

# Factors associated with potentially inappropriate prescriptions and barriers to medicines optimisation among older adults in primary care settings: a systematic review

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## ABSTRACT

**Objective** To identify factors that likely contribute to potentially inappropriate prescriptions (PIPs) among older adults in primary care settings, as well as barriers to medicines optimisation and recommended potential solutions.

**Design** Systematic review.

**Eligibility criteria** Quantitative studies that analysed the factors associated with PIPs among older adults (≥65 years) in primary care settings, and qualitative studies that explored perceived barriers and potential solutions to medicines optimisation for this population.

**Information sources** PubMed, EMBASE, Scopus, CINAHL, PsycINFO, Web of Science, CNKI and Wanfang.

**Results** Of the 13 167 studies identified, 50 were included (14 qualitative, 34 cross-sectional and 2 cohort). Nearly all quantitative studies examined patient-related non-clinical factors (eg, age) and clinical factors (eg, number of medications) and nine studies examined prescriber-related factors (eg, physician age). A greater number of medications were identified as positively associated with PIPs in 25 quantitative studies, and a higher number of comorbidities, physical comorbidities and psychiatric comorbidities were identified as patient-related clinical risk factors for PIPs. However, other factors showed inconsistent associations with the PIPs. Barriers to medicines optimisation emerged within four analytical themes: prescriber related (eg, inadequate knowledge, concerns of adverse consequences, clinical inertia, lack of communication), patient related (eg, limited understanding, patient non-adherence, drug dependency), environment related (eg, lack of integrated care, insufficient investment, time constraints) and technology related (eg, complexity of implementation and inapplicable guidance). Recommended potential solutions were based on each theme of the barriers identified accordingly (eg, prescriber-related factors: incorporating training courses into continuing medical education).

**Conclusions** Older adults with more drugs prescribed and comorbidities may have a greater risk of receiving PIPs in the primary care setting, but it remains unclear whether other factors are related. Barriers to medicines optimisation among primary care older adults comprise

## Key points

### Question

► What factors are associated with potentially inappropriate prescriptions among primary care older adults, and what are the barriers and potential solutions to optimise their medication use?

### Finding

► Most studies identified that patients with a higher number of medications or comorbidities and specific physical or psychiatric comorbidities were more likely to receive potentially inappropriate prescriptions. Barriers and potential solutions to medicines optimisation included the levels of prescribers, patients, the environment and technology.

### Meaning

► More attention should be paid to medication safety in primary care older adults with more prescribed drugs and comorbidities. Barriers to medicines optimisation for this population comprised multiple and interactional factors, which awaits targeted interventions, policies and future studies to address these difficulties in clinical practice.

multiple factors, and evidence-based and targeted interventions are needed to address these difficulties.  
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## INTRODUCTION

The ageing population is a challenge to healthcare systems in China and internationally.<sup>1</sup> Older adults are vulnerable to non-communicable diseases and multimorbidity.<sup>2</sup> More than half of the Chinese people aged 70 and over suffer from coexisting diseases, resulting in concomitant multiple medication use, potentially inappropriate prescriptions (PIPs) and increased medication burden,

which has widely concerned policymakers and health professionals.<sup>3–5</sup>

Potentially inappropriate prescribing refers to the prescribing of medications not recommended in older adults due to significantly higher risks than benefits where more effective and safer alternatives are available.<sup>6</sup> A systematic review showed that approximately 20% of prescriptions to community-dwelling older adults were considered potentially inappropriate.<sup>7</sup> PIPs are independently associated with adverse drug events (ADEs), which can cause emergency department visits, hospital admissions, lower quality of life and increased health expenditure.<sup>8</sup> Most ADEs resulting from PIPs are potentially avoidable, but often underestimated in clinical practice.<sup>7</sup> Researchers generally used criteria based (such as Beers criteria) and judgement based (such as Medication Appropriateness Index (MAI)) screening methods to detect PIPs through databases or surveys.<sup>7</sup>

Primary care practitioners (PCPs) play a critical role in the appropriate prescription of medications and medicines optimisation among older adults in the community.<sup>9</sup> Our previous review suggested wide variations between 1.4% and 37.9% of low-quality outpatient prescriptions in China's community health centres.<sup>10</sup> Several quantitative systematic reviews have focused on factors associated with PIPs among older adults,<sup>9 11–14</sup> and qualitative systematic reviews have synthesised barriers and enablers to minimise potentially inappropriate medications (PIMs).<sup>15–17</sup> However, some reviews included studies conducted in tertiary healthcare settings or nursing homes, in which the population characteristics may vary from primary care settings. Several new studies have emerged since these systematic reviews were published, which may expand on prior findings. Moreover, none have mixed quantitative and qualitative findings, and practical recommendations for quality improvement have rarely been reviewed.

To our knowledge, factors associated with PIPs among primary care older adults and barriers to optimising their medication use have not yet been comprehensively reviewed. Such a review is needed to allow the integration of research theory and practice before preparing the design of interventions. We conducted this systematic review to comprehensively identify the factors associated with PIPs among older adults in primary care settings. This review also synthesised the perceived implementation barriers to medicines optimisation from the stakeholders and their recommended potential solutions.

## METHODS

### Search strategy and data sources

Before the review was carried out, a protocol was guided by the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 statement.<sup>18 19</sup> A preliminary search was conducted to ensure the novelty of our systematic review. Eight literature databases (PubMed, EMBASE, Scopus, CINAHL, PsycINFO, Web of Science, CNKI and Wanfang) were systematically searched for

available original research through 31 December 2020 (date of the last search: 25 February 2021). Search terms were adapted from relevant systematic reviews,<sup>11 15</sup> and were discussed within our team but not peer-reviewed by information specialists or librarians. The full search strategy is presented in online supplemental table S1.

Searches were limited to human studies reported in the Chinese or English language for relevance. Additional articles were retrieved with a manual search through Web of Science based on the reference lists and related citations of relevant reviews, editorials, commentaries, letters and original research included in the review.

### Eligibility criteria

The systematic review identified quantitative (cross-sectional and cohort) studies that analysed the factors associated with PIPs among primary care older adults, and qualitative studies that explored PCPs' and older adults' perceived barriers to medicines optimisation and their recommended potential solutions.

The included quantitative studies met the following criteria: (1) participants were adults aged 65 years and older; (2) participants were recruited from primary care settings (eg, community hospitals, clinics, community pharmacies or home) and (3) data that were used to analyse the factors associated with PIPs were collected through surveys or databases. The included qualitative studies met the following criteria: (1) primary care adults aged 65 years and older, and/or PCPs who prescribed or cared for older adults in the community were involved as participants and (2) participants reported their perceptions of barriers to medicines optimisation among older adults in primary care settings, and/or recommended potential solutions.

Qualitative studies were excluded if they (1) were not published in English or Chinese, (2) were not original research, (3) focused on participants with specific groups of pathologies or medications, or (4) included the patients discharged from the hospital. Besides the former three criteria, quantitative studies were excluded if they (1) did not use a validated screening method to detect PIPs or (2) used improper or incorrect statistical analysis methods.

### Study selection

All search results were imported and organised in EndNote V.20 (Clarivate Analytics; <https://endnote.com/product-details>, accessed 26 February 2021). Duplicate citations were thereafter removed. Three reviewers (ZX, XL and YL) independently screened the titles and abstracts of the identified articles to create a form using Microsoft Excel 2019 (Microsoft; <https://www.microsoft.com/zh-cn/microsoft-365>, accessed 14 January 2021) that contained information on potentially relevant articles. Two reviewers (ZX and XL) examined full-text publications, discussed them, and reached a consensus for eligibility. When the uncertainty of the inclusion of identified

articles remained, a third reviewer (YL) was consulted to resolve the discrepancies.

### Assessment of the quality of studies

The quality of the included full-text articles was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tool (<https://jbi.global/critical-appraisal-tools>, accessed 19 February 2021). The JBI tool assists reviewers in evaluating the relevance, trustworthiness and results of research evidence ensuring that methodology, analysis and interpretations complement one another. Composed of 13 study-specific checklists for appraisal, the JBI tool has eight domains for analytic cross-sectional studies,<sup>20</sup> 11 domains for longitudinal studies<sup>20</sup> and 10 domains for qualitative studies.<sup>21</sup>

Two reviewers (ZX and YZ) independently applied the JBI checklists to rate the methodological quality of the included studies and determine the risk of bias in the design, conduct and analysis. The total score of the included study was calculated by summing each item's score. The disagreement in ratings was resolved through discussion and consultation with a third reviewer (YL). Studies were assessed as low-quality if the number of domains coded as no exceeded one, coded as unclear exceeded two or one domain was coded as no plus any others coded as unclear.

### Data extraction process

Two reviewers (ZX and XL) independently completed the data extraction process using a standardised, pre-piloted spreadsheet designed based on the key features of the articles. The extracted information included general study characteristics (first author's name and year of publication), study design (location, study settings, study period, instrument for assessing PIPs, research and analysis methods) and study population details (sample size, participants' age range in quantitative studies and participants' identities in qualitative studies), the main findings of PIP rate and associated factors in quantitative studies, and barriers and recommendations in qualitative studies. All the results of the selected qualitative studies were entered verbatim into MAXQDA 2020 (VERBI; <https://www.maxqda.com/new-maxqda-2020#>, accessed 20 February 2021) for qualitative synthesis. Unclear or missing data in the selected articles were requested from the study authors via email. Discrepancies in the extracted data were resolved by discussion and consensus between the two reviewers and adjudicated by a third reviewer (YL) if an agreement could not be reached.

### Data synthesis and analysis

Data from quantitative studies (overall PIP rate and associated factors) were synthesised using conventional content synthesis methods.<sup>22</sup> To ensure that the synthesis reflected the original reference findings, the definition of associated factors in each study was examined. Meta-analysis was considered inappropriate due to sample heterogeneity, measurement and analysis methods.

Thematic synthesis was conducted for qualitative studies in line with the methods proposed by Thomas and Harden.<sup>23</sup> The process of deriving the themes was inductive. Following rereading and understanding the results section of selected studies, an initial coding manual was first established by one reviewer (ZX) through line-by-line coding to identify similar concepts across studies and subthemes regarding PCPs' and older adults' perceived barriers to medicines optimisation and recommended potential solutions. Two reviewers (ZX and XL) independently coded selected qualitative studies using this coding manual until no further subthemes emerged. Any discordance between the two reviewers was discussed and adjudicated by a third reviewer (YL) when a disagreement remained. The coding manual was refined accordingly after consensus and was subsequently discussed with all authors who provided expertise in primary care and prescribing behaviour to develop and finalise the analytical construct.

Since our review focused on different subquestions of PIPs among older adults in primary care settings (factors, barriers and recommendations) that neither refute nor confirm each other but rather complement each other, the convergent segregated approach was undertaken to integrate both quantitative and qualitative synthesised findings.<sup>24</sup>

### Patient and public involvement

The main findings of our review were reviewed and commented on by four patients, three primary care physicians and one community pharmacist selected from two community health centres in Hangzhou and Shenzhen. Two of the study authors (YL and YY) have served as PCPs in community health centres involved with community-dwelling older adults' healthcare and medication management. Both the authors participated in determining the research agenda, developing protocols, interpreting and reporting the results.

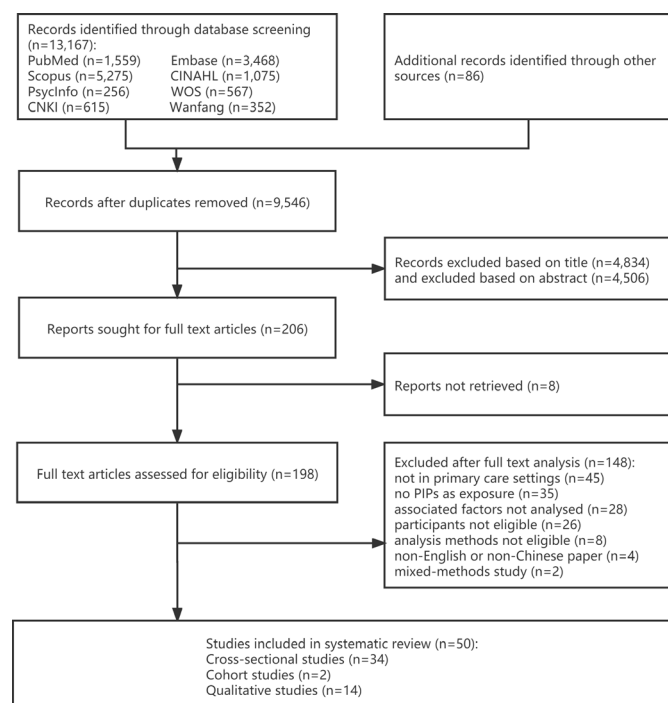
## RESULTS

### Description of study characteristics

The electronic database searches identified 13 167 references for screening, and 44 studies were eligible for the review process. Eighty-six additional studies were identified via manual searches, and six were included after screening. The PRISMA flow chart (figure 1) included a total of 50 studies and reasons for studies excluded from the review process. The most common reason for exclusion was that some studies were not conducted in primary care settings (n=43), followed by exposure not to PIPs (n=35) and associated factors of PIPs not correctly analysed (n=28).

The data extracted from the included studies were summarised in online supplemental table S2 and S3. Of the 50 studies included, 34 were cross-sectional studies,<sup>25–58</sup> 2 were cohort studies<sup>59 60</sup> and 14 were qualitative studies.<sup>61–74</sup> Most studies were conducted in a single





**Figure 1** PRISMA flow diagram of systematic review.

country, except 1 international study involving participants in 11 European countries. In quantitative studies, the majority (84%) involved older adults aged over 65 years, and only six (16%) involved adults aged over 70 years (range of sample size: 89–1 595 054). The Beers criteria were the most commonly used screening methods to detect PIPs (53%), followed by STOPP (45%) and START (26%). In qualitative studies, six studies (43%) involved general practitioners or primary care physicians as participants, with one (7%) involving community pharmacists, and seven (50%) using a mixed sample (range of sample size: 15–152). Nine (64%) studies used semi-structured interviews to collect data, with four (29%) using focus group interviews and one (7%) using mixed methods.

### Quality appraisal results

The methodological quality of the included studies varied (details of quality appraisal results were presented in online supplemental table S4). None were excluded from the quality appraisal process because all studies were of sufficient methodological quality. In quantitative studies, 14 of the included cross-sectional studies (41%) and 2 cohort studies (100%) were assessed as high quality. All cross-sectional studies reviewed met the quality criteria of detailed participants, setting, valid exposure measurement and appropriate statistical analysis. The common problems affecting study quality were failure to (1) establish how the measurement of outcomes was conducted (68%), (2) clearly define exclusion criteria (53%), (3) use standard criteria for measurement of the condition (50%) and (4) deal with confounding factors (41%). Three studies (9%) did not identify any confounding factors. Four items were considered not applicable to

the two cohort studies included in the quality appraisal process. One cohort study reviewed met all the remaining quality criteria in the appraisal, whereas the other study failed to deal with confounding factors.

