Pharmacist-participated medication review in different practice settings: Service or intervention? An overview of systematic reviews

Rafaella de Oliveira Santos Silva[1]☯, Luana Andrade Macêdo[1]☯, Genival Araújo dos Santos, Júnior[1]☯, Patrícia Melo Aguiar[2]☯, Divaldo Pereira de Lyra, Júnior[1]☯ *

1 Laboratory of Teaching and Research in Social Pharmacy (LEPFS), Department of Pharmacy, Federal University of Sergipe, São Cristóvão, Sergipe, Brazil, 2 Department of Pharmacy, Faculty of Pharmaceutical Sciences, University of São Paulo, São Paulo, Brazil

☯ These authors contributed equally to this work.
* lepfs.ufs@gmail.com

Abstract

Introduction

Medication review (MR) is a pharmacy practice conducted in different settings that has a positive impact on patient health outcomes. In this context, systematic reviews on MR have restricted the assessment of this practice using criteria such as methodological quality, practice settings, and patient outcomes. Therefore, expanding research on this subject is necessary to facilitate the understanding of the effectiveness of MR and the comparison of its results.

Aim

To examine the panorama of systematic reviews on pharmacist-participated MR in different practice settings.

Methods

A literature search was undertaken in Biblioteca Virtual em Saúde (BVS), Embase, PubMed, Scopus, The Cochrane Library, and Web of Science databases through January 2018 using keywords for "medication review", "systematic review", and "pharmacist". Two independents investigators screened titles, abstracts, full texts; assessed methodological quality; and, extracted data from the included reviews.

Results

Seventeen systematic reviews were included, of which sixteen presented low to moderate methodological quality. Most of reviews were conducted in Europe (n = 7), included controlled primary studies (n = 16), elderly patients (n = 9), and long-term care facilities (n = 8). Seven reviews addressed MR as an intervention and thirteen reviews cited collaboration

between physicians and pharmacists in the practice of MR. In addition, thirteen terminologies for MR were used and the main objective was to identify and solve drug-related problems and/or optimize the drug use (n = 11).

Conclusion

There is considerable heterogeneity in practice settings, population, definitions, terminologies, and approach of MR as well as poor description of patient care process in the systematic reviews. These facts may limit the comparison, summarization and understanding of the results of MR. Furthermore, the methodological quality of most systematic reviews was below ideal. Thus, international agreement on the MR process is necessary to assess, compare and optimize the quality of care provided.

Introduction

Medication Review (MR) has been defined as a structured assessment of patients' pharmacotherapy whose aim is to optimize the drug use and to improve health outcomes [1]. Despite that concept, MR is used as a generic term and its practice can be performed by some health professionals, such as physicians, nurses and pharmacists, causing confusion regarding its characterization and effectiveness. In the MR, pharmacists play an important role in the detection and resolution of drug-related problems (DRPs) through interaction with patients and/or healthcare professionals [2].

The MR conducted by pharmacists may be classified into three types: Prescription Review, Concordance and Compliance Review (Adherence Support Review), and Clinical Medication Review (with or without prescribing) [3, 4]. This practice, the last type particularly, must be conducted in collaboration with health professionals [5]. There are models of MR performed by pharmacists with collaboration of other health professionals in countries where pharmaceutical education is clinic-oriented as well as in those where pharmacists have no formal clinical education [6–11].

In Australia, there are examples of MR in which after the pharmacist assesses the patient's pharmacotherapy, he sends a report with recommendations to the patient's physician. After agreement with the pharmacist, the physician discusses the proposed recommendations with the patient [8, 9]. The implementation of these recommendations made by the pharmacist may be influenced by some factors such as: a good working relationship between the pharmacist and the health care team [2], the type of communication between the pharmacist and the team (verbal or written) [2, 10, 11] and the clinical relevance of the recommendations [10, 11].

In this context, studies show that pharmacist-participated MR has a positive impact on patients in practice settings such as community pharmacies [12, 13], long-term care facilities [14,15], outpatient clinic [16], home care [17, 18] and hospitals [19, 20]. Besides the identification and resolutions of DRPs [21–23], the studies highlight benefits such as increase in quality of life [24], decrease of hospitalizations and health costs [25, 26]. In order to achieve such results, the implementation of MR demands changes in pharmacists' professional and social behaviour [18].

Although a previous overview of systematic reviews has corroborated the importance of MR for the improvement of patients' health outcomes, it restricted relevant aspects such as methodological quality, practice settings, and assessed outcomes [27]. Moreover, the mentioned overview didn't focus on concepts, terminologies and approach (as service or practice

component) of MR as well as the professionals involved in this practice (interprofessional collaboration). The study of these variables is necessary to facilitate the understanding of the effectiveness of MR and to compare results.

Taking this into consideration, the present overview aimed to examine: 1) the panorama of systematic reviews on pharmacist-participated MR in different practice settings; 2) methodological quality of systematic reviews included in this overview; 3) the concepts, terminologies, and MR approach as well as the interprofessional collaboration in MR.

Methods

This overview of systematic reviews was performed according to the tool "A MeaSurement Tool to Assess systematic Reviews" (AMSTAR) [28].

Definitions

This overview of systematics reviews adopted the following concepts:

- Systematic reviews: studies that: (i) present a clear research question and/or eligibility criteria used to select primary studies; (ii) describe all information sources and the keywords used in the search; (iii) present the number of primary studies found in the information sources and included in the final sample of systematic review.

- Medication Review: critical and structured assessment of patients' drugs with the objective of coming to an agreement of their pharmacotherapy, improving treatment, decreasing DRPs and costs with healthcare systems [29]. MR can be classified in Prescription Review, Concordance and Compliance Review (Adherence Support Review), and Clinical Medication Review (with or without prescribing) depending on their objective, patient's presence, access to information and drugs and/or patient's clinical conditions [3, 4],

Literature search

A comprehensive literature search was conducted on the following databases: Biblioteca Virtual em Saúde (BVS), Embase, PubMed, Scopus, The Cochrane Library, and Web of Science for systematic reviews with or without meta-analysis published until 31 January 2018. To that end, Medical Subject Headings (MESH) vocabulary [30] and non-standard terms (text words) were used. Full search strategy can be seen in S1 Table. This overview has not been registered on PROSPERO International prospective register of systematic reviews.

Systematic reviews selection

Systematic reviews were selected in four stages: 1) exclusion of repeated articles; 2) title and abstract screening; 3) full-text screening; and, 4) manual screening of references of the systematic reviews included after reading full articles. Systematic reviews were independently selected by two investigators (R.O.S.S. and L.A.M.) and divergences were solved by a third investigator (G.A.S.J.). If articles were not available in full, authors were contacted via ResearchGate (www.researchgate.net) and e-mail. The stages 1, 2, and 3 of the study selection were performed using the Rayyan QCRI tool [31].

The included systematic reviews attended the following criteria: (i) they were published in English, Portuguese or Spanish; (ii) they were systematic reviews followed or not by meta-analysis; (iii) they examined MR (focused on MR or included different pharmaceutical services/interventions, but the results were presented by type of service/intervention); (iv) they adopted terminology for MR adopted in the search strategy; and (vi) pharmacist-participated MR in all

primary studies with or without collaboration of other health professionals. Systematic reviews that did not present the definition of MR were included only if the interventions described in primary studies accorded to the concept of MR adopted.

In this overview, other systematic reviews were excluded because: i) full text was unavailable; (ii) MR was performed collaboratively by pharmacist and other health professionals but the pharmacist's role within the team was not clearly defined in the primary studies included.

Data extraction

Two investigators (R.O.S.S. and L.A.M.) extracted independently the following data: authors, publication year, main author's country, aim, country of primary studies, study design, practice setting, and population, number of primary studies included in the systematic review and meta-analysis, number of primary studies related to MR, assessed outcomes related to the drug use process, and economic, clinical, and human outcomes (ECHO model) [32], main results, concepts, terminologies, and approach (service or intervention) of MR, interprofessional collaboration, structure, processes, and outcomes variables [33, 34] described in the systematic reviews as well as limitations or biases. Except for the number of primary studies included in the systematic reviews and meta-analysis, all data were extracted only from primary studies on MR. In case of data absence or clear pieces of information, it was considered that authors did not report such variable. Discrepancies among investigators were solved by consensus.

Study design, practice setting and population were determined according to the authors of systematic reviews. Regarding terminologies of MR, the words used in the search strategies of the included systematic reviews were not considered. If the review presented different MR definitions, the one presented in the methodology was adopted. Moreover, in the absence of a clear definition, components or objectives of MR were extracted. Interprofessional collaboration was considered present if at least one primary study reported it.

Quality assessment

Two investigators (R.O.S.S. and L.A.M.) analyzed independently the methodological quality, and discrepancies were solved by consensus. To achieve that, the AMSTAR tool [28] was used, which is composed by 11 criteria, each one judged as "yes," "no," "cannot answer," or "not applicable". Total score was obtained by the attribution of one point to "yes" answers and zero to other answers, varying score from 0 to 11. The score was ranged according to Mikton and Butchart (2009) [35]: i) score 0–4, low quality; ii) 5–8, moderate quality; and, iii) 9–11, high quality.

Agreement between investigators

Cohen's Kappa index (k) was used to measure degree of agreement between the two investigators (R.O.S.S. and L.A.M.) in the title, abstract and full text screenings as well as in the assessment of methodological quality. Degree of agreement was stratified: i) k < 0.10, no agreement; ii) k < 0.40, weak agreement; iii) 0.40 < k < 0.75, good agreement; and, iv) k > 0.75, excellent agreement [36].

Results

Selection of systematic reviews

The literature search identified 3,053 articles, from which 2,950 were excluded mainly because of: i) simultaneous indexation in two or more databases; ii) language; iii) they were not a systematic review; and/or, iv) they did not examine MR. Thus, 103 articles were selected to full-text screening, from which 17 reviews met the inclusion criteria. Their references were revised

manually, and 68 were identified as potentially relevant. From these, none met the inclusion criteria. Excluded full texts and their reasons for exclusion are summarized in S2 Table.

From 17 articles included, 10 focus on MR [37–46] and seven include other services/interventions besides MR [47–53]. Fig 1 illustrates the selection process.

Degree of agreement between the two investigators (R.O.S.S. and L.A.M.) was excellent for title and abstract screenings (k1 = 0.942) and full-text screening (k2 = 0.805).

Quality assessment

Scores of methodological quality after consensus are presented in Table 1. The percentage of reviews that met each item of AMSTAR is presented in Fig 2. Score varied from 2 to 9, presenting average 4.82 ± 2.09. Degree of agreement between the two investigators (R.O.S.S. and L.A.M.) was excellent (k = 0.802). Among the 17 reviews, eight were categorized as low quality [37, 39, 47–49, 51–53]; eight as moderate quality [38, 40–43, 44, 46, 50]; and one review presented high quality [45]. Seven articles that presented from moderate to high quality were published from 2013 to 2017 [40–46]. Seven reviews with meta-analysis presented AMSTAR score between 4–8 [37, 40– 42, 44, 49, 53].

