

General practice Registrars' Evaluation and Deprescribing of Inappropriate Medicines in the Elderly: the RE-DIME study protocol for a prospective controlled study of a multicomponent educational intervention.

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Abstract

Background: Medicines safety is a significant health issue for older patients. Evidence for harmful effects of inappropriate medicines and of polypharmacy in older patients is abundant while that of the benefits of medicines reviews entailing careful deprescribing of inappropriate medicines is rapidly accumulating. Despite the compelling literature supporting appropriate deprescribing in older patients, considerable practical barriers exist – especially for early-career, less experienced general practitioners (GPs) and GP trainees ('registrars'). Deprescribing by GP registrars for older patients is relatively uncommon.

We aim to deliver a multi-component educational intervention providing registrars with skills to deprescribe in an evidence-based and safe manner. We hypothesise that the educational intervention will increase registrars' deprescribing of inappropriate medicines in older patients.

Methods: We will use a pragmatic non-randomised, non-equivalent control group design nested within an ongoing cohort study of registrars' practice (the ReCEnT study) to assess the intervention's impact on deprescribing in patients 65 years-and-over.

The intervention consists of an online module, a face-to-face session for registrars, a webinar for their supervisors, and facilitation of the registrar-supervisor dyad including case-based discussions of deprescribing in weekly one-on-one teaching meetings. The intervention is underpinned by the Behaviour Change Wheel framework.

Primary outcome measures will be deprescribing of any medicines, and deprescribing of medicines categorized as 'potentially inappropriate'. Secondary outcomes will be deprescribing confined to medicines taken for 3-months or more, and dose reduction with a view to deprescribing. Further evaluation will entail participant interviews and registrars' pre- and post-intervention questionnaire responses.

Discussion: Early-career GPs still developing their clinical practice and prescribing habits are an important target-group for interventions that encourage reviewing and deprescribing inappropriate medicines in older patients.

Interventions embedded in existing training programs or linked to continuing professional development have potentially high impact and sustainability.

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Keywords: Deprescribing, General practice, Graduate medical education, Physician prescribing patterns, Evidence-based medicine

Background

Medicines safety is a significant health issue for older patients. Older people are particularly vulnerable to adverse medicine events due to age-related changes such as reduced physiological reserve, decline in renal and liver function, changes in body fat and water, sarcopaenia, and poor nutrition affecting the distribution, metabolism, excretion and effects of drugs (4-6). At the same time, ageing is often associated with chronic health conditions and multiple morbidities requiring greater use of medicines (7). The single strongest predictor of adverse drug reactions is the absolute drug numbers taken by an individual patient (8).

Polypharmacy

Polypharmacy is often considered to be five or more medications taken daily (9, 10) but is variously considered as more than five or up to 10 or more medications taken regularly (11). However polypharmacy is defined, it is apparent that older patients frequently take multiple medications. A review of observational studies has found that community-based elderly patients take an average of two to nine prescription medications per day (12). The same review found these medicines in the elderly were often lacking an indication, were ineffective, or constituted duplicate indications (12). In a study of patients 70 years or older admitted to Australian general medical units, the mean number of regular medications per day was 7.1 (13). In an Australian community sample, 66% of people aged over 75 take five or more medications (14).

Polypharmacy is associated with medication nonadherence, inappropriate medication use, adverse drug reactions, cognitive impairment, urinary incontinence, falls, decreased Activities of Daily Living, functional decline, hospitalization and mortality (adjusted for co-morbidities) (12, 15-18) and, paradoxically, with undertreatment with appropriate medications (16).

Polypharmacy and associated inappropriate medicines use also has economic consequences for the individual and society. (19) Individuals prescribed one or more potentially inappropriate medications (PIMs) as compared to those prescribed no PIMs have up to two times the risk of health care utilization.(20)

In Australia, NPS MedicineWise, an independent not-for-profit and evidence-based organization that works to improve the way health technologies, medicines and medical tests are prescribed and used, recognized the

significance of polypharmacy and inappropriate medicines use in older patients with their 'Older, Wiser, Safer' program.(11) The Choosing Wisely Initiative aims to reduce low value care and reducing inappropriate polypharmacy has been targeted by many groups through this initiative. Internationally, polypharmacy is one of three targets for the World Health Organization's third global medication safety challenge: medication without harm. (20, 21)

Deprescribing

Deprescribing has been defined as 'the process of withdrawal of an inappropriate medication, supervised by a health care professional with the goal of managing polypharmacy and improving outcomes' (22). Deprescribing can also be considered to include dose reduction and switching to safer medications (15). Deprescribing is being increasingly recognized as a vital component in older person care (11).

The inappropriateness of medicines is not static for an individual patient. Medicines that may have been appropriate when first prescribed may become inappropriate with ageing, new co-morbidities or new medications. Rational prescribing includes appropriate cessation as well as appropriate initiation of medicines in particular patients. Cessation of older patients' medicines when the risk of continued use is deemed to be greater than the benefit of continuation constitutes 'deprescribing'.

While there is widespread support for practitioners, especially GPs, taking a more proactive role in deprescribing medicines in older patients (11, 22), this is a complex area (23). It is important that medicines providing the patient with net benefit are not deprescribed. While deprescribing has the potential to greatly improve health outcomes, the safety of the deprescribing process is paramount. Adverse consequences of medication withdrawal are possible (24) including adverse drug withdrawal reactions and return of the medical condition (15, 24).

The potential adverse effects of deprescribing a medication can be minimized by 'proper planning (ie, tapering), monitoring after withdrawal, and re-initiation of the medication if the condition returns' (24). But the risk-benefit balance of particular medicines (and thus, also, of deprescribing these medicines) is subject to multiple complexities, for example, the patient's age and other patient characteristics, their degree of frailty, co-morbidities, potential drug interactions etc. Thus, though algorithms to aid deprescribing have been developed (25), deprescribing is often not

a straightforward process. Also, considerable barriers to deprescribing by clinicians, and by GPs in particular, have been identified – concerns about bad outcomes, a perceived imperative for adherence to guidelines, reluctance to deprescribe specialist-prescribed medications, therapeutic inertia, concerns regarding the patient-GP relationship, and a lack of specific knowledge (e.g. regarding a medication’s anticholinergic potential) or how to conduct deprescribing (26-31). GPs also raise concerns about finding time for medication review and deprescribing during routine consultations.