Six of the included qualitative studies (43%) were assessed as high quality. None of the included qualitative studies met all the quality appraisal criteria. All studies failed to state the philosophical or theoretical premises on which the study was based. Study quality was also affected by failure to locate the researcher culturally or theoretically (36%) and failure to acknowledge and address the influence of the researcher on the research (93%). All qualitative studies reviewed met the remaining seven quality criteria.

### Factors associated with PIPs

#### Patient-related factors

##### Non-clinical factors

All but one study evaluated patient-related non-clinical factors (table 1). Age and sex were the two most common demographic factors evaluated, but the results varied in these studies. Fourteen studies showed a significant positive association between advanced age and PIPs,<sup>25 28 31 37 39 40 43 45 46 48 50 51 55 56</sup> whereas 5 showed a significant negative association,<sup>27 34 35 38 53 57</sup> and 11 did not show a significant association.<sup>26 29 30 33 41 42 44 47 49 52 54</sup> Female older adults were more likely to have PIPs than male in 11 studies.<sup>29 31 33 37 41 42 47 48 52 56 57</sup> However, 4 studies showed an opposite result,<sup>34 35 38 53</sup> and 15 studies showed no significant association between sex and PIPs.<sup>26–28 30 39 40 43–46 49–51 54 55</sup> Moreover, one study showed mixed results that the association was relevant to specific items of the STOPP criteria.<sup>25</sup>

Race,<sup>37 53 57</sup> region,<sup>29 36 41 44 50 56</sup> socioeconomic status<sup>27 29 31 33 52</sup> and living alone<sup>27 29 47 49 51 53</sup> were inconsistently associated with PIPs among primary care older adults. Nine of 10 studies showed no significant association between education and PIPs,<sup>29 33 42 45 47 48 51 52 55</sup> and all 6 studies reported that marital status was not an associated factor of PIPs.<sup>33 48 51–53 57</sup>

##### Clinical factors

The medication count was examined in most studies, and the results were consistent. Twenty-five of the 28 studies found that older adults on a greater number of medications were more likely to receive PIPs.<sup>26–29 31–35 37–41 44 46–50 52–56</sup> Four studies identified specific types of medications as associated factors PIPs, such as medications for the central nervous system, digestive system, locomotive system, musculoskeletal system and metabolism.<sup>27 33 41 52</sup>

The number and types of comorbidities may also affect the PIPs. Patients with more comorbidities were more likely to receive PIPs in nine studies.<sup>26 41 44–46 50 51 55 57</sup> Fourteen of the 16 studies<sup>29–31 33 39–41 43 46 48 49 53 54 57</sup> and 8 of the 9 studies<sup>27 30 33 46 48 53 54 57</sup> showed some types of physical comorbidities (eg, diabetes, osteoporosis and rheumatoid arthritis) and psychiatric comorbidities (eg, depression and anxiety) were related to PIPs, respectively.

**Table 1** Patient-related factors of PIPs in included quantitative studies

Study	Non-clinical factors					Clinical factors										Use of care delivery
	Age	Sex	Race	Education	Socioeconomic status	Region	Marital status	Living alone	No of drugs	Type of drugs	No of comorbidities	Physical comorbidities	Psychiatric comorbidities	Health status	Unhealthy behaviours	
Bradley (2012) <sup>25</sup>	↑	▲														
Vatcharavongvan (2019) <sup>26</sup>	□	□							↑	↑						
Fialová (2005) <sup>27</sup>	↓	□			▲			▲	↑	▲	□		▲	□		□
Castillo-Páramo (2014) <sup>28</sup>	↑	□							↑					▲		
Núñez-Montenegro (2019) <sup>29</sup>	□	F		□	□	□		□	↑			▲		□		□
Wang (2019) <sup>30</sup>	□	□									□	▲	▲			
Ble (2015) <sup>31</sup>	↑	F			□				↑		↓	▲				
Moriarty (2015) <sup>32</sup>									↑							
Lopez-Rodriguez (2020) <sup>33</sup>	□	F		□	□		□		↑	▲	□	▲	▲			
Cahir (2014) <sup>34</sup>	↓	M							↑							
Bradley (2014) <sup>35</sup>	↓	M							↑		↓	□				
Lund (2012) <sup>36</sup>						▲										
Buck (2009) <sup>37</sup>	↑	F	□						↑							▲
Cahir (2010) <sup>38</sup>	↓	M							↑							
Vezmar Kovatević (2014) <sup>39</sup>	↑	□							↑		□	▲	□			
Lin (2011) <sup>40</sup>	↑	□							↑			▲				
Simões (2019) <sup>41</sup>	□	F				□			↑	▲	↑	▲				
Howard (2004) <sup>42</sup>	□	F		□					□		□			□		
Zeenny (2017) <sup>43</sup>	↑	□										▲			▲	
Awad (2019) <sup>44</sup>	□	□		▲			▲		↑		↑					

Continued

**Table 1** Continued

Study	Non-clinical factors						Clinical factors								Use of care delivery	
	Age	Sex	Race	Education	Socioeconomic status	Region	Marital status	Living alone	No of drugs	Type of drugs	No of comorbidities	Physical comorbidities	Psychiatric comorbidities	Health status		Unhealthy behaviours
Gorup (2017) <sup>45</sup>	↑	♀		□					□		↑					□
Mand (2014) <sup>46</sup>	↑	□							↑		↑	▲	▲			
Tommelein (2016) <sup>47</sup>	□	F		□				□	↑		↑			▲	□	□
Sakr (2018) <sup>48</sup>	↑	F		□			□		↑		↑	▲	▲		□	
Hamano (2014) <sup>49</sup>	□	□						□	↑			▲				□
Zhang (2020) <sup>50</sup>	↑	□				□			↑		↑					▲
Liu (2020) <sup>51</sup>	↑	□		□			□	□	□		↑					▲
Rogero-Blanco (2020) <sup>52</sup>	□	F		□	▲		□		↑	▲						
Bala (2019) <sup>53</sup>	↓	M	▲				□	▲	↑		↑	▲	▲	▲	□	▲
Almoud (2015) <sup>54</sup>	□	□							↑			▲	▲			□
Sayin (2020) <sup>55</sup>	↑	□		□					↑		↑	□				□
Amos (2015) <sup>59</sup>	↑	F				▲			↑							
Pugh (2011) <sup>60</sup>	↓	F	▲				□				↑	▲	▲			▲

↑: Significant positive association; ↓: Significant negative association; ♀: Not significant; ▲: Significant.

Blank cells: the variable was not examined.

F, female; M, male; PIPs, potentially inappropriate prescriptions.

Two studies showed that self-rated poorer health status was associated with a higher number of PIPs,<sup>47 53</sup> yet this association was not found in another two studies.<sup>27 42</sup>

Several studies found that more primary care visits,<sup>37 50</sup> prescribed partly by secondary or tertiary care physicians,<sup>51</sup> a history of hospitalisation in the last 90 days,<sup>53</sup> and receiving geriatric care<sup>60</sup> were associated with an increased risk of PIPs. Five studies examining unhealthy behaviours demonstrated that smoking was not a significant predictor,<sup>43 47 48 51 53</sup> with only one suggesting that alcohol consumption may be a protective factor for PIPs.<sup>43</sup>

### Prescriber-related factors

Nine studies evaluated prescriber-related factors; however, no factor was identified as being associated with PIPs in over half of the studies (table 2). Prescribers' sex and year of experience were inconsistently related to PIPs,<sup>33 38 42 56–59</sup> and the race was not related to PIPs.<sup>56</sup> Reportedly, physicians who prescribed six or more PIM types were more likely to have a board certification in internal medicine and family practice.<sup>56</sup> However, in another study, the physicians' family medicine certification status was not significantly associated with PIPs.<sup>42</sup> Older prescribers were found to have an increased risk of PIPs in two of the four studies.<sup>56 59</sup> One study showed that patients who had prescribers working as postgraduate medical trainers had lower MAI scores.<sup>33</sup>

Patients who had two or fewer prescribers were associated with a decreased likelihood of PIPs in one study.<sup>41</sup> Two studies found that solo practice physicians were more likely to prescribe PIMs to their older patients.<sup>57 59</sup> Prescribers caring for a small number or proportion of older adults were more likely to prescribe PIMs in two studies,<sup>58 59</sup> whereas one study identified caring for older adults as a risk factor.<sup>57</sup>

### Barriers to implementation of medicines optimisation

All studies described barriers to implementing medicines optimisation among older adults in primary care settings (box 1). Four themes of barrier factors were coded from the perspectives of the prescriber, patient, environment and technology. A selection of quotations from participants and interpretations of findings offered by the authors was presented in online supplemental table S5.

### Prescriber-related factors

The theme prescriber-related factors described prescribers' deficiencies in knowledge and capabilities of medicines optimisation. Inadequate knowledge related to prescribers being uninformed or misinterpreting some terms of medicines optimisation and their misinterpretation or unawareness of drug-related risks. Concerns about adverse consequences emphasised the uncertainty of the benefits and harms of medicines optimisation. Clinical inertia referred to prescribers' reluctance to change PIMs prescribed by other health professionals. Lack of communication indicated that prescribers seldom initiate

discussions with patients about drug safety and medicines optimisation.

**Inadequate knowledge**—Prescribers from 10 studies displayed their inadequate knowledge of medicines optimisation.<sup>61–64 66 67 70–73</sup> Some prescribers were unfamiliar with specific terms of medicines optimisation (eg, deprescribing) or misinterpreted the meaning of terms (eg, equating 'inappropriate' with 'carelessness').<sup>62 63</sup> Others were unaware of the drug-related risks and care problem in their clinical practice,<sup>63–65 70 72 73</sup> which was commonplace in older patients with long duration of PIPs use that appeared to work with few adverse effects.

**Concerns of adverse consequences**—Most prescribers expressed their concerns about the adverse consequences of reducing or changing medicines.<sup>61 64 65 67 69 70 73 74</sup> Prescribers feared that deprescribing PIMs may contribute to unexpected clinical efficacy and even worse outcomes, such as withdrawal syndrome, relapse or death.<sup>61 64 65 67 69 70 74</sup> One study demonstrated that the fears also encompassed outcomes regarding reputational damage and deteriorated relationships with patients.<sup>70</sup>

**Clinical inertia**—Eight studies described a tendency that prescribers in primary care settings maintained PIPs initiated by other health professionals.<sup>61–63 65 70 72–74</sup> Prescribers lacked motivation or felt it difficult to reconsider the appropriateness of existing prescriptions, particularly for long-term prescriptions or discharge medications.<sup>61–63 65 70 72–74</sup> Prescribers from one study thought reducing medicines initiated by others was against professional etiquette.<sup>70</sup> Furthermore, prescribers' ageism against PIP discontinuation was reported as a cause of clinical inertia in one study.<sup>63</sup>

**Lack of communication**—Six studies showed a lack of patient education and communication concerning PIP use and medicines optimisation for a variety of reasons.<sup>62 63 65 68 71 73</sup> Poor communication contributed to mutual misunderstandings and patient non-adherence, which impeded the medicines optimisation implementation.<sup>62 65 68 71</sup> Patients in one study reported that they obtained PIPs via telephone, instead of regular personal contact with prescribers.<sup>63</sup>

### Patient-related factors

The theme of patient-related factors described the reasons for patient resistance to medicines optimisation. Limited understanding emphasised patients underestimating the potential risks of ADEs and their reluctance to learn. Drug dependency referred to drug addiction and patients demanding drugs for perceived therapeutic effects. Patient non-adherence described patients' unwillingness to change medication regimens because of misunderstandings or fear of worse outcomes.

**Limited understandings**—Nine studies identified the limited understanding of PIPs as patient-related barriers to medicines optimisation.<sup>62–64 66 68 69 71 73</sup> Patients often lack understanding of their medications and health risks, particularly those with low education and advanced age.<sup>62 63 68 69 71 73</sup> They may accept ADEs, attribute

**Table 2** Prescriber-related factors of PIPs in included quantitative studies

Study	Sex	Age	Race	Position	Practice status	Year of experience	Certification	No of prescriber	No of older patients	Proportion of older patients
Núñez-Montenegro (2019) <sup>29</sup>								α		
Lopez-Rodriguez (2020) <sup>33</sup>	F	α		▲		↑				
Cahir (2014) <sup>38</sup>	M									
Simões (2019) <sup>41</sup>								↑		
Howard (2004) <sup>42</sup>	α					α	α			
Imai (2007) <sup>56</sup>	α	↑	α		α	↓	▲			
Brekke (2008) <sup>57</sup>	α	α			▲	↑			↑	
le (2017) <sup>58</sup>	α	α				α				↓
Amos (2015) <sup>59</sup>	M	↑			▲				↓	▲

↑: Significant positive association; ↓: Significant negative association; α: Not significant; ▲: Significant.

Blank cells: the variable was not examined.

F, female; M, male; PIPs, potentially inappropriate prescriptions.