Item six (characteristics about participants, interventions, and results) was presented by all reviews [37–54]. Most of reviews performed literature search in at least two databases and supplementary search (item 3) [37, 38, 42–49, 51, 53] and performed the quality assessment of systematic reviews (item 7) [37, 38, 40–45, 50]. On the other hand, only two reviews registered the protocol for systematic review (item 1) [40, 42] and presented the assessment of publication bias (item 10) [41, 45].

Characteristics of systematic reviews

Characteristics of systematic reviews are described in Table 1. All reviews were published in English between 2005 and 2016. The main authors of the included systematic reviews were from four continents: America, Asia, Europe, and Oceania. Most of reviews had their main authors from Europe (seven reviews; 41.17%) [30–33, 40, 41, 43, 48], Asia (four reviews; 23.53%) [40, 44, 46, 52], and Oceania (four reviews; 23.53%) [41, 43, 47, 49], especially Australia (three reviews; 17,64%) [43, 47, 49]. Primary studies were performed in 28 different countries, and Australia (n = 13) [37–39, 41, 43–46, 48–51] and the United Kingdom (n = 13) [37, 38, 41, 43–51] were the most frequent countries. No primary study of the systematic reviews was found in Latin America.

Most reviews included controlled studies [37–43, 44–47, 49–53]. Six reviews included only controlled randomized trials [37, 39, 45, 50, 53] and five reviews included primary studies of different design as observational, descriptive, qualitative, surveys, and controlled study [38, 43, 46, 48, 52]. Regarding population, most reviews included elderly patients [37, 39, 44–46, 49–53].

Most frequent primary studies settings were long-term care facilities [37, 46, 47, 49–52], hospitals [37, 38, 42, 44, 45, 52], primary care or clinics [37, 39– 42, 45], pharmacies [37, 39, 40, 41, 44], and patient's home [37, 41, 44, 47].

Number of primary studies in the systematic reviews, meta-analysis, and related to MR; assessed outcomes, main results; and structure, processes and outcomes variables

Number of primary studies in the systematic reviews, meta-analysis and related to MR as well as assessed outcomes and main results are presented in Table 2. Number of primary studies
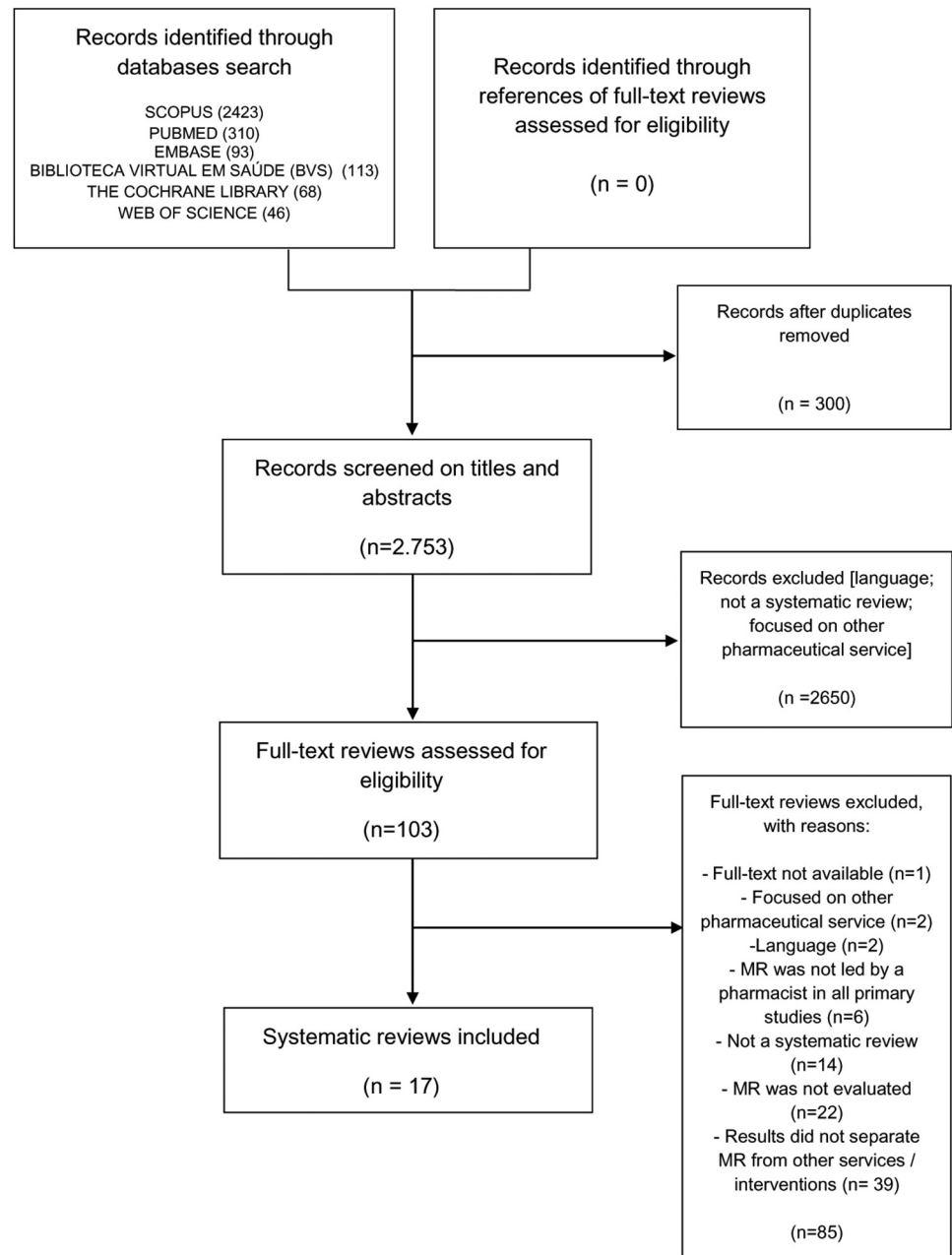
Abbreviation: MR – Medication Review.

Fig 1. Flowchart of systematic reviews included in this overview.

included in the reviews varied from 5 [40] to 69 [52]. The minimum and maximum number of primary studies in the systematic reviews related to MR was 4 [44, 51–53] and 63, respectively [43]. Only seven of these reviews performed meta-analysis [37, 40, 41, 44, 45, 47, 49], in which the number of primary studies varied from 3 to 25 [37, 40].

Table 1. Description of the systematic reviews' aim; primary studies' countries, practice setting, study design and population; and AMSTAR score for quality assessment of systematic reviews followed or not by meta-analyzes.

Reference	Aim	Primary studies countries	Practice setting	Study design	Population	AMSTAR score
[37]	To evaluate systematically and to quantify the effects of medication review by pharmacists on substantive clinical and qualitative outcomes for older people across all care settings	Australia, Canada, Northern Ireland, Singapore, United Kingdom, and United States	Hospital, primary care or clinic, pharmacy, patient's home, and nursing home	Randomized controlled trial	Older patients (mean age > 60 years) with a range of diseases (more than one diagnostic category)	4
[38]	To identify, assess, and summarize the literature investigating the effect of pharmacist-led medication reviews in hospitalized patients	Australia, Belgium, Canada, Denmark, India, Iran, Israel, Jordan, Northern Ireland, Norway, Oman, Spain, Sweden, United Kingdom, and United States	Hospital setting	Descriptive study and controlled study	Hospitalized patients	8
[39]	To investigate how the extent of collaboration between the GP and the pharmacist impacts on the implementation of recommendations arising from medication review	Australia, Canada, Netherlands, New Zealand, United States, and United Kingdom	Community pharmacy, interdisciplinary health clinic, health centre ambulatory clinic, university, general practice, dispensing general practice, and family practice	Randomized clinical trial	Home-dwelling patients ($\geq$ 70 years) in primary care that was not recently discharged (<1 month)	2
[40]	To evaluate the effectiveness of pharmacist-led medication review in chronic pain management	Canada, Germany, United Kingdom, and United States	University pain clinic, general practice, and community pharmacy	Randomized controlled trial and cluster randomized controlled trial	Adult patients with chronic pain	6
[41]	To examine the impact of fee-for-service pharmacist-led medication review on patient outcomes and quantify this according to the type of review undertaken	Australia, Belgium, Canada, Chile, Denmark, Germany, Netherlands, United Kingdom, and United States	Pharmacy, patients' home, general practice clinic/surgery, and community health centre	Randomized and non-randomized controlled trial	Adult patients	5
[42]	To summarize the available evidence on the effect of pharmacist-led medication review initiated early within a patient's hospital course on the length of hospital stay, and on 3-month mortality, hospital readmissions and emergency department revisits based on observed data	Belgium, Canada, Denmark, Northern Ireland, and Sweden	Hospital ward	Randomized controlled trial and controlled clinical trial	Adult patients (>18 years) who presented to an acute care hospital for an unexpected illness	8
[43]	To systematically review the processes and outcomes of clinical medication review in community-settings in Australia	Australia	Community setting	Controlled trial, observational study, uncontrolled study, qualitative study, and survey study	NR	6
[44]	To provide a timely evaluation of the evidence base for pharmacist-provided medication review in the elderly compared with usual care	Australia, Belgium, Brazil, Canada, Denmark, Germany, Malaysia, Netherlands, New Zealand, Northern Ireland, Portugal, Republic of Ireland, Scotland, Spain, Sweden, United Kingdom, and United States	Hospital outpatient clinic, community pharmacy, primary care (such as physician offices), patient's home, and mixed setting (typically with the first intervention carried out at the hospital, and follow-up conducted by telephone or home visits)	Randomized controlled trial	Community dwelling patients with a mean or median age of at least 65 years	5

(Continued)

Table 1. (*Continued*)