Deprescribing must be patient-centred (9, 32). The wishes and expectations of patients and informal carers are central to the deprescribing process.(32) Influences on patients’ and carers’ attitudes towards deprescribing include their perception of a medicine’s appropriateness for the patient; concerns regarding withdrawal reactions; a general dislike of taking medications; and the availability of a process for withdrawal which includes the option of resumption of the medicine if needed (33). The patient’s GP is identified as strongly influencing both positive and negative attitudes to medication withdrawal (32, 33).

Trials of deprescribing

The safety of appropriate deprescribing is well-established, with adverse effects from medication withdrawal being infrequently encountered in trials (34). It has been found in a number of studies that withdrawal of specific classes of medications in older patients leads to a resolution of adverse effects of those medicines (benzodiazepines and non-steroidal anti-inflammatory drugs) (24). Further specific medication class withdrawal studies have found deprescribing of diuretics, digoxin and nitrates to be beneficial (35).

A Cochrane review has established that interventions which aimed to minimize polypharmacy rather than targeting specific medications can reduce measures of patients’ inappropriate medications (36). This review found evidence of safety but still some uncertainties as to a beneficial effect on mortality (35). In a recent meta-analysis (37) two non-randomized studies assessed the effect on mortality of deprescribing in the setting of polypharmacy. These non-randomized studies indicated a significant decrease in mortality (OR 0.32, 95% CI 0.17–0.60). In randomized studies, however, there was a non-significant reduction in mortality (n=10 studies; OR 0.82, 95% CI 0.61–1.11). Mortality was significantly reduced when patient-specific interventions (e.g. medication reviews) were applied (n=8 studies: OR 0.62, 95% CI 0.43–0.88). These studies were conducted in community (four studies), hospital (two

studies) and residential care (two studies) settings (37). In contrast, educational programs (two studies delivered in residential aged care facilities to nurses or to the prescribing doctors), demonstrated no significant change in mortality (OR 1.21, 95% CI 0.86– 1.69) (37).

There are few studies of deprescribing educational interventions in community settings. Deprescribing by GPs in the Australian community context is feasible (38, 39). A particular target for education regarding deprescribing is GP registrars (trainees). Registrars are at a formative stage of their clinical careers. There is qualitative evidence that patterns of prescribing established earlier in GPs' careers tend to be persistent (40). But deprescribing may be particularly challenging for registrars given their junior status and that most of their older patients' medicines (including inappropriate medicines) will have been initiated and maintained by their supervisors, other senior GPs and/or specialists. Evaluation of an educational intervention to improve GP registrars' knowledge and self-efficacy in deprescribing is indicated.

Objectives and hypotheses

We aim to develop and test the efficacy of an educational intervention informed by a theoretical approach and current evidence around interventions to influence clinician behaviour.

Our research question is whether a multicomponent educational intervention can increase general practice registrars' deprescribing of inappropriate medicines in older patients (patients aged 65 years and older).

Our hypotheses are:

a) For registrars' deprescribing behaviour

In registrars of an Australian Regional Training Organisation who have received a multicomponent educational intervention on deprescribing in the elderly, compared to registrars at two Regional Training Organisations who have not received the intervention, there will be, for patients aged over 65 years, a greater increase, from pre-intervention to post-intervention, in

i) The number of medicines deprescribed per 100 consultations.

- ii) The number of medicines (restricted to medicines which have been taken by patients for three months or greater) deprescribed per 100 consultations.
- iii) the number of Beers Criteria list of Potentially Inappropriate Medications and/or Drug Burden Index medicines deprescribed per 100 consultations.

b) for 'anticipated deprescribing behaviour' assessed by questionnaire

In registrars of an Australian Regional Training Organisation who have received a multicomponent educational intervention on deprescribing in the elderly, there will be an increase pre-intervention to post-intervention in the number of registrars who make appropriate responses to each of several clinical vignettes involving deprescribing inappropriate medicines in older patients.

Methods/Design

Study design

The principal element of the Registrars' Evaluation and Deprescribing of Inappropriate Medicines in the Elderly (RE-DIME) project is a pragmatic non-randomized trial employing a non-equivalent control group design, nested within an ongoing cohort study, the Registrar Clinical Encounters in Training (ReCEnT) Study (41).

The project design also includes a questionnaire-based pre- and post-intervention analysis and a qualitative evaluation.

The three constituent elements of the overall project are:

- i) A quantitative evaluation of change in GP registrars' behaviour regarding medicines deprescribing in patients aged 65 years or older, as measured by ReCEnT data. Data for this analysis will be collected during the six-monthly rounds of ReCEnT data collection.
- ii) A quantitative evaluation of change in GP registrars' attitudes and knowledge regarding medicines deprescribing, as measured by questionnaire responses to clinical vignettes. Pre- and post-intervention questionnaires will elicit participants' medication management responses to a number of general practice vignettes (clinical scenarios) involving polypharmacy in older patients. These clinical vignettes

will be designed to reflect situations where deprescribing of medication is either recommended or not warranted, consistent with current research.

- iii) a qualitative evaluation (involving semi-structured interviews) of: a) GP registrars' and supervisors' opinions on how the educational intervention worked well and how it could improve; and b) how GP registrars' practices have changed and barriers to / facilitators of such change.

Study Setting

The intervention will be delivered during a session at a routinely-scheduled educational workshop at the Australian Regional Training Organization (RTO), GP Synergy. RTOs are government-funded, not-for-profit, geographically-defined GP vocational training organizations. There are nine RTOs covering the whole of Australia. GP Synergy is the largest, delivering education and training across the state of New South Wales plus the Australian Capital Territory with an intake of approximately 500 registrars per year (approximately one-third of the entire Australian intake).

The control RTOs will be Eastern Victoria GP Training (covering approximately half of the state of Victoria including half of the capital city, Melbourne) and General Practice Training Tasmania (covering the whole of the state of Tasmania). The intervention and control RTOs cover the full range of Australian GP training settings including practices located in all rural classifications (42). All three RTOs participate in the ReCEnT project.

Within each RTO registrars train in accredited independent practices under the supervision of an experienced GP supervisor (trainer, preceptor). This supervision includes a weekly face-to-face one-on-one teaching session for Term 1 and Term 2 registrars (these are the first of three 6-month full-time-equivalent compulsory general practice-based terms in registrars' 3-year vocational training program). Registrars also receive structured away-from-practice teaching organized by their RTO (at least 125 hours in total in Term 1 and Term 2).

Eligibility criteria

Participants will be Term 1 and Term 2 (that is, in the first 12 months of GP training for a full-time registrar) GP registrars at the three RTOs. The intervention to GP Synergy registrars will be conducted as part of their routine training program.

