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SYSTEMATIC REVIEW AND META-ANALYSIS

Identification of behaviour change techniques in deprescribing interventions: a systematic review and meta-analysis

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Keywords behaviour change techniques, deprescribing, meta-analysis, systematic review

AIMS

Deprescribing interventions safely and effectively optimize medication use in older people. However, questions remain about which components of interventions are key to effectively reduce inappropriate medication use. This systematic review examines the behaviour change techniques (BCTs) of deprescribing interventions and summarizes intervention effectiveness on medication use and inappropriate prescribing.

METHODS

MEDLINE, EMBASE, Web of Science and Academic Search Complete and grey literature were searched for relevant literature. Randomized controlled trials (RCTs) were included if they reported on interventions in people aged ≥65 years. The BCT taxonomy was used to identify BCTs frequently observed in deprescribing interventions. Effectiveness of interventions on inappropriate medication use was summarized in meta-analyses. Medication appropriateness was assessed in accordance with STOPP criteria, Beers' criteria and national or local guidelines. Between-study heterogeneity was evaluated by I-squared and Chi-squared statistics. Risk of bias was assessed using the Cochrane Collaboration Tool for randomized controlled studies.

RESULTS

Of the 1561 records identified, 25 studies were included in the review. Deprescribing interventions were effective in reducing number of drugs and inappropriate prescribing, but a large heterogeneity in effects was observed. BCT clusters including *goals and planning*; *social support*; *shaping knowledge*; *natural consequences*; *comparison of behaviour*; *comparison of outcomes*; *regulation*; *antecedents*; and *identity* had a positive effect on the effectiveness of interventions.

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CONCLUSIONS

In general, deprescribing interventions effectively reduce medication use and inappropriate prescribing in older people. Successful deprescribing is facilitated by the combination of BCTs involving a range of intervention components.

Introduction

Older people (aged ≥65 years) are more vulnerable to medication-related harm and inappropriate prescribing than younger chronically medicated people [1, 2]. Age-related physiological changes contribute to iatrogenic vulnerability in older people, but it is equally a consequence of their multimorbidity and frequent use of multiple medications [1, 3–7]. Vulnerability, polypharmacy and multimorbidity represent complex challenges in the care of older people and often exclude them from clinical trials [6, 8–10]. Therefore, some prescriptions in multimorbid older people are without clear-cut evidence to support them and inappropriate prescribing is highly prevalent [11–13]. Excessive inappropriate prescribing in older people has turned the focus of current research towards deprescribing – the systematic process of identifying and discontinuing drugs in patients for which existing and potential harms outweigh the benefits [14]. Making informed decisions to deprescribe with the goal of reducing inappropriate prescribing and improving patient outcome is hampered by a lack of evidence of withdrawal effects in older people and is further challenged by prescriber- and patient-related factors [15, 16].

Research has demonstrated safety and effectiveness of deprescribing in older people (aged ≥65 years) [17] whilst reluctance of prescribers to deprescribe a medication commenced by another prescriber is described as well [18]. Although evidence suggests that pharmacist involvement and patient-centred interventions are effective, the best ways to engage and support prescribers in deprescribing remain unclear [16, 19–23]. Previous reviews examining the effects of deprescribing interventions on clinical outcomes call for a better understanding of successful implementation of deprescribing [6, 17–19].

Within the clinical context of patient care, there is a need to ensure that behaviour change is a part of any intervention design in order to maximize the chance that prescribers are enacting on recommendations [24, 25]. Recent advances in behavioural science provide insight into the components of complex interventions aiming at behaviour change. The Behaviour Change Techniques (BCTs) taxonomy version 1 (BCTTv1) [26] is designed to assist in the identification of BCTs of interventions. A BCT is defined as 'an observable, replicable, and irreducible component of an intervention designed to alter or redirect causal processes that regulate behaviour' [27]. A clear description of BCTs will clarify the essential content of these complex interventions in a consistent way to assist in future replication of effective interventions [28]. The application of the BCT taxonomy to deprescribing is novel. This review was designed to complement previous reviews [6, 17, 19] on deprescribing by offering a broader analysis of behaviour change techniques in deprescribing interventions.

The aims of this review are (i) to identify behaviour change techniques used more frequently in interventions effective in reducing number of drugs and inappropriate prescribing, (ii) to describe other characteristics of deprescribing interventions and (iii) to determine intervention effectiveness on drug use, prescribing appropriateness and Medication Appropriateness Index (MAI) score in meta-analyses.

Methods

A systematic search of the primary, secondary and grey literature to identify randomized controlled trials (RCTs) on deprescribing was undertaken on December 14, 2016. This systematic review was reported according to the PRISMA guidelines for systematic reviews and meta-analyses [29], and was registered in Prospero (record no. CRD42016037730).

Search strategy

The search strategy was designed in conjunction with an experienced medical librarian (JM) who was trained in systematic review methodology. A combination of text words and subject headings (such as MeSH terms) related to the intervention was used, without restricting publication date or language (Table S1).

The following electronic bibliographic databases were searched: MEDLINE, EMBASE, The Cochrane Central Register of Controlled Trials, Web of Science and Academic Search Complete. Grey literature was searched via the Google Scholar® search engine and from screening reference lists of included studies as well as relevant systematic reviews. Additional searches were done in the System for Information on Grey Literature in Europe (OpenSIGLE) and the clinical trial registries, namely ClinicalTrials.gov, International Standard Registered Clinical/soCial sTudy Number (ISRCTN), WHO International Clinical Trials Registry Platform (ICTRP) and the Australian New Zealand Clinical Trials Register (ANZCTR).