Reference	Aim	Primary studies countries	Practice setting	Study design	Population	AMSTAR score
[45]	To evaluate the impact of in-hospital pharmacist-led medication reviews on clinical outcomes at different time points	Australia, Belgium, China, Denmark, Ireland, Israel, Northern Ireland, Portugal, Sweden, United Kingdom, and United States	Hospital and care units	Randomized controlled trial	Adult or pediatric patients	9
[46]	To assess the impact of medication reviews in aged care facilities, with additional focus on the types of medication reviews (prescription and/or clinical medication reviews) in a single care setting (aged care homes) using a specific study design (randomized controlled trials and prospective studies)	Australia, Belgium, Netherlands, North Ireland, Singapore, Spain, Sweden, Switzerland, United Kingdom, and United States	Aged care facilities	Randomized controlled trial, nonrandomized controlled trial, and observational study (longitudinal and pre and post intervention)	Older people (mean age of subjects > 60 years)	5
[47]	To specifically evaluate the impact of pharmacist delivered community-based services to optimize the use of medications for mental illness	Australia, Sweden, United Kingdom, and United States	Domiciliary and residential aged care setting	Controlled trials, randomized controlled trials, and cluster randomized controlled trials	Patients with mental illness	4
[48]	To provide descriptions of existing remuneration models for pharmacist clinical care services and to summarize the existing evaluations of economic, clinical, and humanistic outcome studies of the remuneration models	Australia	NR	Multistep assessment interviews, focus research group, and mail survey	Stakeholders, pharmacists, consumers and facilitators	3
[49]	To evaluate the evidence pertaining to the impact of medication reviews and/or educational interventions on psychotropic drug use in long-term care facilities	Australia, Sweden, United Kingdom, and United States	Long-term care facility	Randomized and non-randomized controlled trial	Elderly residents (≥ 65 years) who use antipsychotic or hypnotic drugs	4
[50]	To identify, assess, and summarize available scientific evidence about the effect of interventions that could be used to reduce potentially inappropriate use of drugs in nursing homes	Australia, Sweden, and United Kingdom *	Nursing home	Randomized controlled trial	Elderly patients	5
[51]	To interpret the results of studies that have evaluated any type of strategy to improve prescribing in care homes	Australia and United Kingdom	Care homes settings (nursing homes, residential homes, and mixed homes)	Randomized controlled study, cluster randomized controlled study, and controlled before-and-after study	Care home patients or older people	4
[52]	To introduce the concept of safe medication use to both patients and clinicians by presenting multifaceted pharmaceutical concerns in the prevention of medication-related falls among patients in all settings (community dwelling, nursing home, and hospital)	NR	Community dwelling, nursing home, and hospital	Randomized controlled trials**	Elderly patients	2

(*Continued*)

Table 1. (Continued)

Reference	Aim	Primary studies countries	Practice setting	Study design	Population	AMSTAR score
[53]	To identify and analyse full economic evaluation studies assessing the cost-effectiveness of PPS in community setting in Europe and to summarize their findings	Spain and United Kingdom	Community setting	Randomized controlled trial and cluster randomized controlled trial	Elderly and patients with chronic pain	2

Abbreviations:

*Does not report the country of all primary studies;

**Does not report the study design of all primary studies;

AMSTAR—A MeaSurement Tool to Assess systematic Reviews; GP—General practitioner; NR—Not reported.

Primary and secondary outcomes assessed were: mortality [37, 41, 42, 45, 50, 51], hospital visits (admissions, readmissions, hospitalizations and emergency department visits) [37, 41, 42, 45, 46, 50], drug use [37, 41, 46, 49, 51], and quality of life [37, 40, 44, 45]. Regarding the assessment of impact of MR in the meta-analyses, significant impact was not shown in any systematic review of mortality [37, 41, 42, 45], hospitalizations [37, 41], length of hospital stay [42, 45], readmission [45], readmission and/or emergency department visits [45], and revisits to emergency department [42]. MR presented significantly positive impact (p<0.05) on the all-cause emergency department visits [45], blood pressure [41], drug-related readmissions [45] intensity of pain [40], low density lipoprotein [41], number of drugs prescribed [37], quality of life [44], patients' satisfaction [40], and physical functioning [40].

Regarding Structure variables described in the systematic reviews, the most frequent were *"pharmacists qualified to provide MR"* [39, 40, 42, 43, 44, 48], *"access to medical records"* [37–38, 40, 42], *"number of pharmacists"* [37, 39, 42, 44], and *"remuneration system"* [41, 43, 48]. Concerning the Process variables, *"number of drugs used"* [37–39, 41, 43, 46, 47, 49–52], *"number of interventions"* [38–40, 43, 46, 51], and *"accepted interventions"* [38, 40, 43, 44, 46, 52]
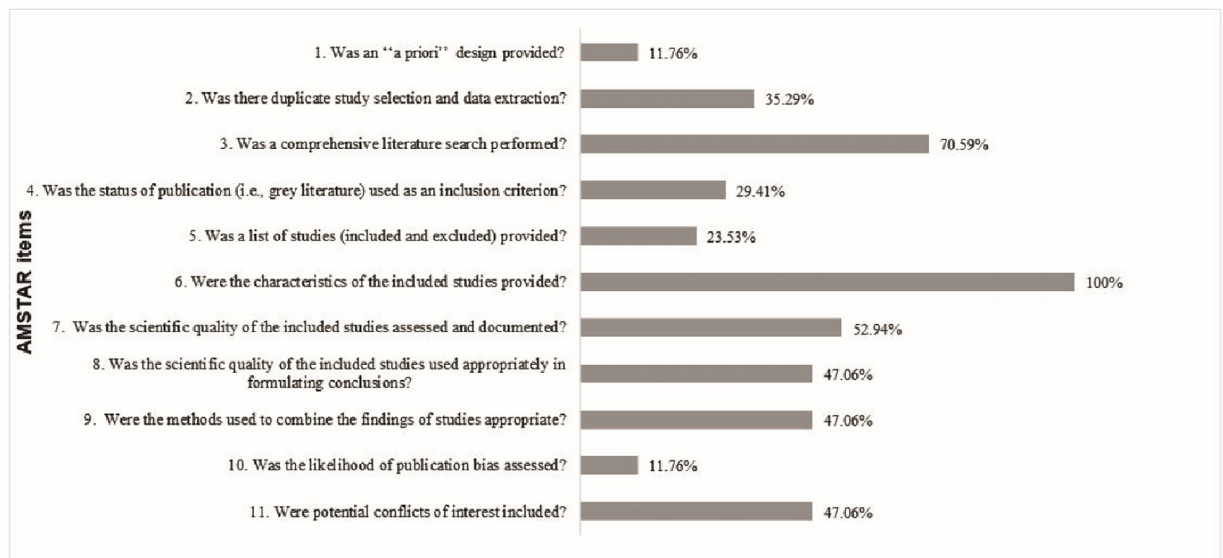

Fig 2. Percentage of systematic reviews that appropriately address each (AMSTAR) item.

Table 2. Number of primary studies in the systematic reviews, meta-analysis, and related to MR; assessed outcomes, main results; and structure, processes and outcomes variables.

Reference	Number of primary studies in the SR	Number of primary studies in the meta-analysis	Number of primary studies related to MR	Assessed outcomes	Main results
[37]	32	Y (25)	32	Primary: proportion of patients with one or more hospital emergency admission (all-cause). Secondary: all-cause mortality and mean drugs prescribed	RT 1- All-cause admission (RR 0.99, 95% CI 0.87 to 1.14, p = 0.92); mortality, (RR 0.96, 95% CI 0.82 to 1.13, p = 0.62); and numbers of drugs prescribed (NDP = -0.48, 95% CI -0.89 to -0.07)
[38]	31	N (0)	31	Data on process and implementation of the pharmaceutical service (number of interventions, acceptance rate and percentage of recommendations implemented by physicians), presence of elements of medication review process and patient outcomes (e.g. health-related quality of life)	RT 2- The number of MRPs varied from 81 to 5122. The proportion of MRPs varied from 0.13 to 10.6 per patient. The acceptance rate of recommendations varied from 39% to 100%. The positive effects were: better quality of prescribing, satisfaction with the pharmacist's service among patients or personnel; decrease of visits to the emergency department, drug-related readmissions, all-causes readmissions, length of in-hospital stay, and costs. The single negative result was on length of in-hospital stay, while health-related quality of life and overall survival only showed overall non-significant results
[39]	12	N (0)	12	Number of key elements that reflects collaborative aspects between a GP and a pharmacist, implementation rate of recommendations following DRPs identified during medication review	RT 2- The mean number of key elements within the intervention was 5.2 (range 1–8). The mean implementation rate of recommendations was 50% (range 17–86). The association between the number of key elements present in the intervention and the implementation rate of recommendations was significant: β = 0.085 (95% CI 0.052 to 0.128; p<0.0001)
[40]	5	Y (3)	5	Pain intensity, physical functioning, patient satisfaction, quality of life, and adverse effects	RT 1 –A 0.8-point reduction in pain intensity on a 0 to 10 numerical rating scale at 3 months (95% CI, -1.28 to -0.36) and a 0.7-point reduction (95% CI, -1.19 to -0.20) at 6 months; a 4.84-point (95% CI, -7.38 to -2.29) and -3.82-point (95% CI, -6.49 to -1.14) improvement in physical functioning on a 0- to 68-point function subscale of at 3 and 6 months, respectively; and a significant improvement in patient satisfaction in 3 months with WMD -0.39 (95% CI, -0.688 to—0.36)
[41]	36	Y (21)	36	Primary outcomes: mortality, hospitalization, and clinical biomarkers or marker of disease progress. Secondary outcomes: medication adherence, economic outcomes and quality of life	RT 1- Blood pressure (OR 3.50, 95% CI 1.58 to 7.75, p = 0.002), low density lipoprotein (OR 2.35, 95% CI 1.17 to 4.72, p = 0.02), hospitalization (OR 0.69, 95% CI 0.39, 1.21, p = 0.19), mortality (OR 1.50, 95% CI 0.65 to 3.46, p = 0.34)
[42]	7	Y (5)	7	Length of hospital stay, mortality, hospital readmissions, and emergency department revisits	RT 1- Length of hospital stay (WMD = −0.04 days, 95% CI −1.63 to 1.55); mortality (OR 1.09, 95% CI 0.69 to 1.72), readmissions (OR 1.15, 95% CI 0.81 to 1.63) and emergency department revisits in 3 months (OR 0.60, 95% CI 0.27 to 1.32)
[43]	63	N (0)	63	Processes (eligibility, referral and procedure) and clinical (e.g. MRPs), humanistic (e.g. adherence) or economic outcomes (e.g. cost and effectiveness)	RT 2- Identification of MRPs (mean 3.6 MRPs per CMR) and improved adherence. Reductions in numbers of medications prescribed hospitalizations, potentially inappropriate prescribing, and costs. Qualitative research identified low awareness of CMR among eligible non-recipients, while benefits were perceived to outweigh barriers to implementation
[44]	25	Y (8)	25	Measures of health-related quality of life (HRQoL) and economic outcomes (eg. direct medical costs and incremental cost-effectiveness ratio)	RT 1—Overall, there was no significant difference in HRQoL and healthcare costs between pharmacist-provided medication review and usual care. Meta-analysis of studies that reported the 36-item Short-Form Health Survey found significant differences in favor of usual care in the body pain (mean difference: 2.94, 95% CI: 0 54–5.34, P = 0.02) and general health perception (mean difference: 1.83, 95% CI: 0.16–3.50, P = 0.03) domains, whereas there were no significant differences in other domains. Meta-analysis of the EuroQol-5D utility (mean difference: 0.01, 95% CI: 0.02–0.01, P = 0 57) and visual analogue scale (mean difference: 0.01, 95% CI: 3.24–3.26, P = 1.00) found no significant differences. Costs of hospitalization, medication, and other healthcare resources consumed were similar between groups

(*Continued*)

Table 2. (*Continued*)