Inclusion criteria

For the analysis using ReCEnT study data: The intervention group will consist of registrars in Terms 1 and 2 of their vocational training program at one RTO (GP Synergy). The control group will consist of registrars in Terms 1 and 2 of their vocational training program at two RTOs (General Practice Training Tasmania – GPTT: and Eastern Victoria GP Training- EVGP).

For the questionnaire-based study: Participants will be registrars in Terms 1 and 2 of their vocational training program at one RTO (GP Synergy).

For the qualitative study: Participants will be registrars in Terms 1 and 2 of their vocational training program at one RTO (GP Synergy) and supervisors of GP Synergy registrars.

Exclusion criteria

For the analysis using ReCEnT study data: Registrars who do not provide consent for the data they collect as part of the ReCEnT project to be used for research purposes.

For the questionnaire-based study: No exclusions.

For the qualitative study: registrars or supervisors who have not attended the workshop or webinar.

The intervention

The educational intervention consists of several components. The first two - access to an online introduction module, and a 60-minute face-to-face session - will be delivered to GP registrars.

The third component is a webinar for the supervisors of these registrars that will be based on the content of the face-to-face presentation. Supervisors will also have pre-webinar access to the online introductory model.

The fourth component is optional joint GP registrar-supervisor education activities for each registrar-supervisor dyad to use in their regular weekly one-on-one teaching meetings.

The face-to-face registrar educational session will be delivered as a one-hour session. The supervisor educational intervention via webinar will be delivered as a one-hour session. The online module and supporting resources may be accessed as often as the participant requires.

The first three components of the intervention will be delivered in June 2018 during General Practice Training Term 2018.1 The fourth component will be delivered at the discretion of supervisors and registrars during the first two months (July-August) of General Practice Training Term 2018.2.

Theoretical framing of intervention content

Interventions aimed at improving clinical practice often require behaviour change among health care providers. The Behaviour Change Wheel (BCW)(43) was chosen as a framework to guide intervention development as, it provides a systematic approach through the steps of understanding the target behaviour, identifying relevant intervention functions and specifying intervention content. Some previous polypharmacy interventions have been based on a BCW approach.(44, 45) The BCW has also previously formed a basis of a benzodiazepine deprescribing intervention for older patients.(46)

GPs must balance clinical imperatives for appropriate increase in medications and for appropriate deprescribing. The behavioural factors driving therapeutic inertia for new medicines and driving inaction on deprescribing are likely to be different. Thus, a tailored approach to the development of any intervention is required. The BCW is a step-by-step theoretically-underpinned process for designing health behaviour interventions that consists of three stages. The first stage involves identifying the potential predictors of the behaviour. In this stage, the COM-B or 'Capability', 'Opportunity', 'Motivation' and 'Behaviour' factors are identified and addressed in order to bring about behaviour change. In the second stage, intervention factors are selected to address the barriers identified in the COM-B analysis. These intervention functions include education, persuasion, incentivisation, coercion, training, restriction, environmental restructuring, modelling and enablement and may be used in any combination depending on the

barriers identified in the first stage. At this stage, a number of individual behaviour change techniques (BCTs) could also be applied from the 93 evidence-based BCTs available. The final stage of the BCW outlines policy interventions that could be applied also in order to facilitate behaviour change. To address appropriate de-prescribing, registrars/GPs must have appropriate capabilities (both physical and psychological) to address the knowledge, skills and motivation needed to perform the behaviour. Training is part of our intervention to address capability. There must also be the opportunity for the appropriate prescribing to occur. This opportunity entails a physical and social environment that is supportive of the new behaviour. Registrars' 'Sources of Behaviour' ('Capability, Opportunity, and Motivation') in relation to de-prescribing will be increased by intervention elements addressing Education, Persuasion, Training, Enablement, Modelling, and Environmental restructuring (six of the nine BCW 'Intervention Functions'). See Table 1.

PLACE TABLE 1 ABOUT HERE

Components of the intervention: Online introduction module

Background material to the face-to-face registrar session and supervisor webinar will be included in the online module to allow a concentration on practical approaches to deprescribing in the face-to-face session and webinar. This introduction module will include material on polypharmacy, inappropriate prescribing in older patients, evidence for deprescribing, an introduction to tools for assessing potentially inappropriate prescribing such as the Beers criteria and the Drug Burden Index and the role of general practitioners in the implementation of deprescribing. The module will also include a discussion of why the management of polypharmacy is a priority for a wide range of health care professionals and consumers. This module will take approximately 30-40 minutes to complete. It will contain links to supporting materials. The online module will be made available to registrars to work through individually at a time prior to the face-to-face session. Access to a text version will also be provided. The module will be made available to registrars and supervisors 2-3 weeks prior to the face-to-face session and webinar, respectively.

Components of the intervention: Educational workshop session

The face-to-face workshop session will consist of a 60-minute educational presentation to approximately 450 registrars, scheduled as part of the standard training program for GP registrars delivered at GP Synergy RTO. The face-to-face session will be led by a geriatrician. A GP experienced in supervising GP registrars will provide further clinical relevance and expertise.

In this face-to-face session, data on GP registrars' deprescribing collected in the ReCEnT project will be used to contextualise and reinforce the practical relevance and importance of the educational message (the ReCEnT data will be that of registrars who have participated in ReCEnT during 2016 and 2017). During the session, GP registrars, by means of clinical cases, will work through the main principles of rational deprescribing. Time will be devoted to the practicalities of how to go about deprescribing within a general practice setting, including how to determine if a patient has polypharmacy; determining the risks vs benefits of a continuing or of deprescribing a particular medicine; identifying opportunities for deprescribing; and how to employ a model of deprescribing. Examples tailored to the general practice setting will be provided. Aspects of patient opinion towards deprescribing will be covered as well as barriers inherent within the general practice setting and the registrar's position within a host practice e.g dealing with older patients whose management the registrar may not usually engage with, and with whom registrars are less likely to have developed a deeper relationship. Collaborative models of registrars and supervisors working together to implement appropriate deprescribing will be promoted.

Post-session supporting resources will be available as links in the Deprescribing online module to reinforce the workshop and provide practical resources including guides to deprescribing individual drug classes (e.g. benzodiazepines and anticholinesterases).

The workshop session content will be constructed by the research team of GPs, GP vocational training educators, academic GPs, and a geriatrician/researcher. The process will be informed by the current literature in the area and our recent work in documenting GP registrars' deprescribing including the prevalence and associations of deprescribing in older patients.

Components of the intervention: Webinar for supervisors

The webinar content will be a more succinct version of the face-to-face workshop session provided to registrars, because supervisors will be more aware of deprescribing and the mechanisms available for practical deprescribing. Supervisors find it difficult to deprescribe in cases where specialists originally established the prescription.(47) Because this is an analogous dyad to that of the registrar-supervisor, approaches to managing the GP-specialist relationship will be covered.