## Box 1 Barriers to medicines optimisation for primary care older adults

### Prescriber-related factors

#### Inadequate knowledge

- ▶ Limited knowledge of medicines optimisation.<sup>61–64 66 67 70–73</sup>
- ▶ Misunderstanding of potentially inappropriate prescriptions (PIPs).<sup>62 63</sup>
- ▶ Unawareness of adverse consequences.<sup>63–65 70 72 73</sup>

#### Concerns of adverse consequences

- ▶ Fear of contributing to a worse outcome.<sup>61 64 65 67 69 70 73 74</sup>
- ▶ Fear of reputational damage and moral blame.<sup>70</sup>
- ▶ Concern about deteriorated relationships with patients.<sup>70</sup>

#### Clinical inertia

- ▶ Lack of motivation to reconsider long-term medications.<sup>61 65</sup>
- ▶ Prescriber's ageism against PIPs discontinuation.<sup>63</sup>
- ▶ Reluctance to change medications prescribed by others.<sup>63 70 72–74</sup>

#### Lack of communication

- ▶ Lack of communication with patients.<sup>62 65 68 71 73</sup>
- ▶ Inadequate personal contact with patients.<sup>63</sup>

### Patient-related factors

#### Limited understandings

- ▶ Lack of knowledge of PIPs.<sup>62 63 68 69 71 73</sup>
- ▶ Inhibited or not interested to know more information.<sup>63 64 71</sup>
- ▶ Misunderstanding of medicines optimisation.<sup>61 66 68 70 71</sup>

#### Drug dependency

- ▶ Drug addiction.<sup>61 63 64</sup>
- ▶ Ineffectiveness of alternatives.<sup>63</sup>
- ▶ Preferences for drugs due to perceived therapeutic effects.<sup>63–65 68 73 74</sup>
- ▶ Demands of receiving PIPs.<sup>63 65 69 74</sup>
- ▶ Distress to be relieved.<sup>65 71</sup>

#### Patient non-adherence

- ▶ Little willingness to change lifestyle.<sup>61</sup>
- ▶ Delay of implementing medication changes.<sup>61</sup>
- ▶ Under-reporting medication use or adverse drug events.<sup>62 64 68</sup>
- ▶ Tolerance to side effects.<sup>63 68</sup>
- ▶ Patient's ageism against PIPs discontinuation.<sup>63</sup>

### Environment-related factors

#### Lack of integrated care

- ▶ Inadequate information exchanged among prescribers.<sup>61 62 64 65 68–71 73</sup>
- ▶ Underdeveloped interprofessional relationships and collaboration.<sup>61 64–67 70 71 73</sup>
- ▶ Difficulty to reach a consensus among prescribers.<sup>61 62 66 68</sup>
- ▶ Limitations of disease-specific care.<sup>65 74</sup>

#### Insufficient investment

- ▶ Incomplete infrastructure.<sup>61</sup>
- ▶ Defects of the electronic health record system.<sup>64 66</sup>
- ▶ Unsatisfactory financial remuneration.<sup>71</sup>

#### Time constraints

- ▶ Time constraints in clinic consultations.<sup>61 64–67 70 73</sup>
- ▶ Non-clinical tasks.<sup>69</sup>

### Technology-related factors

#### Complexity of implementation

- ▶ Challenges of polypharmacy and multimorbidity.<sup>62 66–68 72 73</sup>
- ▶ Complex trade-offs between benefits and harms.<sup>67 68 72</sup>
- ▶ Non-pharmaceutical alternatives not used.<sup>63 70</sup>
- ▶ Time and resource-intensive processes.<sup>66 67 70</sup>

#### Inapplicable guidance

- ▶ Recommendations inapplicable to individuals.<sup>61 62 64–70 72 74</sup>

Continued

## Box 1 Continued

- ▶ Discrepancy between guideline recommendations.<sup>61 73</sup>
- ▶ Lack of recommendations informed by high-quality evidences.<sup>67 68 70 72 73</sup>

All studies cited in the box are high-quality apart from references.<sup>66–73</sup>

drug-related syndrome to part of their ageing, and did not understand the purpose of medicines optimisation.<sup>61 66 68 70 71</sup> Patients from three studies were inhibited or not interested in knowing more information about their medications.<sup>63 64 71</sup>

**Drug dependency**—Eight studies reported patient preference for their PIMs.<sup>61 63–65 68 69 73 74</sup> Some patients that chronically used certain drugs (eg, hypnotics) were influenced by drug addiction.<sup>61 63 64</sup> The ineffectiveness of alternatives was cited as one barrier to stopping medications.<sup>63</sup> Other patients were described as demanding drug treatment and resisting to medicines optimisation for other reasons, such as positive drug side effects and loyalty to former physicians' prescription orders.<sup>63 65 69 74</sup>

**Patient non-adherence**—Five studies described situations in which patients failed to adhere to medicines optimisation.<sup>61–64 68</sup> Patients may feel embarrassed to discuss their ADEs with prescribers and under-reported medication discontinuation.<sup>62 68</sup> Some patients adopted a passive approach to their medication management. For example, they 'postponed implementing medication changes', or had 'wish to take fewer drugs but little willingness to change their lifestyle'.<sup>61</sup> Some patients even asked someone else for medications if the former prescriber declined their request for PIPs.<sup>64</sup> Two studies reported that patients continued medications as long as they could endure the side effects of their medications.<sup>63 68</sup> One study showed patient's ageism against PIPs discontinuation was a cause of non-adherence among older adults.<sup>63</sup>

### Environment-related factors

The theme of environment-related factors described the challenges of the working environment in primary care settings. Lack of integrated care referred to the fragmentation of care and inadequate collaboration between PCPs and other health professionals. Insufficient investment related to unsatisfactory incentives and underdeveloped infrastructure to support medicines optimisation. Time constraints described PCPs' busy work and limited time for clinic consultations.

**Lack of integrated care**—Twelve of 14 studies identified the barrier of lack of integrated care for primary care older patients.<sup>61 62 64–71 73 74</sup> Respondents emphasised inadequate timely information exchange between health professionals,<sup>61 62 64 65 68–71 73</sup> and acknowledged underdeveloped interprofessional relationships and collaboration.<sup>61 64–67 70 71</sup> Four studies reported that PCPs found it difficult to reach a consensus with the specialists,<sup>61 62 66 68</sup> and respondents in two studies criticised the limitations

of disease-specific care lacking comprehensive consideration, which played a role in PIPs.<sup>65 74</sup>

**Insufficient investment**—Respondents from four studies described insufficient support for infrastructure.<sup>61 64 66 71</sup> No internet access,<sup>61</sup> and the poor EHR system was described as obstacles to following the instant guidance of appropriate prescribing.<sup>64 66</sup> One study reported pharmacists' complaints about financial difficulties and unsatisfactory financial remuneration for home medication reviews.<sup>71</sup>

**Time constraints**—Eight studies reported that PCPs' lack of time leads to suboptimal medicines optimisation.<sup>61 64–67 69 70 73</sup> The causes of this barrier included many patients who possibly had varied clinical priorities except medication management,<sup>61 64–67 69 70 73</sup> and working time and energy occupied by non-clinical tasks (eg, administrative work).<sup>69</sup>

### Technology-related factors

Theme technology-related factors described the complexity of implementing medicines optimisation and the limitations of guidance. The complexity of implementation emphasised the technical difficulties faced by prescribers in medicines optimisation for primary care for older adults. Inapplicable guidance related to the limited feasibility, applicability and reliability of guideline recommendations.

**Complexity of implementation**—Technical difficulties in medicines optimisation for primary care older adults were reported in eight studies.<sup>62 63 66–68 70 72 73</sup> Medicines optimisation was a time-and resource-intensive process,<sup>66 67 70</sup> and patients with polypharmacy, multimorbidity and non-adherence further contributed to the complexity of implementation.<sup>62 66–68 72 73</sup> Many respondents emphasised the pivotal challenge of weighing up benefits and harms of medicines optimisation for individuals.<sup>67 68 72</sup> Little access to other services, such as non-pharmaceutical alternatives, was also considered a challenge in implementing medicines optimisation.<sup>63 70</sup>

**Inapplicable guidance**—Eleven of 14 studies discussed that current guideline recommendations were considered not feasible or applicable to the individuals—further disabling prescribers implementing medicines optimisation.<sup>61 62 64 65 67–70 72–74</sup> First, prescribers thought that the recommendations were reasonable but inapplicable to individuals of different age groups or with complex comorbidities.<sup>61 62 64 65 67 69 72 74</sup> Second, the guidance did not provide quantification of the risk and non-pharmaceutical options.<sup>65 68 70 72</sup> Third, there were discrepancies between recommendations of medicines optimisation and general guidelines.<sup>61 73</sup> Fourth, many recommendations were not based on high-quality evidence.<sup>67 68 70 72 73</sup>

### Recommended potential solutions

Twelve of the 14 studies provided recommendations and potential solutions to address barriers to implementing medicines optimisation among older adults in primary care settings (box 2). These recommendations were

## Box 2 Recommended potential solutions of implementing medicines optimisation

### Prescriber-related factors

- ▶ Starting with easier options.<sup>67</sup>
- ▶ Adopting a gradual approach with close patient follow-up.<sup>6</sup>
- ▶ Waiting for favourable circumstances.<sup>72</sup>
- ▶ Finding an alternative path to avoid worse outcomes.<sup>67</sup>
- ▶ Repeated positive experience.<sup>67 68</sup>
- ▶ Training for medication review and optimisation.<sup>66 69 70 74</sup>
- ▶ Incorporating training courses into continuing medical education.<sup>69</sup>
- ▶ Being more reflective in decision-making about prescriptions.<sup>74</sup>
- ▶ Risk stratification and clinical monitoring.<sup>65 72</sup>

### Patient-related factors

- ▶ Earning patient trust.<sup>64</sup>
- ▶ Continuous therapeutic relationship.<sup>67</sup>
- ▶ Patient counselling and education.<sup>63 65 73</sup>
- ▶ Communication skills.<sup>64</sup>
- ▶ Electronic communication.<sup>66</sup>
- ▶ Shared decision making.<sup>64</sup>
- ▶ Activating patients to make them more involved.<sup>70</sup>
- ▶ Public health campaign and advertising.<sup>69</sup>
- ▶ Involving caregivers to assist medication management.<sup>66</sup>

### Environment-related factors

- ▶ Financial remuneration and professional acknowledgement.<sup>69 70</sup>
- ▶ Mutual multidisciplinary involvement and cooperation.<sup>66 69 73</sup>
- ▶ Timely communication with health professionals.<sup>67 69 70 73</sup>
- ▶ Open channels of interdisciplinary communication.<sup>69 70 73</sup>
- ▶ Increasing workflow efficiency through teamwork.<sup>66</sup>
- ▶ Scheduling special timing for medicines optimisation.<sup>64 69 70</sup>

### Technology-related factors

- ▶ Electronic surveillance of medications.<sup>66</sup>
- ▶ Centralised storage of accessible information in the electronic health record (EHR) system.<sup>70</sup>
- ▶ Using a chat in the EHR system among healthcare providers.<sup>73</sup>
- ▶ Providing accessible decision support.<sup>67 70 73</sup>
- ▶ Developing guidelines for the management of common comorbidities.<sup>68 70</sup>
- ▶ Feasible and concrete guidance.<sup>66 68</sup>
- ▶ Reliable information sources.<sup>67</sup>

All studies cited in the box are high-quality apart from references.<sup>66–70 72 73</sup>

categorised into four themes based on the identified barrier factors. A selection of quotations from participants and interpretations of findings offered by the authors were presented in online supplemental table S6.

Training about medication review and optimisation was the most consistent recommendation for prescriber-related barrier factors.<sup>66 69 70 74</sup> One respondent suggested incorporating a training course into continuing medical education to make pharmacists more inclined to participate.<sup>69</sup> Two studies reported that repeated positive experiences could reinforce PCPs' motivation to implement medicines optimisation.<sup>67 68</sup> Respondents emphasised the principle of being reflective in decision making about prescriptions,<sup>74</sup> and regular clinical monitoring of potential side effects.<sup>65 72</sup> Several implementation techniques

were suggested, such as starting medicines optimisation with easier options, waiting for favourable circumstances to obtain patient engagement, adopting a gradual approach with close patient follow-up and finding alternative paths to avoid worse outcomes.<sup>67 72</sup>

Eight studies reported recommendations for improved patient–physician interactions to patient-related barriers.<sup>63–67 69 70 73</sup> A continuous therapeutic patient–physician relationship was considered critical for medicines optimisation implementation,<sup>67</sup> with relevant practical recommendations, including shared decision making,<sup>64</sup> electronic communication<sup>66</sup> and communication skills.<sup>64</sup> Patient counselling and education to improve patients' awareness of PIPs was recommended in three studies.<sup>63 65 73</sup> One study suggested that campaigns from health authorities to patients could be carried out to raise their awareness of PIPs.<sup>69</sup> Another study described that caregivers or family members were helpful in assisting with medication optimisation for complex patients.<sup>66</sup>

Recommendations for environment-related barriers were described in seven studies, and the majority focused on improving cross-disciplinary collaboration.<sup>64 66–70 73</sup> Primary care physicians needed staff support from pharmacists or nurses to implement medicines optimisation in primary care settings.<sup>66 69 73</sup> Direct phone calls were recommended as a feasible strategy for timely information exchange between prescribers and other health professionals.<sup>67 70</sup> Four studies reported solutions to address the barriers to time constraints, such as scheduling a special appointment<sup>64 69 70</sup> and teamwork.<sup>66</sup> Additionally, respondents in two studies suggested that financial remuneration and professional acknowledgement were necessary for medicines optimisation.<sup>69 70</sup>

Five studies reported EHR optimisation and advanced technical aids as two main solutions to address technology-related barriers.<sup>66–68 70 73</sup> EHR optimisation involved adding functions of alerting drug errors and interactions, centralised storage of accessible information and online chat to achieve timely communication between prescribers and other health professionals.<sup>66 70 73</sup> Respondents reported their urgent need for guidance that was concrete, evidence based and applicable to older patients with common multimorbidities.<sup>68 70</sup> The ease of access to guidance was emphasised in three studies,<sup>67 70 73</sup> and one respondent took an iPad app as an example of an accessible tool to optimise medications in clinical practice.<sup>70</sup>

## DISCUSSION

In this systematic review, we comprehensively identified 16 patient-related factors (eight non-clinical and eight clinical, respectively) and ten prescriber-related factors of PIPs among primary care older adults. Also, we synthesised four analytical themes of stakeholders' perceived barrier factors to medicines optimisation and their corresponding recommendations and potential solutions. The results of qualitative studies showed that barriers to medicines optimisation involved factors related to prescribers,

patients, environment and technology. The recommended potential solutions were based on each theme of the barriers identified accordingly. The main findings of our study were reviewed and commented on by stakeholders in different areas to strengthen their practicability. Our study expands on previous systematic reviews by mixing quantitative and qualitative findings, which allowed for greater scope and insights into the factors associated with PIPs and barriers and recommendations to medicines optimisation.

A recent systematic review of 22 papers by Nothelle *et al*<sup>14</sup> explored patient, clinician and environmental factors associated with PIM use in community-dwelling older adults in the USA. Their review identified four patient-related associated factors: a higher number of prescribed (reported by 14 studies), female sex (reported by 10 of 16 studies), psychiatric comorbidity (reported by 6 of 8 studies) and geographical region (reported by 7 of 8 studies), which partly coincided with our findings. However, only three studies examining clinician factors were included in their systematic review, and few were statistically significant.<sup>12</sup> In two systematic reviews, the number of medications, sex and age were the factors most often associated with PIMs among community-dwelling elderly, and both reviews showed a mixed association between PIMs and sex or age.<sup>13 14</sup> Although this result was in line with our findings, the proportion of studies included in our review reporting the positive association was smaller. Similar patient-related factors have been shown in systematic reviews exploring PIPs across different healthcare settings.<sup>15 16</sup>

Despite many factors that previous reviews and our study had identified, it is vital to note that a greater number of medications were the most consistent risk factors for PIPs in all settings. Alarming, the number of medications has been increasing over the years. Qato *et al*<sup>75</sup> reported that 31% of older adults in the USA were taking five or more prescription medications in 2005–2006, rising to 36% in 5 years. These two proportions further increased to 53% and 67% if over-the-counter medications and dietary supplements were included.<sup>75</sup> Moriarty *et al* conducted a repeated cross-sectional study and found that the prevalence of polypharmacy among the elderly (≥65 years) in Ireland increased from 17.8% in 1997 to 60.4% in 2012.<sup>32</sup> Therefore, measures to curb the growth trend of medication use, particularly those unnecessary, ineffective and harmful prescribing, should be the priority in reducing medication-related harms.