Reference	Number of primary studies in the SR	Number of primary studies in the meta-analysis	Number of primary studies related to MR	Assessed outcomes	Main results
[45]	19	Y (16)	19	Primary: all-cause readmissions and/or emergency department visits at different time points. Secondary: all-cause readmissions, all-cause emergency department visits, drug-related readmissions, all-cause mortality, length of hospital stay, adherence, and quality of life	RT 1- All-cause readmission and/or emergency department visits (RR = 0.97, 95% CI 0.90; 1.05, p = 0.44); All-cause readmission (RR = 0.98, 95% CI 0.90; 1.06, p = 0.59); All-cause emergency department visits (RR = 0.70, 95% CI 0.59; 0.85 p = 0.0002); Drug-related readmissions (RR = 0.25, 95% CI 0.14; 0.45, p<0.0001); All-cause mortality (RR = 0.97, 95% CI 0.81; 1.17, p = 0.86); Length of hospital stay (MD -0.45 days, 95% CI -1.73; 0.82, p = 0.48)
[46]	22	N (0)	22	Medication-related outcomes (eg. medication-related problems, pharmacotherapy problems, polypharmacy, and medication appropriateness), medication review-related outcomes (eg. rate of acceptance of the recommendations by the pharmacist or team, number of recommendations, type of recommendations), and adverse outcomes (eg. potential risks such as falls, sentinel events, mortality, adverse drug events, and hospitalization)	RT 2—The majority of the recommendations put forward by the pharmacist or a multidisciplinary team was accepted by physicians. The number of prescribed medications, inappropriate medications, and adverse outcomes (eg, number of deaths, frequency of hospitalizations) were reduced in the intervention group. In the observational studies showed effective in reducing drug-related problems (DRPs), reduction in the number of medications prescribed, improvement in the medication appropriateness score, the mean number of medications per patient decreased, reduction in the number of sentinel events. Results are presented in descriptive statistics
[47]	22	N (0)	7	NR	RT 3—Reductions in the number and cost of medications prescribed; decrease in the use of antipsychotics, hypnotics, anticholinergic antidepressants, benzodiazepines, psycholeptics, psychotropics, antidepressants, potentially inappropriate medications; decrease in urinary incontinence, cognitive decline, depression scores and behavioral disorders
[48]	49	N (0)	6	Economic outcomes: cost-effectiveness and QALYs	RT 2 –Increase of cost-effectiveness and QALYs gains in the future are presented as the main economic results. In Australia, 13% of pharmacists are accredited. The main motivations for this are: professional development and satisfaction in having a more active role in patient care. Among the main barriers reported by pharmacists regarding the HMR program are: initial accreditation costs, rural locations, insufficient remuneration for the workload, lack of consumer awareness, reduced referral of patients by general practitioners, time to complete HMR (3 hours, 6 minutes)
[49]	11	Y (6)	4	Proportion of residents using one or more psychotropics	RT 3 –Reduction of the mean number of psychotropics administered per resident; a significantly greater proportion of residents ceased antipsychotic drugs and nonrecommended hypnotics; and lower proportion of residents were prescribed nonrecommended hypnotics
[50]	20	N (0)	7	Primary: use or prescribing of drugs. Secondary: health-related outcomes falls, physical limitation, hospitalization, and mortality	RT 2 –No statistically significant effect was found on drug use outcomes. No statistically significant effect was found on number of falls, patients who fell, hospitalization, and mortality. Statistically significant reduction of falls per resident
[51]	16	N (0)	3	Effect of an intervention on prescribing, aimed at improving appropriate prescribing or reducing inappropriate prescribing	RT 3—There were significant changes in the number and type of medication (medications discontinued and commenced), but the total number of medications used remained the same. There was a decline in the number of drugs prescribed with corresponding savings in drug costs, although this was not statistically different. No significant differences in drug use (total drugs and subcategories) were identified

(*Continued*)

Table 2. (Continued)

Reference	Number of primary studies in the SR	Number of primary studies in the meta-analysis	Number of primary studies related to MR	Assessed outcomes	Main results
[52]	69	N (0)	3	Medication-related falls	RT 3—Most of pharmacist's recommendations were accepted by general practitioner. The mean number of medication changes per patient increased while the number of falls per patient decreased. There was no significant reduction in the rate of recurrent falls, injurious falls, or overall use of high-risk medications; the number of falls was reduced in the postintervention group resulting in future savings of US$7.74 per patient per day in one of the included studies. The use of the addressed drug classes decreased in the postintervention period
[53]	21	N (0)	3	QALY	RT 3—In Spain, the conSIGUE program was dominant with robust results (in terms of QALY gained, CEAC: 100%, with a WTP at 30,000€ per QALY gained), whereas in the two UK studies, the intervention was unlikely to appear cost-effective: HOMER program showed ICER = £82,678 per QALY gained, CEAC: 25%, with a WTP at £30,000 per QALY gained, only 1/5 scenarios led to an ICER< £30,000 per QALY gained while in MRpain program interventions were more costly and provide similar QALYs than usual care and results were uncertain due to the small sample size

Abbreviations: CEAC—Cost-effectiveness acceptability curve; CMR—Clinical Medication Review; CI—Confidence interval; DRPs—Drug-related problems; HRM—Home Medication Review; HRQoL—Health-related quality of life; MR—Medication Review; MRPs—Medication-related problems; OBRA—Omnibus Reconciliation Act; N—No; NDP—Numbers of drugs prescribed; OR—Odds ratio; QALY—Quality-adjusted life year; RR—Relative risk; RT 1 –Results type 1 (results from meta-analyzes of primary studies on MR); RT 2 –Results type 2 (result of the systematic review on MR); RT 3 –Results type 3 (results of the primary studies on MR); SMD—Standardized mean difference; SR—Systematic review; WMD—Weighted mean difference; WTP—Willingness to pay; Y—Yes.

https://doi.org/10.1371/journal.pone.0210312.t002

were the most common. The most recurrent Outcomes variables, in turn, were *"mortality"* [37–39, 41–43, 45–47, 49–52], *"quality of life"* [37–45, 47, 49, 50], *"economy of costs related to drugs"* [37, 38, 41, 43, 44, 46, 47, 51], *"number of hospital visits"* [37, 41, 42, 45, 46, 50, 51], and *"patients' satisfaction"* [37, 38, 40, 43, 47].

Definitions, terminologies, MR approach, and interprofessional collaboration

Definitions of MR had the objective of identifying and solving DRPs and/or optimizing the drug use (Table 3) [37–39, 41–46, 48, 49]. Four systematic reviews presented components of MR, in which the most cited were: assessment of drug use history, review of patient's medications, and health education [41, 42, 47].

The terminology *"Medication Review"* was used in all reviews (Table 3). Nine reviews used *"Clinical Medication Review"* [38, 39, 41, 45–47, 49, 51, 52] and five reviews, *"Prescription Review"* [38, 39, 41, 42, 46]. Moreover, 52.94% (n = 9) considered it as *"intervention"* [37, 40, 41, 44–46, 50–52], whilst 47.06% (n = 8) of systematic reviews considered MR as service [38, 39, 41, 43, 47–49, 53]. All reviews that used only one terminology considered MR as *"intervention"* [37, 40, 42, 43, 44].

Systematic reviews that reported interprofessional collaboration (Table 3) presented different collaborative models. Collaboration and communication occurred through direct and/or indirect contact, such as letters. The most cited health professionals were the physicians [37–40, 42, 43, 44, 46, 47, 49–52] and nurses [39, 43, 46, 47, 49–52].

Table 3. Definition, terminology, approach of medication review (service or intervention), and interprofessional collaboration.

Reference	Definition of MR	Main terminologies for MR	MR approach	Was there interaction between other health professionals in the MR? (What professionals?)
[37]	DP 1—Structured evaluation of a patient's medicines, aimed at reaching agreement with the patient about drug therapy, optimizing the impact of medicines, and minimizing the number of medication related problems	*Medication Review*	Intervention	Yes (General practitioner and physician)
[38]	DP 3—To identify medication-related problems and recommending changes to optimize the medical treatment	*Clinical Medication Review, Medication Management Review, Medication Review*, and *Prescription Review*	Service	Yes (Physician)
[39]	DP 1—A structured, critical examination of a patient's medicines with the objective of reaching an agreement with the patient about treatment, optimizing the impact of medicines, minimizing the number of medication-related problems and reducing waste	*Clinical Medication Review, Concordance and Compliance Review, Home Medicines Review, Medication Review, Prescription Review*, and *Treatment Review*	Service	Yes (General practitioner and nurse)
[40]	NR	*Medication Review*	Intervention	Yes (General practitioner, and multidisciplinary team)
[41]	DP 2—To include at least two of the following activities: reviewing patient's medications for medication related issues; taking and documenting medication history; educating and counselling patients about medication and/or disease; providing a medication action plan; reaching an agreement with the patient about their medication treatment plan; monitoring drug treatment for effectiveness or adverse event; and optimizing medication effectiveness and minimizing problems related to medication usage	*Clinical Medication Review, Medication Review, Medicines Use Review*, and *Prescription Review*	Service	NR
[42]	DP 2—The best-possible medication history, and a review of a patient's medications to optimize medication use, and identify and resolve medication-related problems including adverse drug events	*Medication Review*	Intervention	Yes (General practitioner, healthcare team, and physician)
[43]	DP 1—Systematic assessment of a consumer's medications and the management of those medications, with the aim of optimizing consumer health outcomes and identifying potential medication-related issues within the framework of the quality use of medicines	*Clinical Medication Review, Home Medicines Review*, and *Medication Review*	Service	Yes (General practitioner, multidisciplinary team, and nurse)
[44]	DP 1—A structured, critical examination of a patient's medicines with the objective of reaching an agreement with the patient about treatment, optimizing the impact of medicines, minimizing the number of medication-related problems and reducing waste	*Medication Review*	Intervention	Yes (Physician)
[45]	DP 1—A structured, critical examination of a patient's medicines with the objective of reaching an agreement with the patient about treatment, optimizing the impact of medicines, minimizing the number of medication-related problems and reducing waste	*Adherence Review, Clinical Medication Review, Medication Review*, and *Prescription Review*	Intervention	Yes (Multidisciplinary team)

(*Continued*)

Table 3. (Continued)

Reference	Definition of MR	Main terminologies for MR	MR approach	Was there interaction between other health professionals in the MR? (What professionals?)
[46]	DP 1- A structured, critical examination of a patient's medicines with the objective of reaching an agreement with the patient about treatment, optimizing the impact of medicines, minimizing the number of medication-related problems and reducing waste	*Clinical Medication Review, Concordance and Compliance Review, Drug Regimen Review, Medication Review, Medicines Use Review, Prescription Review,* and *Residential Medication Management Review*	Intervention	Yes (General practitioner, multidisciplinary team, nurse, and physician)
[47]	DP 2—Comprehensive medication history taking, patient home interviews, medication regimen review, and patient education	*Home Medicines Review, Medication Regimen Review, Medication Review,* and *Residential Medication Management Review*	Service	Yes (Multidisciplinary team, nurse, nurses' assistant, and physician)
[48]	DP 3 –To resolve any drug-related problems to optimize drug use	*Home Medicine Review, Medication Review,* and *Medicines Use Review*	Service	NR
[49]	DP 1—Collaborative service provided by healthcare professionals with expertise in geriatric pharmacotherapy (usually pharmacists), designed to detect and prevent drug-related problems and hence optimize use of medicines	*Medication Review, Clinical Medication Review, Residential Medication Management Review,* and *Medication Chart Reviews*	Service	Yes (Nurses, nursing assistant, and physician)
[50]	NR	*Medication Review*	Intervention	Yes (Assistant nurse, general practitioner, multidisciplinary team, nurse, and physician)
[51]	NR	*Drug Regimen Review, Clinical Medication Review,* and *Medication Review*	Intervention	Yes (General practitioner, nurse, and physician)
[52]	NR	*Clinical Medication Review,* and *Medication Review*	Intervention	Yes (General practitioner, nurse, and physician)
[53]	NR	*Medication Review* and *Medicines Use Review*	Service	Yes (General practitioner)

Abbreviations: DT 1 –Definition type 1 (concept); DT 2 –Definition type 2 (components); DT 3—Definition type 3 (objectives); NR—Not reported.