The webinar will emphasize potential models of supervisor-registrar collaboration in deprescribing for individual patients.

Components of the intervention: Joint registrar/ supervisor activities

Each registrar-supervisor dyad will be encouraged to include a case-based discussion of evidence-based deprescribing in their regular weekly one-on-one teaching meetings. The supervisor will be offered a set of three or four structured cases to include in the meeting. Other options, such as 'random case analysis' or audit of older patients' clinical notes will be suggested. The joint registrar/ supervisor activities will be optional as the content of registrar-supervisor weekly meetings is at the discretion of the supervisors and registrars rather than the RTO.

In addition, for the registrars in the intervention RTO (GP Synergy), there will be a section added to the individual reflective feedback report each registrar receives approximately three weeks post-completion of ReCEnT data collection. As well as the standard feedback of individual data parameters from that round of data collection, registrars will be informed of which medicines they deprescribed during the data collection period, along with a table of the medicines most commonly deprescribed by their registrar peers. Registrars are encouraged to reflect on their individual reports, including joint reflection with their supervisor.

Rationale of intervention components

As well as the overarching theoretical framing of the intervention within the Behaviour Change Wheel, aspects of the intervention were informed by a number of evidence sources,

The rationale for supplementing the educational intervention with supervisor and joint registrar-supervisor educational activities is the registrar-supervisor relationship is the key factor in registrar training (48-51). Our

previous research has suggested that the prescribing patterns (role-modelling) of supervisors and the 'apprenticeship' model of the registrar-supervisor relationship are drivers of prescribing behaviour (52-54) and it is plausible that they will also influence deprescribing. More importantly, there is ample evidence from Australian and international GP vocational training of the complexity of relationships between registrars, supervisors and older patients. These relationships are characterized by reluctance of patients to entrust registrars (rather than supervisors) with their care (particularly when involving chronic disease management) and patients' desire for continuity of care (with a perception of registrars as being transient in the practice). There is some evidence of older patients not fully understanding the status and role of registrar. But there is also evidence of an openness of older patients to collaborative care between the supervisor and registrar(55-57).

Thus, registrars working collaboratively with supervisors within shared-care models is likely to be a functional approach to deprescribing in older patients. Close shared-decision making will also support registrars in what is inherently a complex process, including considerations of safety of medicines withdrawal. We have designed our intervention to influence the registrar-dyad in adopting collaborative approaches to deprescribing, using the characterization of the GP-registrar 'genre' of Brown et al(58) to frame the elements of the intervention related to the registrar-supervisor dyad.

We have framed our aim, promoting rational deprescribing of inappropriate medicines, as one of changing clinician (registrar) behavior. We have thus designed our intervention components, where possible, to be consistent with modalities for which there is evidence of efficacy in changing clinician behavior. We are guided by the findings of the Cochrane Collaborations Effective Practice and Organisation of Care (EPOC) Review Group (59).

Educational meetings alone or combined with other interventions, can improve professional practice (60) and we will have the registrar workshop session and supervisor webinar as central elements of our educational package. Educational meetings in isolation, however, are unlikely to be effective for changing complex behaviours (60) and we will employ other strategies combined with our workshops. We will, firstly, supplement our educational meetings with an online module on deprescribing.

Audit and feedback have been found to lead to small but potentially important improvements in professional practice (61) and feedback may be more effective when the source is a supervisor or colleague (61). Our educational package does not include a usual audit process, but we will be encouraging supervisors and registrars to perform an informal audit of the clinical notes of older patient with a view to joint discussion and feedback from the supervisor. The registrars will also be provided with feedback of any medicines they have deprescribed during their ReCENT data collection period along with aggregated data of the deprescribing of their registrar peers.

Opinion leaders alone or together with other interventions may improve clinicians professional practice (62) . The main presenter at both the registrar session and supervisor webinar will be a senior geriatrician who has published frequently on management of polypharmacy and deprescribing in journals targeting Australian GPs (63-67)), in addition to leading internationally recognized research in the field. Consistent with the Cochrane findings, we will have as co-presenters ‘local’ opinion leaders among the supervisor and registrar communities – two senior GP supervisors.

‘Tailored’ interventions take into account determinants of the participants’ target behavior (that is, barriers and facilitators). They can be effective, with small to moderate effect size (68). In our educational intervention we will specifically address known determinants of registrars clinical practice related to older patients (especially patients’ attitudes and behaviours). We do this primarily through promotion of models involving supervisors in registrars’ deprescribing for particular patients (55-57).

Educational meetings are more efficacious when they are interactive (60). We are limited by structural aspects of our face-to-face session with registrars (the size of the audience and venue) but will employ measures to facilitate audience interaction via electronic comment and questions. Similarly, we will encourage supervisor interaction in the webinar.

Control group procedures

The ‘control group’ of registrars training with two other RTOs will receive “usual education” during the study period. Usual education comprises teaching/education as scheduled by the control RTOs which may include some education on deprescribing medicines in older patients. ‘Usual education’ will not include the online introduction training

component nor supervisor webinar nor provision of materials for use in registrar-supervisor practice-located teaching sessions.

Consent

Deprescribing behaviour (Project element 1): Registrars complete ReCEnT as an integral part of their education and training program. They may choose to provide informed written consent for the data collected to also be used for research purposes.

'Anticipated deprescribing behaviour' questionnaire-based evaluation (Project element 2): potential participants will be provided with an appropriate Information Statement accompanying their invitation to participate. Return of a completed questionnaire will be deemed to constitute consent to participate. Participants will have the option of linking their questionnaire data to their ReCEnT data in lieu of providing demographic data within the questionnaire.

Qualitative evaluation (Project element 3): Potential participants will be provided with an appropriate Information Statement and will provide written consent

Confidentiality

Deprescribing behaviour (Project element 1) and 'Anticipated deprescribing behaviour' questionnaire-based evaluation (Project element 2): All data is and will be de-identified with each registrar having a unique identifier number. The participant list and de-identified data will be stored in separate password-protected computer locations.

Qualitative evaluation (Project element 3): Audio recordings of interviews will be transcribed by research staff, and names of participants will be replaced by numerical codes. Transcript content which might identify participants will be removed from the transcripts. The data will be stored securely on a password protected computer system.