Two systematic reviews by Anderson *et al*<sup>15</sup> and Reeve *et al*<sup>16</sup> synthesised qualitative studies regarding prescribers' and patients' perceived barriers and enablers to minimise PIMs, respectively. Despite differences in the eligibility criteria of participants and healthcare settings, most of the results reported in both reviews were similar to ours. However, one additional barrier described in our study was that PCPs may have no Internet access or computerised decision support systems (CDSSs) owing to underdeveloped infrastructure.<sup>61 62 65 67</sup> CDSSs are considered



promising solutions to improving medication safety since they can efficiently help PCPs process complex clinical information, increase PCPs' adherence to guidelines, and improve the quality of prescribing decisions.<sup>76</sup> Accordingly, potential solutions were recommended for streamlining the EHR system to help prescribers work efficiently and wisely, such as developing CDSS and online chat systems.<sup>67 71 74</sup>

A meta-synthesis by Cullinan *et al*<sup>17</sup> described the prescribers' viewpoints on why PIPs occurred in older patients in detail. They found that prescribers tend to satisfy patients' requests, partly because some patients became aggressive and demanded their medications. This finding was supported by a factorial experiment revealing that patient requests for a specific medication significantly increase the rate at which physicians prescribe that medication.<sup>77</sup> Our study synthesised several practical recommendations to cope with this problem, including patient counselling and education,<sup>64 66 74</sup> shared decision making<sup>65</sup> and involving caregivers for assistance.<sup>67</sup> Furthermore, our findings also added important recommendations regarding deepening cross-disciplinary cooperation among clinical pharmacists, specialists and primary care physicians. However, PCPs' barriers to and experience in responding to older patients demanding PIPs need to be explored in future studies.

Our study analysed both quantitative and qualitative studies and identified the consistency between these findings. For instance, quantitative studies have found that patients with a higher number of comorbidities, and specific physical (eg, osteoporosis) or mental diseases (eg, Alzheimer's disease) were more likely to receive PIPs. This challenge impacts on the qualitative findings of barriers to medicines optimisation, which requires more professional knowledge of physicians, and decreases patient adherence. The challenge could be more severe when the integrated care and applicable guidance were absent. Therefore, many potential solutions have been recommended focusing on improving the ability of PCPs to manage elderly patients with comorbidities, such as shared decision-making and developing guidelines for the management of common comorbidities. In the part of quantitative synthesis, this systematic review demonstrated the associations between PIPs and factors from both patient and prescriber aspects among primary care older adults.

We also identified gaps between the quantitative and qualitative findings. Although prescribers have a greater impact on PIPs, most studies have focused on patient characteristics and clinical information. In contrast, prescriber information has not been adequately investigated, which hampers our ability to identify prescriber-related factors. Many barriers already reported by qualitative studies (eg, patients' limited understanding and drug dependency) were not included as potential risk factors in quantitative studies to date. A possible reason for this gap was the difficulties in data collection because research solely based on the data of patients' prescriptions is easier to conduct.

Future studies in this area may need to consider relevant qualitative findings and design more practice-based approaches to explore the associated factors.

The results of our thematic synthesis disclosed perceived barrier factors of the prescriber, patient, environment and technology that shape PCPs' behaviour towards minimising PIPs in routine clinical practice. Several strategies to improve medicines optimisation could be implemented. First, professional training, including screening methods to detect PIPs, drug-related risk stratification and clinical monitoring, and communication skills of medication use, could be provided to PCPs. One example is the academic detailing. Previous systematic reviews demonstrated that the academic detailing was effective at changing PCPs' prescribing behaviours and improving their capacity for medicines optimisation.<sup>78 79</sup> However, there is still room for improvement in the content design, and more high-quality research is needed to examine the acceptability and feasibility of the training programmes.<sup>78</sup>

Second, patient education on medication use should be integrated into routine clinical practice in primary care settings. A continuous and high-trust therapeutic relationship helps engage patients in self-management of medication. Therefore, PCPs need to understand the motivation of patient use of PIMs and help them make wise decisions. Public health campaigns and advertising are also conducive to patient involvement, apart from direct patient counselling.<sup>69</sup> For example, PCPs may give lectures or send health information via social media to the community-dwelling older adults regularly to increase their awareness of medication safety.

Third, policy initiatives and health system reforms should improve PCPs' working environment of medicines optimisation, such as financial remuneration. Essentially, open channels of information exchange among health professionals are beneficial for developing interprofessional relationships and collaboration. Staff support from pharmacists or nurses can help address difficulties in many ways. They provide reassurance on treatment decisions, contribute to decreased workload and increase patient access to PCPs.<sup>80–82</sup> Policies should be made to encourage PCPs to integrate the pharmacists, nurses and other health professionals on the healthcare team to improve the quality of prescribing. Finally, besides advanced electronic health record (EHR) systems and accessible decision support to reduce PIPs, PCPs need concrete and evidence-based medicines optimisation procedures. This again implies an urgent need for high-quality studies involving individualised and complex interventions.

Our study has several limitations. First, it is difficult to quantitatively evaluate the degree of association between PIPs and factors, and compare the results from the included studies because of the heterogeneity of the sample, measurement and analysis methods. Second, since studies involving participants with specific diseases or medications were excluded from our review, the study results may not be generalisable to specific groups. Third, there remained great variations in the terminology used

for medicines optimisation, increasing the difficulties in identifying relevant studies. To address this problem, we formulated comprehensive search terms that were applied to multiple databases and manually searched reference lists and related citations. Fourth, a proportion of the studies included in our review were assessed to have a high risk of bias. This may reduce the strength of the evidence presented, and conclusions drawn from these must be treated with caution. However, the research quality was acceptable overall, and all studies could help improve the comprehensiveness of the results. Finally, publications were limited to English and Chinese languages only, which contributed to the potential omission of relevant evidence.

## CONCLUSIONS

Older adults with more drugs prescribed and comorbidities may have a greater risk of receiving PIPs in the primary care setting, but whether other factors were related remain unclear owing to the inconsistent or limited findings of associations. Barriers to medicines optimisation among primary care older adults comprised multiple and interactional factors regarding prescriber, patient, environment and technology. Recommended potential solutions could be used to develop targeted interventions to address difficulties in clinical practice.

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## Correction: *Factors associated with potentially inappropriate prescriptions and barriers to medicines optimisation among older adults in primary care settings: a systematic review*

Xu Z, Liang X, Zhu Y, *et al.* Factors associated with potentially inappropriate prescriptions and barriers to medicines optimisation among older adults in primary care settings: a systematic review. *Fam Med Com Health* 2021;9:e001325. doi: 10.1136/fmch-2021-001325

Figure 1 has been corrected in the article HTML and PDF since publication.

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*Fam Med Com Health* 2021;9:e001325corr1. doi:10.1136/fmch-2021-001325corr1



**Table S1** Search terms

<b>PubMed (1559 records identified)</b>
<p>(((((((("primary health care"[MeSH Terms] OR "general practice*"[MeSH Terms]) OR "general practitioner*"[MeSH Terms]) OR "family practice*"[MeSH Terms]) OR "physicians, family"[MeSH Terms]) OR "community health centers"[MeSH Terms]) OR "community health services"[MeSH Terms]) OR "hospitals, community"[MeSH Terms]) OR (((((((("family"[Title/Abstract] AND "physician*"[Title/Abstract]) OR ("family"[Title/Abstract] AND "practice*"[Title/Abstract])) OR ("general"[Title/Abstract] AND "practitioner*"[Title/Abstract])) OR ("general"[Title/Abstract] AND "practice*"[Title/Abstract])) OR ("primary"[Title/Abstract] AND "care"[Title/Abstract])) OR ("community"[Title/Abstract] AND "health center*"[Title/Abstract])) OR ("community"[Title/Abstract] AND "health service*"[Title/Abstract])) OR ("community"[Title/Abstract] AND "hospital*"[Title/Abstract])) OR (((("clinics"[Title/Abstract] OR "township health center*"[Title/Abstract]) OR "rural health station*"[Title/Abstract]) OR "community health station*"[Title/Abstract]) OR "community pharmac*"[Title/Abstract])</p> <p>AND</p> <p>("elder*"[Title/Abstract] OR "old*"[Title/Abstract] OR "senior"[Title/Abstract] OR "ageing"[Title/Abstract] OR "geriatric"[Title/Abstract] OR "aged"[Title/Abstract]) OR ("aged"[MeSH Terms])</p> <p>AND</p> <p>("inappropriate prescribing"[MeSH Terms] OR "medication error*"[MeSH Terms]) OR ("Inappropriate Prescribing"[Title/Abstract] OR "Inappropriate Prescription*"[Title/Abstract] OR "Inappropriate medication*"[Title/Abstract] OR "Inappropriate drug*"[Title/Abstract] OR "Inappropriate medicine*"[Title/Abstract] OR "irrational prescribing*"[Title/Abstract] OR "irrational prescription*"[Title/Abstract] OR "high-risk prescription*"[Title/Abstract] OR "unsafe prescription*"[Title/Abstract] OR "high-risk medication*"[Title/Abstract] OR "unsafe medication*"[Title/Abstract] OR "harmful medication*"[Title/Abstract] OR "prescribing omission*"[Title/Abstract] OR "suboptimal prescribing"[Title/Abstract] OR "suboptimal medication*"[Title/Abstract] OR "overprescribing"[Title/Abstract] OR "over-prescribing"[Title/Abstract] OR "over-prescription"[Title/Abstract] OR "underprescribing"[Title/Abstract] OR "under-prescribing"[Title/Abstract] OR "under-prescription*"[Title/Abstract] OR "limited benefit medication*"[Title/Abstract] OR "medicines optimisation"[Title/Abstract] OR "medicines optimization"[Title/Abstract] OR "reconciliation"[Title/Abstract] OR "deprescrib*"[Title/Abstract] OR "medication review"[Title/Abstract] OR "medication withdrawal"[Title/Abstract] OR "drug withdrawal"[Title/Abstract] OR "medication cessation"[Title/Abstract] OR "drug cessation"[Title/Abstract] OR "discontinuing medication*"[Title/Abstract] OR "medication discontinuation"[Title/Abstract] )</p> <p>AND</p> <p>("factor*"[Title/Abstract] OR "influencing factor*"[Title/Abstract] OR "risk factor*"[Title/Abstract] OR "influence factor*"[Title/Abstract] OR "affecting factor*"[Title/Abstract] OR "barriers"[Title/Abstract] OR "association"[Title/Abstract] OR "obstacle*"[Title/Abstract] OR "associated factor*"[Title/Abstract] OR "factor*"[Title/Abstract] OR "predictor*"[Title/Abstract] OR "determinant*"[Title/Abstract] OR "facilitator*"[Title/Abstract] OR "enabler*"[Title/Abstract] OR "challenge*"[Title/Abstract] OR "difficult*"[Title/Abstract] OR "qualitative"[Title/Abstract] OR "recommendation*"[Title/Abstract] OR "solution*"[Title/Abstract] OR "interview*"[Title/Abstract] OR "thematic analysis"[Title/Abstract] OR "grounded theory"[Title/Abstract] OR "focus group*"[Title/Abstract])</p>

<b>Embase (3468 records identified)</b>
<p>('primary health care'/exp OR 'primary medical care'/exp OR 'general practitioner'/exp OR 'general practice*'/exp OR 'health center*'/exp OR 'community care'/exp OR 'community hospital*'/exp OR 'home care'/exp OR 'general practitioner*':ab,ti OR 'family physician*':ab,ti OR 'family doctor*':ab,ti OR 'general practice':ab,ti OR 'primary health care':ab,ti OR 'primary medical care':ab,ti OR 'community care':ab,ti OR 'home care':ab,ti OR 'township health center*':ab,ti OR 'rural health station*':ab,ti OR 'community health center*':ab,ti OR 'community health service*':ab,ti OR 'clinic*':ab,ti OR 'community health station*':ab,ti OR 'community pharmacist*'/exp OR ('pharmac*'/exp AND shop) OR 'community pharmac*':ab,ti OR 'pharmacy shop*':ab,ti)</p> <p>AND</p> <p>('aged'/exp OR 'older adults'/exp OR 'older people'/exp OR 'older adult'/exp OR 'very elderly'/exp OR 'geriatric*'/exp OR senior:ab,ti OR aged:ab,ti OR old:ab,ti OR older:ab,ti OR elderly:ab,ti)</p> <p>AND</p> <p>('inappropriate prescribing'/exp OR 'medication error*'/exp OR 'inappropriate drug use'/exp OR 'inappropriate drug*':ab,ti OR 'inappropriate medicine*':ab,ti OR 'inappropriate medication*':ab,ti OR 'inappropriate drug use':ab,ti OR 'irrational prescribing':ab,ti OR 'irrational prescription*':ab,ti OR 'high-risk prescription*':ab,ti OR 'high-risk medication*':ab,ti OR 'unsafe prescription':ab,ti OR 'unsafe medication*':ab,ti OR 'harmful medication*':ab,ti OR 'prescribing omission':ab,ti OR suboptimal prescribing:ab,ti OR suboptimal medication*':ab,ti OR overprescribing:ab,ti OR 'over prescribing':ab,ti OR 'over prescription':ab,ti OR underprescribing:ab,ti OR 'under prescribing':ab,ti OR 'under prescription*':ab,ti OR 'limited benefit medication*':ab,ti OR 'medicines minimisation':ab,ti OR 'medicines minimization':ab,ti OR 'reconciliation':ab,ti OR 'deprescrib*':ab,ti OR 'medication review':ab,ti OR 'medication withdrawal':ab,ti OR 'drug withdrawal':ab,ti OR 'medication cessation':ab,ti OR 'drug cessation':ab,ti OR 'discontinuing medication*':ab,ti OR 'medication discontinuation':ab,ti)</p> <p>AND</p> <p>('factor*':ab,ti OR 'influence factor*':ab,ti OR 'influencing factor*':ab,ti OR 'affecting factor*':ab,ti OR 'risk factor*':ab,ti OR 'associated factor*':ab,ti OR predictor*':ab,ti OR facilitator*':ab,ti OR enabler*':ab,ti OR barrier*':ab,ti OR obstacle*':ab,ti OR association:ab,ti OR determinant*':ab,ti OR 'focus group*':ab,ti OR 'grounded theory':ab,ti OR 'thematic analysis':ab,ti OR challenge*':ab,ti OR difficult*':ab,ti OR qualitative:ab,ti OR recommendation*':ab,ti OR solution*':ab,ti OR interview*':ab,ti)</p>