Limitations declared by systematic reviews

Main limitations described were: absence of search in grey literature [37, 39, 41, 46, 50, 53]; possibility of loss and exclusion of primary studies during search and screening processes [39, 40, 50]; number [39, 42, 45, 49] and design of included primary studies [37, 43, 45, 46]; impossibility of performing meta-analysis or limited meta-analysis due to heterogeneity of primary studies [42–44]; and restriction of language in the selection of primary studies [38, 40, 44, 46, 51, 53].

Discussion

Most reviews had main authors and primary studies from Australia, which includes research with elderly people in community pharmacies, long-term care facilities and hospitals. Australia is one of the first countries to incorporate MR in primary outpatient care and has remuneration programs to accredited pharmacists who offer such service [54–57]. Furthermore, elderly people are some of the priority patients of this practice according to international guidelines as well as children and pregnant women [55–60]. Regarding the practice settings, Bulajeva et al. (2014) [54] corroborate our results when reported that in Europe, MR has been performed in community environments, hospitals, and long-term care facilities.

Terminologies for MR are not standardized in literature. Among the most well-known are: *Home Medicines Review*, *Medication Use Review* and *Residential Medication Management Review*, in Australia [61–63]; *Revisión de la medicación* and *Revisión sistemática de la medicación*, in Spain [64, 65]; *Medication Review and Comprehensive Medication Review*, in the United States [66, 67]; *Comprehensive Medication Review*, in Finland [68, 69]; and *Medicines Use Review* in the United Kingdom [70, 71]. These terminologies result from the differences in patient complexity and characteristics of each country and practice setting where MR is performed [72–74].

In pharmacy, there is no consensus among concepts and terminologies of clinical practice [75–79]. Linguistic and cultural questions as well as the overlapping between *"what we do"* and *"how we do"* can be causes of these divergences. Consequently, lack of standardization of definitions and terminologies can confuse researchers and professionals who aim to compare results and to confirm the practice effectiveness [75, 78]. Thus, definitions and terminologies internationally standardized can benefit the assessment of impact of MR [80]. Moreover, modelling of clinical pharmacy services should be used since it facilitates the standardization and comparison of MR and provides a holistic approach to the decision-making process and organizational change [81–85]. Therefore, establishing minimum quality standards for MR is important for comparison of the practice as well as for the optimization of the care provided and, consequently, of the patients' health outcomes.

Regardless of the terminology adopted in systematic reviews, the objective of MR, both as service as well as intervention, is to identify and solve DRPs, implement changes in patients' pharmacotherapy and improve health outcomes. This objective agreed with *guidelines* of the countries where this practice is more frequent. In this regard, interprofessional collaboration is necessary to reach this objective [55–60, 86, 87]. Collaborations among healthcare professionals declared in the systematic reviews can be seen as a positive factor to achieve better clinical, economic, and humanistic outcomes.

Interprofessional collaboration can be encouraged through specializations, since they motivate information sharing and communication between healthcare professionals. Furthermore, appropriate training of these professionals, such as pharmacists, is essential to develop abilities to the clinical practice, for example, critical thinking and collaborative interpersonal practice [88]. In Australia, only pharmacists who are trained and go through assessments are accredited and can provide MR [89]. In the United States, post-graduate pharmacist residency training, as well as physician residency training, has become a requirement for entry-level health-system pharmacy practice [90]. In this same country, the Accreditation Council for Pharmacy Education (ACPE) (2016) [91] established interprofessional collaboration as one of the accreditation standards for the professional program in Pharmacy leading to the Doctor of Pharmacy degree. According to this institution, the curriculum should prepare students to provide entry-level, patient-centered care in different practice settings as member of an interprofessional team (with prescribers or other healthcare professional). Thus, literature supports our finding of *"pharmacists qualified to provide MR"* as a frequently described structure variable.

In this context, MR can be performed by physicians, nurses, and pharmacists. Despite using the same terminology, for physicians and nurses, MR is usually a component of clinical practice whose process has not been well described in literature [92, 93]. In pharmacy, studies and guidelines of different countries described MR as a clinical pharmacy service or intervention [13, 16, 94–100]. In this overview, the systematic reviews who presented practice components of MR (e.g. assessment of drug use history, health education, and review of patient's medications) addressed it as service or intervention. However, the discrepancy between the MR approach as an intervention and the concept of the intervention present in the literature is noticeable.

According to the Society of Hospital Pharmacists of Australia, *"intervention"* is *"any action performed by a clinical pharmacist that directly results in the change of patient management or therapy"* [101]. Suggett and Marriott (2016) [102], in turn, define *"intervention"* as a process in which the pharmacist identifies and makes recommendations in an attempt to prevent or resolve DRPs. The authors emphasize that the definition of "*intervention*" does not include MR without recommendations for changes in treatment.

In Brazil, *"intervention"* is a *"professional action planned, documented and performed by the pharmacist for optimization of pharmacotherapy, promotion, protection and recovery of health, prevention of diseases and other health problems"* [103]. Thus, we understand *"pharmacist intervention"* as an action whose goal is to improve patient health outcomes and that may result in changes in pharmacotherapy. In addition, *"intervention"* is a result of the situational analysis of the patient, and is part of the care plan, step of the patient care process.

Considering the patient care process, three stages are recommended in several health professions, including pharmacists: initial assessment, care plan, and assessment of outcomes. The first stage is a situational analysis in which the pharmacist gathers, analyzes and interprets information about patient's clinical conditions and pharmacotherapy, aiming to evaluate his or her drug-related needs. The second stage is the care plan whose purpose is to agree with the patient the actions necessary to manage his or her clinical conditions successfully with pharmacotherapy. The care plan includes goals of therapy, interventions (e.g. inclusion of new drug therapy, patient education, and referrals to other health professionals), and a schedule for assessment of outcomes. In the third stage, patient outcomes are assessed, documented, and compared to the goals of therapy [104].

From the presented patient care process, the most appropriate MR approaches are as *"service"* or *"practice component"*. As a service, MR should include all steps of the patient care process. As a practice component, MR is part of other health services, such as medication reconciliation, and consists of the situational analysis of the patient's pharmacotherapy. Hence, future studies need to describe if MR is a clinical pharmacy service or a practice component. Only then, it will be possible to compare the impact of its results and assure the robustness of this practice.

Regardless of the MR approach, access to medical records is important for the clinical practice. Literature has reported that pharmacists should rely on medical records and technical drug information to make decisions based on evidences and provides the best possible patient care [105, 106]. Guidelines highlight the need to obtain patient information from different sources, such as interviews with patient and caregiver, clinical laboratory tests, and medical records, considering that they are complementary [55–60]. Therefore, describing access to medical records as a structure variable is relevant, since the limitation of access to any sources of information can result in the restriction of clinical activities of pharmacists.

Although there is no standardization for terminologies and approaches of MR, there are variables related to the care process that are commonly used in this practice, such as: *"number of drugs"* and *"number of interventions"*. Considering the objective of MR, literature confirms that the analysis of the number of drugs is necessary to the assessment of the impact of MR, especially because it can involve vulnerable patients which present polypharmacy, therapeutic duplication, drug interactions, and contraindications [55–60]. Thus, Cipolle et al. (2012) highlight that interventions related to the resolution of DRPs, usually in interprofessional collaboration, may result in the reduction of the number of drugs [104].

Despite Jokanovic et al. (2016) [27] mentioning the positive impact of MR in primary studies performed in community environments (e.g. blood pressure control, quality of life, and healthcare costs), some reviews included in our study show that MR results were contradictory, had little significant or were inconclusive. A systematic review conducted by Huiskes

et al. (2017) [107] showed positive and negative effects for some outcomes variables described in our overview. According to the authors, the different results found may be a reflection of factors such as: 1) selection of patients, which may not fit the objective of MR; 2) how MR is performed in the clinical practice, since there is heterogeneity in the work processes and there is no gold standard on how it should be performed; and 3) outcomes and time of follow-up used to assess the impact of MR, variables that should be chosen according to the objective of MR and being more specific to diseases and drugs. Thus, heterogeneity of processes can affect the method of data analysis as well as the sensitivity and specificity of results, such as mortality, economy of drugs costs, hospital readmissions, quality of life and patients' satisfaction.

Another factor that influences the impact analysis of MR is the methodological quality of the reviews. Although systematic reviews are considered a key element used to the practices of patient care, low quality of reviews have limited processes of decision making and performance of healthcare systems. Our findings were corroborated by literature that has reported low methodological quality of systematic reviews on clinical pharmacy practice. Melchiors et al. (2012) [108] assessed the quality of 31 systematic reviews, in which 24 presented low and moderate quality. In overview of seven systematic reviews, Aguiar et al. (2014) [109] noticed that 71.4% of the reviews had low and moderate quality. Rotta et al. (2015) [110], in turn, found in overview of 49 systematic reviews that no review met all AMSTAR criteria. Therefore, future systematic reviews should value high methodological quality to result in more reliable evidences of real impact of clinical services.

Strengths and limitations

Strengths of this overview include: research in six different databases as well as manual search in the references of the included systematic reviews; use of MESH terms and text words for the literature search; use of 15 different terminologies to MR in the literature search; title, abstract, and full text screenings as well as quality assessment performed by two independent investigators. Moreover, systematic reviews were not excluded based on methodological quality, study design, practice setting, and population. Thus, our study presents a panorama of systematic reviews about pharmacist-participated MR. This overview comprised variables little explored in overviews of systematic reviews on MR, such as definitions and terminologies of MR; interprofessional collaboration; MR approach as well as structure, processes, and outcomes variables described in the systematic reviews.

