikums/a?	☐ Keine Vorteile ☐ _____ ☐ _____ ☐ _____	☐ Ja ☐ Nein
s) Ich werde Ihnen nun verschiedene Aspekte zu Medikamenten aufzählen. Denken Sie an Ihre Generika, welches könnte ein Vorteil Ihres/Ihrer Generikums/a sein?	Preis ☐ Ja ☐ Nein ☐ nicht relevant Teilbarkeit ☐ Ja ☐ Nein ☐ nicht relevant Form ☐ Ja ☐ Nein ☐ nicht relevant Grösse ☐ Ja ☐ Nein ☐ nicht relevant Hilfsstoffe ☐ Ja ☐ Nein ☐ nicht relevant Farbe des Medikaments ☐ Ja ☐ Nein ☐ nicht relevant Geschmack ☐ Ja ☐ Nein ☐ nicht relevant Schachtel ☐ Ja ☐ Nein ☐ nicht relevant Medikamentenverpackung (Blister/Flasche…) ☐ Ja ☐ Nein ☐ nicht relevant Entnahme aus Blister ☐ Ja ☐ Nein ☐ nicht relevant Name des Medikaments ☐ Ja ☐ Nein ☐ nicht relevant Kalenderpackung ☐ Ja ☐ Nein ☐ nicht relevant Medikamentenwirkung ☐ Ja ☐ Nein ☐ nicht relevant Schluckbarkeit ☐ Ja ☐ Nein ☐ nicht relevant Aussehen Verpackung ☐ Ja ☐ Nein ☐ nicht relevant ☐ Andere:	☐ Ja ☐ Nein
t) Stellen Sie sich vor, dass Ihr Arzt Ihnen ein neues Medikament verschreibt. Würden Sie Generika bevorzugen?	☐ Ja ☐ Nein Begründung:	

Die Fragen auf der folgenden Seite sind durch den Assistenten im Assistenzjahr oder den Apotheker auszufüllen. →→→

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3. Fragen zum Patienten	Antwort des Assistenten/Apothekers:	Besteht Handlungsbedarf?
a) Erkennen Sie Bedarf für ein anderes System/andere Technik als der Patient bisher benutzt zu empfehlen?	☐ Ja ☐ Nein	☐ Ja ☐ Nein
b) Hat der PMC Ausschlag für eine Empfehlung eines Wochendosiersystems durch den Apotheker gegeben?	☐ Ja ☐ Nein	
c) Wurden dem/r Patienten/In während des Gespräches weitere Generika empfohlen?	☐ Ja ☐ Nein Falls **nein**: ☐ Alle Medikamente sind bereits substituiert. ☐ Der Patient/die Patientin wünscht keine weiteren Generika (z.B. auch in der Vergangenheit abgeklärt). ☐ Durch die Substitution würde ein Risiko für Non-Compliance entstehen. ☐ Andere Gründe:	
d) Veranlasst Sie die Rückmeldung des Patienten/der Patientin bezüglich Generika zu vermehrter Empfehlung von Generika?	☐ Ja, ich werde mehr Generika empfehlen. ☐ Es hat keinen Einfluss auf meine Empfehlung. ☐ Nein, ich werde weniger Generika empfehlen.	

Ende (Uhrzeit) _____

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I.II.III. Medication reconciliation form (hospital discharge) [B-3]

Medication Reconciliation				**Matrikelnummer StudentIn:** **Datum:**	
1) Medikation auf dem Spitalaustrittsrezept inkl. Name, Stärke und galenischer Form	**Dosierung pro Tag (x-x-x-x)**	**2) Medikation vor Spitaleintritt (Patientenhistory plus Patienteninterview) inkl. Name, Stärke und galenischer Form**	**Dosierung pro Tag (x-x-x-x)**	**3) Gibt es Unterschiede zwischen Kolonne 1) und 2)?**	**4) Begründung**
Beispiel: *ASS cardio Axapharm Tabl 100 mg*	*0-0-1-0*	*Aspirin cardio Filmtabletten 100 mg*	*1-0-0-0*	☒ Ja ☐ Nein	*Beispiel:* *- generische Substitution* *- Unterschied im Zeitpunkt der Einnahme*
A)				☐ Ja ☐ Nein	A)
B)				☐ Ja ☐ Nein	B)
C)				☐ Ja ☐ Nein	C)
D)				☐ Ja ☐ Nein	D)
E)				☐ Ja ☐ Nein	E)
F)				☐ Ja ☐ Nein	F)
G)				☐ Ja ☐ Nein	G)
H)				☐ Ja ☐ Nein	H)

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1) Medikation auf dem Spitalaustrittsrezept mit Name, Stärke und galenischer Form	Dosierung pro Tag (x-x-x-x)	2) Medikation vor Spitaleintritt (Patientenhistory plus Patienteninterview) inkl. Name, Stärke und galenischer Form	Dosierung pro Tag (x-x-x-x)	3) Gibt es Unterschiede zwischen Kolonne 1) und 2)?	4) Begründung
I)				☐ Ja ☐ Nein	I)
J)				☐ Ja ☐ Nein	J)
K)				☐ Ja ☐ Nein	K)
L)				☐ Ja ☐ Nein	L)
M)				☐ Ja ☐ Nein	M)
N)				☐ Ja ☐ Nein	N)
O)				☐ Ja ☐ Nein	O)
P)				☐ Ja ☐ Nein	P)
Q)				☐ Ja ☐ Nein	Q)
R)				☐ Ja ☐ Nein	R)

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I.III. Project C

I.III.I. Adapted GSASA (Swiss Society of Public Health Administration and Hospital Pharmacists) classification and illustrative examples of DRPs detected at hospital discharge in the cantonal hospital Zug. [C-1]

Cause of pharmaceutical intervention – main categories and subcategories		
MAIN CATEGORIES AND SUBCATEGORIES	**DESCRIPTION OF CATEGORY**	**EXAMPLES**
1) Medication reconciliation problem at hospital admission	**The DRP identified at hospital discharge, was caused by an inaccuracy from medication reconciliation at hospital admission**	
1.1 Incorrect medication recorded	The patient's home medication was incorrectly recorded at hospital admission	Prednisolone 20 mg recorded at hospital admission instead of dexamethasone 20 mg.
1.2 Omission of a medication	The patient's home medication was not recorded at hospital admission	Apixaban not recorded at hospital admission in a patient with atrial fibrillation.
1.3 Incorrect strength / dose recorded	The dose/strength of the patient's home medication was incorrectly recorded at hospital admission	Lamotrigine 100 mg (1-1-2) instead of lamotrigine 50 mg (1-1-2).
2) Prescribing problem during the hospital stay or at discharge	**The DRP identified at hospital discharge, was caused by an inaccuracy in medication prescribing during the hospital stay or at discharge prescription**	
2.1 Incorrect or lack of substitution back to patient's home medication	The substitution from hospital medication to the patient's home medication was incorrect or lacking.	Levothyroxine 75 mcg (1 tablet daily) substituted to levothyroxine 50 mcg (1.5 tablets daily) during the hospital stay and levothyroxine 75 mcg (1.5 tablets daily) prescribed at hospital discharge.
2.2 No restart of medication, that was paused during the hospital stay	A medication was paused at hospital admission and was not restarted at hospital discharge	Discontinuation of folic acid in a patient treated with methotrexate. Rivaroxaban 10mg was substituted to dalteparin 5000 during the hospital stay in an immobile patient, but no thrombosis prophylaxis was prescribed at hospital discharge.
2.3 Missing / inappropriate dosage	The dosage of a medication is lacking or the dosage is inappropriate on the discharge prescription	Methotrexate prescribed once daily instead of once weekly. Tacrolimus prescribed once daily instead of twice daily.