Outcomes

Primary outcomes

The primary outcomes will be:

- i) Change in the number of medicines deprescribed by registrars per 100 consultations with patients aged 65 years or older. The number of medicines deprescribed per 100 consultations with patients aged 65 years and older will be calculated using deprescribing data recorded in-consultation by each registrar each six-months as part of the ReCEnT cohort study.
- ii) Change in the number of medicines from a) the Beers Criteria list of Potentially Inappropriate Medications (1, 2) and/or b) the Drug Burden Index (2, 3) and/or iii) the medicine groups most highly rated as suitable for deprescribing by a Canadian expert clinician Delphi process (69) deprescribed by registrars per 100 consultations with patients aged 65 years and older. The number of medicines deprescribed per 100 consultations with patients aged 65 years and older will be calculated using deprescribing data recorded in-consultation by each registrar each six-months as part of the ReCEnT cohort study.

Secondary outcomes

Secondary outcomes will be:

- i) Change in the number of medicines deprescribed per 100 consultations with patients aged 65 years or older, with analysis restricted to medicines which have been taken by patients for three months or greater. (The number of medicines deprescribed will be measured pre- and post-intervention, at approximately the midpoint of registrars' training Term 1 and Term 2 via data collected in the ReCEnT cohort study).
- ii) Change in the number of medicines deprescribed by registrars per 100 consultations with patients aged 65 years or older, or for which medicine dose was reduced with a view to later cessation, by registrars (measured pre- and post-intervention, at approximately the midpoint of registrars' training Term 1 and

Term 2). This outcome will apply only to data from the two ReCEnT data collection rounds (pre- and post-intervention) in 2018. For these two rounds we will have data on medicines for which dose was reduced with a view to ceasing as well as medicines ceased.

- iii) Change in anticipated deprescribing as measured by responses to clinical vignettes in a questionnaire. Responses will be via multiple choice options of actions in response to each clinical vignettes and will be classified as 'appropriate deprescribing chosen' or 'appropriate deprescribing not chosen'. This outcome will apply only to intervention group registrars. Control group registrars will not participate in the questionnaire study. This outcome will be measured one-month pre-intervention and two months post-intervention. This outcome will apply only to intervention group registrars and supervisors. Control group registrars or supervisors will not participate in the questionnaire study.
- iv) Registrars' and supervisors' experiences of undertaking the intervention as measured by semi-structured qualitative interview. The interviews will be conducted during a period two-to-four months post-intervention.

Rationale of outcomes

The Beers criteria and similar lists are designed to alert clinicians to Potentially Inappropriate Medicines (PIMs) in older patients and prompt consideration of deprescribing if the likely harms of drug continuation are assessed to be greater than the likely benefits of drug continuation. The medicines in these lists are commonly inappropriate in individual older patients. Thus, an analysis confined to medicines identified in the Beers criteria and the Drug Burden Index could be expected to have high specificity for medicines identified by the registrars as having likely harms of drug continuation greater than the likely benefits. But many medicines not on these lists would be deemed inappropriate in individual clinical situations encountered by registrars. Thus, an analysis limited to Beers criteria and Drug Burden Index medicines would not capture a large number of episodes of registrars' appropriate deprescribing.

The secondary analysis including only those medicines which had been prescribed for 3 months or more will capture a somewhat different outcome – medicines that are more likely to have been deprescribed as part of a rational

review of older persons' medicines (as will be recommended in our intervention) rather than being medicines ceased in response to short term adverse effects or short-term lack of apparent efficacy.

The secondary analysis including medicines reduced in dose with a view to deprescribing, as well as those ceased in the consultation, recognizes the fact that many medicines in older patients (for example benzodiazepines) should usually be deprescribed via a reducing dose schedule. It also recognizes that we are encouraging the registrar-supervisor dyad to engage with deprescribing for individual patients. Thus, the registrar may occasionally not cease the final quantum of inappropriate medicine for a particular patient but may have been involved in the deprescribing process via earlier dose reductions. As the ReCEnT data collection period (60 patient consultations) is less than a registrar's average working week, we do not anticipate duplicate recording of the same patient for dose reduction and cessation.

Sample size calculation

Project element 1: Primary analysis- evaluation of change in registrars' actual deprescribing

There will be approximately 450 registrars eligible to take part in the intervention workshop. The great majority, but not all, of these registrars will also be in general practice training terms and completing ReCEnT in 2018.2. There will be approximately 200 at the control RTOs and who will have pre- and post-intervention ReCEnT data. Some registrars are part-time and will not have post-intervention ReCEnT data by the time of analysis. Based on ratios from previous rounds of ReCEnT, we anticipate there will be 624 registrars with post- intervention data and we have based our power/sample size calculations on this number.

We have estimated the detectable effect size assuming a total sample size 6,590 encounters with patients aged >65 years for 624 registrars post-intervention. The intervention to control allocation ratio is approximately 2.7 : 1 (based on the number of Term 1 and 2 registrars at each of the participating RTOs). Assuming a deprescribing rate of 2.1% in control total consultations (from previous ReCEnT data), we will have 80% power to detect a deprescribing rate of 3.4% in intervention consultations, post-intervention, at a two-sided significance level of 0.05. This corresponds with

a 62% increase in the deprescribing rate (Relative risk = 1.62). Allowing for potential clustering of deprescribing rates within registrars, assuming possible Intra-cluster Correlation Coefficients of either 0.01 or 0.02, we will be able to detect post-intervention deprescribing rate increases of 65% (RR=1.65) and 68% (RR=1.68). This assumes each registrar has 10 – 11 relevant encounters, corresponding to Design Effects of 1.095 and 1.19, respectively. These effect estimates are based on an assumption of independence of pre- and post-intervention observations. Thus, these estimates are likely to be slightly conservative and detectable effect sizes somewhat smaller, given that most registrars will contribute data for both pre- and post-intervention periods and thus provide within-registrar information, decreasing residual variation.

Recruitment

Project element 1: evaluation of change in registrars' actual deprescribing.

No additional recruitment will be required for this component. Participants will be registrars in the three participating RTOs and will undertake ReCEnT project data collection as a routine part of their training programs.

Project element 2: A quantitative evaluation of change in GP registrars' attitudes and knowledge regarding medicines deprescribing, as measured by questionnaire responses to clinical vignettes

All Term 1 and Term 2 registrars at the intervention RTO will be approached by both email and post inviting them to complete the study questionnaire four weeks prior to the intervention. There will be a single follow-up email invitation to non-responders two-three weeks later. The sample frame will be the enrolment lists of the participating RTO.

Post-intervention questionnaires will be sent to registrar participants by email and post two months post-intervention. There will be a follow-up email reminder two-three weeks following the initial post-intervention post and email.