Study selection

One reviewer (C.H.) screened titles of all retrieved citations. Two reviewers (C.H. and S.C.) independently screened abstracts and full-texts for eligibility according to protocol-defined inclusion and exclusion criteria. Any disagreements between reviewers were resolved by consensus and both reviewers agreed on the final inclusion of studies.

Inclusion and exclusion criteria

Inclusion was restricted to randomized controlled study design, including randomized controlled trials (RCTs) and cluster RCTs. The control group could involve either active interventions or inactivity, e.g. sham or no intervention. This

study design was chosen to allow for between-study comparison of intervention effectiveness in meta-analyses. Studies were included if they reported on interventions encouraging the deprescribing of existing drugs or the reduction of existing inappropriate prescribing. Only those interventions involving older patients (aged ≥65 years) or a healthcare professional with prescribing, dispensing or administration authority were included. No restrictions were applied to language, clinical setting of the intervention, sample size, blinding procedures or other design characteristics. We excluded interventions specifically focusing on the clinical effects of drug withdrawal processes, e.g. opioid withdrawal effects.

Risk of bias assessment

Risk of bias was assessed separately by two reviewers (C.H. and A.R.) using the Cochrane Collaboration Tool for randomized controlled studies [30] with a descriptive purpose of summarizing the quality of the studies that met inclusion criteria. Studies were not excluded from data analysis because of methodological flaws if they otherwise met inclusion criteria. Incomplete outcome data was in general rated as high risk of bias if the loss of patients to follow-up was 20% or higher and rated as low risk of bias if the loss was 10% or less. Imbalance in the numbers lost to follow-up between intervention and control groups was also considered to introduce bias. The risk of bias assessment is described in detail in Table S2.

Data extraction strategy

Data were collected using a pre-agreed data extraction form (see Table S3). Two reviewers (C.H. and L.S.) independently pilot tested the form on two randomly chosen studies both included in the review. Thereafter data extraction on all studies was completed independently by L.S. and C.H. Disagreements on study inclusion/exclusion were resolved by discussion leading to consensus; where consensus could not be achieved, the study was excluded. Primary outcomes were: (i) number of total and inappropriate prescriptions and/or drugs as defined in the individual studies according to prescribing appropriateness criteria, e.g. STOPP criteria, Beers' criteria and local or national prescribing guidelines; (ii) proportion of participants with a reduction in number of total and inappropriate prescriptions and/or drugs; and (iii) implementation of recommendations. Secondary outcome was change in MAI score.

Behaviour change techniques coding

Coding of BCTs was performed independently by two reviewers (C.H. for all interventions and C.J.A., S.T. and L.S. for a subset of interventions each) by identifying BCTs for each intervention using the BCTTv1 [26]. C.H. had completed online training in BCTTv1. A coding manual and instructions made by C.H. were given to the other reviewers and, exercises from the online training were made available to them. Any questions about the coding were solved by discussion and consensus between the reviewers. The target behaviour was the decision making to discontinue a drug or an inappropriate prescription. Findings were tabulated across studies by computing frequencies. The information was used to determine the BCTs used more frequently in studies that reported effectiveness of interventions to reduce number of drugs and/or improve prescribing appropriateness.

Statistical analysis

We calculated odds ratios (OR) with standard deviations (SD) for each of the reported outcomes and used RevMan v5.3 to statistically combine the outcome data [31]. Continuous outcomes were expressed as difference in means between groups with a 95% confidence interval (95% CI). The level of between-study heterogeneity was evaluated by calculation of the I^2 and Chi-squared statistics. Where possible, stratified random effects meta-analyses was used to identify factors affecting intervention effectiveness. Subgroup analyses were performed by risk of bias assessment, intervention setting and intervention target. If the level of reporting did not allow for inclusion of a study in one or more meta-analyses, additional information was sought from the study authors. If the information was not made available, the study was excluded from the meta-analysis.

Results

Literature search and review process

The database search identified 1444 records, and grey literature yielded 117 records. After removal of duplicates and title screening, 178 abstracts were screened for eligibility and 58 of these met the inclusion criteria. Assessment of full texts resulted in 25 studies included in this review [32–56]. Study selection and reasons for exclusion are illustrated in Figure 1.

Study characteristics

Included studies were RCTs (n = 22) [32–41, 43–45, 47, 49–56] and cluster RCTs (n = 3) [42, 46, 48] with a follow-up period from 6 weeks [45] to 13 months [42]. A total of 20 812 patients were enrolled in the studies ranging from 95 [41] to 1188 per study [55]. Detailed study characteristics are provided in Table 1. Three studies aimed primarily to reduce the number of drugs taken by patients [41, 44, 46]. Other objectives included reduced prevalence of inappropriate medications [32, 33, 38, 39, 42, 49], improved prescribing appropriateness [34–36, 47, 50–55], or better patient health outcomes and medicines management [35, 40, 48, 56]. Ten out of the 25 studies included in this review showed evidence to support intervention effectiveness [34, 35, 37, 40, 41, 45, 46, 50, 53, 56]. Most of the studies reporting intervention effectiveness of the key outcomes of this review delivered recommendations or feedback to the prescriber orally, often face-to-face, and many of them followed up on the recommendations/feedback given. Recommendations and feedback were given immediately after identification of a problem or at the time of prescribing using an on-demand service. For studies reporting no intervention effectiveness on the key outcomes, some delivered recommendations using written communication and many of the interventions did not follow up on the recommendations with the prescriber. None