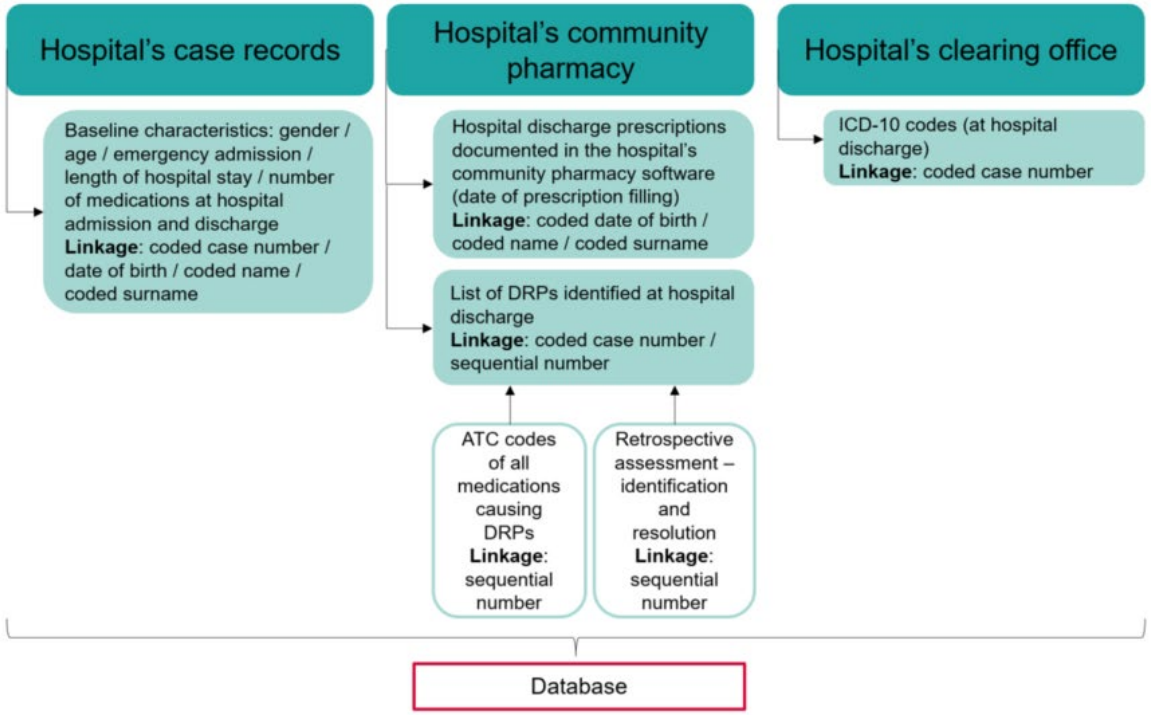
2.4 Missing / inappropriate therapy duration	Therapy duration is too long/short or missing on the discharge prescription	Prescription of antibiotic / antifungal / antiviral agents without information about the therapy duration. Prescription of rivaroxaban 15 mg (twice) daily for six weeks instead of three weeks in a patient with pulmonary embolism.
2.5 Medication not indicated or duplication	Medication use without an indication or inappropriate use of two medications from the same therapeutic class	Prescription of bisoprolol and atenolol at the same time. Prescription of potassium chloride for an indefinite period in a patient with a potassium level in the normal range.
2.6 Untreated indication	Preventive, therapeutic, or concomitant medication not prescribed for a valid indication	Patient with atrial fibrillation, but without prescription of an anticoagulant for the prevention of a stroke. Patient with documented glaucoma, but without prescription of eye drops for the glaucoma treatment.
2.7 No concordance with guidelines or contraindication	Medication selection does not comply with treatment guidelines Patients show a contraindication to the therapy due to his/her medical conditions	Prescription of metoclopramide in a patient with Parkinson disease, switch to domperidone suggested.
2.8 Interaction	Combination of a medication with another medication or with food representing a potential or manifest negative outcome	Simultaneous intake of fluoroquinolones or levothyroxine and polyvalent cations (e.g. calcium, magnesium, potassium).
2.9 Adverse effect	Response to a medication that is noxious and unintended and occurs at doses normally used in man for the prophylaxis, diagnosis or therapy of disease, or modification of physiological function	Prescription of co-amoxicillin in a patients with known penicillin allergy.
2.10 Medication not suitable or of limited suitability	The prescribed medication is not the ideal option for a specific patient condition.	Prescription of naproxen as long-term treatment in a 93-years old patient.
3) Incomplete patient documentation	**Lack of patient information in the hospital record**	Initiation of mirabegron during the hospital stay, but no diagnosis added to the hospital case record.
4) Other		Prescription of salmon calcitonin nasal spray 100 IU/dose, which has been withdrawn from the market.
Outcome of intervention		
1) Change in the discharge letter to the general practitioner (GP)	The information regarding the change in the patient's therapy was added to the discharge letter delivered to the GP.	

2) Change of the discharge prescription and medication list	A pharmaceutical intervention results in a change of the discharge prescription and the patient's medication list.	
3) Not accepted	The physician did not accept or implement a change in a patient's therapy proposed by the pharmacist.	
4) Information to the physician, result unknown	A change in the patient's therapy was proposed to the physician, but the pharmacist was not informed whether the physician implemented the change.	
5) Information to patient	The patient was informed of a change in the therapy that did not need the approval from the physician.	

I.III.II. Development and validation of the database

Development of the database:

The data used to create this database originated from different information sources (hospital's case records / hospital's community pharmacy and hospital's clearing office). Within the database, all patient-specific information were linked via unique identifiers (the coded case number, coded date of birth, coded name, coded surname and sequential number):



Validation of the database:

After the development of the database, the investigators had temporary read privileges to a random set of cases (1% of the database) within the hospital to validate the data linkage and each variable of the output tables used for the subsequent analysis

I.III.III. Baseline characteristics of the inpatient stays without documented DRP at hospital discharge (n = 4720). [C-1]

Determinants	Value
Female, n (%)	2338 (49.5%)
Age at discharge (in years), median (IQR)	73 (59-83)
Emergency admission, n (%)	4235 (89.7%)
Length of hospital stay (in days), median (IQR)	4.2 (2.8-7.1)
Medication	
Number of medications at admission, median (IQR)	5 (2-8)
Number of medications at discharge, median (IQR)	6 (4-10)
Clinical status	
Elixhauser comorbidity score [32, 33], median (IQR)	2 (1-4)
Specific Elixhauser comorbidities†, n	
- Hypertension (uncomplicated/complicated)	2243 (47.5%)
- Cardiac arrhythmias	1130 (23.9%)
- Renal failure	1060 (22.5%)
- Fluid and electrolyte disorders	875(18.5%)
- Diabetes (uncomplicated/complicated)	747 (15.8%)
- Congestive heart failure	684 (14.5%)
- Chronic pulmonary disease	534 (11.3%)
- Solid tumor without metastasis	447 (9.5%)
- Weight loss	365 (7.7%)
- Valvular disease	361 (7.6%)
- Other neurological disorders	339 (7.2%)
- Depression	301 (6.4%)
Number of ICD-10 diagnoses at hospital discharge, median* (IQR)	6 (3-9)

IQR = interquartile range, † Twelve most frequent comorbidities

* n = 4718 cases and two cases without documented diagnosis at hospital discharge

I.IV. Project D

I.IV.I. Outcome sheet - Electronic medication list after hospital discharge in the canton of Aargau [D-1]

Universität Basel
Departement Pharmazeutische Wissenschaften

eHealthAargau
Gesundheit digital vernetzt

KSB Kantonsspital Baden

I EMILIA

EMILIA – Information

Vorname Patient:	Apotheke:
Nachname Patient:	Tel. Apotheke:
Geb. Datum Patient:	Fax Apotheke:
Datum Spitaleintritt:	

Patienten-ID:_____
Bitte notieren Sie diese Nummer auf sämtlichen Dokumenten im entsprechenden Feld!!!

Liebes Apothekenteam

Der oben genannte Patient ist Teilnehmer in der EMILIA-Studie und hat angegeben, das Spitalaustrittsrezept bei Ihnen in der öffentlichen Apotheke einzulösen.

Bitte bereiten Sie folgendes vor:

1. Erfassen Sie einen Kommentar im Patientendossier Ihres Apothekensystems, dass es sich bei diesem Patienten, um einen Teilnehmer in der EMILIA-Studie handelt (inkl. Patienten ID)
2. Bitte suchen und ergänzen Sie den Patienten auf der eMedikationsplattform
3. Legen Sie dieses Dokument in die Mappe mit den Dokumentationsbögen.
4. Halten Sie die Mappe mit den Dokumentationsbögen griffbereit.
5. Sobald dieser Patient Ihre Apotheke kommt, folgen Sie der Anleitung auf dem Dokument „EMILIA Outcomebogen“

Bei Fragen stehe wir Ihnen sehr gerne zur Verfügung (tamara.isenegger@unibas.ch; Tel. 078 / 876 18 33).

EMILIA_Outcomebogen_V2.0 Tamara Imfeld-Isenegger, tamara.isenegger@unibas.ch, Tel 078 / 876 18 33 (Notfall-Nummer)

EMILIA – Outcomebogen

Patienten-ID:_____

Teil 1 - Interventionen:

Start Teil 1 – Interventionen (Uhrzeit):_____

Ihr Vorname / Name: _____

Beruf: ☐ Apotheker/in ☐ Pharma-Assistent/in ☐ _____

Wann wurde das Rezept eingelöst? Datum :_____

Anzahl Medikamente auf dem Spitalaustrittsrezept: _____

Falls der Platz für die Dokumentation nicht ausreichen sollte, verwenden Sie bitte ein zusätzliches Set an Blättern.