Project element 3: a qualitative evaluation of GP registrars' and supervisors' experience of the educational intervention.

All Intervention RTO registrars who have attended the face-to-face workshop session and all supervisors who have attended the webinar will be approached by both email and post inviting them to participate in either phone or Skype or Zoom interviews. There will be two follow-up email reminders two and four weeks following the initial invitation. The sample frame will be the attendance lists of the face-to-face workshop session and webinar. Selection of responding registrars and supervisors for invitation will be purposive, based on age, gender, rurality of practice, place of graduation (Australian versus international). If possible, some registrar-supervisor dyads will be recruited.

Assignment of interventions

Assignment to intervention or control will not be random. Assignment was at the level of RTO and is on the basis of willingness and capacity of the intervention RTO to include the deprescribing intervention within their routine educational program.

A randomized control trial design is not appropriate for the RE-DIME evaluation of change in registrars' deprescribing. Regarding assignment to intervention or control at the level of RTO: assignment at the level of registrar or of other smaller units within the RTOs is impracticable. Registrars within each RTO share regular educational and professional contacts (for example, at RTO-delivered face-to-face educational sessions). Thus, assignment at levels less than RTO will result in risk of contamination.

Cluster randomization, rather than non-random assignment, at the RTO level is also not viable. There are only three RTOs participating in the ReCEnT cohort study in which RE-DIME is nested. With a major reorganization of Australian vocational training in 2016 there are now only nine RTOs covering the whole of Australia.

Finally, the educational programs in which the intervention is to be included are crowded, with multiple topics competing for inclusion (necessitating considerable negotiation to justify a regular teaching place for a new session)

and are set up to 12 months in advance. Randomization of teaching sessions within their educational programs is not acceptable to RTOs.

We will deal with the non-random allocation in our analyses via multivariable analyses utilizing the large number of potential confounding variables measured in ReCEnT.

Independent variables measured in the ReCEnT project

Independent variables relate to registrar, patient, practice and consultation factors.

Registrar factors will be age, gender, training term at the time of the intervention (Term 1 or Term 2), place of basic medical qualification (dichotomized as Australia/international), if the registrar worked at the practice during a previous term, the RTO with which the registrar is enrolled, registrars' year of medical graduation, duration of pre-GP training time spent in hospital practice, and registrars' full-time/part-time status.

Patient factors will be age, gender, Indigenous (Aboriginal or Torres Strait Islander) status, non-English-speaking background, if the patient is a new patient to the practice and if the patient is new to the registrar.

Practice factors will be level of rurality of the practice location, practice size (number of full-time equivalent GPs dichotomized to 'large' i.e. greater than full-time equivalent five GPs or 'small' – less than six full-time equivalent GPs), socio-economic status of the practice location, and if the practice routinely bulk bills (that is, patients pay no fee for the consultation). Practice postcode is used to define the Australian Standard Geographical Classification-Remoteness Area (ASGC-RA(70)) classification (the degree of rurality) of the practice location and to define the practice location's Socioeconomic Index for Area (SEIFA(42)) Relative Index of Disadvantage

Consultation factors will be duration of consultation (in minutes), the number of diagnoses/problems dealt with in the consultation, if the diagnosis/problem was new or was existing, if the problem/diagnosis was a chronic disease (classified according to an existing classification system), if pathology test/s was/were ordered, if imaging test/s

was/were ordered, if follow-up was organized, if specialist referral was made, if the registrar sought clinical information during the consultation from a specialist or from electronic or hard-copy resources, and if the registrar generated a learning goal related to the problem/diagnosis.

Data collection, management, and analysis

Data collection

Project element 1: evaluation of change in registrars' actual deprescribing.

No data will be collected beyond that already routinely collected in ReCEnT.

ReCEnT is an ongoing prospective multi-site cohort study of GP registrars/registrar's consultations. From 2010 to 2015 it was conducted in five of Australia's then 17 GP RTPs (41) and from 2016 it has been conducted in three of Australia's nine RTOs (following the 2016 major restructure of Australia's general practice vocational training program).

ReCEnT longitudinally documents the nature and association of consultation-based clinical and educational experiences of GP registrars. Registrars record details of 60 consecutive consultations at approximately the midpoint of three six-month (full-time equivalent) terms based in general practices. Details are recorded on paper-based Case Report Forms and include patient demographics, diagnoses/problems managed, medications prescribed, medications ceased, medications dose reduced with a view to later cessation, investigations ordered, referrals made, follow-up arranged, information/assistance sought during the consultation (including supervisor advice and recourse to other sources of information – hard copy, electronic, specialist doctor), and learning goals generated.

Only data of office-based consultations (not home visits or nursing home visits) are recorded.

Registrar characteristics and the characteristics of the practice they are currently training in are also documented via paper-based questionnaires.

ReCEnT is part of the registrars' training program and includes reflection on practice and future training directions via detailed feedback (71). The majority of GP registrars consent to the data also being used for research purposes.

As a result, participation and retention rates are singularly high for studies of GPs – greater than 95%.

Project element 2: A quantitative evaluation of change in GP registrars' attitudes and knowledge regarding medicines deprescribing, as measured by questionnaire responses to clinical vignettes

Term 1 and Term 2 registrars at the intervention RTO will complete pre- and post-intervention questionnaire (either hard-copy or electronic via REDCap, a web application for managing online surveys).

The questionnaire will contain several clinical vignettes consistent with clinical presentations of older patients in registrars' practice and comprising scenarios where deprescribing would be appropriate. Registrars will be asked to respond to multiple choice options as to how they would manage these vignettes.

The questionnaire responses will be linked to the registrar's ReCEnT data via a unique identifier which will enable us to use demographic data collected during ReCEnT.

Participant retention and follow-up will be promoted through follow-up invitations to complete the post-intervention workshop augmented by articles in the GP Synergy monthly Training Update newsletter (delivered electronically to all registrars monthly).

Project element 3: a qualitative evaluation of GP registrars' and supervisors' experience of the educational intervention.

Data collection will employ one-on-one interviews conducted by phone or Skype or Zoom (as elected by the participant registrar or supervisor). Interviews will be informed by an interview schedule informed by the study aims and the literature but interviews will as much as possible be informant-led and themes emerging from the interviews will iteratively inform revisions of the interview schedule.

Recruitment will continue until thematic saturation is deemed to have occurred (no new themes are emerging from the interviews).