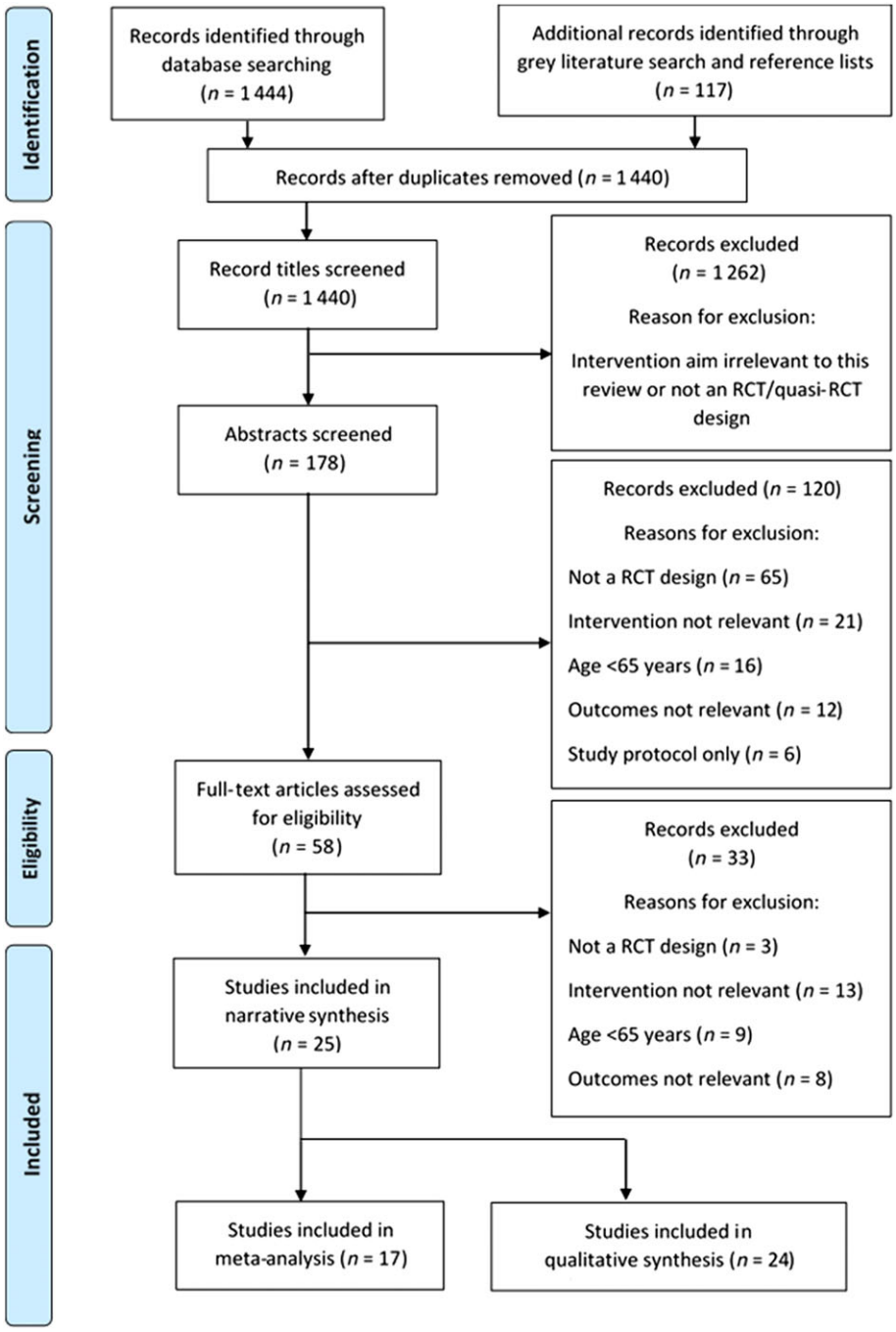


Figure 1
PRISMA flow chart of study selection

of the included studies reported the use of explicit theories of behaviour change as part of the interventions and no study reported the use of a systematic and theoretical approach, such as the UK Medical Research Council's complex intervention framework [57], in the intervention design. Reported educational interventions were based on the principles of constructive learning theory in one study [39] and social constructivist learning and self-efficacy theory in another study [46].

Risk of bias

Risk of bias assessment is illustrated in Figure 2. Risk of bias not pertaining to any of the defined categories were categorized as 'others' and these are described in Table S2.

Behaviour change techniques

All but one study [48] reported the behaviour change components underpinning the intervention. The BCT coding is

Table 1

Characteristics of included studies (n = 25)