Tamara Imfeld-Isenegger, tamara.isenegger@unibas.ch, Tel 078 / 876 18 33

Welche Interventionen haben Sie durchgeführt? (Bitte verwenden Sie das separate Dokument *PharmDISC: Dokumentation von pharmazeutischen Interventionen*)

Nr.	Medikament/e	A Problem (Nr., max. 1)	B Problemtyp (Nr., max. 1)	C Grund (Nr., max. 1)	D Art der Intervention (Nr., max. 1)	E Involvierte Person/en (Nr., mehrere möglich)	Fallbeschreibung
Bsp.	Name / Stärke / Galenische Form / Hersteller *Co-Amoxicillin Sandoz Filmtabl 625 mg*	*6*	*1*	*7.1*	*10*	*2*	*Therapiedauer fehlt auf dem Rezept*
1	Name / Stärke / Galenische Form / Hersteller						
2	Name / Stärke / Galenische Form / Hersteller						
3	Name / Stärke / Galenische Form / Hersteller						
4	Name / Stärke / Galenische Form / Hersteller						
5	Name / Stärke / Galenische Form / Hersteller						
6	Name / Stärke / Galenische Form / Hersteller						
7	Name / Stärke / Galenische Form / Hersteller						
8	Name / Stärke / Galenische Form / Hersteller						
9	Name / Stärke / Galenische Form / Hersteller						
10	Name / Stärke / Galenische Form / Hersteller						

Wurden alle Ihrer Interventionen akzeptiert? ☐ Ja ☐ Nein, diese nicht: _____

Wurden alle Ihre Interventionen umgesetzt? ☐ Ja ☐ Nein, diese nicht: _____

Ende Teil 1 – Interventionen (Uhrzeit):_____

Tamara Imfeld-Isenegger, tamara.isenegger@unibas.ch, Tel 078 / 876 18 33

Teil 2 – Diskrepanzen

Patienten-ID:_____

Start Teil 2 – Diskrepanzen (Uhrzeit):_____ **Datum:**

Ihr Vorname / Name: _____ oder (☐ gleich Person wie im Teil 1 - Interventionen)

Beruf: ☐ Apotheker/in ☐ Pharma-Assistent/in ☐_____

Bitte vergleichen Sie das Spitalaustrittsrezept mit den dispensierten Medikamente und der Apotheken-History (3 Monate vor Spitaleintritt): Ergänzen Sie zuerst alle Medikamente des Spitalaustrittsrezepts in Spalte a), danach die dispensierten Medikamente in Spalte b) und zum Schluss die Medikamente der letzten drei Monate vor dem Spitaleintritt **(inkl. OTC-Präparate).** Dokumentieren Sie sämtliche Unterschiede in Spalte d).

Nr.	a) Medikamente - Spitalaustrittsrezept	b) Medikamente – Dispensiert durch Apotheke / erfasst im System (nd = nicht dispensiert)	c) Medikamente - Apotheken-History (alle Medikamente der letzten 3 Monate vor Spitaleintritt)	d) Begründen Sie die Unterschiede:
	Name / Stärke / Galenische Form / Hersteller / Dosierung	Name / Stärke / Galenische Form / Hersteller / Dosierung	Name / Stärke / Galenische Form / Hersteller / Dosierung	
Bsp.	*Co-Amoxicillin Sandoz Filmtabl 625 mg 1-1-1-0*	*Co Amoxi Mepha Lactab 625 mg 1-1-1-0, zu Beginn der Mahlzeit, bis und mit 01.01.17*	-	*a+b: Anpassung Generika-Hersteller, Dauer der Therapie*
1				
2				
3				
4				
5				
6				
7				

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Nr.	a) Medikamente - Spitalaustrittsrezept	b) Medikamente – Dispensiert durch Apotheke / erfasst im System	c) Medikamente - Apotheken-History (alle Medikamente der letzten 3 Monate vor Spitaleintritt)	d) Begründen Sie die Unterschiede:
8	Name / Stärke / Galenische Form / Hersteller / Dosierung	Name / Stärke / Galenische Form / Hersteller / Dosierung	Name / Stärke / Galenische Form / Hersteller / Dosierung	
9				
10				
11				
12				
13				
14				
15				

Endzeit Teil 2:_____

Haben Sie ein zweites Set an Blätter verwendet? ☐ Ja ☐ Nein

Bitte bereiten Sie einen Ausdruck der 3-monatigen Patienten-History inkl. der heute dispensierten Medikamente vor. → **Heften Sie den Outcomebogen mit dem gefaxten Dokument "EMILIA Information" zusammen** → **Legen Sie alle vorbereiteten Dokumente in einen Briefumschlag** → **Briefumschlag per Post an: Kantonsspital Baden z.H Tamara Imfeld,Spitalapotheke Im Ergel 1, 5404 Baden**

Bei Fragen stehe ich Ihnen sehr gerne zur Verfügung (tamara.isenegger@unibas.ch; Tel. 078 / 876 18 33).
Ich freue mich sehr über jeden eingereichten Datensatz! Herzlichen Dank, Tamara Imfeld-Isenegger

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I.IV.II. 30-days follow-up interview [D-1]

Universität Basel
Departement Pharmazeutische Wissenschaften

KSB Kantonsspital Baden

I ♥ EMILIA

EMILIA – Interviewguide (30 Tage nach Spitalaustritt)

Patientenname:

Datum:

Patienten-ID: 1

Startzeitpunkt:

Einleitung:

Guten Tag Frau/Herr, _____

Hier spricht_____. Ich rufe Sie an wegen dem Projekt „EMILIA“ eMedikationsplan nach Spitalaustritt im Kanton Aargau an welchem Sie teilgenommen haben. Gerne würde ich Ihnen in den nächsten 10-20 Minuten einige Frage zum eMedikationsplan, zu Ihren aktuellen Medikamenten und zu allfälligen Spitalaufenthalten/Hausarztbesuchen stellen.
Passt es Ihnen gerade, oder soll ich zu einem anderen Zeitpunkt nochmals anrufen?

(☐ späterer Zeitpunkt (Datum/Zeit):_____)

Ihre Antworten werden selbstverständlich anonym festgehalten, d.h. niemand wird Ihre Antworten Ihrer Person zuordnen können. Sind Sie noch immer bereit meine Fragen mit mir durchzugehen?

Ich werde mich bei den folgenden Fragen an einen Interviewleitfaden halten. Das heisst, dass ich ab und zu mitlesen muss, oder Ihre Antworten eingeben muss. Das Interview ist in verschiedene Bereiche, u.a. einige Fragen zu Ihrer Person, zum, aktuelle Medikation, allfällige Spitalaufenthalte/Hausarztbesuche, eMedikationsplan gegliedert.
Sie können bei jedem Bereich wie auch bei jeder einzelnen Frage entscheiden, ob Sie diese beantworten möchten. Zudem können Sie das Gespräch jederzeit beenden, ohne dass Sie negative Konsequenzen davon tragen werden.
Das Telefongespräch wird nicht aufgezeichnet, Ihre Antworten werden auf einem vorgefertigten Interviewbogen dokumentiert.

Haben Sie in diesem Moment Fragen, oder ist Ihnen etwas unklar?

Startzeit: _____

Dann beginnen wir, zuerst einige Einstiegsfragen zu Ihrer Person.

	Sind Sie männlich oder weiblich?	☐ männlich		☐weiblich		
	Wie lautet Ihr Geburtsjahr?	_____ (Bsp. 1958)				
	Was ist Ihr Zivilstand aktuell?	☐ Ledig	☐in Partnerschaft lebend	☐ verheiratet	☐geschieden	☐verwitwet
	Wie viele Personen wohnen in Ihrem Haushalt (inkl. Kinder)?	_____ Personen				
	Sind Sie zurzeit erwerbstätig?	☐Ja	☐Nein	☐Pensioniert	☐Arbeitsunfähig	☐Hausfrau/-mann
	FALLS erwerbstätig:	Was ist Ihre aktuelle berufliche Tätigkeit? Offene Antwort:				
		Mit welchem Pensum arbeiten Sie? _____%				
	Können Sie Ihren Haushalt selbstständig durchführen?	☐Ja (weiter bei Frage 10)		☐Nein (weiter bei Frage 9)		
	FALLS „Nein“:	Welche Art von Hilfe nehmen Sie in Anspruch? Offenen Antwort:				

Nun möchten ich Ihnen einige Fragen zu Ihren Medikamenten stellen.

	Wann am Tag wenden Sie welche Medikamente an? Können wir zusammen einen Tagesablauf bzw. einen Wochenablauf durchgehen?					
	Welches Medikament?	Wie oft? Anzahl Mal pro Woche /jeden Tag	Morgens	Mittags	Abends	Nachts
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
	Wie viele unterschiedliche Apotheken haben Sie in den letzten 12 Monaten besucht?	Anzahl:_____				
	Haben Sie eine Stammapotheke?	☐Ja		☐Nein		

Nun möchte ich Ihnen zum noch einige Fragen zu allfälligen Spitalaufenthalten oder Arztbesuchen stellen.

	Hatten Sie nach dem Spitalaustritt einen **geplanten Besuch bei einem Arzt?** (= mit Termin im vornherein vereinbart)	☐Ja ☐ Hausarzt ☐Spezialist ☐ Spital	☐Nein
	Hatten Sie nach dem Spitalaustritt einen **ungeplanten Besuch beim Arzt**? (ohne Termin im vornherein vereinbart)	☐Ja	☐Nein
	Falls JA: Wann und aus welchem Grund erfolgte der Besuch?	Datum Arztbesuch: Offenen Antwort: Grund:	

	Waren Sie nach dem **Spitalaustritt vor 4 Wochen noch einmal ungeplant** als Patient ins **Spital** eingetreten?	☐Ja (weiter bei Frage 15)	☐Nein
	Falls JA: Wann und aus welchem Grund erfolgte der Spitalaufenthalt?	Datum Arztbesuch: Offenen Antwort: Grund:	

Ich möchte Ihnen einige generelle Fragen zu Ihrer Mediennutzung stellen.