**Scopus (5275 records identified)**

(TITLE-ABS-KEY ("primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "township health service\*" OR "home care" OR "pharmacy shop\*" OR "township health center\*" OR "rural health station\*" OR "community health station\*") AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL OR PSYC OR SOCI)) AND (TITLE-ABS-KEY(elder\* OR old\* OR aged OR "elderly patient" OR "elderly adult\*" OR "older patient\*" OR "older adult\*" OR senior OR geriatric) AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL OR PSYC OR SOCI)) AND (TITLE-ABS-KEY ("inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "suboptimal medication\*" OR "limited benefit medication\*" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR "medicines optimisation" OR "medicines optimization" OR deprescrib\* OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation") AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL OR PSYC OR SOCI)) AND (TITLE-ABS-KEY(factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\*) AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL OR PSYC OR SOCI))

**CINAHL (1075 records identified)**

TI ( "primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" ) OR AB ( "primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" )

AND

AG aged: 65+ years OR TI ( elder\* or aged or old\* or geriatric or senior ) OR AB ( elder\* or aged or old\* or geriatric or senior )

AND

TI ( "inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation") OR AB ( "inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation")

AND

TI ( ( factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* ) OR AB ( factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* )

**PsycInfo (256 records identified)**

TI ( "primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP\* OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" ) OR AB ( "primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP\* OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" )

AND

AG aged: 65+ years OR TI ( elder\* or aged or old\* or geriatric or senior ) OR AB ( elder\* or aged or old\* or geriatric or senior )

AND

TI ( "inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation" ) OR AB ( "inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation" )

AND

TI ( ( factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* ) OR AB ( factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* )

**WOS (567 records identified)**

(TI=(primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" OR "community pharmac\*") OR AB=(primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" OR "community pharmac\*"))

AND

(TI=(elder\* OR old\* OR aged OR senior OR geriatric\*) OR AB=(elder\* OR old\* OR aged OR senior OR geriatric\*))

AND

(TI=("inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "suboptimal medication\*" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation") OR AB=("inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "suboptimal medication\*" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation"))

AND

(TI=(factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* ) OR AB=(factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* ))

**CNKI (615 records identified)**

(TI=( '社区卫生服务中心'+ '社区健康服务中心'+ '社区卫生服务站'+ '社康中心'+ '社区医院'+ '社区门诊'+ '卫生院'+ '卫生室'+ '基层医疗机构'+ '基层医院'+ '基层医院'+ '家庭医生'+ '社区医生'+ '社区药师'+ '社区药房'+ '全科医生'+ '全科门诊'+ '老年社区'+ '诊所'+ '居家')) OR (AB=( '社区卫生服务中心'+ '社区健康服务中心'+ '社区卫生服务站'+ '社康中心'+ '社区医院'+ '社区门诊'+ '卫生院'+ '卫生室'+ '基层医疗机构'+ '基层医院'+ '基层医院'+ '家庭医生'+ '社区医生'+ '社区药师'+ '社区药房'+ '全科医生'+ '全科门诊'+ '老年社区'+ '诊所'+ '居家')))

在结果中检索

(TI=( '不合理用药'+ '不适当用药'+ '不合理处方'+ '不适当处方'+ '高危用药'+ '不规范处方'+ '不规范用药'+ '处方精简'+ '处方优化'+ '处方评估'+ '处方点评'+ '处方审查' + 'Beers' + 'STOPP' + 'START')) OR (AB=( '不合理用药'+ '不适当用药'+ '不合理处方'+ '不适当处方'+ '高危用药'+ '不规范处方'+ '不规范用药'+ '处方精简'+ '处方优化'+ '处方评估'+ '处方点评'+ '处方审查'+ 'Beers' + 'STOPP' + 'START' )))

在结果中检索

(TI=( '老年'+ '老龄'+ '高龄'+ '高人')) OR (AB=(( '老年'+ '老龄'+ '高龄'+ '老人')))

在结果中检索

(TI=( '因素'+ '分析'+ '预测'+ '情况'+ '现况'+ '现状'+ '质性研究'+ '定性研究'+ '访谈'+ '建议'+ '主题分析'+ '扎根理论'+ '困难'+ '挑战')) OR (AB=(( '因素'+ '分析'+ '预测'+ '情况'+ '现况'+ '现状'+ '质性研究'+ '定性研究'+ '访谈'+ '建议'+ '主题分析'+ '扎根理论'+ '困难'+ '挑战')))

**Wanfang (352 records identified)**

(摘要:( "社区卫生服务中心"or "社区健康服务中心"or "社区医院"or "社区卫生服务站"or "社康中心"or "社区门诊"or "卫生院"or "卫生室"or "基层医疗机构"or "基层医院"or "家庭医生"or "社区医生"or "社区药师"or "社区药房"or "全科医生"or "全科门诊"or "老年社区"or "诊所"or "居家") or (题名:( "社区卫生服务中心"or "社区健康服务中心"or "社区医院"or "社区卫生服务站"or "社康中心"or "社区门诊"or "卫生院"or "卫生室"or "基层医疗机构"or "基层医院"or "家庭医生"or "社区医生"or "社区药师"or "社区药房"or "全科医生"or "全科门诊"or "老年社区"or "诊所"or "居家")))

and

((摘要:( "老年"or "老龄"or "高龄"or "老人") or (题名:( "老年"or "老龄"or "高龄"or "老人")))

and

(摘要:( "不合理用药"or "不合理处方"or "不适当处方"or "不适当用药"or "高危用药"or "不规范处方"or "不规范用药"or "潜在风险处方"or "潜在有害药物"or "处方精简"or "处方优化"or "处方点评"or "处方审查"or "处方评估"or "Beers"or "STOPP"or "START")) or (题名:( "不合理用药"or "不合理处方"or "不适当处方"or "不适当用药"or "高危用药"or "不规范处方"or "不规范用药"or "潜在风险处方"or "潜在有害药物"or "处方精简"or "处方优化"or "处方点评"or "处方审查"or "处方评估"or "Beers"or "STOPP"or "START")))

and

(摘要:( "因素"or "分析"or "预测"or "情况"or "现况"or "现状"or "质性研究"or "定性研究"or "访谈"or "建议"or "主题分析"or "扎根理论"or "困难"or "挑战") or (题名:( "因素"or "分析"or "预测"or "情况"or "现况"or "现状"or "质性研究"or "定性研究"or "访谈"or "建议"or "主题分析"or "扎根理论"or "困难"or "挑战")))



**Table S2** Summary of included quantitative studies

First author (year)	JBİ score	Period studied	Setting	Participant information	Sample size	Tool	Prevalence of PIPs
<b>Cross-sectional Studies</b>							
Bradley (2012) <sup>25</sup>	7	2009-2010	Prescribing database, UK	Older adults (≥70y)	166,108	STOPP/START (version 1)	32.2%
Vatcharavongvan (2019) <sup>26</sup>	8	2016-2017	Primary care unit, Thailand	Older adults (>65y)	400	Beers criteria (version 2015), STOPP (version 2), Winit-Watjana	75.3%
Fialová (2005) <sup>27</sup>	7	2000-2003	AdHOC data set, Czech Republic, Denmark, Finland, Iceland, Italy, the Netherlands, Norway, France, Germany, Sweden, and UK.	Older adults (≥65y)	2,707	Beers criteria (version 1997&2003), Mcleod criteria (version 1997)	19.8%
Castillo-Páramo (2014) <sup>28</sup>	7	2011	Fifty-three health centers, Spain	Older adults (≥65y)	108,322	STOPP/START (version 1)	37.5-50.7%
Núñez-Montenegro (2019) <sup>29</sup>	7	NM	Primary care centers, Spain	Older adults (>65y)	425	STOPP/START (version 1)	45.2%
Wang (2019) <sup>30</sup>	6	2013-2015	Twenty-three community pharmacies, Taiwan	Older adults (≥65y)	13,873	Beers criteria (version 2015)	65.5%
Ble (2015) <sup>31</sup>	7	2003-2011	Five hundred and four general practices, UK	Older adults (≥65y)	13,900	Beers criteria (version 2012)	36.9-38.7%
Moriarty (2015) <sup>32</sup>	6	1999, 2002, 2007, and 2012	Pharmacy claims data, Ireland	Older adults (≥65y)	1,595,054	STOPP criteria (version 1)	28.6-37.3%
Lopez-Rodriguez (2020) <sup>33</sup>	7	2016-2017	38 healthcare centres, Spain	Older adults (65-74y), primary care physicians	593+38	Beers criteria (version 2015&2019), STOPP criteria (version 1&2),	43.6-94.1%

						MAI	
Cahir (2014) <sup>34</sup>	6	2007	Pharmacy claims database, Ireland	Older adults (≥70y) and general practitioners	338,725+1,938	STOPP criteria (version 1)	35.8%
Bradley (2014) <sup>35</sup>	6	2007	Clinical Practice Research Datalink, UK	Older adults (≥70y)	1,019,491	STOPP criteria (version 1)	29.0%
Lund (2012) <sup>36</sup>	6	2007	Veterans Affairs database, USA	Older adults (≥65y)	1,549,824	Zhan criteria (version 2001), Fick criteria (version 2003)	16.5-17.9%
Buck (2009) <sup>37</sup>	7	2006	Two outpatient primary care settings, USA	Older adults (≥65y)	61,251	Beers criteria (version 2002), Zhan criteria (version 2001)	16.6-23.2%
Cahir (2010) <sup>38</sup>	6	2007	Pharmacy claims database, Ireland	Older adults (≥70y)	338,801	STOPP criteria (version 1)	35.8%
Kovačević (2014) <sup>39</sup>	4	2012	Five community pharmacies, Serbia	Older adults (≥65y)	509	STOPP/START (version 1)	27.3%
Lin (2011) <sup>40</sup>	5	2008	One community health center, Taiwan	Older adults (≥65y)	327	Beers criteria (version 2003)	27.5%
Simões (2019) <sup>41</sup>	6	2018	Electronic prescription platform, Portugal	Older adults (≥65y)	757	Beers criteria (version 2015)	68.6%
Howard (2004) <sup>42</sup>	5	NM	Forty-eight family practices, Canada	Older adults (≥65y)	777	Beers criteria (version 1997)	16.3%
Zeenny (2017) <sup>43</sup>	5	2012	Community pharmacies, Lebanon	Older adults (≥65y)	248	Beers criteria (version 2012)	45.2%
Awad (2019) <sup>44</sup>	5	2016	Ten primary healthcare centers, Kuwait	Older adults (≥65y)	420	Beers criteria (version 2015), STOPP/START (version 2), 2014 FORTA list	44.3-55.7%
Gorup (2017) <sup>45</sup>	5	2014-2015	Thirty general practices, Slovenia	Older adults (>65y)	503	STOPP/START (version 1)	42.9%
Mand (2014) <sup>46</sup>	6	2000-2007	One hundred	Older adults (≥65y)	24,619	Beers criteria	10.4%

			and forty-eight family practices, Germany				
Tommelein (2016) <sup>47</sup>	5	2013-2014	Two hundred and four community pharmacies, Belgium	Older adults (≥70y)	1,016	GheOP <sup>3</sup> S tool	97.1%
Sakr (2018) <sup>48</sup>	4	2016-2017	Twenty community pharmacies, Lebanon	Older adults (≥65y)	350	Beers criteria (version 2015), STOPP/START	29.4-60.0%
Hamano (2014) <sup>49</sup>	5	2013	One clinic, Japan	Older adults (≥65y)	89	STOPP/START (version 1)	40.4%
Zhang (2020) <sup>50</sup>	5	2018	Six community health centers, China	Older adults (≥65y)	968	Beers criteria (version 2015)	32.7%
Liu (2020) <sup>51</sup>	5	NM	One community health center, China	Older adults (≥65y)	360	Beers criteria (version 2015), STOPP/START (version 2)	22.2%
Rogero-Blan co (2020) <sup>52</sup>	5	2016-2017	Thirty-eight health care centers, Spain	Older adults (65-75y)	593	Beers criteria (version 2015), STOPP/START (version 2014)	72.8%
Bala (2019) <sup>53</sup>	5	2015	Database, New Zealand	Older adults (≥65y)	16,568	Beers criteria (version 2015)	41.3-57.7%
Alhmoud (2015) <sup>54</sup>	6	2013	Home Health Care Services, Qatar	Older adults (≥65y)	501	Beers criteria (version 2012)	38.2 %
Sayin (2020) <sup>55</sup>	4	2018-2019	Two community pharmacies, Turkey	Older adults (≥65y)	158	GheOP <sup>3</sup> S tool	83.5%
Imai (2007) <sup>56</sup>	6	1997-1998	Data warehouse, USA	Older adults (>65y) and primary care physicians	2,035+166	Beers criteria (version 1997)	26.1%
Brekke (2008) <sup>57</sup>	4	NM	Prescription database, Norway	Older adults (≥70y) and general practitioners	85, 836+454	Norwegian General Practice (NORGE) criteria	18.4%
le (2017) <sup>58</sup>	5	2015-2016	Family medicine practices, USA	Older adults (≥65y) and family physicians	932+61	Beers criteria (version 2015), STOPP criteria (version 2)	35.5%

Longitudinal Studies							
Amos (2015) <sup>59</sup>	5	2012	Administrative healthcare database, Italy	Older adults (≥65y) and general practitioners	868,277	Maio criteria (version 2011)	27.8%
Pugh (2011) <sup>60</sup>	7	2002-2006	Veterans Affairs outpatient clinics, USA	Older adults (≥65y)	1,567,467	HEDIS HRME	12.3-13.1%