Author (year)	Country Setting	No. of patients % Female	Mean age of patients (±SD), years	Intervention (I) Delivered by (D)	Target behaviour Target person(s) (P)
Allard *et al.* (2001) [32]	Canada Community	266 67.7%	80.6 (4.5)	(I) Medication review and suggestions made and mailed to GPs (D) Multidisciplinary team of physicians, pharmacists and nurses	Reducing the number of potentially inappropriate prescriptions given. (P) GPs.
Bregnhøj *et al.* (2009) [47]	Denmark Primary care physician practice	212 66.1%	76.5 (7.2)	(I) Interactive educational meeting (single intervention) and combined with individualized feedback on prescribed medication (combined intervention) (D) Clinical pharmacologist and pharmacists	Improving prescribing appropriateness. (P) GPs.
Crotty *et al.* (2004) [48]	Australia Nursing home	154 59.6%	84.5 (5.0)	(I) Medication review and case conferences (D) Multidisciplinary team of geriatrician, pharmacist, representative of the Alzheimer's Association of South Australia	Improving medication appropriateness. (P) Residential care staff and residents' GPs.
Dalleur *et al.* (2014) [33]	Belgium Teaching hospital	146 63.0%	85.0 (5.2)	(I) Medication review and recommendations provided to discontinue medications based on the STOPP criteria (D) Multidisciplinary team of nurses, geriatricians, dietician, occupational therapist, physiotherapist, speech therapist and psychologist	Discontinuation of PIMs (P) Hospital physicians
Fick *et al.* (2004) [49]	USA Primary care physician practice	Not specified	Not specified	(I) Decision support service comprising educational brochure, list of suggested inappropriate medications based on the STOPP criteria, and list of patients with STOPP criteria identified (D) Research team and expert panel of physicians and pharmacists	Changing prescribing behaviour and decreasing PIM use. (P) GPs
Frankenthal *et al.* (2014) [56]	IsraelChronic care geriatric facility	239 66.6%	82.7 (8.7)	(I) Medication review and recommendations provided based on the STOPP/ START criteria (D) Study pharmacist	Improving clinical and economic outcomes by giving STOPP/START recommendations. (P) Chief physicians.
Gallagher *et al.* (2011) [34]	Ireland Teaching hospital	382 53.1%	75.6 (7.3)	(I) Medication review and recommendations provided to change medications based on the STOPP/START criteria (D) Research physician	Improving prescribing appropriateness (P) Hospital physician and medical care team
García-Gollarte *et al.* (2014) [35]	Spain Nursing home	1018 73.0%	84.4 (12.7)	(I) Educational workshops, material and on-demand advice on prescriptions (D) Nursing home physician with geriatric expertise	Improving the quality of prescriptions (P) Nursing home physicians
Hanlon *et al.* (1996) [36]	USA Ambulatory clinic	172 1.0%[a]	69.8 (3.8)	(I) Medication review and prescribing recommendations provided	Improving prescribing appropriateness (P) GPs and patients

(continues)

Table 1

(Continued)

Author (year)	Country Setting	No. of patients % Female	Mean age of patients (±SD), years	Intervention (I) Delivered by (D)	Target behaviour Target person(s) (P)
				(D) Pharmacists	
Lenaghan *et al.* (2007) [37]	UK Primary care physician practice	136 65.6%	84.3[b]	(I) Medication review and development of action plan of agreed amendments (D) Pharmacists	Reducing hospital admissions and number of drug items prescribed (P) GPs and patients
Meredith *et al.* (2002) [50]	USA Home health setting	317 74.9%	80.0 (8.0)	(I) Medication review and development of action plan to address identified problem (D) Multidisciplinary team of physicians, nurses and pharmacists	Improving medication use (P) Nurses and patients
Milos *et al.* (2013) [38]	Sweden Nursing home and community	374 74.9%	87.4 (5.7)	(I) Medication review and feedback given to physician on drug-related problems (D) Pharmacists	Reducing the number of patients using PIMs (P) GPs
Pitkälä *et al.* (2014) [39]	Finland Nursing home	227 71.0%	83.0 (7.2)	(I) Staff training and list of harmful medications provided to encourage nurses to bring this to the physician's attention (D) Research team	Improving the use of potentially harmful medications (P) Nurses
Pope *et al.* (2011) [40]	Ireland Hospital	225 62.9%	82.9[b]	(I) Clinical assessment by a senior doctor and multidisciplinary medication review using Beer's criteria. Recommendations given to GP (D) Consultant or senior specialist registrar and a multidisciplinary panel of consultant geriatricians, specialist registrars, hospital pharmacists and senior nurse practitioners	Reducing the number of drugs prescribed (P) GPs
Potter *et al.* (2016) [41]	Australia Nursing home	95 52.0%	84.0 (7.0)	(I) Medication review and cessation plan of non-beneficial medications (D) Research team of GP and geriatrician	Reducing the total number of medicines taken (P) GPs and patients
Richmond *et al.* (2010) [51]	UK Primary care trusts	760 43.2%	80.4 (4.1)	(I) Pharmaceutical care including medication reviews (D) Research team	Improving prescribing appropriateness (P) GPs
Saltvedt *et al.* (2005) [52]	Norway Teaching hospital	254 65.0%	82.1 (5.0)	(I) Comprehensive geriatric assessment and treatment of all illnesses (D) Multidisciplinary team of geriatrician, nurses, residents, occupational therapists and physiotherapists	Increasing the number of drugs withdrawn (P) Medical care team
Schmader *et al.* (2004) [53]	USA Hospital	864 2.5%[a]	46% aged 65–73 54% aged ≥74 years	(I) Treatment in a geriatric evaluation and management unit (GEMU) in either inpatient or outpatient care or both (D) Pharmacists and a multi-disciplinary team of geriatrician, social worker and nurse	Improving prescribing (P) Medical care team

(continues)

Table 1

(Continued)