	Bereich 1 Mediennutzung					
1.	Besitzen Sie ein Smartphone?	☐ ja			☐ nein	
2.	FALLS FRAGE 1 MIT JA BEANTWORTET WURDE: Wie häufig nutzen Sie ihr Smartphone?	☐ stündlich	☐ mehrmals täglich	☐ täglich	☐ mehrmals pro Woche	☐ wöchentlich
3.	FALLS FRAGE 1 MIT JA BEANTWORTET WURDE: Welche Apps nutzen Sie regelmässig (mindestens 1x pro Monat) auf Ihrem Smartphone?	☐ Telefon				
		☐ SMS				
		☐ Chat/Nachrichten (WhatsApp, Telegram, Threema, Snapchat)				
		☐ Soziale Netzwerke (Facebook, Twitter, Instagram, XING, LinkedIn)				
		☐ News (Aargauer Zeitung, SRF News, NZZ, Tagesanzeiger, 20 Minuten)				
		☐ Bankgeschäfte (eBanking, ApplePay, Twint)				
		☐ Gesundheit (Schrittzähler, Sporttracking, Ernährung)				
		☐ Navigation (Google Maps, TomTom, Karten)				
		☐ Streaming (YouTube, AppleMusic, Spotify, Twitch)				
		☐ Shopping (Zalando, Exlibris, LeShop, Coop@Home)				

4.	Welche dieser Geräte besitzen Sie zusätzlich zum Smartphone?	☐ Computer								
		☐ Laptop								
		☐ Tablet								
		☐ Spielkonsole (PS4, XBOX, Nintendo Switch)								
		☐ Festnetztelefon								
		☐ Fernseher								
5.	Wie schätzen Sie ihre Kenntnisse im Umgang mit modernen elektronischen Medien ein?	Sehr schlecht								Sehr gut
		1	2	3	4	5	6	7	8	9	10
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6.	Mehr und mehr Lebensbereiche werden von der *Digitalisierung* (d.h. Erstellung und Speicherung von Informationen in elektronsicher Form) erfasst. Wie wichtig ist Ihnen dabei der Datenschutz?	Überhaupt nicht wichtig								sehr wichtig
		1	2	3	4	5	6	7	8	9	10
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Kommen wir nun zur Nutzung des eMedikationsportals.

	Bereich 2 Nutzung Portal eMedikation		
1.	Haben Sie das Portal seit Ihrer Anmeldung an EMILIA benutzt?	☐ ja (weiter mit Frage 3)	☐ nein
2.	FALLS FRAGE 1 MIT NEIN BEANTWORTET WURDE: Warum haben Sie das Portal nicht genutzt?	☐ Zu kompliziert FALLS JA: Was empfanden Sie als speziell kompliziert? (OFFENE ANTWORT)	
		☐ Kein Bedarf	
	FALLS JA Weiter im Bereich 3: eHealth und elektronisches Patientendossier	☐ Kein Nutzen : Was fehlt Ihnen, bzw. was würde Ihnen konkreten Nutzen bringen? (OFFENE ANTWORT)	
		☐ Benutzername / Kennwort vergessen	
		☐ Es funktionierte nicht FALLS JA: Um unseren Dienst zu verbessern: Wann hat was nicht funktioniert? (OFFENE ANTWORT)	
		☐ Keine App	
		☐ Bedenken bezüglich Datenschutz und Datensicherheit	
		☐ Andere? (BITTE AUSFÜHREN)	

Seite 6 von 8

3.	FALLS FRAGE 1 MIT **JA** BEANTWORTET WURDE: Wie häufig haben Sie die Plattform verwendet?	☐ Sehr Oft	☐ Oft	☐ manchmal	☐ selten	☐ sehr selten					
4.	FALLS FRAGE 1 MIT **JA** BEANTWORTET WURDE: Welche Funktionen haben Sie auf der Plattform genutzt?	☐ Medikationsplan anzeigen									
		☐ Eigene Medikamente hinzufügen									
		☐ Medikationsplan kommentieren									
		☐ Verlauf anzeigen									
		☐ Passwort ändern									
		☐ Andere SPEZIFIZIEREN:									
5.	Wie beurteilen Sie die Bedienerfreundlichkeit der Plattform?	Sehr schlecht									Sehr gut
		1	2	3	4	5	6	7	8	9	10
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6.	Wie beurteilen Sie die Geschwindigkeit (Seitenaufbau, Darstellung, etc.) der Plattform?	Sehr langsam									Sehr schnell
		1	2	3	4	5	6	7	8	9	10
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7.	Sie mussten sich mit Benutzernamen, Passwort und einem SMS Code anmelden. Wie umständlich war dieses Anmeldeverfahren / Login?	Sehr umständlich									Sehr bequem
		1	2	3	4	5	6	7	8	9	10
		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7.1	FALLS SCORE 1-5 BEI 7: Warum war das umständlich? Wie stellen Sie sich ein einfaches und sicheres Login vor? (Offene Frage):										

8.	Könnten Sie sich vorstellen, ein Loginverfahren anzuwenden, das noch sicherer ist, aber dafür zusätzlichen Aufwand darstellt (z.B. mit einer Smartcard)?	☐ Ja	☐ Nein	☐ weiss nicht
9.	Welche Funktion hat Ihnen gefehlt? Welche Funktion wäre Ihres Erachtens speziell nützlich? (OFFENE FRAGE, AUCH PATIENTENDOSISER ALLGEMEIN)			

Bereich 3 Fragen zu eHealth und elektronischem Patientendossier
ERKLÄRUNG INTERVIEWER: Per 15. April 2017 ist das Bundesgesetz über das elektronische Patientendossier in Kraft getreten. Es bezweckt die Einführung des elektronischen Patientendossiers in der Schweiz nach einheitlichen Regeln bezüglich Datenschutz, Datensicherheit sowie Regeln für den Datenaustausch. Die Eröffnung eines Patientendossiers ist für Patientinnen und Patienten freiwillig. Sie können Ihren Gesundheitsfachpersonen dabei Zugriff auf Daten wie etwa bestehende Erkrankungen, Allergien und Unverträglichkeiten, Medikation oder etwa Impfstatus für Ihre gewähren. Ein Zugriff ist nur für Gesundheitsfachpersonen und nur mit explizit von Ihnen erteilten Zugriffsrechten möglich. Sie können als Patientin oder Patient auch veranlassen, dass Gesundheitsfachpersonen ohne vorgängige Erteilung von Zugriffsrechten in einem Notfall Zugriff auf die wichtigsten Daten erhalten – Sie als Patientin oder Patient werden aber in jedem Fall nachträglich informiert. Das elektronische Patientendossier ist für die Bevölkerung im Aargau kostenlos.

1.	Würden Sie ein elektronisches Patientendossier eröffnen?	☐ Ja	☐ Nein	☐ weiss nicht	
	Könnten Sie sich vorstellen für Zusatzdienste (z.B. Erfassung von Fitnessdaten, Coachings, etc.) zu bezahlen?	☐ Ja	☐ Nein	☐ weiss nicht	
	WENN JA: Wieviel wären Sie maximal bereit zu bezahlen?	☐ bis CHF 5 / Jahr	☐ bis CHF 10 / Jahr	☐ bis CHF 20 pro Jahr	☐ mehr als CHF 20 pro Jahr
	Könnten Sie sich vorstellen, ein elektronisches Patientendossier für eine Person zu verwalten, die das selbst nicht will oder kann? BEISPIELE: Kinder, ältere Personen, Personen die mit Internetanwendungen wenig vertraut sind, etc.	☐ Ja	☐ Nein	☐ weiss nicht	
	Könnten Sie sich vorstellen, Daten aus Ihrem elektronischen Patientendossier anonymisiert für spezifische, von Ihnen ausgewählte Forschungsprojekte zur Verfügung zu stellen?	☐ Ja	☐ Nein	☐ weiss nicht	

Endzeit: _____

I.IV.III. List with problems and bugs identified in the electronic medication list and eHealth platform [D-1]

Rückmeldung an Post – Vivates:

Rückmeldung 31.07.2017

- Farblicher Unterschied zwischen Liste AB und CD wäre sehr hilfreich, für eine bessere Übersicht.

- Anzeige von Umlauten ungünstig: (Abbildung)

Von ihnen verordnete medikamente	**EUTHYROX 100 Tabl 0.1 mg 100 Stk** (Levothyroxin natricum (0,1mg)), 0 Packung, nicht erneuerbar, [tabl][dispensation] not translated, 1 Tablette morgens, 0 Tablette mittags, 0 Tablette abends, 0 Tablette zur Schlafenszeit, Oral einnehmen, auf nÃ¼chternen Magen, täglich, vom 31 Juli 2017, tablette mindestens 30 min vor dem frühstück einnehmen., chronisch, schilddrüsenunterfunktion

Rückmeldung 28.07.2017:

Diese Produkte sind nicht im HospINDEX vorhanden. Sie sind jedoch Teil der MiGeL (Mittel- und Gegenstandsliste) und werde durch den Arzt wie ein Medikament verschrieben und wäre optimalerweise im Medikationsplan auch abgebildet.