**Abbreviation**

NM: Not mentioned

**Table S3** Summary of included qualitative studies

First author (year)	JB score	Period studied	Setting	Participant information	N	Approach	General results
<b>Qualitative Studies</b>							
Rieckert (2018) <sup>61</sup>	9	2015-2016	GP practices, Germany	General practitioners	21	Semi-structured interviews	Barriers to deprescribing medications included the GP and/or the patient prioritised differently, the GP regarded the medication as necessary, the GP feared that changing medication could get complex, recommendation not applicable to the patient, and GP's unwillingness of interfering with medication prescribed by a colleague.
Clyne (2016) <sup>62</sup>	8	2013	GP practices, Ireland	General practitioners	17	Semi-structured interviews	Several inter-related factors that contribute to the occurrence of PIP including a complex prescribing environment, paternalistic doctor-patient relationships and limited relevance of the PIP concept for GPs.
Heser (2018) <sup>63</sup>	8	2014-2015	Germany	Elderly patients, General practitioners, and significant others of the patients	52+ 52+ 48	Semi-structured interviews	Barriers to deprescribing include that PIM is not rated as problematic medication; patient does not care about side effects of PIM; alternative treatments are not utilized; resistance against cessation of PIM; Dependency or failed discontinuation of the medicine; ageism by the patient.
Straßner (2017) <sup>64</sup>	8	2012-2014	Germany	General practitioners, specialists, pharmacists, nurses, medical assistants, and other professionals	24+ 4+1 +3+ 6+1 7	Thirty-eight semi-structured interviews and 2 focus groups	A much wider range of domains need to be addressed, such as communication skills, patient involvement and practice organization.
Pohontsch (2017) <sup>65</sup>	8	2014-2015	Germany	General practitioners	47	Semi-structured interviews	Prescription-, medication-, general practitioner-, patient- and system-related aspects related to the long-term use of PIM.
Heyworth (2013) <sup>66</sup>	8	2012	Veterans Affairs clinic facilities, USA	Primary care physicians, nurse practitioners or physician assistants	13+ 2	Semi-structured interviews	Providers highlighted a number of patient-level obstacles hindering high-quality medication reconciliation, emphasizing the difficulty in achieving accurate medication reconciliation among complex or elderly patients. Providers identified limited time and support for medication reconciliation as key barriers.
Anderson (2017) <sup>67</sup>	7	2014	Australia	General practitioners and consultant pharmacists	32+ 15	Five GP focus group interviews and two CP focus group interviews	Poorly developed interprofessional relationships and a lack of dedicated time and tacit knowledge/familiarity with patients for GPs and CPs, respectively, are important barriers to deprescribing for community-based older adults with polypharmacy. Well developed interprofessional relationships and less-siloed care will be critical to minimizing problematic polypharmacy and ultimately improving



							patient outcomes
Schuling (2012) <sup>68</sup>	7	2010-2011	The Netherlands	General practitioners	27	Three focus group interviews	A range of factors affecting the GPs' deprescribing for elderly patients with multimorbidity, including a lack of information on the benefit/risk ratio for preventive medication, poor communication to the patients, and difficulties in identifying ADEs, cooperation with prescribing medical specialists, etc.
Hansen (2018) <sup>69</sup>	7	2017	Community pharmacies, Ireland	Community pharmacists	18	Semi-structured interviews	Community pharmacists described challenges of overcoming social and environmental barriers, compounded by a lack of relevant guidelines for reducing PIP and education on the subject of PIP.
Wallis (2017) <sup>70</sup>	7	NM	New Zealand	Primary care physicians	24	Semi-structured interviews	Physicians described deprescribing as "swimming against the tide" of patient expectation, the medical culture of prescribing, and organizational constraints.
Weir (2019) <sup>71</sup>	7	NM	Australia	Pharmacists, older adults, and companions	11+ 17+ 4	Semi-structured interviews	Barriers to effective home medication reviews include gaps in inter-professional communication and factors related to patient involvement.
Magin (2015) <sup>72</sup>	7	2009-2010	Australia	General practitioners	22	Semi-structured interviews	The concept of 'appropriate' versus 'inappropriate' medications implicit in classification systems is at odds with complex considerations informing decision-making prescribing PIMs in older persons.
AlRasheed (2018) <sup>73</sup>	7	2016	Saudi Arabia	Family medicine specialists, residents, and general practitioners	15	Three focus group interviews	Barriers included lack of knowing the deprescribing term and process, patient comorbidities, risk/fear of conflict between physicians and clinical pharmacists, lack of documentation and communication, lack of time or crowded clinics, and patient resistance/acceptance.
Frich (2010) <sup>74</sup>	7	NM	Norway	General practitioners and tutors	39+ 20	Nine focus group interviews	Explanations for inappropriate prescriptions were with lack of knowledge, factors associated with patients, the GP's background, the practice, and other health professionals or health care facilities.

**Abbreviation**

CIR-G: number of cumulative illness rating scale for geriatric patients; CCI, Charlson comorbidity index;

NM: Not mentioned

**Table S4** Quality appraisal results

<b>Joanna Briggs Institute (JBI) scores for qualitative studies</b>												
Study	JBI score	Results of quality appraisal	Is there congruity between the stated philosophical perspective and the research methodology?	Is there congruity between the research methodology and the research question or objectives?	Is there congruity between the research methodology and the methods used to collect data?	Is there congruity between the research methodology and the representation and analysis of data?	Is there congruity between the research methodology and the interpretation of results?	Is there a statement locating the researcher culturally or theoretically?	Is the influence of the researcher on the research, and vice-versa, addressed?	Are participants, and their voices, adequately represented?	Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?
Rieckert (2018)	9	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clyne (2016)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Heser (2018)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Straßner (2017)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Pohontsch (2017)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Heyworth (2013)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Anderson (2017)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes
Schuling	7	Low	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes

(2012)		quality										
Hansen (2018)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes
Wallis (2017)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes
Weir (2019)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	Yes
Magin (2015)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	Yes
AlRasheed (2018)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	Yes
Frich (2010)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes

Joanna Briggs Institute (JBI) scores for cross sectional studies										
Study	JBI score	Results of quality appraisal	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?
Bradley (2012)	7	High quality	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Vatcharavongvan (2019)	8	High quality	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fialová (2005)	7	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Castillo-Páramo (2014)	7	High quality	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Núñez-Montenegro (2019)	7	High quality	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Wang (2019)	6	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Ble (2015)	7	High quality	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes

Moriarty (2015)	6	High quality	Yes	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes
Lopez-Rodriguez (2020)	7	High quality	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Cahir (2014)	6	High quality	Unclear	Yes	Yes	Unclear	Yes	Yes	Yes	Yes
Bradley (2014)	6	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Lund (2012)	6	High quality	Yes	Yes	Yes	Not applicable	Yes	Yes	Unclear	Yes
Buck (2009)	7	High quality	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes
Cahir (2010)	6	High quality	Unclear	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes
Kovačević (2014)	4	Low quality	Yes	Yes	Yes	No	No	No	Unclear	Yes
Lin (2011)	5	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes
Simões (2019)	6	Low quality	No	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Howard (2004)	5	Low quality	Unclear	Yes	Yes	No	Yes	Yes	Unclear	Yes
Zeenny (2017)	5	Low quality	Unclear	Yes	Yes	No	Yes	Yes	Unclear	Yes



Awad (2019)	5	Low quality	Unclear	Yes	Yes	No	Yes	No	Yes	Yes
Gorup (2017)	5	Low quality	Yes	Yes	Yes	No	No	No	Unclear	Yes
Mand (2014)	6	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Yes	Yes
Tommelein (2016)	5	Low quality	Unclear	Yes	Yes	Yes	No	No	Yes	Yes
Sakr (2018)	4	Low quality	Unclear	Yes	Yes	Unclear	Yes	No	Unclear	Yes
Hamano	5	Low quality	Unclear	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes
Zhang (2020)	5	Low quality	Yes	Yes	Yes	No	Yes	No	Unclear	Yes
Liu (2020)	5	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes
Rogero-Bla nco (2020)	5	Low quality	Yes	Yes	Yes	Unclear	Yes	No	Unclear	Yes
Bala (2019)	5	Low quality	Unclear	Yes	Yes	No	Yes	Yes	Unclear	Yes
Alhmoud (2015)	6	Low quality	Yes	Yes	Yes	No	Yes	Yes	Unclear	Yes
Sayin (2020)	4	Low quality	Unclear	Yes	Yes	No	Yes	No	Unclear	Yes

Imai (2007)	6	High quality	Yes	Yes	Yes	Not applicable	Yes	Yes	Unclear	Yes
Brekke (2008)	4	Low quality	Unclear	Yes	Yes	Unclear	Yes	No	Unclear	Yes
le (2017)	5	Low quality	Unclear	Yes	Yes	No	Yes	Yes	Unclear	Yes

Joanna Briggs Institute (JBI) scores for cohort studies													
Study	JBI score	Results of quality appraisal	Were the two groups similar and recruited from the same population?	Were the exposures measured similarly to assign people to both exposed and unexposed groups?	Was the exposure measured in a valid and reliable way?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	Were the outcomes measured in a valid and reliable way?	Was the follow up time reported and sufficient to be long enough for outcomes to occur?	Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	Were strategies to address incomplete follow up utilized?	Was appropriate statistical analysis used?
Pugh (2011)	6	High quality	Yes	Yes	Yes	Yes	No	Not applicable	Yes	Not applicable	Not applicable	Not applicable	Yes
Amos (2015)	7	High quality	Yes	Yes	Yes	Yes	Yes	Not applicable	Yes	Not applicable	Not applicable	Not applicable	Yes

**Table S5** Illustrative quotations for barrier themes and subthemes

Themes & subthemes (reference)	Quotations from participants in primary study	Interpretations of findings offered by authors
<b>Prescriber-related factors</b>		
inadequate knowledge (61-64, 66 67, 70-73)	What do you mean by deprescribing? The term? I don't know <sup>73</sup>	The FPs lacked the knowledge of deprescribing in a safe and effective manner <sup>73</sup>
	Inappropriate connotes carelessness, and I think very few of us are careless... <sup>62</sup>	The term "potentially inappropriate prescribing" evoked mixed reactions in the GPs, with six of them reporting that they found the term particularly negative, value-laden and accusatory and did not incorporate the difficulties of prescribing for older patients faced by the GPs <sup>62</sup>
	In our practice all this happens automatically already and this is why there was nothing that needed changed <sup>64</sup>	Several statements suggested that the participants were not aware of the care problem or the deficiencies in their own practice and therefore saw no need to implement the recommendations <sup>64</sup>
concerns of adverse consequences (61, 64, 65, 67, 69, 70, 73, 74)	Fear, that they'll have a negative outcome from you reducing some of these medicines <sup>67</sup>	the fear of contributing to a worse outcome, possibly death, as a result of deprescribing was part of the justification for maintaining the status quo <sup>67</sup>
	You could be viewed as being neglectful, as being a bad doctor, as being not competent, if you're taking medications away and someone has an event <sup>70</sup>	they feared reputational damage (being seen to be a "bad doctor"—GP-5), accountability repercussions, and moral blame and shame ("feeling terrible"—GP-2) <sup>70</sup>
clinical inertia (61, 63, 65, 70, 72-74)	And that is simply a drug that the patient is using for 30 years now and under which she is well managed concerning her blood levels...I would not touch it, that is [a case of] "never change a winning team", therefore these are things I wouldn't change <sup>61</sup>	Frequently they had been prescribing the medication for years and lacked motivation to reconsider it or did not want to diverge too far from a standard of therapy (guidelines) <sup>61</sup>
	Sometimes the medication is prescribed under another treating team, so I ignore it <sup>73</sup>	The FPs in our study were reluctant to deprescribe medications that had been prescribed by a specialist or another practitioner. This study also illustrates that FPs feel pressured into continuing the prescription of certain medicines initiated by specialists <sup>73</sup>
	He prescribed it to me anyway and then he always said afterwards "Ah, do you know what? Shall we cancel that? No" he said, "we won't do that. You are so old now, it doesn't matter anymore. Just go on taking it" <sup>63</sup>	Some patients reported that their age was used as an argument against PIM discontinuation or for continuation by their GPs <sup>63</sup>
lack of communication (62, 63, 65, 68, 71, 73)	People may then get the feeling, "Don't I count anymore, am I not important?" <sup>68</sup>	GPs are reluctant to initiate a discussion about stopping medication because they are concerned that patients may interpret this as a sign of being given up on <sup>68</sup>
	I call them and it is prescribed (laughs). [...] They know that I, the girls know that I don't come around regularly because I can't <sup>63</sup>	Some patients reported that they obtain prescriptions for their PIM without regular personal contact. For example, a rather uncomplicated request by phone was described for benzodiazepines and other PIM <sup>63</sup>
<b>Patient-related factors</b>		
limited understandings (62-64, 66, 68, 69-71, 73)	What I quite always have then, dry mouth, dry eyes, stuff like that, you know? That should also be caused by the medication, but I don't certainly know <sup>63</sup>	A lack of knowledge might contribute to the chronic usage of PIM as patients are probably hindered to initiate its cessation <sup>63</sup>
	Part of the problem is that patients do not dare to say: I have not understood this! Communicating on an equal level is not so well developed in many cases. The patients sits there reverently and nods <sup>64</sup>	Some patients had limited understanding about their medicines and were not interested to know more <sup>71</sup>
patient nonadherence (61-64, 68)	Because sometimes, if a tablet is upsetting them, some of them [patients] can be embarrassed to tell you, and they just don't take them, and they end up with a stock pile, so I ask them to bring everything in <sup>62</sup>	However, it is unclear if this paternalistic model was employed by choice, or if GPs felt compelled to take responsibility where patients adopted a more passive approach to their medication management <sup>62</sup>
	And she doesn't like doing that, because she just says "It damages your brain". What can you damage in mine anymore, I'm going to be ninety years old soon <sup>63</sup>	Some patients made fatalistic statements that implied ageism as they reported that different medication-based efforts or alterations were not worthwhile due to their own age or due to already established impairments <sup>63</sup>

