BMC Health Services Research

RESEARCH

Open Access

Medication-related infrastructure and medication reviews in nursing homes—a rapid appraisal study

Carla Meyer-Massetti[1,2,3*], Magdalena Osińska[4], Naomi Welte[1,5] and Franziska Zúñiga[4]

Abstract

Background Around 86% of Switzerland's nursing home (NH) residents have polypharmacy (≥ 5 concomitant medications); almost 80% use a potentially inappropriate medication increasing their risk of medication-related problems. Medication reviews can optimize medication safety by fostering interprofessional collaboration, leading to medication therapy adjustments; they are currently being considered as a future national quality indicator of NH performance in Switzerland.

The present study aimed to survey current medication-use infrastructure and processes and medication review practices in NHs in the German-speaking part of Switzerland. It also aimed to explore the barriers to, facilitators of, and prerequisites for medication review to become a national NH quality indicator.

Methods We took a rapid appraisal approach. Between February and August 2022, we distributed a structured online questionnaire to the participating NHs assessing the infrastructure and processes surrounding medication use, analyzing them quantitatively and descriptively. We followed up with 60-minute, in-depth, interprofessional, online group interviews, using a semi-structured interview guide, focusing on interprofessional collaboration and medication reviews. Data analysis was done iteratively in a descriptive manner.

Results Fourteen NHs in German-speaking regions of Switzerland completed the questionnaire, with 31 professionals from eleven of these NHs participating in group interviews.

Almost half of the NHs (42.9%) had a cantonal license to run an in-house pharmacy, and in two-thirds of these, the legally responsible specialist was an external pharmacist. Community pharmacies supplied 92.9% of NHs with their medicines, mostly stored on the wards and prepared by nurses (57.1%). Accordingly, pharmacists were predominantly tasked with logistics, but were also key contacts for medication information. A clinical pharmacist participated in monthly ward rounds in just one NH. Medication verification occurred predominantly in the presence of physicians and sometimes nurses, mostly in the form of discussions during ward rounds or medication checks subsequent to an adverse event, rather than as part of comprehensive, proactive, interprofessional medication reviews.

*Correspondence:
Carla Meyer-Massetti
carla.meyer-massetti@extern.insel.ch

Full list of author information is available at the end of the article

Interviewees identified numerous prerequisites before medication review could be used as a national NH quality indicator.

Conclusions None of our participants contested the importance of medication safety and quality in NHs; they mostly favored regular medication reviews. However, interviewees expected that the nationwide introduction of medication reviews would require a standardized guide about its content, execution, analysis, and documentation, as well as interprofessional collaboration and some form of financial incentive. Promoting the use of medication reviews in NHs will have to involve interprofessional stakeholders in developing a specific implementation approach and defining the quality assessment requirements of an indicator. Further research into these topics would be highly relevant to ensure acceptance and success.

Keywords Nursing homes, Long-term care, Medication review, Polypharmacy, Potentially inappropriate medication, Clinical pharmacy, Interprofessional collaboration, Quality indicators

Background

Medication therapy is among the most common healthcare interventions, but medication-related problems are among the most frequent adverse events. Old age, multimorbidity, and polypharmacy are particular threats to medication safety, and all these factors tend to apply to nursing home (NH) residents [1].

In 2021 there were 1,536 NHs operating in Switzerland, caring for up to 100,555 residents (amounting to a calculated mean of 65 residents per institution), 95% of whom were 65 years old or older, and 30% of whom were 90 or older [2]. International data show comparable demographics: in a European context, 11,680 NHs in Germany reported space for 918,000 residents in 2024, with a reported mean of 78 residents per institution [3]. In the US, around 15'300 NHs care for 1.3 Mio. residents with a calculated mean of 85 residents per institution, where 82% were 65 years old or older, and 33% were 85 years old and older [4].

A Swiss report based on insurance claims data found that in 2016, NH residents over 65 took an average of 9.3 concomitant medications. In contrast, among the general population over 65, this was only 5.6 different medications [5]. The proportion of NH residents with polypharmacy (defined as ≥ 5 different drugs purchased within the past three months in this publication) was 85.5%, regardless of sex, compared with 50.4% among Switzerland's general population over 65 [5]. While definitions of polypharmacy vary considerably in the literature, Masnoon et al. reported in their review that the most common definition of polypharmacy was the numerical definition of five or more medications daily [6]. International statistics also report high percentages of polypharmacy. Two recent studies in Spain observed polypharmacy among 54.9% and 78.8% of NH residents, with excessive polypharmacy (≥ 10 different drugs) among 22.1% [7, 8]. The 2013 SHELTER study analyzed data from eight European countries: polypharmacy was observed in 2,000 (49.7%) residents and excessive polypharmacy in 979 (24.3%) residents [9].

In 2016, in Switzerland's NHs, 79.1% of all residents were recorded to have been prescribed at least one potentially inadequate medication (PIM), based on the Beer's Criteria, published in 2015 [10], and the German Priscus list [11]. One in two residents (56.2%) showed long-term PIM use, corresponding to at least three prescriptions of the same PIM. Among the most common PIMs were non-steroidal anti-inflammatory drugs, neuroleptics, and benzodiazepines [5]. In France, 47.7% of NH residents were reported to have at least one PIM [12]. A study of 14 Austrian NHs found at least one PIM among 72.4% of residents, consisting predominantly of tranquilizers, antipsychotics, osmotic laxatives, non-steroidal anti-inflammatory drugs, and anticholinergics [13].

One of the indicators commonly applied to measure medication safety is polypharmacy [14–16]. This indicator's use is also mandated in NHs in Switzerland, where the importance of medication safety is increasingly being recognized at the national level [17]. While polypharmacy is an important signal, a distinction has to be made between appropriate and inappropriate polypharmacy. Therefore, as an isolated indicator without in-depth medication review, it is of limited value [18].

The international literature shows that conducting medication reviews is associated with improved medication safety among older adult residents in long-term care. A systematic review by Huiskes et al.. found an effect on many drug-related problems: medication review resulted in a decrease in the number of drug-related problems, more changes in medication, more drugs taken at lower dosages, and bigger decreases or smaller increases in the number of drugs taken [19].

In Switzerland, therefore, the future introduction of a quality indicator to measure the percentage of residents with a medication review in the last twelve months is currently being discussed at the political level. This would bring the country into line with other nations' practices [16]. It would also be congruous with previous findings by Meyer-Massetti et al. that different medication safety assessment methods complement each other

due to the minimal overlap in the problems they identify. This suggests that different methods should be combined to detect medication-related problems and as a basis for subsequent prioritization and deciding on a course or action [20].