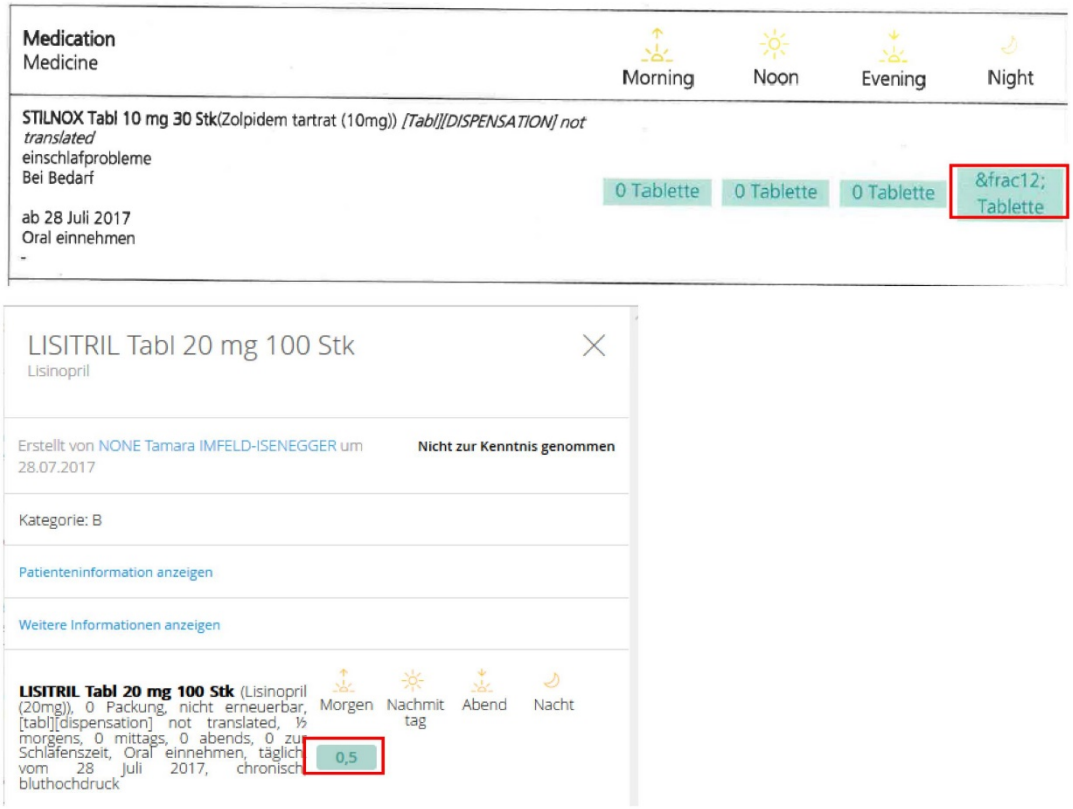
Von ihnen verordnete medikamente	**MR: Accu-Chek Aviva**, 0 Packung, nicht erneuerbar, 0 morgens, 0 mittags, 0 abends, 0 zur Schlafenszeit, Injektion, subkutan, -, vom 28 Juli 2017, chronisch, diabetes typ 2 (blutzucker)
Von ihnen verordnete medikamente	**MR: Mylife Clickfine Pen Nadeln 8mm 31G 100 Stk**, 0 Packung, nicht erneuerbar, 0 morgens, 0 mittags, 0 abends, 0 zur Schlafenszeit, Injektion, subkutan, -, vom 28 Juli 2017, chronisch, nadeln für insulinapplikation

Keine Anzeige der Tabletten auf dem ausgedruckten Medikationsplan / Übersetzungsfehler:

Medication Medicine	Morning	Noon	Evening	Night
STILNOX Tabl 10 mg 30 Stk(Zolpidem tartrat (10mg)) *[Tabl][DISPENSATION] not translated* einschlafprobleme Bei Bedarf ab 28 Juli 2017 Oral einnehmen -	0 Tablette	0 Tablette	0 Tablette	½ Tablette

Erfassung und Anzeige von halben Tabletten ist fehlerhaft und inkonsistent:

Von ihnen verordnete medikamente	**LANTUS Inj Lös 100 E/ml SoloStar Pen 5 x 3 ml** (Insulin glargin (100Einheit)), 0 Packung, nicht erneuerbar, [inj lös][dispensation] not translated, 0 morgens, 0 mittags, 42 abends, 0 zur Schlafenszeit, Injektion, subkutan, nach dem Essen, täglich, vom 28 Juli 2017, ampullen bis zur verwendung im kühlschrank aufbewahren., chronisch, diabetes typ 2 (blutzucker)
Von ihnen verordnete medikamente	**LASIX Tabl 40 mg 50 Stk** (Furosemid (40mg)), 0 Packung, nicht erneuerbar, [tabl][dispensation] not translated, 1 Tablette morgens, 0 Tablette mittags, 0 Tablette abends, 0 Tablette zur Schlafenszeit, Oral einnehmen, täglich, vom 28 Juli 2017, chronisch, herzinfussizienz
Von ihnen verordnete medikamente	**LISITRIL Tabl 20 mg 100 Stk** (Lisinopril (20mg)), 0 Packung, nicht erneuerbar, [tabl][dispensation] not translated, ½ morgens, 0 mittags, 0 abends, 0 zur Schlafenszeit, Oral einnehmen, täglich, vom 28 Juli 2017, chronisch, bluthochdruck



Medication Medicine	Morning	Noon	Evening	Night
STILNOX Tabl 10 mg 30 Stk(Zolpidem tartrat (10mg)) *[Tabl][DISPENSATION] not translated* einschlafprobleme Bei Bedarf ab 28 Juli 2017 Oral einnehmen -	0 Tablette	0 Tablette	0 Tablette	½ Tablette

LISITRIL Tabl 20 mg 100 Stk

Lisinopril

Erstellt von NONE Tamara IMFELD-ISENEGGER um 28.07.2017

Nicht zur Kenntnis genommen

Kategorie: B

Patienteninformation anzeigen

Weitere Informationen anzeigen

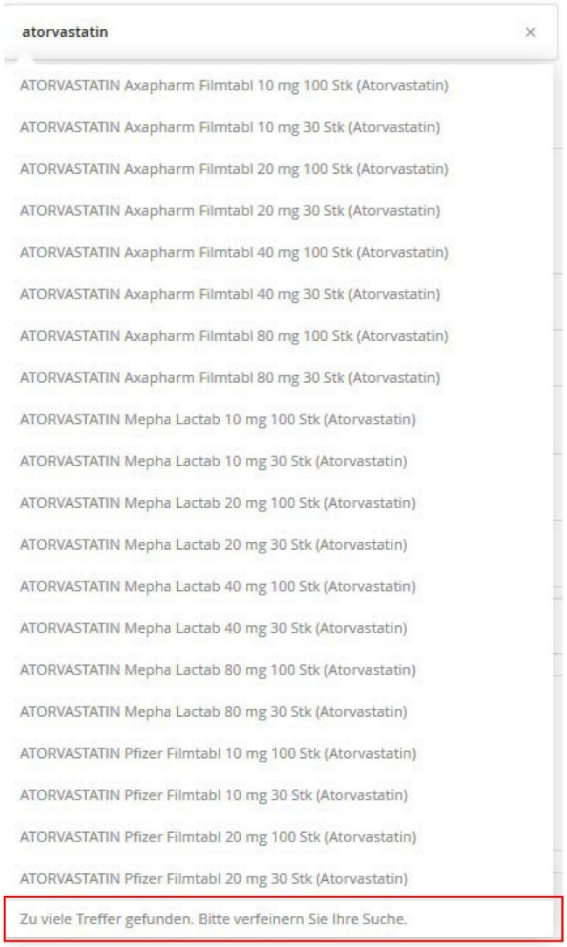
	Morgen	Nachmittag	Abend	Nacht
LISITRIL Tabl 20 mg 100 Stk (Lisinopril (20mg)), 0 Packung, nicht erneuerbar, [tabl][dispensation] not translated, ½ morgens, 0 mittags, 0 abends, 0 zur Schlafenszeit, Oral einnehmen, täglich vom 28 Juli 2017, chronisch bluthochdruck	0,5			

Rückmeldung 21.07.2017:

Online Plattform

Nachmittag anstatt Mittag:

Suche im HospINDEX: Atorvastatin Sandoz Filmtabl 20 mg 30 Stk. (kann nicht gefunden werden)



Bedeutung MR: Definition

Medikament*

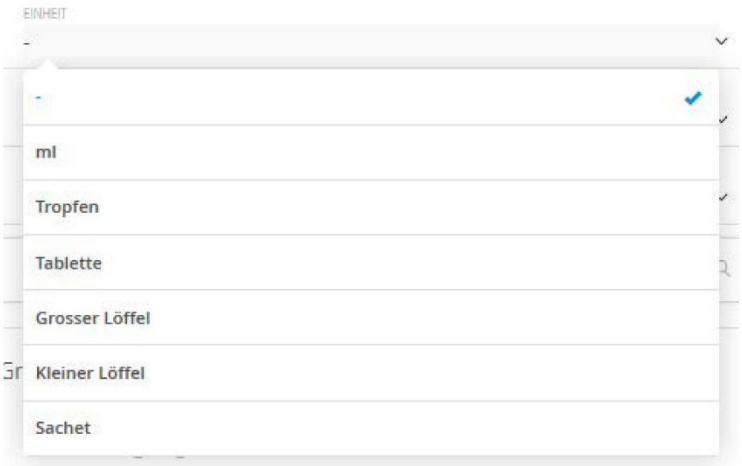
atorvastatin sandoz × MR

Aktuelle Medikationsliste anzeigen

Quelle: hospINDEX

Einheiten nicht vollständig:
- Einheiten (I.E./U) (bei Insulin)
- Brausetabletten, Lutschtabletten, Schmelztabletten
- Kapseln
- Grosse-/Kleine Löffel ? (Kaffeelöffel, Suppenlöffel) bzw. nur Löffel, bei Sirup
- Spritze, Injektion
- Sprühstoss
- Hub
- Zäpfchen
- Ovula
- cm (bei Creme/Salbe etc)
- Ampulle