Author (year)	Country Setting	No. of patients % Female	Mean age of patients (±SD), years	Intervention (I) Delivered by (D)	Target behaviour Target person(s) (P)
Spinewine *et al.* (2007) [54]	Belgium Hospital	203 69.4%	82.2 (6.6)	(I) Pharmaceutical care including medication review and development of a therapeutic care plan with prescribing recommendations (D) Pharmacists	Improving prescribing appropriateness (P) Medical care team and patients
Tamblyn *et al.* (2003) [42]	Canada Primary care physician practice	12 560 62.7%	75.4 (6.3)	(I) Electronic alerts instituted in the electronic patient prescription record to identify prescribing problems (D) Research team	Reducing inappropriate prescribing (P) GPs
Tannenbaum *et al.* (2014) [46]	Canada Community pharmacy	303 69.0%	75.0 (6.3)	(I) Educational booklet to empower and encourage patients to discontinue benzodiazepines (D) Research team	Discontinuation of benzodiazepines (P) Patients
Vinks *et al.* (2009) [43]	The Netherlands Community pharmacy	196 74.7%	76.6 (6.5)	(I) Medication review and prescribing recommendations provided (D) Pharmacists	Reducing the number of potential DRPs and the number of drugs prescribed (P) GPs
Weber *et al.* (2008) [44]	USA Ambulatory clinic	620 79.3%	76.9[b]	(I) Electronic messages sent to physician via electronic medication record to give prescribing recommendations (D) Pharmacist and geriatrician	Reducing medication use (P) GPs
Williams *et al.* (2004) [45]	USA Ambulatory clinic	140 57.1%	73.7 (5.9)	(I) Medication review based on MAI and prescribing recommendations provided and action plan made (D) Pharmacists	Simplifying medication regimens (P) Patients
Zermansky *et al.* (2001) [55]	UK Primary care physician practice	1188 56.0%	73.5 (6.5)	(I) Prescription review and treatment recommendations given to patients (D) Pharmacist and physician	Making changes to repeat prescriptions and reducing the number of medicines taken (P) Patients

[a]The low percentages of females reported was explained by the nature of male patients in Veterans Affairs (VA) clinics
[b]The SDs were not reported and could not be retrieved from the authors

presented in Table S4. Based on the reported results, 10 of the 25 studies showed an effect on the key outcomes (i) or (ii) of this review when comparing the intervention group to the control group [34, 35, 37, 40, 41, 45, 46, 50, 53, 56]. No direct pattern was seen between the number of individual BCTs used and reported intervention effectiveness. The median number of BCTs used were similar for studies reporting effective and non-effective interventions (6 BCTs, IQR 3–8 and 5 BCTs, IQR 4–7, respectively). BCT clusters coded more frequently in studies reporting effectiveness [34, 35, 37, 40, 41, 45, 46, 50, 53, 56] compared to studies reporting no effectiveness were: *goals and planning*; *social support*; *shaping knowledge*; *natural consequences*; *comparison of behaviour*; *comparison of outcomes*; *regulation*; *antecedents*; and *identity* (see Figure 3).

Intervention effectiveness

(a) Drug use

Overall, the mean number of drugs post-intervention was significantly lower among intervention participants compared to the control participants in the presence of moderate between-study heterogeneity (mean difference −0.96, 95%