Of the different language regions in Switzerland, the French-speaking region is more advanced in introducing medication reviews in NHs, with several papers and reports describing current practices and innovations [21–23]. Although around 75% of all residents are living in the German-speaking part of Switzerland, little is known about medication review practices in this part. Accordingly, our aim was to assess the current state of medication review practices in NHs in the German speaking part of Switzerland and their employees' attitudes towards performing regular, systematic, structured interprofessional medication reviews in the future. Specifically, our questions were:

1. What is the general approach to the medication use processes in the German speaking part of Switzerland's NHs?
2. What are the prerequisite conditions for conducting medication reviews (medication analyses) and introducing a corresponding quality indicator in the German speaking part of Switzerland's NHs?

Methods

Design

We combined quantitative and qualitative methods in a rapid appraisal approach: [24]

1) A structured online survey of the NHs that included open-ended questions, and 2) group interviews.

The online survey had the purpose to collect information about the size, location and organizational structure pertaining to the medication use process of each NH. The interviews were used to clarify the current implementation of medication reviews and extrapolate on their future implementation.

The rapid appraisal methodology is particularly appropriate when researchers from different disciplines—in this case, nursing scientists and pharmacists—collaborate with other stakeholders to quickly arrive at an answer, e.g., how a methodological approach could be applied in practice. Different sources can be used, and their results can be discussed iteratively within the research team [24].

Sample and sampling

To meet our aims, we recruited NHs in Switzerland's German-speaking regions.

A NH was included if: 1) the NH was on the cantonal NH list, 2) it collected and submitted the polypharmacy quality indicator to Switzerland's Federal Office of Public Health, and 3) it was willing to engage in written and verbal exchanges to discuss its medication-use processes and the topic of medication reviews.

Twelve institutions previously involved in research projects with the University of Basel's Institute for Nursing Science (INS), in Switzerland, were contacted via email and sent a link to a short outline survey. Recruitment was also promoted via the newsletters of an association of NHs, CURAVIVA, in the Swiss cantons of Basel-City and Basel-Country, inviting interested NHs to contact the INS, yielding another two participating NHs.

An overview of the characteristics of the NHs involved in this study is displayed in Table 1.

Definitions

Within the context of our study, we distinguished between three types of medication reviews:

By *medication review* (or medication analysis), we mean a structured, standardized (i.e., systematic) evaluation of an individual NH resident's medication with the aim of optimizing their medication and improving his/her health outcomes, as described by the Pharmaceutical Care Network Europe [25]. A medication review follows a standardized process, possibly using a checklist, and usually leads to concrete interventions. Additionally, it should be interprofessional, that is, involving at least

Table 1 Characteristics of the nursing homes

NH	Setting	Number of beds	Software	Physician system	Physician prescription		Accepted modalities of prescription transfer - via				Pharmacy collaboration		Medication supply	Medication storage			Medication preparation	
			automated polypharmacy count		electronically via software	handwritten in the NH	email	fax	phone	resident	cantonal authorization for an in-house dispensary	legally responsibel responsible permit holder		centralized storage	on the wards	resident's room	unit-dose	re-usable dispenser
1	urban	41 - 90	yes	GP	no	yes	yes	yes	yes	no	no	N/A	CP	no	yes	yes	yes	no
2	urban	91 - 120	yes	GP	no	yes	yes	yes	no	no	no	N/A	CP	no	yes	no	no	yes
3	urban	41 - 90	yes	GP	no	yes	yes	yes	yes	yes	yes	external pharmacist	CP	no	yes	no	yes	no
4	urban	41 - 90	yes	GP	no	yes	yes	yes	yes	yes	no	N/A	CP	no	yes	no	yes	no
5	urban	91 - 120	yes	GP	no	yes	yes	no	yes	no	no	N/A	CP	no	yes	no	yes	no
6	urban	91 - 120	yes	GP	no	yes	yes	yes	yes	yes	yes	external pharmacist	CP	yes	yes	no	no	yes
7	urban	41 - 90	yes	GP	no	yes	yes	yes	yes	yes	yes	external pharmacist	CP	yes	yes	no	no	yes
8	urban	>120	yes	GP, NHP	yes	yes	yes	no	yes	yes	yes	internal pharmacist	WS	yes	yes	no	no	yes
9	urban	<40	no	NHP	yes	yes	yes	no	yes	no	no	N/A	CP	yes	yes	no	no	yes
10	rural	>120	yes	NHP	yes	yes	yes	no	yes	no	no	N/A	CP	yes	yes	no	no	yes
11	urban	91 - 120	yes	GP	no	yes	yes	no	yes	no	no	N/A	CP	yes	yes	no	yes	no
12	rural	<40	yes	GP	no	yes	yes	no	yes	no	yes	external pharmacist	WS	yes	no	no	no	yes
13	urban	91 - 120	no	NHP	yes	yes	yes	no	yes	no	yes	NH physician	CP, WS, GP	yes	yes	no	no	yes
14	urban	>120	yes	GP, NHP	yes	yes	yes	no	yes	yes	no	N/A	CP	no	yes	no	no	yes

Abbreviations: *CP* community pharmacy, *GP* general practitioner, *N/A* not applicable, *NHP* nursing home physician, *WS* wholesaler

a nurse–physician dyad, but optimally also involving a pharmacist.

We divided non-standardized and non-interprofessional medication reviews into two methodological approaches:

- *Medication discussions* were defined as the active ad hoc exchange of aresident's medication information in the context of regular, planned activities such as medical visits or ward rounds.
- *Medication checks* were defined as non-structured medication reviews triggered by an acute event, such as a deterioration in general condition, a request by nursing staff, or an ad hoc review by the pharmacy, e.g., as part of a prescription validation.

These definitions were used consistently throughout the study.

Table 2 Medication-use processes in the nursing homes

Medication use process in nursing homes	***n* = 14**	**100%**
	n	**%**
Physician care system		
External primary care physician	9	64.3
Physician employed by NH	3	21.4
Mixed model	2	14.3
Legal aspects - cantonal permission to store drugs		
yes	6	42.9
Pharmacist as responsible person	5	35.7
Primary care physician as responsible person	1	7.1
Medication supply[a]		
Community pharmacy	13	92.9
Wholesaler	2	14.3
External primary care physician	1	7.1
Medication storage		
On the ward	6	42.9
In a centralized pharmacy	1	7,1.
In residents' rooms and in a centralized pharmacy	1	7.1
On the ward and in a centralized pharmacy	6	42.9
Medication preparation[a]		
Disposable dispensers	5	35.7
Reusable dispensers	9	64.3
External - in the community pharmacy	1	7.1
External - blister center via public pharmacy	5	35.7
Nursing home - centralized pharmacy - nurses	3	21.4
Nursing home - ward - nurses	5	35.7
Nursing home - ward - pharmacy technician	1	7.1
Nursing home or pharmacy - depending on demand	4	28.6
Interprofessional collaboration		
Physician prescription[a]		
Manual prescription most common	10	71.4
Possibility of electronic prescription - commonly used	4	28.6
Possibility of electronic prescription - rarely used	1	7.1
Certain clinical data accessible by pharmacy	9	64.3

[a] multiple responses possible

Variables and data collection

The online survey, composed in Findmind® (www.findmind.ch, Version 2022, Fabian Keller, Switzerland) inquired about NHs' characteristics and their structures and processes pertaining to medication management, e.g., type of cooperation with pharmacists, medication storage, or tools available for checking the quality of medication prescriptions (e.g., interaction checks, overdosing alerts). Preliminary questions about medication reviews were also integrated. The survey took place between February and March 2022, with the local contact person in each NH responding. This could have been an NH director, an advanced practice nurse, a quality assurance manager, or another person responsible for the NH's medication processes. The complete survey in German is available from the authors upon request.