→ Freitext



Verabreichungsform:
Diese Begriffe sind für Patienten schwierig zu verstehen: Ophthalmisch, Respiratorisch, rektal,topisch

Nasal

Ophthalmisch

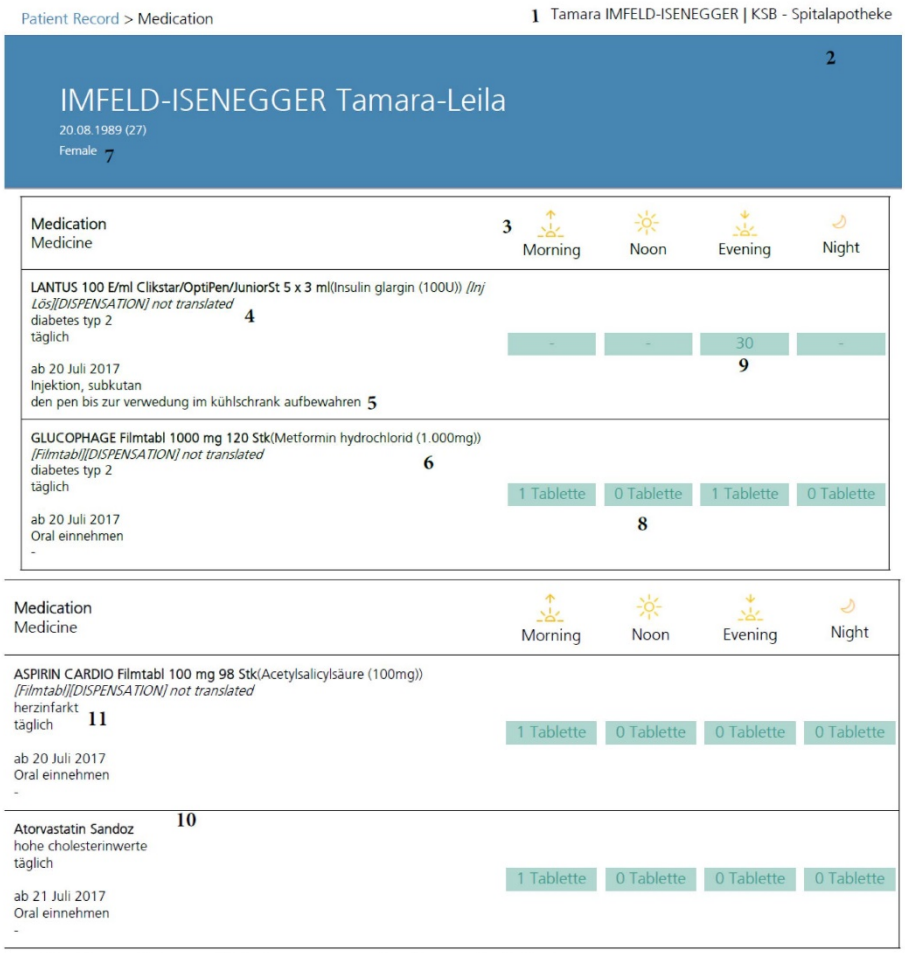
Respiratorisch

Verantwortung:
Was ist die Bedeutung/Funktion dieser Begriffe? Definition


Care Manager
Care Manager
Hausarzt
Gesundheitsfachperson / Organisation des Vertrauens
Normale Gesundheitsfachperson / Organisation

Ausdruck eMedikationsplan

Ausdruck eMedikationsplan: (Erläuterung zu den Nummer finden Sie unten)



Patient Record > Medication

1 Tamara IMFELD-ISENEGGER | KSB - Spitalapotheke

2

IMFELD-ISENEGGER Tamara-Leila

20.08.1989 (27)

Female 7

Medication Medicine	3 Morning	Noon	Evening	Night
LANTUS 100 E/ml Clikstar/OptiPen/JuniorSt 5 x 3 ml(Insulin glargin (100U)) *[Inj Lös][DISPENSATION] not translated* diabetes typ 2 täglich 4 ab 20 Juli 2017 Injektion, subkutan den pen bis zur verwedung im kühlschrank aufbewahren 5	-	-	30 9	-
GLUCOPHAGE Filmtabl 1000 mg 120 Stk(Metformin hydrochlorid (1.000mg)) *[Filmtabl][DISPENSATION] not translated* diabetes typ 2 täglich 6 ab 20 Juli 2017 Oral einnehmen -	1 Tablette	0 Tablette 8	1 Tablette	0 Tablette

Medication Medicine	Morning	Noon	Evening	Night
ASPIRIN CARDIO Filmtabl 100 mg 98 Stk(Acetylsalicylsäure (100mg)) *[Filmtabl][DISPENSATION] not translated* herzinfarkt täglich 11 ab 20 Juli 2017 Oral einnehmen -	1 Tablette	0 Tablette	0 Tablette	0 Tablette
Atorvastatin Sandoz 10 hohe cholesterinwerte täglich ab 21 Juli 2017 Oral einnehmen -	1 Tablette	0 Tablette	0 Tablette	0 Tablette

1) Name/Adresse/Telefonnummer der Gesundheitsfachperson
2) Datum des Ausdrucks/Datum der letzten Änderung
3) Dosierung Englisch anstatt Deutsch (Morgen /Mittag/ Abend/ zur Nacht)
4) DISPENSATION, not translated
5) Gross-Kleinschreibung
6) 1000 mg ist nicht 1.000 mg → Problem HospINDEX?
7) Geschlecht Englisch anstatt Deutsch (weiblich, männlich)
8) Strich oder leeres Feld anstatt 0 Tablette (Die Eingabe auf der Plattform ist bei Lantus und Glucophage 0, jedoch ist die Anzeige auf dem eMedikationsplan verschieden)
9) Bei Insulin braucht es die Angabe „Einheiten“
10) Manuelle Eingabe eines Medikamentes → Gross-Kleinschreibung
11) Gross-Kleinschreibung

Pro A4 Seite haben nur zwei Medikamente Platz, bei Spitalaustritt haben Patienten gut und gerne 15-20 Medikamente, folglich 10 Seiten?!

Medication Medicine	Morning	Noon	Evening	Night
LANTUS Inj Lös 100 E/ml SoloStar Pen 5 x 3 ml(Insulin glargin (100U)) *[Inj Lös][DISPENSATION] not translated* diabetes typ 2 (blutzucker) nach dem Mittagessen täglich ab 28 Juli 2017 Injektion, subkutan ampullen bis zur verwendung im kühlschrank aufbewahren.	-	-	42	-
Accu-Chek Aviva diabetes typ 2 (blutzucker) - ab 28 Juli 2017 Injektion, subkutan -	-	-	-	-
Novo Rapid Penpill 300 E/U = 3mL diabetes type 2 (blutzucker) nach dem Mittagessen Nach jeder Mahlzeit ab 28 Juli 2017 Injektion, subkutan abhängig vom gemessenen blutzuckerwert werden folgende einheiten an insulin applzieren: 8-10 = 10 einheiten insulin 11-15 = 15 einheiten insulin 16-20 = 25 einheiten insulin	-	-	-	-

Medication Medicine	Morning	Noon	Evening	Night
STILNOX Tabl 10 mg 30 Stk(Zolpidem tartrat (10mg)) *[Tabl][DISPENSATION] not translated* einschlafprobleme Bei Bedarf ab 28 Juli 2017 Oral einnehmen -	0 Tablette	0 Tablette	0 Tablette	½ Tablette
ASPIRIN CARDIO Filmtabl 100 mg 98 Stk(Acetylsalicylsäure (100mg)) *[Filmtabl][DISPENSATION] not translated* herzinfarkt täglich ab 28 Juli 2017 Oral einnehmen -	1 Tablette	0 Tablette	0 Tablette	0 Tablette
ALDACTONE Filmtabl 25 mg 100 Stk(Spironolacton (25mg)) *[Filmtabl][DISPENSATION] not translated* herzinfarkt täglich ab 28 Juli 2017 Oral einnehmen -	1	-	-	-

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Department of Pharmaceutical Sciences