Project documents

The ReCEnT Case Report Form, registrar demographics form, and practice characteristics form; RE-DIME pre- and post-intervention questionnaires; and RE-DIME qualitative study interview guide can be found at the RE-DIME project page in the GP Synergy NSW and ACT Research and Evaluation Unit sub-website at <https://research.gpsynergy.com.au/>

Data management

Project element 1:

All ReCEnT data collected is de-identified. Each GP registrar is allocated a unique numerical code to protect privacy which will be used on all survey forms instead of names. The de-identified ReCEnT information is data entered at GP Synergy's premises into a Heroku secure on-line international computer database which is run by a USA (United States of America) based organization. The list linking GP registrars name and ID (identification) number is stored separately in a password protected computer file at GP Synergy which is only accessible by specified members of the research team.

Project element 2:

Electronic questionnaire data will be collected and managed using REDCap electronic data capture tools (72) hosted at Hunter Medical Research Institute (HMRI). Any paper questionnaires will be transferred to the REDCap database, at which time the paper copy will be destroyed. Participant email addresses will be stored in a REDCap project "Participant list" module intended for sending emails and tracking responders/non-responders. Questionnaire responses are stored on a separate module. This means that at no stage will the participants' email addresses be directly linked to the survey responses. The ability to join these two modules is restricted and accessible only by authorized users. The REDCap participant list and survey responses will be stored on a password-protected server at the HMRI with access permitted only by project personnel or HMRI authorised staff directly involved in the project. Research related datasets are stored indefinitely by HMRI unless requested to archive by the Principal Investigator, or expire in a set timeframe.

Project element 3:

Any information collected by the researchers which might identify participants will be removed from the transcripts. The transcripts will be stored securely. The transcript can only be accessed by the researchers. Interview data will be analysed and themes that emerge will be reported in an aggregated format - no individuals will be identified in any

findings reported. The data will be stored securely for at least 5 years on GP Synergy's password protected computer system prior to being destroyed in accordance with State and Commonwealth legislation.

Statistical methods

Analysis of deprescribing behaviour (Project element 1)

Change in GP registrars' deprescribing behaviour will be assessed via ReCEnT data pre- and post-intervention. The changes in GP registrars' deprescribing will be compared with the changes of GP registrars of the two RTOs who are not receiving the intervention (control group). For the primary analyses all registrar data for ReCEnT collection rounds in 2016.2, 2017.1, 2017.2, 2018.1 and 2018.2 will be used. For the secondary analysis including reduction in doses with a view to medicine cessation, as well as medicine cessation, only 2018.1 and 2018.2 data will be included (recording of dose reduction only commenced for 2018.1)

Analyses will employ univariate and multivariable logistic regression within the Generalized Estimating Equation (GEE) framework to account for repeated measures within registrars. The unit of analysis will be consultations involving patients over 65 years and the outcome factor will be medicines deprescribed (dichotomous).

Independent variables in the model will be treatment group (intervention/control), time (before/after) and an interaction term of treatment group by time. The p-value of the interaction term will be used to determine statistical significance. 'Intention to treat' and 'as treated' analyses (all intervention registrars, and workshop attendees only, respectively) will be conducted.

Due to the high participation and retention rates in ReCEnT it is not anticipated that imputation will be required in the analyses

Analysis of 'anticipated deprescribing behaviour' questionnaire-based evaluation (Project element 2)

McNemar's test will be used to assess changes in registrars' questionnaire responses to each clinical vignette pre- and post-intervention.

Analysis of qualitative evaluation (Project element 3)

Thematic analysis will be employed (73).

Data collection and analysis will be iterative and concurrent. Inductive thematic analysis will employ a process of constant comparison with emerging themes being identified for further exploration in subsequent interviews.

Analyses will consider commonalities and differences in registrar and supervisor responses. If interviews have been conducted with both parties of a registrar-supervisor dyad, this relationship will be considered in analysis.

Independent coding will be conducted by two researchers - the principle qualitative researcher (who will have conducted the interviews) and a further study investigator. Differences in researcher perspective in interpretation of the transcripts will be resolved by negotiation.

From this process of coding and negotiation a codebook will be developed. The codebook will be iteratively revised as new transcripts are analysed. The resultant codes will be mapped and organized into second order 'themes' and named and applied to the transcripts.

Methods: Monitoring

The nature of the study is of an evaluation of a discrete educational package nested in an ongoing cohort study.

Thus, interim analyses and stopping guidelines are not appropriate and a separate Data Monitoring Committee is not required.

Discussion

There is abundant evidence for the harmful effects of inappropriate medicines and of polypharmacy in older patients. There is accumulating evidence for the benefits of medicines reviews followed by careful deprescribing of inappropriate medicines for which the risks of continuation outweigh the risks of discontinuation.

Despite the compelling literature for deprescribing in the elderly, in practice considerable barriers persist – especially for GPs. It is reasonable to believe that these barriers may operate especially in the practice of early-career less experienced GPs and registrars. Our preliminary ReCEnT data suggests deprescribing by GP registrars for

older patients is relatively uncommon. In this study we aim to address the evidence-practice gap of abundant evidence for the harms of polypharmacy and inappropriate medicines in older patients yet relatively limited levels of deprescribing of these medicines. We will do this via a complex educational intervention that aims to increase registrars' deprescribing in an evidence-based and safe manner.

In the proposed study we target educational interventions to early-career GPs when they are still developing their own prescribing "style" and "habits". Delivering educational interventions to early-career GPs rather than established GPs may also be a more efficient and sustainable way to educate prescribers about evidence-based deprescribing Registrars' existing educational programs provide a structure for scheduled face-to-face sessions as well as access to web-based educational structures. This infrastructure is pre-existing and using it is more efficient than organizing individual practice-level educational sessions and setting up web-based educational delivery systems de novo. The effectiveness of the educational intervention will be assessed using data of an extant project (ReCEnT), also contributing to the efficiency of the RE-DIME project [19].

The concurrent evaluation of change in registrars' anticipated (vignette-based) deprescribing and actual (ReCEnT-measured) deprescribing will provide insights into limitations of the translation of educational changes in knowledge and attitudes to clinical behaviours. Together with our qualitative evaluation this will facilitate iterations to the educational package in annual delivery to future GP registrar cohorts. It will also have implications for clinical educational practice more generally.

Limitations of the project

In our non-randomized trial, inferences of causality will be less strong than for a Randomized Controlled Study (RCT). An RCT, however, is impractical for this research question. Individual RTOs will only participate if it is practicable to introduce the intervention into existing educational programs. Initially, for this educational intervention, this is only practicable for GP Synergy. We will, however, adjust for the non-randomized design with multivariable analyses. The large set of independent variables recorded in ReCEnT allows for fine-grained adjustment for confounding in these analyses. We are confident that our design is the most robust approach to the research question in the context of

Australian GP vocational training and we have used this methodology previously with interventions addressing other GP registrar clinical behaviours.(74, 75)

Our outcomes, deprescribing intentions and actual deprescribing behaviour, are surrogate measures. The clinical outcomes of health effects in older patients are beyond the scope of our study. There is strong evidence, however, for the benefits of deprescribing, and deprescribing education is being advocated and included in GP training programs without evidence of efficacy in increasing deprescribing.