	I'm sometimes a little bit insecure then, you know? [...] But I made arrangements therefore, I know exactly where my slippers are, [...] So, that's working well <sup>63</sup>	The intensity and valence of these side effects varied and side effects did not affect the patients in a sufficiently strong way to create a wish to stop the intake <sup>63</sup>
	[Patients say] "I don't really know why the doctor's wanting me to do this", they'll get all defensive and just go, "I'm fine, I can manage my medication fine" <sup>71</sup>	patients can feel as if they are being tested or their GP thinks they have done something wrong <sup>71</sup>
drug dependency (61, 63-65, 68, 69, 73, 74)	I was demanding that. I said [to him] "My wife always got your prescription for that [drug]", and then I said "and she always fell asleep immediately" <sup>63</sup>	Patient demands and their relative interest in medication were noted to strongly influence the changing or discontinuation of medication. Some patients were described as demanding treatment and not being content to adjust their medication due to fear of change or loyalty to the doctors' prescription orders <sup>69</sup>
	Some patients love his or her medications even more than their kids, even if you recommend something better they resist to change <sup>73</sup>	Patients may not always be willing to stop or change medicines they have been taking for a long time, despite the physician's recommendations <sup>73</sup>
	I don't know, if it is psychogenic or, but I do think so, that it is being addicted <sup>63</sup>	Several patients that chronically used benzodiazepines or hypnotics in particular reported some sort of dependency on the drug <sup>63</sup>
<b>Environment-related factors</b>		
lack of integrated care (61, 62, 64-71, 73, 74)	A lot of the time when we get the prescriptions, it's from an outpatient clinic. It might be in good cases 2 weeks later, in other cases, 5 or 6 months later when we get a letter of explanation for why the changes were made, ok, so do we ignore the prescription until we get an explanation for it <sup>62</sup>	Communication between primary and secondary care was identified as problematic in both directions. However, for the study participants, the most salient issue was that changes made in hospital/outpatient settings were often not communicated in a timely manner to inform decision making <sup>62</sup>
	I think a lot ends up falling on primary care...we're often called upon to reconcile things that we're not necessarily managing. So it has to be something that the whole medical center buys into so that we can get the help of subspecialists...we might not be able to resolve the discrepancies ourselves <sup>66</sup>	Many providers acknowledged a lack of support staff to assist with medication reconciliation, primarily taking on this task alone <sup>66</sup>
	All doctors should speak with one voice. Different stories provoke distrust <sup>68</sup>	Contacting the specialist to change medication, however, took additional effort and GPs feared that it would be difficult to reach a consensus as the specialists often have a different viewpoint <sup>61</sup>
	A classic is of course Ibuprofen. Well, Diclofenac, NSAIDs which are taken very, very often. [...] I always try to include the orthopaedist, [...] they very, very quickly recommend [...] this group [of medications] without asking themselves, "Is there a pre-existing internal condition?" <sup>65</sup>	Compared with the GP, they know much less about the patients concerning comorbidities, established medications or other specifics (e.g. medication sensitivity, changed metabolism) and may, therefore, consider risks and benefits less <sup>65</sup>
insufficient investment (61, 64, 66, 71)	This actually is a relatively long process, as I don't have internet access here. [...] I print it [the CMR] and make notes. [...] Then I wait until the patient comes again. But I have [a study patient] who doesn't come very often and then it's difficult <sup>61</sup>	The functions of the practice software were another issue because not all systems allowed easy adaption of the template for medication lists, and compatibility with the systems in hospitals or other practices was usually not given <sup>64</sup>
	It's a very difficult system to use. It's often...not working and it's not easy to get into...If I need to use secure messaging...I have to look [the patient] up and wait and wait for the delay <sup>66</sup>	The functions of the practice software were another issue because not all systems allowed easy adaption of the template for medication lists, and compatibility with the systems in hospitals or other practices was usually not given <sup>64</sup>
	Some of it has been abused ... it's really deplorable, but I think that is probably a reflection of the status of what the [pharmacy] profession is in. They're trying to re-invent themselves in another way because ... everything's so badly paid <sup>71</sup>	Pharmacists talked about the financial difficulties related to the monthly cap on HMRs – that remuneration was not enough for the time spent with patients and on HMR paperwork – and how this may have led to a subset of pharmacists over-servicing HMRs <sup>71</sup>
time constrains (61, 64-67, 69, 70, 73)	There is no time ... [You've got] complicated, complex patients and you never have more than 15 minutes and sometimes its double booked. There's never time to spend on this <sup>70</sup>	The FPs reported lack of time as one of the barriers, as time constraints may stop them from addressing all of the patients' concerns, which may lead to suboptimal medicine management <sup>73</sup>
	Well it's just, I guess, everybody's busy. Ehm, things maybe are not reviewed as often as they should be (...). So, you know, it does not, it just flies by and you know, you have got a number of other reasons, which are far more immediate in terms of inappropriate	Being busy with serving many patients and doing administrative work were believed to restrict time to do medication reviews and to have follow-up contact with prescribers to discuss potential changes <sup>69</sup>

	prescribing, that you need to look out for <sup>69</sup>	
<b>Technology-related factors</b>		
complexity of implementation (62, 63, 66-68, 70, 72, 73)	These elderly people who have a lot of symptomatic illnesses as well, you know, attend me, and I have less and less options <sup>62</sup>	GPs felt that polypharmacy, multimorbidity, and patient heterogeneity, all contributed to complexity at the patient level. Potential side-effects and drug interactions, and perceived poor patient medication adherence, further compounded these difficulties from the GP perspective <sup>62</sup>
	The problem is that you are trying to weigh up unmeasurable harm quite often against unmeasurable benefit. We are trying to do that in our minds and trying to work out—Is it more likely to be doing benefit or more likely to harm? <sup>67</sup>	The process of making a decision in a patient with potentially inappropriate polypharmacy involved trying to estimate and weigh up the harms and benefits of therapeutic options in the face of many unknowns in this diverse and complex patient group <sup>67</sup>
	It's harder to access other services. Non-pharmaceutical options are often a lot harder to access than medications <sup>70</sup>	These alternative treatments either were not effective or they were used in addition to the intake of the PIM <sup>63</sup>
	A very cognitively impaired person, who's living independently, is going to take a lot more time, because we are going to look in the bottles and potentially do some pill counts to check <sup>66</sup>	Participants in the GP focus groups viewed deprescribing as a time and resource intensive process, requiring not just an up-front, but ongoing commitment of effort, particularly when there are competing clinical priorities <sup>67</sup>
inapplicable guidance (61, 62, 64, 65, 67-70, 72-74)	To me, the guidelines are kind of a hindrance. At the moment they do not cater for older patients <sup>68</sup>	Sometimes GPs found the new recommendations not comprehensible or considered the recommendations as not applicable to the individual patient who was perceived biologically younger <sup>61</sup>
	So you have to ultimately stick to the general guidelines, because if you go there now radically, then you contravened the guidelines of the professional societies. It's difficult <sup>61</sup>	Discrepancy between guidelines' recommendations and lack thereof for older patients <sup>73</sup>
	I think, therefore, sometimes you are doing it without the really significant evidence-based security—or at least I don't even know <sup>67</sup>	The lack of scientific evidence presented difficulties for professional accountability <sup>67</sup>



**Table S6** Illustrative quotations for recommendation themes and subthemes

Themes & subthemes	Quotations from participants in primary study	Interpretations of findings offered by authors
<b>Prescriber-related factors</b>		
implementation techniques (67,72)	Straightaway my first thought was what are the low flying ones that we can get rid of <sup>67</sup>	Strategies included targeting medicines that are easier to deprescribe in the first instance, adopting a gradual approach to changing medicine regimens and deferring to patients in making a deprescribing decision <sup>67</sup>
	When people first come, I don't usually go OK well we need to stop this, this, this, this and this. I mean, you've got to gain some sort of confidence that you know what you are doing <sup>72</sup>	A common response was to take a conservative approach, deferring any attempt to intervene and cease PIMs until the circumstances were most favourable for obtaining patient engagement <sup>72</sup>
	It means that you wouldn't also stop some medicine that protects their bones, alendronate, cholecalciferol, Caltrate. Even (if) the Caltrate is contributing to the constipation, find something else to blame <sup>67</sup>	The more unstable or ill the patient or the more complicated the issues, the better to find an alternative path to avoid creating a more serious risk, especially among patients who express no desire or expectation for change in their medicines <sup>67</sup>
repeated positive experience (67, 68)	I think, as you get older, you realize that is not really true because you have done it so many times and they have not had a stroke the next week <sup>67</sup>	The exchange between these participants demonstrates how repeated positive experiences can shift the risk frame. It also again reinforces the desire for better evidence that deprescribing is safe and effective <sup>67</sup>
professional training (66, 69, 70, 74)	Maybe if there was some sort of training about how to review those [PIP] that would be good [...] and some sort of training so then it makes us aware that 'right, we are going to look out for' you know <sup>69</sup>	The participating GPs experienced the CME group meetings as an important arena for learning. They reported picking up good advice from others and learning practical alternatives to drugs that should not be used <sup>73</sup>
	If it [medication reviews] could be incorporated into your CPD [continuing professional development], I know pharmacists who would be much more inclined to do it because we are all trying to clock up our CPD hours <sup>69</sup>	Pharmacists believed their pharmacology/therapeutics knowledge to be sufficient to identify PIP but stressed the need for continuing professional education to bring their knowledge in line with new medications and most up-to-date guidelines <sup>69</sup>
reflective in decision-making (74)	The whole point is to reflect more, that you think twice, and with respect to this it has been a good project. It should have been done within other areas too <sup>74</sup>	One important outcome for the GPs was an experience of being more reflective in decision-making about prescriptions <sup>74</sup>
clinical monitoring (65, 72)	Before I start anybody [on NSAIDs] I always check their renal function make sure their eGFR is good <sup>72</sup>	Risk stratification of potential harm could be conducted for some PIMs prior to commencement of therapy and, once a PIM was being used, monitoring of side-effects could be instituted <sup>72</sup>
<b>Patient-related factors</b>		
public health campaigns (69)	Well those IPU [Irish Pharmacy Union] and HSE [Health Services Executive] campaigns about generic medications for example, have been very successful. I think a similar campaign along the lines of 'do you need everything you are taking?'. Or encouraging patients to go to their doctor <sup>69</sup>	Suggested initiatives were campaigns from health authorities to patients and/or healthcare providers (Table 1). The purpose of these campaigns should be to inform patients or GP about particularly problematic drug classes and raise awareness <sup>69</sup>
caregiver assistance (66)	It helps if there's a caregiver or someone in the family who comes with them [...] sometimes you can't complete medication reconciliation with the veteran themselves in that situation, so you have to rely on caregivers <sup>66</sup>	Presence of a caregiver or someone who had knowledge of the patient's medication administration in this situation was felt to be very helpful in achieving accurate medication reconciliation <sup>66</sup>
Improved patient-physician interaction (63-65, 67, 70, 71, 73)	I take the decision and we don't know if there will be a side effect, but they have to trust me that the medication is right for them. They are not able to understand all this, I don't even know if they understand me <sup>64</sup>	GPs communication skills (e.g. the ability to use patient-centred language or to structure the conversation) and attitude towards shared decision-making were determinants on a healthcare-professional level <sup>64</sup>
	Given an education to the patient <sup>73</sup>	Patient counseling/education In the present study, the FPs also highlighted the need for improving patients' awareness on such issues <sup>73</sup>
	But that's the starting point — to establish what the relationship is. I guess that's my point. So, until you know what the relationship is — whether it is an ongoing relationship or whether it's an episodic one; then that would lead to where you take the consultation and if it's appropriate. That's the starting point: who the person's	An underpinning element to working through uncertainties with regard to deprescribing was the consideration of relationships. For GP participants, a continuous therapeutic relationship with a patient was critical to better assessing harms and benefits and committing to the potentially protracted process of deprescribing <sup>67</sup>

	primary GP is <sup>67</sup>	
	The electronic communication is wonderful. It avoids the whole issue of phone tag. It avoids the whole issue of someone having to give their message to another person, which often distorts the meaning of the request. The asynchronous communication makes all communication easier <sup>66</sup>	The direct patient contact via SM reduced time spent in “phone tag” (ie, leaving messages for the patient to call back) and providers reported feeling like communication was easier and often more descriptive <sup>66</sup>
	A recall that sends out something to the patient every year and says, “Next time you’re at the doctor make sure to look over the pills.” <sup>70</sup>	activating patients to become more involved in medicines management and alert to the possibility that less might be better <sup>70</sup>
<b>Environment-related factors</b>		
financial remuneration (69, 70)	I suppose it’s [PIP] a bit under the radar in a lot of my daily work because you are not incentivised to look for it [...] Well it’s really a case of your incentives. You know, you are not incentivised to do it. It does not really benefit you directly at all <sup>69</sup>	State reimbursement, or professional acknowledgement, for doing medication reviews was both considered to be motivating factors to do medication reviews <sup>69</sup>
cross-disciplinary collaboration (64, 66-70, 73)	I would love [for pharmacists] to review the prescriptions with the patient after the visit. If there was...a real problem patient... If I could say to them, look I’m really having a problem with this patient. He brought all his medications in but he’s also in congestive heart failure or he’s worse or whatever problem I might need to deal with that day, could you go over his meds with him <sup>66</sup>	A majority of providers envisioned a scenario where a pharmacist or clinical staff member performed detailed medication reconciliation prior to the provider’s visit. This could minimize the time necessary for medication reconciliation by the provider, freeing up time to discuss clinical issues <sup>66</sup>
	That strategy of phoning specialists there and then, in front of them — we collaborate on this and this is what we are doing <sup>67</sup>	Good working relationships, that is, between GPs and CPs or in the following case between a GP and specialist, facilitated timely, collaborative deprescribing decisions <sup>67</sup>
	The channels need to be a bit more open. Sometimes they are very closed and if they [the doctors] were a bit more open and a bit more receptive to what our [pharmacists] role as like a professional could be <sup>69</sup>	Suggested improvements included more direct lines of communication and willingness to collaborate from all parties. Geographic proximity and face-to-face interaction were believed to be key facilitators of a good collaborative relationship <sup>69</sup>
workflow optimisation (64, 66, 69, 70)	I think it can also get to the point of it much more succinctly. Not to be antisocial, but you don’t have to deal with the niceties of ‘How are you feeling today?’ They write you with whatever is the concern and you respond to it <sup>66</sup>	The team-based model of SM triage means that providers never saw many of the messages that patients addressed to them, as team members were able to answer and fulfill requests by SM with minimal or no provider input, something providers appreciated <sup>66</sup>
	You need some funded time with the patient so that you can bring the patient in and say “This is a special appointment that’s not to talk about your current medical problems, it’s specifically about managing your medicines better.” <sup>70</sup>	Protected time to review medications facilitated by extra pharmacist staff was a suggested solution <sup>69</sup>
<b>Technology-related factors</b>		
electronic health record optimisation (66, 70, 73)	An alert would give you a little bit of courage to do it, or give you more reassurance, or give you a way to bring it up with the patient like, “Look, you see, the computer has noticed you’re on too many medications, maybe we can reduce it” <sup>70</sup>	Providers imagined a variety of approaches to improve medication reconciliation, many involving streamlining the EHR to identify errors and interactions <sup>66</sup>
	I feel that must have a chat in the system between the physicians <sup>73</sup>	A need for technology and/or a system: better communication between physicians and health care providers <sup>73</sup>
advanced technical aids (65-67, 70, 73)	It would be good to have some figures so—there is going to be a big push to be not prescribing statins forever—so some figures to back it up <sup>67</sup>	Better evidence that deprescribing is safe and effective and decision support provided in a format that is easily accessible at the point of care (e.g., integrated into the practice software) for use in discussion with patients was offered by participants as a key facilitative strategy <sup>67</sup>
	I’ve recently come across an app, which I have on my iPad [MedStopper], and you can put in the medication list there and it will prioritize them for you. So, that’s a really neat little tool <sup>70</sup>	Improved access to expert advice and user-friendly decision support <sup>70</sup>
	I think we need multi-morbidity guidelines, the commonest multi-morbidities like chronic pain from arthritis and heart	Updating guidelines to include advice on when to consider stopping medicines, developing new guidelines for the

	failure and diabetes together <sup>70</sup>	management of common comorbidities, tools and resources to assist in the communication of risk to patients <sup>70</sup>
	I simply find it better to have concrete recommendations made for the elderly. [...] I would prefer something with a positive formulation <sup>65</sup>	Rather than having a black- list “banning” certain medications, they would prefer a whitelist indicating which medications can be safely used for elderly patients <sup>65</sup>