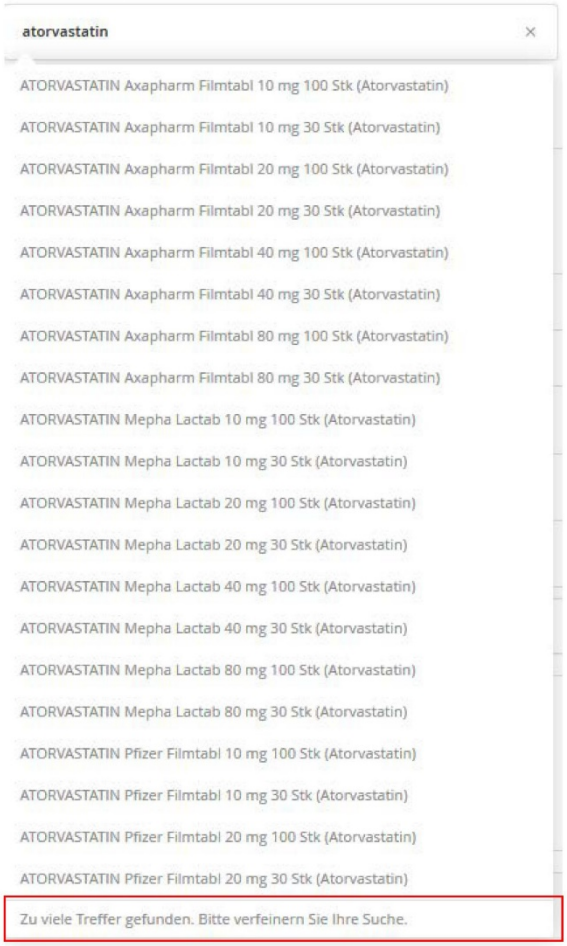
DEPARTMENT OF PHARMACEUTICAL SCIENCES

Rückmeldung an Post – Vivates:

Online Plattform

Nachmittag anstatt Mittag:

Suche im HospINDEX: Atorvastatin Sandoz Filmtabl 20 mg 30 Stk. (kann nicht gefunden werden)



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Bedeutung MR: Definition

Medikament*

atorvastatin sandoz × MR

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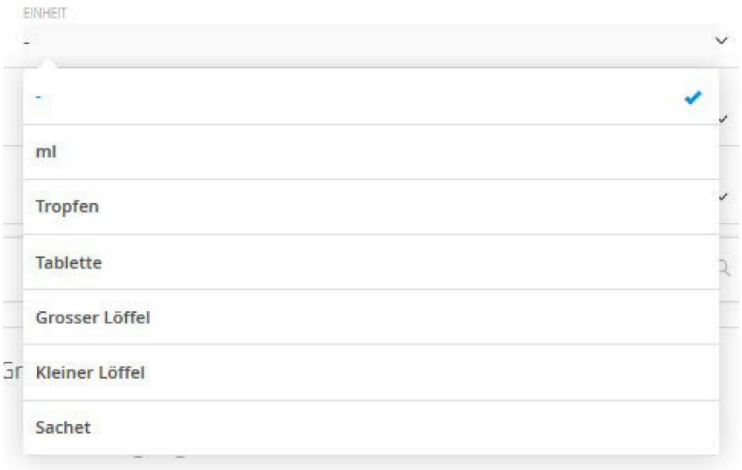
- Sprühstoss
- Hub
- Zäpfchen
- Ovula
- cm (bei Creme/Salbe etc)
- Ampulle

→ Freitext



Verabreichungsform:
Diese Begriffe sind für Patienten schwierig zu verstehen: Ophthalmisch, Respiratorisch, rektal,topisch

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Department of Pharmaceutical Sciences

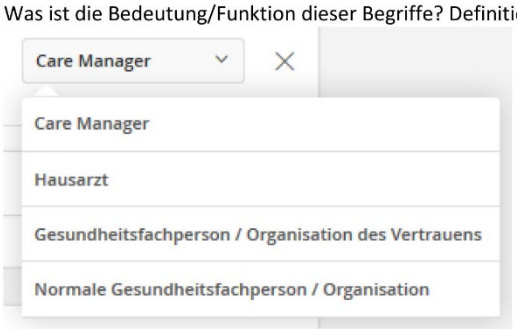
DEPARTMENT OF PHARMACEUTICAL SCIENCES

Nasal

Ophthalmisch

Respiratorisch

Verantwortung:
Was ist die Bedeutung/Funktion dieser Begriffe? Definition



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Department of Pharmaceutical Sciences

DEPARTMENT OF PHARMACEUTICAL SCIENCES

Ausdruck eMedikationsplan

Ausdruck eMedikationsplan: (Erläuterung zu den Nummer finden Sie unten)

Patient Record > Medication

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2

IMFELD-ISENEGGER Tamara-Leila
20.08.1989 (27)
Female 7

Medication Medicine	3 Morning	Noon	Evening	Night
LANTUS 100 E/ml Clikstar/OptiPen/JuniorSt 5 x 3 ml(Insulin glargin (100U)) *[Inj Lös][DISPENSATION] not translated* diabetes typ 2 4 täglich ab 20 Juli 2017 Injektion, subkutan den pen bis zur verwedung im kühlschrank aufbewahren 5	-	-	30 9	-
GLUCOPHAGE Filmtabl 1000 mg 120 Stk(Metformin hydrochlorid (1.000mg)) *[Filmtabl][DISPENSATION] not translated* diabetes typ 2 täglich 6 ab 20 Juli 2017 Oral einnehmen -	1 Tablette	0 Tablette	1 Tablette 8	0 Tablette

Medication Medicine	Morning	Noon	Evening	Night
ASPIRIN CARDIO Filmtabl 100 mg 98 Stk(Acetylsalicylsäure (100mg)) *[Filmtabl][DISPENSATION] not translated* herzinfarkt täglich 11 ab 20 Juli 2017 Oral einnehmen -	1 Tablette	0 Tablette	0 Tablette	0 Tablette
Atorvastatin Sandoz 10 hohe cholesterinwerte täglich ab 21 Juli 2017 Oral einnehmen -	1 Tablette	0 Tablette	0 Tablette	0 Tablette

1) Name/Adresse/Telefonnummer der Gesundheitsfachperson
2) Datum des Ausdrucks/Datum der letzten Änderung
3) Dosierung Englisch anstatt Deutsch (Morgen /Mittag/ Abend/ zur Nacht)
4) DISPENSATION, not translated
5) Gross-Kleinschreibung
6) 1000 mg ist nicht 1.000 mg → Problem HospINDED?
7) Geschlecht Englisch anstatt Deutsch (weiblich, männlich)
8) Strich oder leeres Feld anstatt 0 Tablette (Die Eingabe auf der Plattform ist bei Lantus und Glucophage 0, jedoch ist die Anzeige auf dem eMedikationsplan verschieden)
9) Bei Insulin braucht es die Angabe „Einheiten“
10) Manuelle Eingabe eines Medikamentes → Gross-Kleinschreibung

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Department of Pharmaceutical Sciences

DEPARTMENT OF PHARMACEUTICAL SCIENCES

11) Gross-Kleinschreibung
Pro A4 Seite haben nur zwei Medikamente Platz, bei Spitalaustritt haben Patienten gut und gerne 15-20 Medikamente, folglich 10 Seiten?!

I.IV.IV. Feasibility testing of the first version of the electronic medication reconciliation tool – research team confirmed the results generated by the software [D-2]

Feasibility testing of the first version of the electronic medication reconciliation tool – research team confirmed the results generated by the software

	MEDICATION HISTORY			NEW PRESCRIPTION			DISCREPANCIES				
# Cases	Medication	ATC / active ingredient	Posology	Medication	ATC / active ingredient	Posology	Active ingredient	Strength	Formulation	Package size	Posology
1.	SORTIS cpr pell 40 mg 100 pce	C10AA05 Atorvastatine	1 tablet per day	ATORVASTATIN Pfizer cpr pell 20 mg 100 pce	C10AA05 Atorvastatine	Two tablets per day	ATC5	different	identic	identic	different
2.	SORTIS cpr pell 40 mg 100 pce	C10AA05 Atorvastatine	0.5-0-0-0	-	-	-	Stop	-	-	-	-
	-	-	-	COMILORID Mepha mite cpr 2.5/25 30 pce	C03EA01 Hydrochlorothiazide avec diurétiques antikaliurétiques	1-0-0-0	Start	-	-	-	-
3.	ESIDREX cpr 25 mg bte 100 pce	C03AA03 Hydrochlorothiazide	0.5-0-0-0				Stop	-	-	-	-
	SORTIS cpr pell 40 mg 100 pce	C10AA05 Atorvastatine	1 tablet per day	ATORVASTATIN Pfizer cpr pell 20 mg 100 pce	C10AA05 Atorvastatine	2 tablets per day	ATC5	different	identic	identic	different
4.	CADUET cpr pell 10mg/10mg 98 pce	C10BX03 Atorvastatine et amlodipine	1-0-0-0	ATORVASTATIN Mepha Lactab 10 mg 30 pce	C10AA05 Atorvastatine	1-0-0-0	ATC2				
	LASIX cpr 40 mg 12 pce	C03CA01 Furosémide	1 tablet every second day	LASIX sol perf 250 mg/25ml i.v. 6 amp 25 ml	C03CA01 Furosémide	250 mg per day	ATC5	different	different	different	different
5.	TOREM cpr 5 mg 20 pce	C03CA04 Torasémide	1-0-0-0	TOREM cpr 10 mg 100 pce	C03CA04 Torasémide	0-0.5-0-0	ATC5	different	identic	different	different
6.	MULTAQ cpr pell 400 mg 60 pce	C01BD07 Dronédarone	1-0-1-0	MULTAQ cpr pell 400 mg 60 pce	C01BD07 Dronédarone	-	GTIN				different
	INDAPAMID Spirig HC cpr pell ret 1.5 mg 30 pce	C03BA11 Indapamide	-	INDAPAMID Spirig HC cpr pell ret 1.5 mg 30 pce	C03BA11 Indapamide	1-0-0-0	GTIN				different