For the medication review part of the study, we invited one representative from each NH's nursing staff, one NH physician or general practitioner (GP), and one representative of the pharmacy collaborating with the NH to participate in a 60-minute, audio-recorded, joint semi-structured interview. These took place between June and August 2022 via Zoom® (www.zoom.us) and were guided by two main questions:

a) How do medication reviews take place in this NH?
b) What is your attitude towards medication reviews, and what factors need to be considered to evaluate medication review quality and create a national NH quality indicator?

The guide for these semi-structured interviews is available in Appendix 1 (translated to English using www.deepl.com, Köln/Germany).

The interview was conducted by a senior researcher with expertise in qualitative research. During each interview, two research group members took notes on a rapid assessment sheet. These notes were reconciled within one day of the interview. If notes or recollections differed, they were supplemented or corrected based on the audio recordings.

Data analysis

For the online survey, we calculated the numbers and percentages of answers for the different categories of responses, as displayed in Tables 1 and 2. Full-text answers were used to correctly interpret the quantitative data as well as for the compilation of the structured interview guide.

The information on the rapid appraisal sheets was analyzed using MAXQDA software, version 2022 (www.maxqda.com). Two nursing scientists, both members of the research team, with experience in qualitative research assigned initial thematic codes deductively based on the

interview guide's questions. Further codes were created inductively to cover additional themes in the notes. After coding all the notes, codes were combined into categories that were summarized narratively.

Results

Fourteen NHs from German-speaking Switzerland participated in the overall study as a convenience sample ($n = 14$), with one home represented by two sites.

12 NHs were located in urban settings, two in the suburbs, and none in rural areas. They had between two and 12 wards (units), with a mean of seven and a median of six wards per NH. The number of residents ranged from 21 to 286, with a mean of 154 and a median of 135 residents.

The medication use process—organizational information

Almost half of the NHs (6/14, 43%) had a cantonal license to run an in-house pharmacy, and in four of these six, the legally responsible specialist was an external pharmacist. One NH employed its own pharmacist, and an NH physician was responsible in the final NH.

A community pharmacy supplied most of the NHs (81%) with medicines, a wholesaler supplied 13%, and an external GP supplied 6% (termed *self-dispensation*, physicians in several Swiss cantons are legally allowed to dispense drugs directly to their patients in their primary care practice).

The medicines in NHs were commonly stored in a ward medicine cabinet (62%) and dispensed by nurses. Less frequently, they were stored in the NH's central pharmacy (33%), and in one home, they were stored directly in residents' rooms (5%).

An overview of the NHs' medication-use processes is displayed in Table 2.

Prescribing practices

Few of the NHs used clinical decision support software to perform quality checks on medication prescriptions, with 11 participants out of 14 answering negatively (79%). There were a total of 17 mentions of clinical decision support options, with multiple mentions possible. Six NHs were able to check medications for interactions, and four NHs were able to check for duplicate prescriptions based on active ingredients. Two NHs were able to check for allergies to active substances or excipients. Five NHs (36%) were able to make other checks, mostly for food interactions and overdoses. Usually, NHs with interaction checks at their disposition had other technological tools available as well.

Six NHs (6/14, 43%) reported using PIM lists: the German PRISCUS list [11] was mentioned by three NHs (3/6, 50%) and the STOPP/START list [26] by two (2/6, 33%). One NH using the PRISCUS list reported also using the Beers [27] list and the FORTA classification [28] (1/6, 17%). No NHs mentioned the Medication Appropriateness Index (MAI) [29] as a tool to assess prescription quality. Four NHs (4/14, 29%) reported using other means of assessing medication quality: two noted that medications were regularly checked by a physician. One NH reported performing proactive interaction checks; another checked medications every three months during a pharmacist's visit.

In five of the 14 NHs (36%), the pharmacy did not have access to the resident documentation software or the electronic patient record.

Ten out of 14 NHs reported that their first point of contact for medication questions was a pharmacist (71%). Two of the remaining four stated that this was a physician (14%), and the final two contacted nursing experts (14%).

An overview of quality management and medication safety practices in the NHs is displayed in Table 3.

Medication reviews

Eleven NHs, via 31 members of their professional staff, participated in the medication review-related interviews. Three NHs declined to participate due to individual absences or their staffing situations. The interviewees comprised 14 nursing professionals, 9 pharmacists, and 8 physicians. The nursing professionals worked in the NHs as nursing experts (2 of which were Advanced Practice Nurses), in a management role (e.g., director of nursing, ward manager), or in another role (e.g., research/practice development, professional training, coding officer). Among the pharmacists, one had completed a certificate of advanced studies in clinical pharmacy, one was still in training, and three had a specialist certificate in residential care (for details, see www.fphch.org). The participating physicians were specialists in general internal medicine or physical medicine, with five having an additional specialization in geriatrics. Four physicians worked as NH physicians, and four were GPs with their own practices who also cared for several residents in an NH. Three NH physicians worked exclusively in their NH, whereas one had his own practice as well.

Regular, prepared interprofessional medication reviews, as defined in the methods section, were only conducted in one NH on a monthly basis. The clinical pharmacist had access to residents' health data and did rounds with nurses and the head physician. The other pharmacists predominantly validated prescriptions in their community pharmacies, but without access to clinical data like diagnoses or laboratory values. These validations encompassed dosing and interaction checks, avoiding duplicate therapies, and verifying dispensing quantities. Pharmacists mostly contacted NHs if prescriptions were unclear, dosing needed verification, or