This overview also presents limitations. Search in the grey literature was not performed. As most systematic reviews are found in databases, the inclusion of only indexed reviews may not have influenced the final sample. Data extraction and analysis of the variables studied were based on systematic reviews rather than primary studies, which may have resulted in overlapping of primary studies in the evaluation of results of MR. Many included reviews did not provide clear information or presented few details on primary studies' design, population, and practice setting; definitions of MR; and impact of MR, this might have compromised data extraction. Moreover, AMSTAR limitations, such as the subjectivity of items *"no"* and *"cannot answer"* and the dependence of quality of reports [111, 112], could have influenced the assessment of methodological quality of systematic reviews included in this overview.

Toward a future research agenda

This overview of systematic reviews is a starting point to analyze the panorama of literature on pharmacist-participated MR in different practice settings regarding to the concepts, terminologies and approach of MR as well as interprofessional collaboration. From the findings of this overview, it is possible to identify the need for future systematic reviews and primary studies to

clarify these variables. The lack of clarity about concepts, terminologies and MR approach as well as interprofessional collaboration extracted from the primary studies of the included systematic reviews may be due to the summarization of the results found in these primary studies and/or to the lack of clarity of the primary studies themselves. Thus, future systematic reviews should analyze these variables in the primary studies in order to reinforce the need to standardize concepts, terminologies and approach of MR in the literature. Moreover, the findings of this overview should also be addressed in future primary studies since any systematic review is only as good as the primary studies that compose it. That is, having in the literature high quality of systematic reviews is just as important as having high quality primary studies. Therefore, future studies, both systematic reviews and primary studies, should clearly present the variables studied in this manuscript in order to facilitate the understanding of effectiveness of MR and the comparison of its results.

Conclusion

In this overview, considerable heterogeneity of systematic reviews about MR was evidenced, especially regarding practice setting, population, MR approach and terminology. Description of patient care process of the primary studies is not clear in some reviews. These facts may limit the comparison, summarization and understanding of MR results. *"Medication Review"* was the most used terminology, whose main objective is the identification and resolution of DRPs to optimize the drug use. MR practice is mostly comprehended as *"intervention"*, and its main collaborator is the physician. Moreover, methodological quality of most systematic reviews was below ideal. In the light of what was mentioned, it is necessary to come to an international agreement regarding the work process of MR, as a clinical service or practice component, improving, then, the assessment, comparison and optimization of care quality given to patients.

Supporting information

S1 Table. Search strategy in databases.
(DOC)

S2 Table. List of excluded studies and reasons for exclusion. Abbreviation: MR—Medication Review.
(DOC)

S1 Checklist. PRISMA checklist. Abbreviations: NA: Not Applicable; U: Unrealized.
(DOC)

Acknowledgments

Author Contributions

Conceptualization: Rafaella de Oliveira Santos Silva, Luana Andrade Macêdo, Genival Araújo dos Santos, Júnior, Patrícia Melo Aguiar, Divaldo Pereira de Lyra, Júnior.

Formal analysis: Rafaella de Oliveira Santos Silva, Luana Andrade Macêdo, Genival Araújo dos Santos, Júnior.

Investigation: Rafaella de Oliveira Santos Silva, Luana Andrade Macêdo, Genival Araújo dos Santos, Júnior.

Project administration: Divaldo Pereira de Lyra, Júnior.

Supervision: Patrícia Melo Aguiar, Divaldo Pereira de Lyra, Júnior.

Writing – original draft: Rafaella de Oliveira Santos Silva, Luana Andrade Macêdo, Patrícia Melo Aguiar, Divaldo Pereira de Lyra, Júnior.

Writing – review & editing: Rafaella de Oliveira Santos Silva, Luana Andrade Macêdo, Divaldo Pereira de Lyra, Júnior.

References

1. Pharmaceutical Care Network Europe. Medication review definition approved. 2016 Feb 20 [cited 10 March 2016]. In: Pharmaceutical Care Network Europe Website [Internet]. Europe: Pharmaceutical Care Network Europe (PCNE) 2016. http://www.pcne.org/news/35/medication-review-definition-approved.

2. Blenkinsopp A, Bond C, Raynor DK. Medication reviews. Br J Clin Pharmacol. 2012; 74(4): 573–580. https://doi.org/10.1111/j.1365-2125.2012.04331.x PMID: 22607195

3. Clyne W, Blenkinsopp A, Seal R. A guide to medication review. London: National Prescribing Centre (NPC), 2008.

4. Pharmacy Council of New Zealand. Medicines management: definition, levels, competence framework. Wellington: Pharmacy Council of New Zealand; 2006.

5. American Pharmacists Association, National Association of Chain Drug Stores Foundation. Medication therapy management in pharmacy practice: core elements of an MTM service model (version 2.0). J Am Pharm Assoc. 2008; 48(3): 341–353.

6. Aslani P, Krass I. Adherence: a review of education, research, practice and policy in Australia. Pharm Pract (Granada). 2009; 7(1): 1–10.

7. Nunes-da-Cunha I, Arguello B, Martinez FM, Fernandez-Llimos F. Comparison of patient-centered care in pharmacy curricula in the United States and Europe. Am J Pharm Educ. 2016; 80(5): 83. Available from: https://www.ajpe.org/doi/10.5688/ajpe80583 PMID: 27402986

8. Australian Government. Department of Health and Ageing. Domiciliary medication management— home medicines review: helping your patients manage Their Medicines at Home. Canberra: Australian Government; 2005.

9. Pharmacy Guild of Australia and Australian Divisions of General Practice Limited. Home medicines review: information for pharmacy staff. Canberra: Pharmacy Guild of Australia and Australian Divisions of General Practice Limited; 2005.

10. Bedouch P, Tessier A, Baudrant M, Labarere J, Foroni L, Calop J, et al. Computerized physician order entry system combined with on-ward pharmacist: analysis of pharmacists' interventions. J Eval Clin Pract. 2012; 18(4): 911–918. https://doi.org/10.1111/j.1365-2753.2011.01704.x PMID: 21689216

11. Bülow C, Faerch KU, Armandi H, Jensen BN, Sonne J, Christensen HR, et al. Important Aspects of pharmacist-led medication reviews in an acute medical ward. Basic Clin Pharmacol Toxicol. 2018; 122(2): 253–261. https://doi.org/10.1111/bcpt.12901 PMID: 28871627

12. Chau SH, Jansen AP, van de Ven PM, Hoogland P, Elders PJ, Hugtenburg JG. Clinical medication reviews in elderly patients with polypharmacy: a cross-sectional study on drug-related problems in the Netherlands. Int J Clin Pharm. 2016; 38(1): 46–53. https://doi.org/10.1007/s11096-015-0199-8 PMID: 26597955

13. 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(1): 145. Available from: https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-016-1384-8

14. Costa FA, Silvestre L, Periquito C, Carneiro C, Oliveira P, Fernandes AI, et al. Drug-related problems identified in a sample of Portuguese institutionalised elderly patients and pharmacists' interventions to improve safety and effectiveness of medicines. Drugs Real World Outcomes. 2016; 3(1): 89–97. https://doi.org/10.1007/s40801-016-0061-x PMID: 27747806

15. Tang MM, Wollsen MG, Aagaard L. Pain monitoring and medication assessment in elderly nursing home residents with dementia. J Res Pharm Pract. 2016; 5(2): 126–131. https://doi.org/10.4103/2279-042X.179578 PMID: 27162807

16. Rose O, Mennemann H, John C, Lautenschläger M, Mertens-Keller D, Richling K, et al. Priority setting and influential factors on acceptance of pharmaceutical recommendations in collaborative medication reviews in an ambulatory care setting—analysis of a cluster randomized controlled trial (WestGem-Study). PLoS One. 2016; 11(6): e0156304. Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0156304 PMID: 27253380

17. Basheti IA, Al-Qudah RA, Obeidat NM, Bulatova NR. Home medication management review in outpatients with chronic diseases in Jordan: a randomized control trial. Int J Clin Pharm. 2016; 38(2): 404–413. https://doi.org/10.1007/s11096-016-0266-9 PMID: 26960406

18. Chen TF. Pharmacist-Led home medicines review and residential medication management review: the Australian model. Drugs Aging. 2016; 33(3): 199–204. https://doi.org/10.1007/s40266-016-0357-2 PMID: 26961696

19. Gallagher J, O'Sullivan D, McCarthy S, Gillespie P, Woods N, O'Mahony D, et al. Structured pharmacist review of medication in older hospitalised patients: a cost-effectiveness analysis. Drugs Aging. 2016; 33(4): 285–294. https://doi.org/10.1007/s40266-016-0348-3 PMID: 26861468

20. McKean M, Pillans P, Scott IA. A medication review and deprescribing method for hospitalised older patients receiving multiple medications. Intern Med J. 2016; 46(1): 35–42. https://doi.org/10.1111/imj.12906 PMID: 26387783

21. Geurts MME, Stewart RE, Brouwers JRBJ, Graeff PA, Gier JJ. Implications of a clinical medication review and a pharmaceutical care plan of polypharmacy patients with a cardiovascular disorder. Int J Clin Pharm. 2016; 38: 808–815. https://doi.org/10.1007/s11096-016-0281-x PMID: 27052212

22. Ocampo CC, Garcia-Cardenas V, Martinez-Martinez F, Benrimoj SI, Amariles P, Gastelurrutia MA. Implementation of medication review with follow-up in a Spanish community pharmacy and its achieved outcomes. Int J Clin Pharm. 2015; 37(5): 931–940. https://doi.org/10.1007/s11096-015-0145-9 PMID: 26040837

23. Nishtala PS, Castelino RL, Peterson GM, Hannan PJ, Salahudeen MS. Residential medication management reviews of antithrombotic therapy in aged care residents with atrial fibrillation: assessment of stroke and bleeding risk. J Clin Pharm Ther. 2016; 41(3): 279–284. https://doi.org/10.1111/jcpt.12385 PMID: 27062272

24. Adams RP, Barton G, Bhattacharya D, Grassby PF, Holland R, Howe A, et al. Supervised pharmacy student-led medication review in primary care for patients with type 2 diabetes: a randomised controlled pilot study. BMJ Open. 2015; 5(11): e009246. Available from: https://bmjopen.bmj.com/content/bmjopen/5/11/e009246.full.pdf https://doi.org/10.1136/bmjopen-2015-009246 PMID: 26537500

25. Hanna M, Larmour I, Wilson S, O'Leary K. The impact of a hospital outreach medication review service on hospital readmission and emergency department attendances. J Pharm Pract Res. 2016; 46(2): 112–121.

26. Malet-Larrea A, Goyenechea E, García-Cárdenas V, Calvo B, Arteche JM, Aranegui P, Zubeldia JJ, et al. The impact of a medication review with follow-up service on hospital admissions in aged polypharmacy patients. Br J Clin Pharmacol. 2016; 82(3): 831–838. https://doi.org/10.1111/bcp.13012 PMID: 27195696

27. Jokanovic N, Tan EC, Sudhakaran S, Kirkpatrick CM, Dooley MJ, Ryan-Atwood TE, et al. Pharmacist-led medication review in community settings: An overview of systematic reviews. Res Social Adm Pharm. 2017; 13(4): 661–685. https://doi.org/10.1016/j.sapharm.2016.08.005 PMID: 27665364

28. Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C, et al. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol. 2007; 7: 10. Available from: https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/1471-2288-7-10 PMID: 17302989

29. Shaw J, Seal R, Pilling M. Task force on medicines partnership and the national collaborative medicines management services programme. Room for review—a guide to medication review: the agenda for patients, practitioners and managers. London: Medicines partnership; 2002.