Further implications

We will introduce an educational innovation within the singular setting of GP training and the registrar-supervisor dyad. If the intervention is successful, the multicomponent model developed for the RE-DIME study could also be used as a basis of interventions for testing in trials targeting established GPs.

List of abbreviations

<u>ANZCTR</u>	<u>Australia New Zealand Clinical Trials Registry</u>
<u>ASGC-RA</u>	<u>Australian Standard Geographical Classification-Remoteness Area</u>
<u>BCT</u>	<u>Behaviour Change Technique</u>
<u>BCW</u>	<u>Behaviour Change Wheel</u>
<u>COM-B</u>	<u>'Capability', 'Opportunity', 'Motivation' and 'Behaviour'</u>
<u>EPOC</u>	<u>Effective Practice and Organisation of Care</u>
<u>ERG</u>	<u>Educational Research Grant</u>
<u>EVGP</u>	<u>Eastern Victoria GP Training</u>
<u>GEE</u>	<u>Generalized Estimating Equation</u>
<u>GP</u>	<u>General Practitioner</u>
<u>GPTT</u>	<u>General Practice Training Tasmania</u>
<u>HMRI</u>	<u>Hunter Medical Research Institute</u>
<u>HREC</u>	<u>Human Research Ethics Committee</u>
<u>ID</u>	<u>Identification number</u>
<u>PIM</u>	<u>Potentially Inappropriate Medicine</u>

<u>RACGP</u>	<u>Royal Australian College General Practitioners</u>
<u>RCT</u>	<u>Randomised Controlled Trial</u>
<u>ReCEnT</u>	<u>Registrar Clinical Encounters in Training (study)</u>
<u>REDCap</u>	<u>Research Electronic Data Capture</u>
<u>RE-DIME</u>	<u>Registrars' Evaluation and Deprescribing of Inappropriate Medicines in the Elderly</u>

Declarations

Ethics approval

Ethical approval for the ReCEnT and Re-DIME projects has been granted by the Human Research Ethics Committee (HREC) from the University of Newcastle (reference, H-2009-0323).

Consent for publication

Not applicable.

Availability of data and material

The database for the study will be available to the study investigators.

Advice from the approving ethics committee precludes making the database publicly available. Participants in the ReCEnT study have in the past not provided explicit consent for their data to be made available in this way and some of the data analyzed in this project will be of participants who have not provided that consent.

Findings from the study will be communicated to participants via routine communications from their RTO, for example the GP Synergy Training Updates for registrars and supervisors.

There will be no restrictions on publication or presentation to disseminate study findings to health care professionals and the public.

There will be no use of professional writers for publications reporting study findings.

Competing interests

All investigators declare no financial or other competing interests

Funding

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The RE-DIME project is funded by a competitive Educational Research Grant of the Royal Australian College of General Practitioners (RACGP) (ERG-03). GP Synergy, the Regional Training Organisation delivering general practice education and training in New South Wales and the Australian Capital Territory, is delivering the educational intervention as part of the GP Synergy educational program.

The funders had and will have no role in study design; collection, management, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication

Authors' contributions

PM is the study sponsor and principal investigator, responsible for overall conduct of the study. PM conceived the study. PM, BB, SH co-ordinated design of intervention. BB provided expertise in behavior change. SH, MVD, BB, EH, CE-B, AT, NS, AD, KF, CG, JF, RT provided methodological and clinical input into quantitative study design and analysis. MVD will provide oversight of qualitative study and analysis. AT is responsible for data management and conduct of in-house statistical analyses. EH is providing overall supervision of statistical analyses. SB led construction of the on-line module. LK and MVD will provide assistance in conduct of qualitative study. KP is the overall project manager. DQ is responsible for day-to-day running of the project, development of study and regulatory documents and construction of REDCap survey tools. All authors contributed to refinement of the study protocol and approved the final manuscript.

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Table 1: Theoretical framing of the intervention within the Behaviour Change Wheel

Sources of behaviour	Intervention functions	Intervention component	Aim	Intervention component content
Capability Motivation	Education Persuasion	Online module	Increase motivation and capability to deprescribe by changing knowledge and attitudes	Background information on polypharmacy Introduction of Beers criteria, Drug Burden Index. Evidence of benefits of deprescribing
Capability Motivation	Education Persuasion Feedback	Face-to-face workshop (Geriatrician-led segment)	Increase motivation and capability to deprescribe by changing knowledge and encouraging reflection	Expert opinion on polypharmacy and potentially inappropriate medicines (PIMs) in the older patient. ReCEnT data on registrar’s deprescribing will be used to contextualise and reinforce practical relevance.
Capability Motivation Opportunity	Modelling Education Training Persuasion Environmental restructuring	Face-to face workshop (Segment led by experienced supervisors)	Increase motivation and capability through discussion regarding functioning of the supervisor-registrar dyad and simulated cases role-play	‘How to’ deprescribe within the environment of everyday general practice. Role play scenarios: Supervisor + Registrar + Patient.
Capability Motivation	Education Persuasion Modelling Enablement Environmental restructuring	Supervisor webinar	Increase registrar capability and motivation through empowerment	Succinct overview of polypharmacy and imperative to deprescribe inappropriate medicines. Provision of potential models of supervisor-registrar collaboration and reciprocity in deprescribing. Discussion of processes for detection of PIMs in general practice and methods for increasing opportunities for registrar deprescribing.

Capability	Education	Supervisor/Registrar	Increase registrar	Registrar and supervisor encouraged to review
Motivation	Persuasion	teaching activities	capacity to review	deprescribing cases, clinical notes, and ReCENT
Opportunity	Training		medicine regime by	data on registrars' deprescribing. Supervisor
	Modelling		augmenting self-efficacy.	gives registrar license to review patient
	Enablement		Drive opportunities to	management and deprescribe in collaboration
	Environmental		discuss and initiate	with the supervisor. Supervisor invites registrar
	restructuring		deprescribing	to review supervisor's patients medicine
				regimens. Registrar does the groundwork for
				supervisor regarding initial medication review
				and becomes a collaborator with the supervisor
				in managing individual deprescribing scenarios.