Table 3 Quality management and medication safety practices in the nursing homes

Quality management and medication safety	*n* = 14	100%	
	n	%	missing *n*
Availability of standard operating procedures - yes[b]			
Competency matrix[a]	14	100	0
Prescription transcription double check	14	100	0
Ordering drugs	14	100	0
Medication access	14	100	0
Control delivered drugs	13	92.9	0
Medication storage	14	100	0
Cleaning of medication storage space	14	100	0
Handling drugs in multi dose containers	13	100	1
Drug preparation double check	12	85.7	0
Narcotics control	14	100	0
Disposing of drugs	12	92.3	1
Medication safety - yes[b]			
Written information about divisibility and mortarability	12	85.7	0
No structured information about compatiblity of parenteral drugs	8	57.1	0
No structured information about application via feeding tube	5	35.7	0
Availability of clinical decision support in the software[b]	11	78.6	0
Interaction check	6	54.5	0
Alert in case of medication duplication	4	36.4	0
Allergy check	2	18.2	0
Other	5	45.5	0
Tools for verifying prescription quality[b]	6	42.9	0
Priscus list	3	50	0
Stopp Start criteria	2	33.3	0
Beer's list	1	16.7	0
Forta criteria	1	16.7	0
Medication Appropriateness Index (MAI)	0	0	0
Professional support			
Interprofessional case discussions - yes[b]	13	92.9	0
With nurses	12	92.3	0
With primary care physicians	9	69.2	0
With geriatricians	7	53.8	0
With pharmacists	5	38.5	0
With psychiatrist	2	15.4	0
With nursing home physician	1	7.7	0
With family/informal caregivers	1	7.7	0
With legal representative	1	7.7	0
Medication-related continuous education - yes[b]	8	57.1	0
Topics - pharmacology			0
Topics - therapy monitoring	2	25	0
Topics - polymedication	3	37.5	0
Topics - pharmacology	6	75	0
Topics - storage/logistics	5	62.5	0
Topics - drug dispensing	4	50	0
Frequency - at least once per year	6	75	0
Frequency - several times per year	1	12.5	1
Frequency - less frequently than annually	1	12.5	1
Teachers - regular nurses	6	85.7	1
Teachers - pharmacists	5	71.4	0
Teachers - physicians	1	14.3	0

Table 3 (continued)

Quality management and medication safety	*n* = 14	100%	
	n	%	missing *n*
Collaboration with a pharmacist - yes	14	100	0
Contractually regulated - yes	10	71.4	0
Clinical data not accessible by pharmacy	9	64.3	0
Polypharmacy count			
Electronic	14	100	
Manual	7	50	
Both	7	50	
Missing data	0	0	

[a]overview of permitted activities according to educational background of care staff

[b]multiple responses possible

interaction checks triggered an alert. One NH had its own pharmacy, but the pharmacy personnel's core tasks encompassed medication logistics in general and the preparation of weekly dispensers specifically. Despite occasional access to clinical data like renal function, access to clinical information in electronic health records, that would help perform clinical pharmacy activities, was not readily available.

In most NHs, adjustments to medication usually occurred within the scope of *medication checks* triggered by specific requests from nursing staff or pharmacists or as part of *medication discussions* during medical rounds. Thus, our results focus on *medication discussions* and *medication checks*.

Based on our rapid appraisal sheets, we summarized the findings on how medication discussions and medication checks were initiated and executed, which tools were used to guide them, and how they were documented. As to the future implementation of a national quality indicator for scope of implementation of medication reviews (e.g., proportion of residents with polypharmacy for whom a medication review was carried out), we summarized attitudes towards such an indicator and the barriers to and facilitators of this, along with the perceived prerequisites for its introduction.

Initiation of medication discussions and medication checks

The triggers for *medication checks* were mainly changes in the NH resident's health status, such as pain, changes in vital signs, swallowing problems, a deterioration in mental state or cognition, and palliative situations. Other triggers mentioned were new admissions, transfers from hospital, and regular nursing assessments, which included the collection of medication-related information. Ambiguities discovered by pharmacists during prescription checks, including, e.g., incorrect dosages, duplicate prescriptions, or possible interactions, could also lead to *medication checks*. In addition, some pharmacies and nursing teams sent NH residents' medication lists to physicians for a regular yearly assessment. In NHs with an NH physician system, medical rounds, including *medication discussions*, occurred regularly, from weekly to at least every three months. In NHs with external GPs, there were no specific intervals between checks, except when one physician looked after several residents, which often resulted in them planning regular rounds at their own initiative.

Execution of medication discussions and medication checks

In most cases, at least one nurse or nursing expert was present with the physician during *medication discussion*s or *medication checks*. In one NH, the NH physician always verified medication alone; in another, medication was mainly discussed within the nursing team and rarely with a physician present.

Pharmacists visited some NHs regularly, but they only participated in medical rounds in one and, consequently, only in interprofessional *medication discussions*. However, pharmacists were regularly approached by the nursing teams with specific questions about medication administration, usually by email or telephone.

The extent to which residents or relatives were involved in reviewing medication depended on their interest and residents' cognitive abilities (e.g., in decision-making), which was assessed by health professionals, mostly without consulting residents or relatives. Depending on the situation, information about changes in medication was communicated to NH residents by physicians during ward rounds, or it was passed on by nursing staff, e.g., if questions arose during medication administration or if the physician was off-site and new prescriptions had to be made.

Guidance for medication discussions and medication checks

Tools like checklists or grids were rarely used to guide medication discussions or checks at the institutional level, although individuals within institutions may have used them, as reported in the written survey. Contrary to the questionnaire findings, one NH reported that it used the MAI Medication Appropriateness Index [29]; another

used the German PRISCUS [11] list. An automated drug interaction checking system was also sometimes used as a trigger tool [20].

Physicians were most likely to examine medication lists based on their experience and check medications against the diagnostic list, if possible using laboratory values—especially for renal function—and considering current or acute symptoms, e.g., severe weight loss, edema, or recent behavioral problems. Some physicians focused on specific groups of medications, e.g., cardiovascular drugs, sedatives, or statins. The benefits, necessity, and risks of medications are all considered when selecting a therapy. Dosages and dosage forms are examined, e.g., divisibility/mortarability in cases of swallowing disorders. Drug–drug interactions, polypharmacy, potential for deprescribing, changes in medication at transfers from hospital or home, as-needed medications, and NH residents' preferences, all also influenced medication discussions and checks.

Documentation of medication discussions and checks

All the NHs recorded general medication changes in a medication list, to some degree. This was often the only way to deduce whether a medication discussion or check had taken place. Physicians kept their own documentation on rounds, where they sometimes specifically recorded which medications had been verified. Some used email exchanges with, e.g., pharmacies or residents themselves, as a means of documenting that reviews had been done. Documentation was rarely very detailed: it was usually only a note from which it was difficult to consistently understand whether or to what extent a verification had taken place.

In some NHs and pharmacies, medication inputs were documented in patients' electronic health records. One physician used a documentation tool provided by the Swiss Association of Public Health Administration and Hospital Pharmacists (GSASA) in an Excel® format for the structured classification of medication changes [30]. Nursing staff sometimes made entries in their nursing reports, but usually no specific documentation was made.

Medication reviews—future implementation

Attitudes toward medication review as a national NH quality indicator

The opinions of the nursing professionals and pharmacists participating in our interviews on the introduction of medication reviews as a national NH quality indicator were almost exclusively positive. Their opinions were associated with the conviction, or hope, that the introduction of this quality indicator would strengthen interprofessional collaboration, promote professionalism, and contribute to a better quality of life for NH residents.