30. National Center for Biotechnology Information. 2016 [cited 2016 Apr 28]. In: MeSH (Medical Subject Headings) [Internet]. Bethesda: U.S. National Library of Medicine 2016. http://www.ncbi.nlm.nih.gov/mesh.

31. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Syst Rev. 2016; 5: 210. Available from: https://systematicreviewsjournal.biomedcentral.com/articles/10.1186/s13643-016-0384-4 PMID: 27919275

32. Kozma CM, Reeder CE, Schulz RM. Economic, clinical, and humanistic outcomes: a planning model for pharmacoeconomic research. Clin Ther. 1993; 15(6): 1121–1132. PMID: 8111809

33. Donabedian A. Evaluating the quality of medical care. Milbank Mem Fund Q. 1966; 44: 166–206.

34. Donabedian A. The quality of care. How can it be assessed? JAMA. 1988; 260(12): 1743–1748. PMID: 3045356

35. Mikton C, Butchart A. Child maltreatment prevention: a systematic review of reviews. Bull World Health Organ. 2009; 87(5): 353–361. https://doi.org/10.2471/BLT.08.057075 PMID: 19551253

36. Hosmer DW, Lemeshow S. Applied logistic regression. 2nd ed. New York: Wiley; 1989.

37. Holland R, Desborough J, Goodyer L, Hall S, Wright D, Loke YK. Does pharmacist-led medication review help to reduce hospital admissions and deaths in older people? A systematic review and meta-analysis. Br J Clin Pharmacol. 2008; 65(3): 303–316. https://doi.org/10.1111/j.1365-2125.2007.03071.x PMID: 18093253

38. Graabaek T, Kjeldsen LJ. Medication reviews by clinical pharmacists at hospitals lead to improved patient outcomes: a systematic review. Basic Clin Pharmacol Toxicol. 2013; 112(6): 359–373. https://doi.org/10.1111/bcpt.12062 PMID: 23506448

39. Kwint HF, Bermingham L, Faber A, Gussekloo J, Bouvy ML. The relationship between the extent of collaboration of general practitioners and pharmacists and the implementation of recommendations arising from medication review: a systematic review. Drugs Aging. 2013; 30(2): 91–102. https://doi.org/10.1007/s40266-012-0048-6 PMID: 23322285

40. Hadi MA, Alldred DP, Briggs M, Munyombwe T, Closs SJ. Effectiveness of pharmacist-led medication review in chronic pain management: systematic review and meta-analysis. Clin J Pain. 2014; 30(11): 1006–1014. https://doi.org/10.1097/AJP.0000000000000063 PMID: 24480911

41. Hatah E, Braund R, Tordoff J, Duffull SB. A systematic review and meta-analysis of pharmacist-led fee-for-services medication review. Br J Clin Pharmacol. 2014; 77(1): 102–115. https://doi.org/10.1111/bcp.12140 PMID: 23594037

42. Hohl CM, Wickham ME, Sobolev B, Perry JJ, Sivilotti ML, Garrison S, et al. The effect of early in-hospital medication review on health outcomes: a systematic review. Br J Clin Pharmacol. 2015; 80(1): 51–61. https://doi.org/10.1111/bcp.12585 PMID: 25581134

43. Jokanovic N, Tan EC, van den Bosch D, Kirkpatrick CM, Dooley MJ, Bell JS. Clinical medication review in Australia: a systematic review. Res Social Adm Pharm. 2016; 12(3): 384–418. https://doi.org/10.1016/j.sapharm.2015.06.007 PMID: 26250049

44. Loh ZW, Cheen MH, Wee HL. Humanistic and economic outcomes of pharmacist-provided medication review in the community-dwelling elderly: A systematic review and meta-analysis. J Clin Pharm Ther. 2016; 41(6): 621–633. https://doi.org/10.1111/jcpt.12453 PMID: 27696540

45. Renaudin P, Boyer L, Esteve MA, Bertault-Peres P, Auquier P, Honore S. Do pharmacist-led medication reviews in hospitals help reduce hospital readmissions? A systematic review and meta-analysis. Br J Clin Pharmacol. 2016; 82(6): 1660–1673. https://doi.org/10.1111/bcp.13085 PMID: 27511835

46. 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.e1–87.e14. Available from: https://www.jamda.com/article/S1525-8610(16)30482-0/pdf.

47. Bell S, McLachlan AJ, Aslani P, Whitehead P, Chen TF. Community pharmacy services to optimise the use of medications for mental illness: a systematic review. Aust New Zealand Health Policy. 2005; 2: 29. Available from: https://anzhealthpolicy.biomedcentral.com/articles/10.1186/1743-8462-2-29 PMID: 16336646

48. Chan P, Grindrod KA, Bougher D, Pasutto FM, Wilgosh C, Eberhart G, et al. A systematic review of remuneration systems for clinical pharmacy care services. Can Pharm J. 2008; 141(2): 102–112.

49. Nishtala PS, McLachlan AJ, Bell JS, Chen TF. Psychotropic prescribing in long-term care facilities: impact of medication reviews and educational interventions. Am J Geriatr Psychiatry. 2008; 16(8): 621–632. https://doi.org/10.1097/JGP.0b013e31817c6abe PMID: 18669940

50. Forsetlund L, Gjerberg E, Vist GE. Effect of interventions to reduce potentially inappropriate use of drugs in nursing homes: a systematic review of randomised controlled trials. BMC Geriatrics. 2011; 11: 16. Available from: https://bmcgeriatr.biomedcentral.com/articles/10.1186/1471-2318-11-16 PMID: 21496345

51. Loganathan M, Singh S, Franklin BD, Bottle A, Majeed A. Interventions to optimise prescribing in care homes: systematic review. Age Ageing. 2011; 40(2): 150–162. https://doi.org/10.1093/ageing/afq161 PMID: 21262782

52. Chen Y, Zhu LL, Zhou Q. Effects of drug pharmacokinetic/pharmacodynamic properties, characteristics of medication use, and relevant pharmacological interventions on fall risk in elderly patients. Ther Clin Risk Manag. 2014; 10: 437–448. https://doi.org/10.2147/TCRM.S63756 PMID: 24966681

53. Perraudin C, Bugnon O, Pelletier-Fleury N. Expanding professional pharmacy services in European community setting: Is it cost-effective? A systematic review for health policy considerations. Health Policy. 2016; 120(12): 1350–1362. https://doi.org/10.1016/j.healthpol.2016.09.013 PMID: 28228230

54. Bulajeva A, Labberton L, Leikola S, Pohjanoksa-Mäntylä M, Geurts MM, de Gier JJ, Airaksinen M. Medication review practices in European countries. Res Social Adm Pharm. 2014; 10(5): 731–740. https://doi.org/10.1016/j.sapharm.2014.02.005 PMID: 24661800

55. Pharmaceutical Society of Australia. Guidelines for pharmacists providing Home Medicines Review (HMR) services. Deakin West: Pharmaceutical Society of Australia (PSA); 2011.

56. Pharmaceutical Society of Australia. Guidelines for pharmacists providing Residential Medication Management Review (RMMR) and Quality Use of Medicines (QUM) services. Deakin West: Pharmaceutical Society of Australia (PSA); 2011.

57. Pharmaceutical Society of Australia. Guidelines for pharmacists providing medicines use review (MedsCheck) and diabetes medication management (Diabetes MedsCheck) services. Deakin West: Pharmaceutical Society of Australia (PSA); 2012.

58. Sistema Sanitario Publico Andaluz (Spain). Guía de trabajo para la revisión sistemática de medicación en pacientes polimedicados en Atención Primaria. Andaluz: Sistema Sanitario Publico Andaluz (SSPA); 2013.

59. National Health System (United Kingdom). Guidance on the medicines use review service. Pharmaceutical Services Negotiating Committee. United Kingdom: National Health System Employers; 2013.

60. Health and Social Care Board (United Kingdom). Medication review guidance. United Kingdom: Health and Social Care Board, 2016.

61. Stewart K, George J, Mc Namara KP, Jackson SL, Peterson GM, Bereznicki LR, et al. A multifaceted pharmacist intervention to improve antihypertensive adherence: a cluster-randomized, controlled trial (HAPPy trial). J Clin Pharm Ther. 2014; 39(5): 527–534. https://doi.org/10.1111/jcpt.12185 PMID: 24943987

62. Bereznicki LR, van Tienen EC, Stafford A. Home medicines reviews in Australian war veterans taking warfarin do not influence international normalised ratio control. Intern Med J. 2016; 46(3): 288–294. https://doi.org/10.1111/imj.12964 PMID: 26602177

63. Palagyi A, Keay L, Harper J, Potter J, Lindley RI. Barricades and brickwalls—a qualitative study exploring perceptions of medication use and deprescribing in long-term care. BMC Geriatr. 2016; 16: 15. Available from: https://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-016-0181-x PMID: 26767619

64. López TM, Camacho JCD, Morgado DP, Camacho MLC, Serna JCM, Rubio SL. A review of the medication in polymedicated elderly with vascular risk: a randomised controlled trial. Aten Primaria. 2012; 44(8): 453–460. https://doi.org/10.1016/j.aprim.2011.09.015 PMID: 22341703

65. Blundell DB. Revisión de medicación según criterios STOPP/START en pacientes mayores del servicio de sistema personalizado de dosificación de medicamentos de una farmacia comunitária. Farmacéuticos comunitarios. 2015; 7(2): 31–36.

66. Patel CH, Zimmerman KM, Fonda JR, Linsky A. Medication complexity, medication number, and their relationships to medication discrepancies. Ann Pharmacother. 2016; 50(7): 534–540. https://doi.org/10.1177/1060028016647067 PMID: 27147704

67. Wang J, Shih YCT, Qin Y, Young T, Thomas Z, Spivey CA, et al. Trends in Medicare Part D medication therapy management eligibility criteria. Am Health Drug Benefits. 2015; 8(5): 247–255. PMID: 26380030

68. Leikola SN, Tuomainen L, Peura S, Laurikainen A, Lyles A, Savela E, et al. Comprehensive medication review: development of a collaborative procedure. Int J Clin Pharm. 2012; 34(4): 510–514. https://doi.org/10.1007/s11096-012-9662-y PMID: 22711383

69. Koskela T, Sandström S, Mäkinen J, Liira H. User perspectives on an electronic decision-support tool performing comprehensive medication reviews—a focus group study with physicians and nurses. BMC Med Inform Decis Mak. 2016; 166: 6. Available from: https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-016-0245-z

70. Ramsbottom HF, Fitzpatrick R, Rutter P. Post discharge medicines use review service for older patients: recruitment issues in a feasibility study. Int J Clin Pharm. 2016; 38(2): 208–212. https://doi.org/10.1007/s11096-015-0243-8 PMID: 26746903

71. Rodgers RM, Gammie SM, Loo RL, Corlett SA, Krska J. Comparison of pharmacist and public views and experiences of community pharmacy medicines-related services in England. Patient Prefer Adherence. 2016; 10: 1749–58. https://doi.org/10.2147/PPA.S112931 PMID: 27672313

72. Benrimoj SI, Feletto E, Gastelurrutia MA, Martinez MF, Faus MJ. Un enfoque holístico e integrado de la implantación de los servicios farmacéutico cognitivos. Ars Pharmaceutica. 2010; 51(2): 69–87.