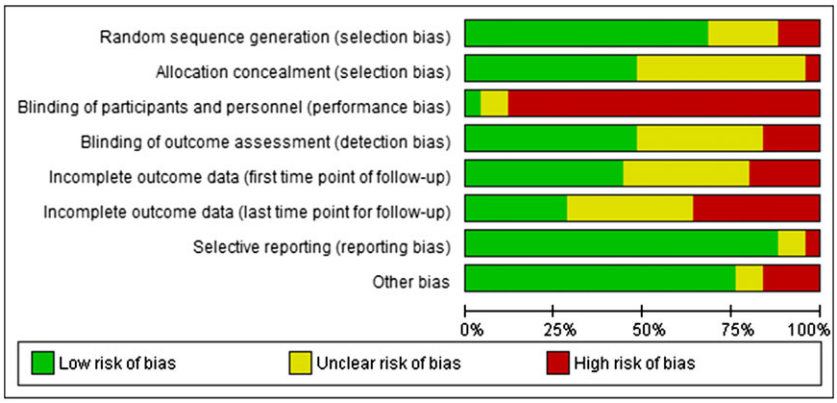


Figure 2

Results of risk of bias assessment

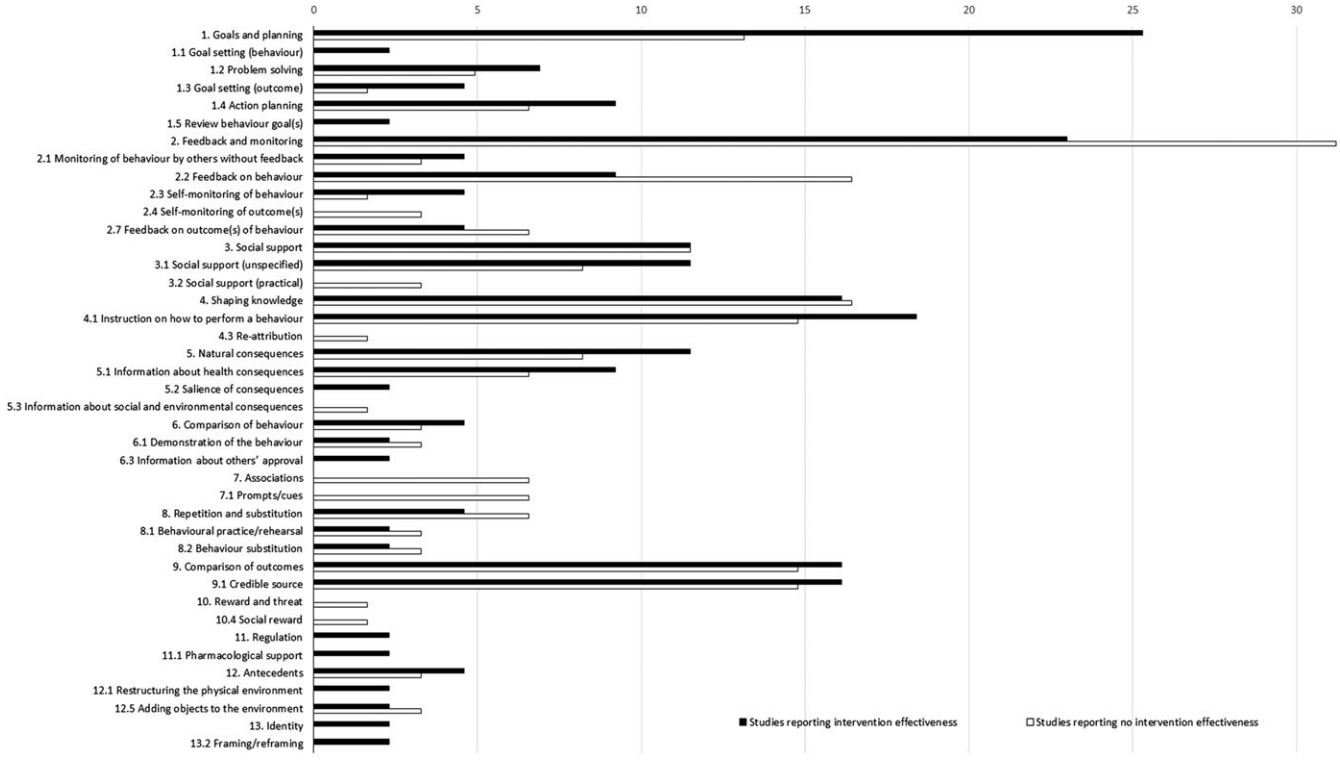


Figure 3

Frequency of behaviour change techniques (BCTs) coded for studies reporting intervention effectiveness on the key outcomes of this review compared to studies reporting no effectiveness of interventions. The frequencies are weighed values based on the number of studies in each group, i.e. effectiveness versus no effectiveness

CI −1.53, −0.38, heterogeneity I^2 = 70% and P = 0.002, Figure S1). Regarding the difference in change in the number of drugs taken per patient, deprescribing interventions lowered the number (−0.74, 95% CI −1.26, −0.22), but effects varied greatly across studies (I^2 = 92%, $P < 0.001$) (Figure 4). Stratified analyses by: (i) whether the intervention was patient-centred or targeting solely healthcare professionals (Figure S2), (ii) intervention setting (Figure 4) and (iii) study quality (Figure S3) showed no effect of these factors on summary estimates. In addition, the unexplained variation within subgroups remained large.

(b) Prescribing appropriateness

Deprescribing interventions demonstrated a relatively small effect and a high level of heterogeneity on the number

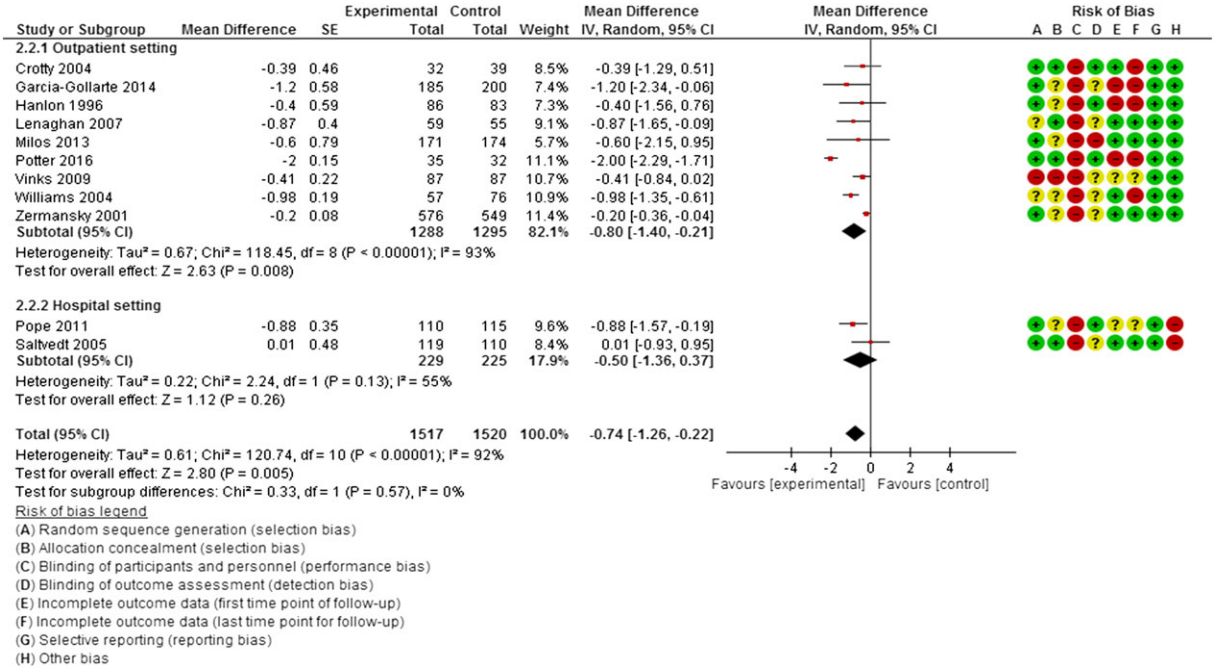


Figure 4

Mean difference in the change in number of drugs comparing experimental (intervention) group and control group. Subgroup analysis on intervention setting (outpatient setting versus hospital setting)

of inappropriate drugs per participant comparing intervention and control groups post-intervention (−0.19, 95% CI −0.40, 0.02, heterogeneity I^2 = 90% and P = 0.07, Figure S4). The proportion of participants with at least one inappropriate drug, as defined in the individual studies, were reduced when a deprescribing intervention was applied, but confidence intervals were wide, and a high level of heterogeneity was present (Figure 5).