The physicians were more critical, however. Some were of the opinion that medication monitoring already worked very well and, therefore, introducing this new indicator was unnecessary. Others were in favor of it or were at least willing to participate, but they pointed out the minimum conditions that would have to be met for this to be feasible, especially concerning resources, i.e., financing the time involved. Some physicians expressed their preference for only conducting medication reviews in a targeted manner and when deemed necessary, preferably without involving any additional staff or administrative effort.

Barriers to and facilitators of medication reviews

Factors facilitating and hindering the implementation of structured interprofessional medication reviews were mentioned. In some NHs, the factors conducive to reviews were access to the expertise of specialist staff (e.g., regular rounds by NH physicians or GPs, the employment of nursing experts), good contact with pharmacists, good pre-existing professional cooperation between different professions, and an openness and willingness to cooperate from all health professionals. Access to drug–drug interaction checks via computer was also appreciated.

The barriers to the introduction of medication reviews as an NH quality indicator that were frequently mentioned by all the professional groups involved a lack of resources, time, or personnel. Nursing experts mentioned how nursing staff were already overworked, which could lead to dissatisfaction and a lack of motivation for taking on additional tasks, even if these were considered useful in principle.

Medical rounds—which occurred anyway—were perceived as time-consuming with regards to preparation and follow-up. This was specifically associated with the large number of residents in some NHs. However, nurse experts and physicians were hopeful that as reviews became routine, the time required per medication review would probably reduce.

Attention was also drawn to the difficulties and efforts involved in coordinating appointments. Nursing professionals spoke of the poor accessibility of some GPs, whether by telephone or email. Some GPs came to their designated NH very rarely or only when requested to do so.

The current system's insufficient or total lack of compensation for the additional work of conducting medication reviews was mentioned as an aggravating factor. Medication checks by physicians are compensated via the Swiss physicians' tariff system, TARMED: they are either billed as a part of a visit to an NH resident based on the time spent with them or as a part of the medical services (without the resident having to be present) that can be

billed up to a maximum of 60 min every three months and which are often used for services other than medication reviews. Pharmacists' collaboration with NHs and their compensation for services were organized differently: either via a contract with the NH at a fixed hourly rate or a flat rate, plus a sales margin on the medications and/or the blister packaging regulated by the pharmacy service-based tariff system in Switzerland. This tariff system, called LOA IV, the German abbreviation for performance-oriented compensation system, version 5, reimburses pharmacies for specific services according to the allocated tax points (https://pharmasuisse.org/de/dienstleistungen/tarifvertraege/loa). Some pharmacists had no specified means of compensation at all. For nursing staff, however, participation in medication reviews could not be billed separately as it is part of their overall work.

Nursing staff and resident physicians' lack of specialist expertise and knowledge on medication and the use of systematic tools to assess medication quality were also seen as obstacles by themselves. In some cases, there was a lack of good instruments for carrying out medication verification, and NHs' IT systems were often suboptimal for medication documentation.

Pharmacists stated that access to information from residents' electronic health records, such as diagnoses and current, complete medication lists, was often lacking, such that they were limited in their ability to provide advice based on a comprehensive picture of a resident's situation.

Perceived prerequisites for introducing a national NH medication review quality indicator

Introducing a national NH medication review quality indicator would require certain framework conditions being met, according to the interview participants. Several expressed the need for clear guidelines about the definition and content of a medication review, including the needs and expectations of the various professional groups involved. It was also noted that it would be critical, for data reliability reasons, that all NHs follow the same approach to medication reviews. It was also stated that the accessibility of GPs would need to be a component of the survey so that an NH's quality is not judged on a factor it cannot influence: GPs' visits to NHs should be regular.

Medication reviews require personnel, time and space, as well as rules for financing the services performed by all the professional groups involved in the review. A physician would have to be physically present in an NH to make the medication review, and a nurse would have to be able to take time out of their daily routine to prepare and conduct it. Good preparation is important because it enables the NH resident's situation to be adequately described, preferably by a nurse who knows them well, e.g., a direct caregiver. Documents such as current lists of diagnoses, medications, and laboratory values also have to be prepared.

If pharmacists are involved, they also need access to this data. An in-depth, interprofessional medication review requires a quiet location—nursing offices or residents' rooms are unsuitable.

Interviewees agreed that medication reviews should be as time efficient as possible, and they suggested including them in ward rounds. Prioritization might be helpful, e.g., starting with residents with high numbers of medications or according to other risks, as might bundling medication reviews per floor or ward or physician's visit. Another idea mentioned was that a nursing expert could consult with the pharmacist before their visit and prepare specific questions for the physician.

Several participants stated the need to train nursing staff in patient observation, communicating with physicians, using standardized tools for medication reviews, and communicating with residents and relatives regarding medication changes, e.g., if they are afraid of discontinuing medication.

Licensed practice nurses (three years of practical education) should also be explicitly involved since they usually outnumber registered nurses in NHs and perform a large proportion of the work of distributing medication.

Participants also expressed a need for aids such as guidelines and an agreement on specific recognized, standardized tools for performing medication reviews, such as checklists or grids. Participants thought it important that the same or comparable instruments were applied across acute geriatric settings so that unnecessary changes in medication did not occur across care interfaces (e.g., from inpatient to outpatient settings or from one NH to another) and results were comparable.

One explicit wish was for IT systems that support the implementation of medication reviews and their documentation. These could include displays with an appropriate overview of residents' medication and diagnoses on one screen rather than having to laboriously switch between displays, an electronic screening of risk factors to help prioritization, real-time drug–drug interaction checks, GP access to up-to-date medication lists directly via NH software, and a single joint documentation system instead of some information entering the doctor's system and the next information entering the NH's nursing documentation.

It was also considered important that the interventions or decisions made during medication reviews could themselves be evaluated, e.g., whether medication adjustments were indeed made or when the next review would take place. This would show the benefits of medication reviews more clearly than simply recording the number performed.

Participants also suggested that it would be important to strengthen medical and nursing staff's acceptance of and motivation for having a medication review NH quality indicator, mainly by demonstrating the indicator's benefits for medication management. This could be achieved, e.g., by communicating indicators' results back to the teams, linked with indications of what can be achieved in terms of quality.

In taking it a step further towards interventions, the reduction of polypharmacy, i.e., deprescribing as the ultimate goal of medication reviews, the education of residents and relatives is also considered important. Some interviewees had experienced NH residents or their relatives who had been very insistent about continuing with their medication and not wanting to reduce it. Ideas mentioned here included that professional associations could provide support, e.g., with information sheets, or that organizations could join campaigns, such as 'Smarter Medicine' (www.smartermedicine.ch), which encourage a public discussion about medication review and, ultimately, deprescribing.