73. Correr CJ, Rotta I, Salgado TM, Fernandez-Llimos F. Tipos de serviços farmacêuticos clínicos: o que dizem as revisões sistemáticas? Acta Farmacêutica Portuguesa. 2013; 2(1): 21–34.

74. Pan American Health Organization. Primary health care based pharmaceutical services: PAHO/WHO position paper. Washington: Pan American Health Organization (PAHO); 2013.

75. Franklin BD, van Mil J. Defining clinical pharmacy and pharmaceutical care. Pharm World Sci. 2005; 27(3): 137. Available from: https://link.springer.com/article/10.1007%2Fs11096-005-7060-4 PMID: 16096876

76. Rodis J, Pruchnicki MC, Casper KA, Bennett MS, Mehta BH. The importance of terminology in the profession of pharmacy. Am J Pharm Educ. 2009; 73(4): 74. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2720370/

77. Ahmed SI, Hasan SS. Clinical pharmacy and pharmaceutical care: a need to homogenize the concepts. Am J Pharm Educ. 2010; 74(10): 193g. PMID: 21436940

78. Scahill SL, Atif M, Babar ZU. Defining pharmacy and its practice: a conceptual model for an international audience. Integr Pharm Res Pract. 2017; 6: 121–129. https://doi.org/10.2147/IPRP.S124866 PMID: 29354558

79. van Mil JW, Henman M. Terminology, the importance of defining. Int J Clin Pharm. 2016; 38(3): 709–713. https://doi.org/10.1007/s11096-016-0294-5 PMID: 27073076

80. Pintor-Marmol A, Baena MI, Fajardo PC, Sabater-Hernandez D, Saez-Benito L, Garcia-Cardenas MV, et al. Terms used in patient safety related to medication: a literature review. Pharmacoepidemiol Drug Saf. 2012; 21(8): 799–809. https://doi.org/10.1002/pds.3296 PMID: 22678709

81. International Pharmaceutical Federation. The Tokyo Declaration: Standards for quality of pharmacy services. Tokyo: Federation Internationale Pharmaceutique (FIP); 1993.

82. World Health Organization. WHO Expert Committee on Specifications for Pharmaceutical Preparations—WHO Technical Report Series, no. 885—Thirty-fifth Report. Annex 7: Good manufacturing practices: supplementary guidelines for the manufacture of pharmaceutical excipients. Geneva: World Health Organization (WHO); 1999.

83. World Health Organization; International Pharmaceutical Federation. WHO Expert Committee on Specifications for Pharmaceutical Preparations—WHO Technical Report Series, no. 961—Fortieth-fifth Report. Annex 8: Good pharmacy practice: standards for quality of pharmacy services (joint FIP/WHO). Switzerland: World Health Organization (WHO); 2011.

84. Kötter T, Blozik E, Scherer M. Methods for the guideline-based development of quality indicators—a systematic review. Implement Sci. 2012; 7: 21. Available from: https://implementationscience.biomedcentral.com/articles/10.1186/1748-5908-7-21 PMID: 22436067

85. Santos GA Júnior, Marques TC, Silva ROS, Silvestre CC, Lyra DP, Silva FA. Quality indicators to medication review services: evaluation of the structure. Lat Am J Pharm. 2015; 34: 1172–1179.

86. Weiss BD, Brega AG, LeBlanc WG, Mabachi NM, Barnard J, Albright K, et al. Improving the effectiveness of medication review: guidance from the health literacy universal precautions toolkit. J Am Board Fam Med. 2016; 29(1): 18–23. https://doi.org/10.3122/jabfm.2016.01.150163 PMID: 26769873

87. Leikola SN, Virolainen J, Tuomainen L, Tuominen RK, Airaksinen MS. Comprehensive medication reviews for elderly patients: findings and recommendations to physicians. J Am Pharm Assoc (2003). 2012; 52(5): 630–633.

88. Vouri SM, Stranges PM, Burke JM, Micek S, Pitlick MK, Wenger P. The importance of research during pharmacy residency training. Curr Pharm Teach Learn. 2015; 7(6): 892–898. https://doi.org/10.1016/j.cptl.2015.08.018 PMID: 26594260

89. Moles RJ, Stehlik P. Pharmacy practice in Australia. Can J Hosp Pharm. 2015; 68(5): 218–226.

90. Knoer SJ, Eck AR, Lucas AJ. A review of American pharmacy: education, training, technology, and practice. J Pharm Health Care Sci. 2016; 2: 32. Available from: https://jphcs.biomedcentral.com/articles/10.1186/s40780-016-0066-3 PMID: 27843574

91. Accreditation Council for Pharmacy Education. Accreditation standards and key elements for the professional program in pharmacy leading to the Doctor of Pharmacy degree ("Standards 2016"). Chicago: Accreditation Council for Pharmacy Education (ACPE); 2015.

92. Tarn DM, Paterniti DA, Kravitz RL, Fein S, Wenger NS. How Do Physicians conduct medication reviews? J Gen Intern Med. 2009; 24(12): 1296–1302. https://doi.org/10.1007/s11606-009-1132-4 PMID: 19813063

93. Griffiths R, Johnson M, Piper M, Langdon R. A nursing intervention for the quality use of medicines by elderly community clients. Int J Nurs Pract. 2004; 10(4): 166–176. https://doi.org/10.1111/j.1440-172X.2004.00476.x PMID: 15265227

94. Federal Council of Pharmacy (Brazil). Pharmaceutical prescription and the clinical attributions of the pharmacist. Brazil: Federal Council of Pharmacy (CFF); 2016.

95. Brito GC. Serviços clínicos farmacêuticos em unidades do programa Farmácia Popular do Brasil do estado de Sergipe: implantação, implementação e consolidação. Ph.D. Thesis, Federal University of Sergipe. 2015. https://ri.ufs.br/bitstream/riufs/3592/1/GISELLE_CARVALHO_BRITO.pdf

96. Marques TC. Avaliação de indicadores de estrutura e processo na implementação de um serviço de Revisão da Farmacoterapia. Ph.D. Thesis, Federal University of Sergipe. 2015. https://ri.ufs.br/bitstream/riufs/3572/1/TATIANE_CRISTINA_MARQUES.pdf

97. Rigoni CC, Brito ES, Alano GM, Galato D. Pharmacotherapy review: a proposal to improve medication adherence among hypertensive patients. Braz J Pharm Sci. 2015; 51(4): 763–773.

98. Casserlie LM, Mager NAP. Pharmacists' perceptions of advancing public health priorities through medication therapy management. Pharm Pract (Granada). 2016; 14(3): 792. Available from: https://www.pharmacypractice.org/journal/index.php/pp/article/view/792/464

99. Dolovich L, Consiglio G, MacKeigan L, Abrahamyan L, Pechlivanoglou P, Rac VE, et al. Uptake of the MedsCheck annual medication review service in Ontario community pharmacies between 2007 and 2013. Can Pharm J. 2016; 149(5): 293–302.

100. Karani MV, Haddad Y, Lee R. The role of pharmacists in preventing falls among America's older adults. Front Public Health. 2016; 4: 250. Available from: https://dx.doi.org/10.3389/fpubh.2016.00250 PMID: 27882314

101. SHPA Commitee of Specialty Practice in Clinical Pharmacy. SHPA Standards of practice for clinical pharmacy services. J Pharm Pract Res. 2005; 35(2): 122–146.

102. Suggett E, Marriott J. Risk factors associated with the requirement for pharmaceutical intervention in the hospital setting: a systematic review of the Literature. Drugs Real World Outcomes. 2016; 3(3): 241–263. https://doi.org/10.1007/s40801-016-0083-4 PMID: 27747829

103. Pan American Health Organization. Brazilian consensus on pharmaceutical care: proposal. Brasília: Pan American Health Organization (PAHO); 2002.

104. Cipolle RJ, Strand LM, Morley PC. Pharmaceutical care practice. 3rd ed. New York: McGraw-Hill; 2012.

105. Jorgenson D, Dalton D, Farrell B, Tsuyuki RT, Dolovich L. Guidelines for pharmacists integrating into primary care teams. Can Pharm J (Ott). 2013; 146(6): 342–352.

106. Kelly DV, Young S, Phillips L, Clark D. Patient attitudes regarding the role of the pharmacist and interest in expanded pharmacist services. Can Pharm J (Ott). 2014; 147(4): 239–247.

107. Huiskes VJB, Burger DM, van den Ende CMH, van den Bemt BJF. Effectiveness of medication review: a systematic review and meta-analysis of randomized controlled trials. BMC Fam Pract. 2017; 18: 5. Available from: https://bmcfampract.biomedcentral.com/articles/10.1186/s12875-016-0577-x PMID: 28095780

108. Melchiors AC, Correr CJ, Venson R, Pontarolo R. An analysis of quality of systematic reviews on pharmacist health interventions. Int J Clin Pharm. 2012; 34(1): 32–42. https://doi.org/10.1007/s11096-011-9592-0 PMID: 22183578

109. Aguiar PM, Brito GD, Correr CJ, Lyra DP Júnior, Storpirtis S. Exploring the quality of systematic reviews on pharmacist interventions in patients with diabetes: an overview. Ann Pharmacother. 2014; 48(7): 887–996. https://doi.org/10.1177/1060028014529411 PMID: 24692605

110. Rotta I, Salgado TM, Silva ML, Correr CJ, Fernandez-Llimos F. Effectiveness of clinical pharmacy services: an overview of systematic reviews (2000–2010). Int J Clin Pharm. 2015; 37(5): 687–697. https://doi.org/10.1007/s11096-015-0137-9 PMID: 26001356

111. Wegewitz U, Weikert B, Fishta A, Jacobs A, Pieper D. Resuming the discussion of AMSTAR: What can (should) be made better? BMC Med Res Methodol. 2016; 16(1): 111. Available from: https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/s12874-016-0183-6 PMID: 27566440

112. Burda BU, Holmer HK, Norris SL. Limitations of A Measurement Tool to Assess Systematic Reviews (AMSTAR) and suggestions for improvement. Syst Rev. 2016; 5: 58. Available from: https://systematicreviewsjournal.biomedcentral.com/articles/10.1186/s13643-016-0237-1 PMID: 27072548