(c) Implementation of recommendations

Only four studies reported implementation rates of recommendations to discontinue a medication or change a medication [36, 38, 43, 49]. Action was taken in 55.1% of recommendations given by a pharmacist compared to only 19.8% of the nurse recommendations as part of usual pharmaceutical care [36]. In the study by Vinks *et al.* [43], 27.7% of pharmacists' recommendations were implemented, and action was taken in 56% of drug-related problems identified by a pharmacist in Milos *et al.* [38]. A lower recommendation implementation rate of 15.4% was shown in Fick *et al.* [49]. This result was based on self-reported action taken by the physicians; only 71% of physicians reported this, which may explain the lower frequency of action observed.

(d) MAI score

Seven studies reported changes in MAI scores for participants pre- and post-interventions [34, 36, 47, 48, 51, 53, 54]. Across studies, deprescribing interventions demonstrated a significant effect on reducing the MAI score comparing intervention and control groups post-intervention (−5.04, 95% CI −7.40, −2.68, heterogeneity I^2 = 88% and $P < 0.0001$, Figure S5).

Discussion

Effectiveness of deprescribing interventions is determined by a combination of factors. Consistent with the findings of recent reviews [6, 17], our meta-analysis showed that deprescribing interventions are effective in reducing the number of drugs and inappropriate prescribing (reduced MAI scores) in older people, although the evidence is heterogeneous.

Based on the findings of the BCT coding exercise, effective deprescribing interventions included: (i) a goal and an action plan to solve prescribing problems, (ii) monitoring of behaviour, (iii) social support and the use of a credible source, and (iv) clear instructions and guidance on implementation to the prescriber and information about health consequences of doing/not doing the behaviour. Support from colleagues and information about potential risks and benefits to the patients in the presence/absence of a behaviour change may also be effective techniques of deprescribing.

Differences in the delivery of prescribing recommendations were seen in the studies reporting intervention effectiveness compared to studies reporting no effect on key outcomes of this review. Studies reporting effectiveness [34, 35, 37, 40, 41, 45, 46, 50, 53, 56] used oral and face-to-face communication to discuss and implement deprescribing recommendations consistent with the principles of educational outreach to inform clinical decision making as described by Soumerai and Avorn [58]. Investigation of the delivery of recommendations to deprescribe may provide useful information on the delivery of a successful deprescribing intervention in addition to the use of BCTs.

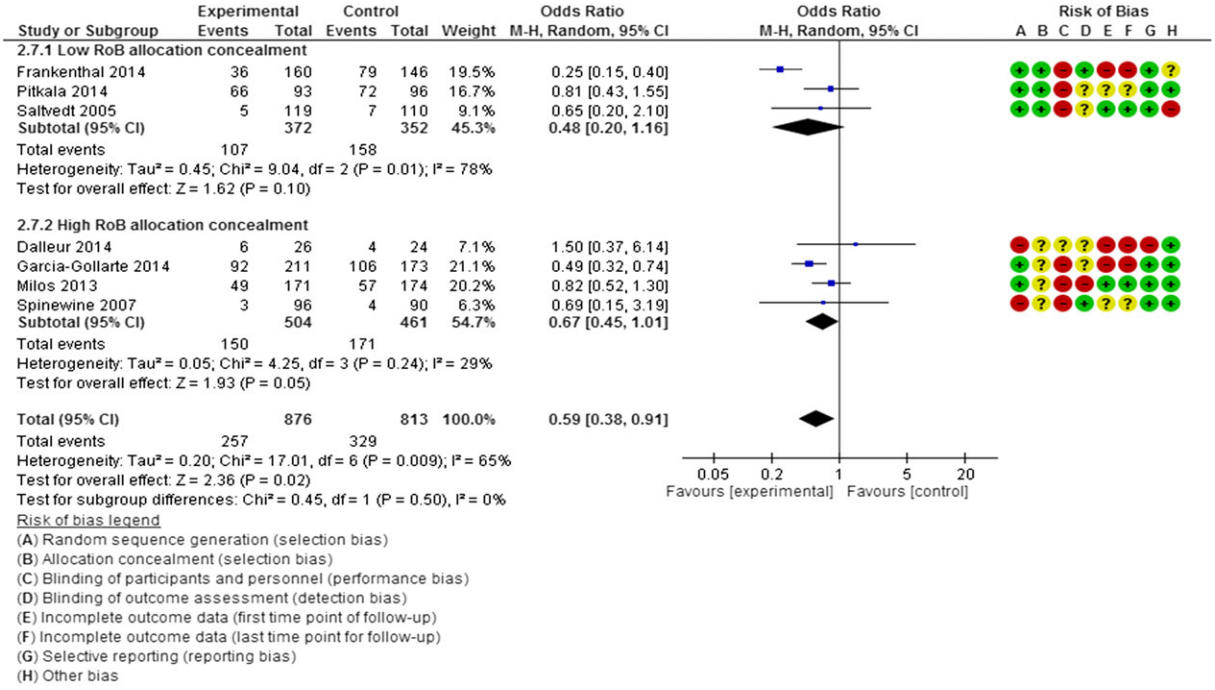


Figure 5

Number of participants with inappropriate drugs comparing experimental (intervention) group and control group. Subgroup analysis on risk of bias assessment (allocation concealment)

Pharmacist recommendations to reduce drug intake and inappropriate prescribing were frequently enacted on in some studies [36, 38], consistent with previous literature reporting benefits of pharmacist-led interventions to optimize medication use in older people [21, 59]. Other studies [43, 49] reported a lower acceptance rate of pharmacist recommendations, between 15% and 28% of recommendations enacted on. Recent research has demonstrated a high level of agreement between prescribers and pharmacists in the assessment of potential target medications for deprescribing [60, 61]. In contrast, other research studies indicate that acceptance rates for recommendations made by pharmacists are lower than those made by their physician colleagues [62]. The lower uptake of pharmacist recommendations despite a high level of agreement about deprescribing is noteworthy. It may indicate that challenges to deprescribing are in fact dependent on the particular ways deprescribing interventions are delivered, particularly when there is a question of behaviour change. Based on the findings of this review, we suggest that future research should investigate the behaviours associated with the acceptance and rejection of deprescribing recommendations to gain a better understanding of a successful delivery of deprescribing interventions.