Discussion

To the best of our knowledge, this was the first study of current medication-use practices in Switzerland's NHs that focused on interprofessional collaboration and, specifically, medication reviews. Taking a rapid appraisal approach enabled us to combine our process-based quantitative data with group interviews, giving us insight into healthcare professionals' attitudes towards the future introduction of medication reviews as a national NH quality indicator, the definition of medication reviews, the challenges in the area of interprofessional collaboration, and contextual barriers for their implementation.

Overall, our survey and interview participants had a thoroughly positive attitude towards medication review, with pharmacists and nurses being its staunchest supporters. All participants also agreed that medication (safety) was an important topic—one that should be pursued further, especially in long-term care. Nevertheless, there were many perceived obstacles to the introduction of medication reviews as a national NH quality indicator.

First, the definition of what counts as a medication review in NHs is unclear. Despite a 2016 survey conducted and published by the Swiss Patient Safety Foundation (www.patientensicherheit.ch) finding that 65% of NHs regularly did medication reviews [31], our in-depth interviews showed that few actually carried out medication reviews in their true sense. Targeted, structured, interprofessional medication review interventions [25], usually outside the framework of regular medical visits, remained very rarely implemented and were certainly hampered by the lack of access to clinical data across care interfaces. Medication discussions during physicians' rounds or medication checks triggered by acute events were the most common forms of medication verification, performed by a physician–nurse dyad at best. In addition, involvement of residents and/or relatives was largely determined by the assessment of their willingness by healthcare professionals. While many people residing in NHs may be cognitively impaired, a conscious effort should be made by health professionals involved to assess and reassess the needs of patients and their relatives. At the same time, we need structured, low-effort processes for NHs to be able to implement them in daily practice.

Second, while interprofessional collaboration is key for a successful medication review, there are multiple barriers in this area. Based on the literature, pharmacist-led medication reviews in residential old age care lead to better resident outcomes [32]. However, in the majority of the NHs we investigated, pharmacists were not directly involved in interprofessional medication discussions. Instead, they made their analysis beforehand, e.g., in the context of prescription validations, the results of which are passed on to nursing staff and physicians. Thus, although our interviewees described interprofessional approaches, resource constraints made regular reviews in interprofessional teams difficult. Access to specialist staff might be more challenging for smaller institutions. Providing on-site medication reviews might also be more resource-intensive for GPs with patients in different institutions. Telemedicine might not only reduce travel time for physicians, but also facilitate interprofessional integration of specialist staff like pharmacists [33].

While the use of clinical pharmacy services has increased tremendously in acute care settings in the last decade [34, 35], their dissemination in ambulatory and long-term care settings seems much slower. As shown in our rapid appraisal, pharmacists were predominantly tasked with logistical roles and quality-management processes designed to fulfill the legal requirements for storing medications in those institutions. Legally responsible pharmacists are valued partners for ensuring legal compliance, timely medication provision, and competently, if reactively, answering medication-related questions (mostly by telephone or email), but their proactive clinical role in interprofessional teams has yet to be widely applied in Switzerland. Community pharmacists, on the other hand, often also provide pharmaceutical care to NH residents. They are increasingly involved in chronic care and, as a result, identify significant numbers of drug-related problems [36, 37]. This might also spill over to pharmacists' roles in NHs, extending from purely logistical tasks to more clinical activities. This is already common practice in other countries: The services analysed in a review published in 2019 encompassed medication reviews, multidisciplinary team meetings in connection with medication reviews and staff education [38].

Increasingly acknowledged is also the importance of medication reconciliation for the reduction of medication discrepancies if NH residents transition between different care providers and/or settings of care [39].

Collaboration with advanced practice nurses or other nurses in expanded roles, who can initiate, coordinate, and contribute to medication reviews, might be very beneficial for ensuring interprofessional collaboration and targeted approaches for vulnerable residents in long-term care [40–42]. However, this opportunity to collaborate might also depend on NHs hiring more advanced practice nurses, which might be limited in smaller institutions, or regular nurses adopting leadership roles in quality improvement [43, 44].

For GPs with their own practice, organizational aspects of regular medication reviews located in the NHs are a huge hurdle to their implementation. Physicians acknowledged the added value regular medication reviews might provide, but also emphasized that they are already regularly reassessing medication use. They also stressed the importance of an effective, time-saving approach when working interprofessionally, for example by focusing on residents at elevated risk for medication-related problems. It also became evident that clinical notes are often kept in separate systems, limiting shared access to clinically relevant patient information, a key basis for medication review. On a national level in Switzerland, there is no shared electronic patient record system implemented. These organizational issues have to be resolved for a successful implementation, as already the identification of quality indicators for safe medication use in NHs by the Swiss Patient Safety Foundation stated [45].

Third, contextual aspects further hinder the full implementation of medication reviews. On the one hand, reimbursement for medication reviews will be a challenge: although the physicians' tariff system contains options for compensation for medication reviews, the pharmacists' system does not, unless the NH would be paying for this service. On the other hand, the lack of availability of residents' medication-related data across care interfaces hinders collaboration, aggravated by the lack of connectivity between the systems used in ambulatory care practice and NHs.

The international literature shows that while medication reviews may have short-term intervention effects on many drug-related outcomes, their mid-to-long-term influence on clinical outcomes, quality of life, and costs remains limited or unclear [19, 38]. Thus, barriers for successfully introducing medication reviews with the maximum impact will have to be addressed at various levels. Considering the Consolidated Framework of Implementation Research (CFIR), we found factors at different levels that impact the successful implementation of medication reviews, including the innovation complexity with the need to clearly define medication review, the inner setting with the available resources and its information technology infrastructure, as well as the outer setting with the local conditions and its financing mechanisms [46]. Implementation strategies to introduce medication reviews in NHs and to strengthen interprofessional collaboration need to address these factors, e.g. by providing a consensus-definition over all language regions for medications reviews in NHs, educational materials, improvement of IT, and mechanisms for reimbursement. Research might also be needed to address concerns about comparability between different NHs, specifically, ensuring the quality of medication reviews instead of just accounting for their number and considering different physician systems, e.g., NH physicians vs. GPs, to ensure comparisons are appropriate.

Although we have provided insights into current medication-use practices and the potential barriers to and facilitators of the broader implementation of medication reviews in Switzerland's NHs, the present study had some limitations. Due to the study's selection of a convenience sample of NHs, it may have been somewhat biased. These NHs had previously participated in other research projects with the research team and may be more open to innovation than other institutions. We are also aware that our research focused solely on NHs in the German speaking part of Switzerland. Because in some of the French speaking cantons, interprofessional collaboration is financially supported by the government, the level of pharmaceutical services, including medication reviews, might be more advanced [21]. It is planned to take into account practices and experiences from French- and Italian-speaking regions in a next phase of the research. Interpretation bias might have led to overemphasis, neglect or misinterpretation of results. To avoid bias, triangulation of methods in our research as well as different professional backgrounds in the research team helped to reflect own values and experiences. In addition, the results were reported back to the participants to check our interpretations. In addition, our interviews reached the point of thematic saturation. The diversity of participants both in view of their professional background and their roles is a strength of our study and helped to broaden the perspective on issues related to medication reviews in NHs.