7.	TRIVERAM cpr pell 10/5/5mg bte 30 pce	C10BX11 Atorvastatine, amlodipine et périndopril	1-0-0-0	ATORVASTATINE Axapharm cpr pell 80 mg 30 pce	C10AA05 Atorvastatine	1 tablet per day	ATC 2				
8.	EZETROL cpr 10 mg 98 pce	C10AX09 Ézétimibe	Jeweils 12 Stunden pro Tag, dann 12 Stunden Pause				Stop				
	JINARC cpr 30 mg 28 pce	C03XA01 Tolvaptan	Twice daily one table with 8h in between	JINARC cpr 30 mg 28 pce	C03XA01 Tolvaptan	-	GTIN				different
9.	ZOCOR cpr pell 20 mg 98 pce	C10AA01 Simvastatine	1-0-1-0	SIMVASTATINE Helvepharm cpr pell 40 mg 98 pce	C10AA01 Simvastatine	0.5-0.5-0.5-.05	ATC 5	different	identic	identic	different
10.	QUANTALAN poudre s sucre 50sach 4g	C10AC01 Colestyramine	1-0-1-0	INEGY cpr 10/10 mg 28 pce	C10BA02 Simvastatine et ézétimibe	0-1-0-1	ATC2				
11.	QUANTALAN poudre s sucre 50sach 4g	C10AC01 Colestyramine	1-1-1-1	EZETROL cpr 10 mg 98 pce	C10AX09 Ézétimibe	1 tablet per day	ATC 3				
	SIMVASINE Spirig HC cpr pell 20 mg 98 pce	C10AA01 Simvastatine	0-0-1-0	CRESTOR cpr pell 5 mg 100 pce	C10AA07 Rosuvastatine	1-0-0-1	ATC 4				
12.	TRIVERAM cpr pell 10/5/5mg bte 30 pce	C10BX11 Atorvastatine, amlodipine et périndopril	1-0-0-0			-	Stop				
	TOREM cpr 5 mg 20 pce	C03CA04 Torasémide	1-0-0-0	TORASEMIDE Sandoz eco cpr 5 mg 20 pce	C03CA04 Torasémide	0-0-0-2	ATC 5	identic	identic	identic	different
13.	ALDACTONE cpr pell 50 mg 50 pce	C03DA01 Spironolactone	1-1-1-0	LASILACTON cpr pell 50 mg 20 pce	C03EB01 Furosémide avec diurétiques antikaliurétiques	1-1-1-0	ATC2				
	FUROSEMIDE Zentiva cpr 40 mg 12 pce	C03CA01 Furosémide	0.5-0.5-0.5	LASILACTON cpr pell 50 mg 20 pce	C03EB01 Furosémide avec diurétiques antikaliurétiques	1-1-1-0	ATC2				
14.	LASIX cpr 40 mg 50 pce	C03CA01 Furosémide	1-0-0-0	FUROSEMIDE Zentiva cpr 40 mg 50 pce	C03CA01 Furosémide	1-0-1-0	ATC5	identic	identic	identic	different
15.	XENALON Lactab 50 mg 50 pce	C03DA01 Spironolactone	1-0-1-0	FUROSPIR Lactab 50mg/20mg SDO	C03EB01 Furosémide avec diurétiques antikaliurétiques	1-0-0-0	ATC2				

	FURODRIX cpr 40 mg 10 pce	C03CA01 Furosémide	0.5-0-0-0	FUROSPIR Lactab 50mg/20mg SDO	C03EB01 Furosémide avec diurétiques antikaliurétiques	1-0-0-0	ATC2				
16.	TORASEMIDE Sandoz eco cpr 20 mg 20 pce	C03CA04 Torasémide	1-0-0-0	FURSOL cpr 40 mg 10 pce	C03CA01 Furosémide	0-0-0-1	ATC4				
17.	OEDEMEX cpr 40 mg 10 pce	C03CA01 Furosémide	1-0-0-0	OEDEMEX cpr 40 mg 50 pce	C03CA01 Furosémide	1-0-0-0	ATC5	identic	identic	Different	identic
	OEDEMEX cpr 40 mg 10 pce	C03CA01 Furosémide	1-0-0-0	FURSOL cpr 40 mg 50 pce	C03CA01 Furosémide	0-0-0-1	ATC5	identic	identic	Different	different
18.	COMILORID Mepha cpr 5/50 100 pce	C03EA01 Hydrochlorothiazide avec diurétiques antikaliurétiques	-	JINARC cpr 45 mg/15 mg 56 pce	C03XA01 Tolvaptan	-	ATC2				
	EPLERENON Mepha Lactab 25 mg 30 pce	C03DA04 Éplérénone	0-1-0-0	JINARC cpr 45 mg/15 mg 56 pce	C03XA01 Tolvaptan	-	ATC2				
19.	LESCOL Retard cpr ret 80 mg 98 pce	C10AA04 Fluvastatine	0.5-0-0.5-0	SIMVASTATINE Helvepharm cpr pell 40 mg 98 pce	C10AA01 Simvastatine	0-1-0-1	ATC4				
20.	SIMVASTATINE Helvepharm cpr pell 20 mg 98 pce	C10AA01 Simvastatine	1-0-0-0	INEGY cpr 10/20 mg 28 pce	C10BA02 Simvastatine et ézétimibe	1-0-0-0	ATC2				
	EZETIMIBE Sandoz cpr 10 mg 98 pce	C10AX09 Ézétimibe	1-0-0-0	INEGY cpr 10/20 mg 28 pce	C10BA02 Simvastatine et ézétimibe	1-0-0-0	ATC2				
21.	ATORVASTATINE Axapharm cpr pell 10 mg 30 pce	C10AA05 Atorvastatine	1-0-0-0	TRIVERAM cpr pell 10/5/5mg bte 30 pce	C10BX11 Atorvastatine, amlodipine et périndopril	1-0-0-0	ATC 2				
			-	CORDARONE cpr 200 mg 60 pce	C01BD01 Amiodarone	1-0-0-0	Start				
22.	FLUVASTATINE Sandoz mite caps 20 mg 98 pce	C10AA04 Fluvastatine	1-0-1-0	SIMVASTATINE Streuli cpr pell 40 mg 98 pce	C10AA01 Simvastatine	2-0-0-0	ATC4				
23.	CRESTOR cpr pell 5 mg 50 pce	C10AA07 Rosuvastatine	1-0-0-1	EZETIMIBE MSD cpr 10 mg 28 pce	C10AX09 Ézétimibe	2-0-0-0	ATC3				
24.	SIMVASINE Spirig HC cpr pell 20 mg 98 pce	C10AA01 Simvastatine	0-0-1-0	CRESTOR cpr pell 5 mg 100 pce	C10AA07 Rosuvastatine	1-0-0-0	ATC 4				
			-	AMIODAR cpr 200 mg 60 pce	C01BD01 Amiodarone	1-0-0-0	Start				

25.	BRINAVESS conc perf 500 mg/25ml flac 25 ml	C01BG11 Vernakalant	3 mg/kg over 10 min			-	Stop				
	ATOZET cpr pell 10/80 mg 30 pce	C10BA05 Atorvastatine et ézétimibe	1 tablet per day	ATORVASTATINE Axapharm cpr pell 80 mg 30 pce	C10AA05 Atorvastatine	1 tablet per day	ATC2				
26.	EZETIMIB ROSUVAST Mepha caps 10 mg/10 mg 30 pce	C10BA06 Rosuvastatine et ézétimibe	1.00 tous les 1 jours	ATORVASTATIN Zentiva cpr pell 10 mg 30 pce	C10AA05 Atorvastatine	1.00 tous les 1 jours					
	EZETIMIB ROSUVAST Mepha caps 10 mg/10 mg 30 pce	C10BA06 Rosuvastatine et ézétimibe	1.00 tous les 1 jours	EZETIMIBE Sandoz cpr 10 mg 28 pce	C10AX09 Ézétimibe	1.00 - .00 - .00 - .00					
	FUROSPIR Lactab 50mg/20mg 50 pce	C03EB01 Furosémide avec diurétiques antikaliurétiques	1.00 - .00 - 1.00 - .00	FUROSPIR Lactab 50mg/20mg 50 pce	C03EB01 Furosémide avec diurétiques antikaliurétiques	.50 - .50 - .50 - .00					
	METOLAZONE Galepharm cpr 5 mg 20 pce	C03BA08 Métolazone	Bei Gewichtszunahme von mehr als 3 kg, 1 Tablette	METOLAZONE Galepharm cpr 5 mg 20 pce	C03BA08 Métolazone	.50 - .00 - .00 - .00					
	AMIODAR cpr 200 mg 60 pce	C01BD01 Amiodarone	1.00 - .00 - .00 - .00	AMIODAR cpr 200 mg 60 pce	C01BD01 Amiodarone	1.00 tous les 1 jours					
			ND	ISOKET spray 15 ml	C01DA08 Dinitrate d'isosorbide	ND					

Curriculum vitae and publication list

Current version available from the author on request.