This is the first review to identify BCTs in deprescribing interventions necessary to achieve a change in behaviours towards deprescribing. Our findings complement previous reviews on deprescribing [17, 19] by offering a broader analysis of BCTs that are effective for deprescribing.

Limitations and strengths

The review findings are based on a comprehensive search of the literature. The novel aspect of this review is in the use of a validated taxonomy to describe intervention content that facilitates behaviour change. Limitations of this review reside mostly in the limited data available. RCTs to date are of a relatively small size (often ≤100 participants) and usually with short follow-up periods. Other limitations relate to the high-risk blinding procedures; these were needed because the interventions in question required blinding of the personnel whose behaviour was targeted, and this was logistically difficult. Absence of blinding procedures for outcome assessors were not considered to introduce important bias because the study outcomes, e.g. number of drugs taken, was not a particularly subjective measure. Random sequence generation and allocation concealment were considered high importance biases in this review because participant characteristics such as multimorbidity, age and polypharmacy could have an impact on the number of drugs taken and risk of inappropriate prescribing [1, 5–8].

The meta-analysis was reliant on published or reported data and, while some reported outcomes were adjusted for baseline patient characteristics, others were not, which makes the direct comparison of intervention effect on specific outcomes open to question. Similarly, and as described in a previous review [27], the BCT coding was limited to the intervention descriptions reported in the studies. Limited reporting on interventions used to encourage deprescribing could have resulted in BCTs being undercoded

and others overcoded due to assumptions made about the strategies used based on the information available. For example, we assumed that the reporting of prescribing recommendations given to the prescriber would involve BCT codes: *instructions on how to perform a behaviour* and *feedback on behaviour*. Prescribing recommendations were a commonly used intervention in the studies and this may have resulted in these two BCTs being overcoded. One study was also excluded from the BCT coding due to lack of information which could have potentially impacted the true findings of this review. Furthermore, we were unable to code BCTs in the control groups due to limited reporting of the control conditions. The control conditions such as usual care in hospital settings or in outpatient settings could include BCTs with potential implications on the interpretation of the review findings. Reporting of future behaviour change interventions and control conditions will benefit from the use of comprehensive checklists, such as the TIDieR [63], and give reviewers the ability to adequately code BCTs and extensively appraise the reporting quality of such interventions. This will improve the identification of relationships between BCTs used and intervention effectiveness.

The main limitation of our pooled estimates is the presence of typically large between-study variation and, for some of the analyses, the wide confidence intervals including trivial effects. Some may argue that a meta-analysis should not be done in the presence of important heterogeneity. Meta-analytical methods, however, allow for the exploration of sources of heterogeneity and we fully acknowledge that the magnitude of the summary estimates should be interpreted with care. To minimize the level of heterogeneity due to different study designs, we also decided to limit the inclusion criteria to randomized controlled studies and cluster randomized controlled studies only. Although the direction of effect was favouring deprescribing, the magnitude of effect was very variable. This inconsistency, together with the imprecision and risk of bias issues lower our confidence in the estimates of effect so that the magnitude of effect is very low.

Conclusion

Deprescribing interventions are effective in reducing the number of drugs taken by patients and improving prescribing inappropriateness. Their success may be explained by a combination of BCTs spanning a range of different intervention functions, although we could not empirically show this. The use of BCTs and delivery of such behaviour change interventions should be considered of importance to facilitate successful implementation of deprescribing. This review contributes to the existing evidence by critically analysing the content of deprescribing interventions in terms of behaviour change, clearly demonstrating that the current evidence base is too small to derive strong conclusions on determinants of success.

Contributors

C.H., S.C., L.S. and S.B. conducted the study selection for this review, performed data extraction and evaluated study quality. A.R. verified quality assessments. C.H., P.K., L.S., S.T. and C.J.A. performed the quantitative meta-analyses and the behaviour change analysis. C.H. drafted the manuscript with contributions from D.O.M., P.K., S.B., L.S., S.C., W.K., S.T., C.J.A. and S.S. A.R. helped in the interpretation of results. All authors read and approved the final manuscript. S.B. was the senior author.

Competing Interests

In cases where a co-author of this review was also a co-author of an included study, the author in question was not involved in the study selection, quality evaluation or data analysis.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

http://onlinelibrary.wiley.com/doi/10.1111/bcp.13742/suppinfo

Table S1 Search strategy
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Figure S2 Subgroup analysis on target person (patient or healthcare professional) for mean difference in the change in number of drugs per patient
Figure S3 Subgroup analysis on risk of bias assessment (random sequence generation) for mean difference in the change in number of drugs per patient
Figure S4 Mean difference in the number of inappropriate drugs per participant comparing experimental (intervention) group and control group
Figure S5 Mean difference in the change in MAI score per participant comparing experimental (intervention) group and control group