Conclusion

Medication safety's importance as an integral part of overall patient safety in Switzerland's NHs is increasingly recognized. At the national level, the development of quality indicators complementing the existing calculation of polypharmacy is being discussed, favoring medication reviews.

Full medication reviews, in their true sense, are rarely conducted in NHs. Medication verification is mostly done through medication discussions during ward rounds or in reaction to acute events in the form of medication checks.

In order to introduce the use of medication reviews as a reliable quality indicator of NH care, the most pressing issues raised by healthcare professionals need to be addressed with a clear definition, a standardized guide and minimal criteria what counts as medication review in a NH. The NHs need supporting materials to be able to introduce medication review in their processes and to structure the interprofessional collaboration. All professions involved need access to clinical resident information, tools for the preparation, execution, and documentation of medication reviews, as well as educational and suitable cost reimbursement mechanisms. Stakeholders should be closely involved in defining the details of what makes a medication review a high-quality medication review.

Future research could focus on the quality and comparability of medication reviews in different NHs, as well as the prerequisites for improving clinical outcomes, reducing costs, and raising NH residents' quality of life.

Abbreviations

GP	General practitioner (primary care provider, family physician)
INS	Institute for Nursing Science, University of Basel, Switzerland
NH	Nursing home
PIM	Potentially inappropriate medication
QI	Quality indicator

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-025-12505-2.

Supplementary Material 1.

Acknowledgements

We are very thankful to all the NHs and individual healthcare professionals who offered their insights into their medication-use processes, generously provided their time, and openly shared their opinions on medication reviews and their future use.

We gratefully acknowledge copy-editing by Darren Hart of www.publish-or-perish.ch.

Authors' contributions

NW, CM, and FZ designed the questionnaire. NW led the analysis, with CM and FZ contributing to data interpretation. CM and FZ drafted the interview guide with input from MO and NW. FZ led the interviews, with CM and MO contributing to documentation and analysis. CM drafted the manuscript's first version, with FZ, MO, and NW providing substantial contributions to the final version. All authors agreed to the submission of the final version of the manuscript.

Funding

No specific funding was obtained for this research project. All the authors contributed their time within the scope of their regular professional duties or their studies at their respective universities.

Data availability

The original data generated and analyzed during the present study are not publicly available because they contain information that might enable the identification of participating individuals or NHs. However, additional blinded data are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of Northwestern Switzerland, EKNZ 2021–02468. Nursing home staff gave their written informed consent to participate in the survey and audio-recorded informed consent to participate in the interviews. Participants also gave their informed consent for publication of data obtained in the context of this study.

Consent for publication

All the institutions and individuals participating in this study gave their informed consent for the publication of the data obtained within the scope of this research project in an anonymous format.

Competing interests

The authors declare no competing interests.

Author details

[1]Clinical Pharmacy and Epidemiology, Department of Pharmaceutical Sciences, University of Basel, Basel, Switzerland
[2]Institute for Primary Healthcare (BIHAM), University of Bern, Bern, Switzerland
[3]Present address: Clinical Pharmacology and Toxicology, Department of General Internal Medicine, Inselspital– University Hospital of Bern, Bern, Switzerland
[4]Nursing Science, Department Public Health, Faculty of Medicine, University of Basel, Basel, Switzerland
[5]Hospital Pharmacy, Hospital Thun-Simmental AG, Thun, Switzerland

Received: 1 August 2023 / Accepted: 1 March 2025
Published online: 02 April 2025

References

1. Laatikainen O, Sneck S, Turpeinen M. Medication-related adverse events in health care-what have we learned? A narrative overview of the current knowledge. Eur J Clin Pharmacol. 2022;78(2):159–70.
2. Federal Statistics Office. Socio-medical institutions - elderly and nursing homes 2021, 2021. [www.bfs.admin.ch, last accessed: 08.12.2024].
3. Meissner S. Anzahl und Statistik der Altenheime in Deutschland. Hamburg, Deutschland 28.05.2024. [www.pflegemarkt.com, last accessed: 08.12.2024].
4. Long-Term Care Statistics Branch (LTCSB). National Post-acute and Long-term Care Study. Hyattsville, MD 2020. [https://www.cdc.gov/nchs/npals/webtables/overview.htm#table4, last accessed: 08.12.2024].
5. Schneider RS, Reinau N;D, Schwenkglenks D, Meier M. CR. [Helsana Arzeimittel Rep 2017], 2017. [www.helsana.ch, last accessed: 08.12.2024].
6. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. BMC Geriatr. 2017;17(1):230.
7. Cadenas R, Diez MJ, Fernandez N, Garcia JJ, Sahagun AM, Sierra M, et al. Prevalence and associated factors of polypharmacy in nursing home residents: a cross-sectional study. Int J Environ Res Public Health. 2021;18(4):2037.
8. Diez R, Cadenas R, Susperregui J, Sahagun AM, Fernandez N, Garcia JJ, et al. Drug-related problems and polypharmacy in nursing home residents: a cross-sectional study. Int J Environ Res Public Health. 2022;19(7):4313.
9. Onder G, Liperoti R, Fialova D, Topinkova E, Tosato M, Danese P, et al. Polypharmacy in nursing home in Europe: results from the SHELTER study. J Gerontol Biol Sci Med Sci. 2012;67(6):698–704.
10. By the American Geriatrics Society Beers Criteria Update Expert P. American geriatrics society 2015 updated beers criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc. 2015;63(11):2227–46.
11. Holt S, Schmiedl S, Thurmann PA. Potentially inappropriate medications in the elderly: the PRISCUS list. Dtsch Arztebl Int. 2010;107(31–32):543–51.
12. Herr M, Grondin H, Sanchez S, Armaingaud D, Blochet C, Vial A, et al. Polypharmacy and potentially inappropriate medications: a cross-sectional

analysis among 451 nursing homes in France. Eur J Clin Pharmacol. 2017;73(5):601–8.
13. Alzner R, Bauer U, Pitzer S, Schreier MM, Osterbrink J, Iglseder B. Polypharmacy, potentially inappropriate medication and cognitive status in Austrian nursing home residents: results from the OSiA study. Wien Med Wochenschr. 2016;166(5–6):161–5.
14. Jyrkka J, Enlund H, Korhonen MJ, Sulkava R, Hartikainen S. Polypharmacy status as an indicator of mortality in an elderly population. Drugs Aging. 2009;26(12):1039–48.
15. Gomez C, Vega-Quiroga S, Bermejo-Pareja F, Medrano MJ, Louis ED, Benito-Leon J. Polypharmacy in the elderly: a marker of increased risk of mortality in a population-based prospective study (NEDICES). Gerontology. 2015;61(4):301–9.
16. Osinska M, Favez L, Zuniga F. Evidence for publicly reported quality indicators in residential long-term care: a systematic review. BMC Health Serv Res. 2022;22(1):1408.
17. Vincent CS. A. [Nationaler Bericht zur Qualität und Patientensicherheit im schweizerischen Gesundheitswesen im Auftrag des Bundesamtes für Gesundheit]. 2019.
18. Viktil KK, Blix HS, Moger TA, Reikvam A. Polypharmacy as commonly defined is an indicator of limited value in the assessment of drug-related problems. Br J Clin Pharmacol. 2007;63(2):187–95.
19. Huiskes VJ, Burger DM, van den Ende CH, van den Bemt BJ. Effectiveness of medication review: a systematic review and meta-analysis of randomized controlled trials. BMC Fam Pract. 2017;18(1):5.
20. Meyer-Massetti C, Cheng CM, Schwappach DL, Paulsen L, Ide B, Meier CR, et al. Systematic review of medication safety assessment methods. Am J Health Syst Pharm. 2011;68(3):227–40.
21. Mena S, Moullin JC, Schneider M, Niquille A. Implementation of interprofessional quality circles on deprescribing in Swiss nursing homes: an observational study. BMC Geriatr. 2023;23(1):620.
22. Cateau D, Ballabeni P, Niquille A. Effects of an interprofessional deprescribing intervention in Swiss nursing homes: the individual deprescribing intervention (IDeI) randomised controlled trial. BMC Geriatr. 2021;21(1):655.
23. Locca JF, Ruggli M, Buchmann M, Huguenin J, Bugnon O. Development of pharmaceutical care services in nursing homes: practice and research in a Swiss Canton. Pharm World Sci. 2009;31(2):165–73.
24. Beebe J. Basic concepts and techniques of rapid appraisal. Hum Organ. 1995;54:42–51.
25. Griese-Mammen N, Hersberger KE, Messerli M, Leikola S, Horvat N, van Mil JWF, et al. PCNE definition of medication review: reaching agreement. Int J Clin Pharm. 2018;40(5):1199–208.
26. O'Mahony D. STOPP/START criteria for potentially inappropriate medications/potential prescribing omissions in older people: origin and progress. Expert Rev Clin Pharmacol. 2020;13(1):15–22.
27. By the American Geriatrics Society Beers Criteria Update Expert P. American Geriatrics Society. 2019 Updated AGS beers Criteria(R) for potentially inappropriate medication use in older adults. J Am Geriatr Soc. 2019;67(4):674–94.
28. Kuhn-Thiel AM, Weiss C, Wehling M, members Faep. Consensus validation of the FORTA (Fit fOR the Aged) list: a clinical tool for increasing the appropriateness of pharmacotherapy in the elderly. Drugs Aging. 2014;31(2):131–40.
29. Hanlon JT, Schmader KE. The medication appropriateness index: a clinimetric measure. Psychother Psychosom. 2022;91(2):78–83.
30. Stampfli D, Baumgartner P, Boeni F, Bedouch P, Lampert ML, Hersberger KE. Translation and validation of a tool to assess the impact of clinical pharmacists' interventions. Int J Clin Pharm. 2019;41(1):56–64.
31. Niederhauser A, Bruhwiler LD, Fishman L, Schwappach DLB. [Selected safety-relevant medication processes in Swiss nursing homes: current state of affairs and optimization potentials]. Z Evid Fortbild Qual Gesundhwes. 2019;146:7–14.
32. Thiruchelvam K, Hasan SS, Wong PS, Kairuz T. Residential aged care medication review to improve the quality of medication use: a systematic review. J Am Med Dir Assoc. 2017;18(1):87. e1- e14.
33. Shafiee Hanjani L, Peel NM, Freeman CR, Gray LC. Using telehealth to enable collaboration of pharmacists and geriatricians in residential medication management reviews. Int J Clin Pharm. 2019;41(5):1256–61.
34. Studer H, Boeni F, Messerli M, Hersberger KE, Lampert ML. Clinical pharmacy activities in Swiss hospitals: how have they evolved from 2013 to 2017? Pharmacy (Basel). 2020;8(1):19.
35. Messerli M, Maes KA, Hersberger KE, Lampert ML. Mapping clinical pharmacy practice in Swiss hospitals: a cross-sectional study. Eur J Hosp Pharm. 2016;23(6):314–9.
36. Hersberger KE, Messerli M. Development of clinical pharmacy in Switzerland: involvement of community pharmacists in care for older patients. Drugs Aging. 2016;33(3):205–11.
37. Messerli M, Blozik E, Vriends N, Hersberger KE. Impact of a community pharmacist-led medication review on medicines use in patients on polypharmacy–a prospective randomised controlled trial. BMC Health Serv Res. 2016;16:145.
38. Lee SWH, Mak VSL, Tang YW. Pharmacist services in nursing homes: a systematic review and meta-analysis. Br J Clin Pharmacol. 2019;85(12):2668–88.
39. Patterson ME, Bollinger S, Coleman C, Rhodes JAM. Medication discrepancy rates and sources upon nursing home intake: a prospective study. Res Social Adm Pharm. 2022;18(5):2830–6.
40. Rantz MJ, Popejoy L, Vogelsmeier A, Galambos C, Alexander G, Flesner M, et al. Impact of advanced practice registered nurses on quality measures: the Missouri quality initiative experience. J Am Med Dir Assoc. 2018;19(6):541–50.
41. Vogelsmeier A, Popejoy L, Crecelius C, Orique S, Alexander G, Rantz M. APRN-Conducted medication reviews for long-stay nursing home residents. J Am Med Dir Assoc. 2018;19(1):83–5.
42. Basinska K, Wellens NIH, Simon M, Zeller A, Kressig RW, Zuniga F. Registered nurses in expanded roles improve care in nursing homes: Swiss perspective based on the modified Delphi method. J Adv Nurs. 2021;77(2):742–54.
43. Zuniga F, Wicki R, Staudacher S, Basinska K. [How nurse experts in Swiss nursing homes shape their role development: a qualitative secondary analysis]. Pflege. 2022;35(6):337–43.
44. Favez L, Simon M, Serdaly C, Zuniga F. Expanded role of nurses in Swiss nursing homes and their engagement in quality improvement: a cross-sectional study. Nurs Open. 2023;10(8):5356–65.
45. Bruhwiler LD, Niederhauser A, Fischer S, Schwappach DLB. Quality standards for safe medication in nursing homes: development through a multistep approach including a Delphi consensus study. BMJ Open. 2021;11(10):e054364.
46. Damschroder LJ, Reardon CM, Widerquist MAO, Lowery J. The updated consolidated framework for implementation research based on user feedback. Implement Sci. 2022;17(1):75.

Publisher's Note