**Table S1** Search terms

<b>PubMed (1559 records identified)</b>
<p>((((((((("primary health care"[MeSH Terms] OR "general practice*"[MeSH Terms]) OR "general practitioner*"[MeSH Terms]) OR "family practice*"[MeSH Terms]) OR "physicians, family"[MeSH Terms]) OR "community health centers"[MeSH Terms]) OR "community health services"[MeSH Terms]) OR "hospitals, community"[MeSH Terms]) OR (((((((("family"[Title/Abstract] AND "physician*"[Title/Abstract]) OR ("family"[Title/Abstract] AND "practice*"[Title/Abstract])) OR ("general"[Title/Abstract] AND "practitioner*"[Title/Abstract])) OR ("general"[Title/Abstract] AND "practice*"[Title/Abstract])) OR ("primary"[Title/Abstract] AND "care"[Title/Abstract])) OR ("community"[Title/Abstract] AND "health center*"[Title/Abstract])) OR ("community"[Title/Abstract] AND "health service*"[Title/Abstract])) OR ("community"[Title/Abstract] AND "hospital*"[Title/Abstract])) OR (((("clinics"[Title/Abstract] OR "township health center*"[Title/Abstract]) OR "rural health station*"[Title/Abstract]) OR "community health station*"[Title/Abstract]) OR "community pharmac*"[Title/Abstract])</p> <p>AND</p> <p>("elder*"[Title/Abstract] OR "old*"[Title/Abstract] OR "senior"[Title/Abstract] OR "ageing"[Title/Abstract] OR "geriatric"[Title/Abstract] OR "aged"[Title/Abstract]) OR ("aged"[MeSH Terms])</p> <p>AND</p> <p>("inappropriate prescribing"[MeSH Terms] OR "medication error*"[MeSH Terms]) OR ("Inappropriate Prescribing"[Title/Abstract] OR "Inappropriate Prescription*"[Title/Abstract] OR "Inappropriate medication*"[Title/Abstract] OR "Inappropriate drug*"[Title/Abstract] OR "Inappropriate medicine*"[Title/Abstract] OR "irrational prescribing*"[Title/Abstract] OR "irrational prescription*"[Title/Abstract] OR "high-risk prescription*"[Title/Abstract] OR "unsafe prescription*"[Title/Abstract] OR "high-risk medication*"[Title/Abstract] OR "unsafe medication*"[Title/Abstract] OR "harmful medication*"[Title/Abstract] OR "prescribing omission*"[Title/Abstract] OR "suboptimal prescribing"[Title/Abstract] OR "suboptimal medication*"[Title/Abstract] OR "overprescribing"[Title/Abstract] OR "over-prescribing"[Title/Abstract] OR "over-prescription"[Title/Abstract] OR "underprescribing"[Title/Abstract] OR "under-prescribing"[Title/Abstract] OR "under-prescription*"[Title/Abstract] OR "limited benefit medication*"[Title/Abstract] OR "medicines optimisation"[Title/Abstract] OR "medicines optimization"[Title/Abstract] OR "reconciliation"[Title/Abstract] OR "deprescrib*"[Title/Abstract] OR "medication review"[Title/Abstract] OR "medication withdrawal"[Title/Abstract] OR "drug withdrawal"[Title/Abstract] OR "medication cessation"[Title/Abstract] OR "drug cessation"[Title/Abstract] OR "discontinuing medication*"[Title/Abstract] OR "medication discontinuation"[Title/Abstract] )</p> <p>AND</p> <p>("factor*"[Title/Abstract] OR "influencing factor*"[Title/Abstract] OR "risk factor*"[Title/Abstract] OR "influence factor*"[Title/Abstract] OR "affecting factor*"[Title/Abstract] OR "barriers"[Title/Abstract] OR "association"[Title/Abstract] OR "obstacle*"[Title/Abstract] OR "associated factor*"[Title/Abstract] OR "factor*"[Title/Abstract] OR "predictor*"[Title/Abstract] OR "determinant*"[Title/Abstract] OR "facilitator*"[Title/Abstract] OR "enabler*"[Title/Abstract] OR "challenge*"[Title/Abstract] OR "difficult*"[Title/Abstract] OR "qualitative"[Title/Abstract] OR "recommendation*"[Title/Abstract] OR "solution*"[Title/Abstract] OR "interview*"[Title/Abstract] OR "thematic analysis"[Title/Abstract] OR "grounded theory"[Title/Abstract] OR "focus group*"[Title/Abstract])</p>

Embase (3468 records identified)
<p>('primary health care'/exp OR 'primary medical care'/exp OR 'general practitioner'/exp OR 'general practice*'/exp OR 'health center*'/exp OR 'community care'/exp OR 'community hospital*'/exp OR 'home care'/exp OR 'general practitioner*':ab,ti OR 'family physician*':ab,ti OR 'family doctor*':ab,ti OR 'general practice':ab,ti OR 'primary health care':ab,ti OR 'primary medical care':ab,ti OR 'community care':ab,ti OR 'home care':ab,ti OR 'township health center*':ab,ti OR 'rural health station*':ab,ti OR 'community health center*':ab,ti OR 'community health service*':ab,ti OR 'clinic*':ab,ti OR 'community health station*':ab,ti OR 'community pharmacist*'/exp OR ('pharmac*'/exp AND shop) OR 'community pharmac*':ab,ti OR 'pharmacy shop*':ab,ti)</p> <p>AND</p> <p>('aged'/exp OR 'older adults'/exp OR 'older people'/exp OR 'older adult'/exp OR 'very elderly'/exp OR 'geriatric*'/exp OR senior:ab,ti OR aged:ab,ti OR old:ab,ti OR older:ab,ti OR elderly:ab,ti)</p> <p>AND</p> <p>('inappropriate prescribing'/exp OR 'medication error*'/exp OR 'inappropriate drug use'/exp OR 'inappropriate drug*':ab,ti OR 'inappropriate medicine*':ab,ti OR 'inappropriate medication*':ab,ti OR 'inappropriate drug use':ab,ti OR 'irrational prescribing':ab,ti OR 'irrational prescription*':ab,ti OR 'high-risk prescription*':ab,ti OR 'high-risk medication*':ab,ti OR 'unsafe prescription':ab,ti OR 'unsafe medication*':ab,ti OR 'harmful medication*':ab,ti OR 'prescribing omission':ab,ti OR suboptimal prescribing:ab,ti OR suboptimal medication*':ab,ti OR overprescribing:ab,ti OR 'over prescribing':ab,ti OR 'over prescription':ab,ti OR underprescribing:ab,ti OR 'under prescribing':ab,ti OR 'under prescription*':ab,ti OR 'limited benefit medication*':ab,ti OR 'medicines minimisation':ab,ti OR 'medicines minimization':ab,ti OR 'reconciliation':ab,ti OR 'deprescrib*':ab,ti OR 'medication review':ab,ti OR 'medication withdrawal':ab,ti OR 'drug withdrawal':ab,ti OR 'medication cessation':ab,ti OR 'drug cessation':ab,ti OR 'discontinuing medication*':ab,ti OR 'medication discontinuation':ab,ti)</p> <p>AND</p> <p>('factor*':ab,ti OR 'influence factor*':ab,ti OR 'influencing factor*':ab,ti OR 'affecting factor*':ab,ti OR 'risk factor*':ab,ti OR 'associated factor*':ab,ti OR predictor*':ab,ti OR facilitator*':ab,ti OR enabler*':ab,ti OR barrier*':ab,ti OR obstacle*':ab,ti OR association:ab,ti OR determinant*':ab,ti OR 'focus group*':ab,ti OR 'grounded theory':ab,ti OR 'thematic analysis':ab,ti OR challenge*':ab,ti OR difficult*':ab,ti OR qualitative:ab,ti OR recommendation*':ab,ti OR solution*':ab,ti OR interview*':ab,ti)</p>



**Scopus (5275 records identified)**

(TITLE-ABS-KEY ("primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "township health service\*" OR "home care" OR "pharmacy shop\*" OR "township health center\*" OR "rural health station\*" OR "community health station\*") AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL OR PSYC OR SOCI)) AND (TITLE-ABS-KEY(elder\* OR old\* OR aged OR "elderly patient" OR "elderly adult\*" OR "older patient\*" OR "older adult\*" OR senior OR geriatric) AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL OR PSYC OR SOCI)) AND (TITLE-ABS-KEY ("inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "suboptimal medication\*" OR "limited benefit medication\*" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR "medicines optimisation" OR "medicines optimization" OR deprescrib\* OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation") AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL OR PSYC OR SOCI)) AND (TITLE-ABS-KEY(factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\*) AND SUBJAREA(MULT OR MEDI OR NURS OR VETE OR DENT OR HEAL OR PSYC OR SOCI))

**CINAHL (1075 records identified)**

TI ( "primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" ) OR AB ( "primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" )

AND

AG aged: 65+ years OR TI ( elder\* or aged or old\* or geriatric or senior ) OR AB ( elder\* or aged or old\* or geriatric or senior )

AND

TI ( "inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation") OR AB ( "inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation")

AND

TI ( ( factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* ) OR AB ( factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* )

**PsycInfo (256 records identified)**

TI ( "primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP\* OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" ) OR AB ( "primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP\* OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" )

AND

AG aged: 65+ years OR TI ( elder\* or aged or old\* or geriatric or senior ) OR AB ( elder\* or aged or old\* or geriatric or senior )

AND

TI ( "inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation" ) OR AB ( "inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation" )

AND

TI ( ( factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* ) OR AB ( factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* )

**WOS (567 records identified)**

(TI=(primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" OR "community pharmac\*") OR AB=(primary health care" OR "primary medical care" OR "primary care" OR "family physician\*" OR "general practitioner\*" OR "family practice\*" OR "general practice\*" OR GP OR "community pharmac\*" OR clinic\* OR "community hospital\*" OR "community health center\*" OR "home care" OR "township health center\*" OR "rural health station\*" OR "community health station\*" OR "community pharmac\*"))

AND

(TI=(elder\* OR old\* OR aged OR senior OR geriatric\*) OR AB=(elder\* OR old\* OR aged OR senior OR geriatric\*))

AND

(TI=("inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "suboptimal medication\*" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation") OR AB=("inappropriate prescribing" OR "medication error\*" OR "inappropriate prescription\*" OR "inappropriate medication\*" OR "inappropriate drug\*" OR "inappropriate medicine\*" OR "irrational prescribing" OR "irrational prescription\*" OR "high-risk prescription\*" OR "high-risk medication\*" OR "unsafe prescription\*" OR "unsafe medication\*" OR "harmful medication\*" OR "prescribing omission\*" OR "suboptimal prescribing" OR "suboptimal medication\*" OR "limited benefit medication\*" OR "medicines optimisation" OR "medicines optimization" OR overprescribing OR over-prescribing OR over-prescription\* OR underprescribing OR under-prescribing OR under-prescription\* OR deprescrib\* OR reconciliation OR "medication review" OR "discontinuing medication\*" OR "medication discontinuation" OR "medication withdrawal" OR "drug withdrawal" OR "medication cessation" OR "drug cessation"))

AND

(TI=(factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* ) OR AB=(factor\* OR barrier\* OR obstacle\* OR predictor\* OR facilitator\* OR enabler\* OR determinant\* OR "influence factor\*" OR "influencing factor\*" OR "risk factor\*" OR "affecting factor\*" OR association OR "associated factor\*" OR "focus group\*" OR "grounded theory" OR "thematic analysis" OR challenge\* OR difficult\* OR qualitative OR recommendation\* OR solution\* OR interview\* ))

**CNKI (615 records identified)**

(TI=( '社区卫生服务中心'+ '社区健康服务中心'+ '社区卫生服务站'+ '社康中心'+ '社区医院'+ '社区门诊'+ '卫生院'+ '卫生室'+ '基层医疗机构'+ '基层医院'+ '基层医院'+ '家庭医生'+ '社区医生'+ '社区药师'+ '社区药房'+ '全科医生'+ '全科门诊'+ '老年社区'+ '诊所'+ '居家')) OR (AB=( '社区卫生服务中心'+ '社区健康服务中心'+ '社区卫生服务站'+ '社康中心'+ '社区医院'+ '社区门诊'+ '卫生院'+ '卫生室'+ '基层医疗机构'+ '基层医院'+ '基层医院'+ '家庭医生'+ '社区医生'+ '社区药师'+ '社区药房'+ '全科医生'+ '全科门诊'+ '老年社区'+ '诊所'+ '居家')))

在结果中检索

(TI=( '不合理用药'+ '不适当用药'+ '不合理处方'+ '不适当处方'+ '高危用药'+ '不规范处方'+ '不规范用药'+ '处方精简'+ '处方优化'+ '处方评估'+ '处方点评'+ '处方审查' + 'Beers' + 'STOPP' + 'START')) OR (AB=( '不合理用药'+ '不适当用药'+ '不合理处方'+ '不适当处方'+ '高危用药'+ '不规范处方'+ '不规范用药'+ '处方精简'+ '处方优化'+ '处方评估'+ '处方点评'+ '处方审查'+ 'Beers' + 'STOPP' + 'START' )))

在结果中检索

(TI=( '老年'+ '老龄'+ '高龄'+ '高人')) OR (AB=(( '老年'+ '老龄'+ '高龄'+ '老人')))

在结果中检索

(TI=( '因素'+ '分析'+ '预测'+ '情况'+ '现况'+ '现状'+ '质性研究'+ '定性研究'+ '访谈'+ '建议'+ '主题分析'+ '扎根理论'+ '困难'+ '挑战')) OR (AB=(( '因素'+ '分析'+ '预测'+ '情况'+ '现况'+ '现状'+ '质性研究'+ '定性研究'+ '访谈'+ '建议'+ '主题分析'+ '扎根理论'+ '困难'+ '挑战')))

**Wanfang (352 records identified)**

(摘要:( "社区卫生服务中心"or "社区健康服务中心"or "社区医院"or "社区卫生服务站"or "社康中心"or "社区门诊"or "卫生院"or "卫生室"or "基层医疗机构"or "基层医院"or "家庭医生"or "社区医生"or "社区药师"or "社区药房"or "全科医生"or "全科门诊"or "老年社区"or "诊所"or "居家") or (题名:( "社区卫生服务中心"or "社区健康服务中心"or "社区医院"or "社区卫生服务站"or "社康中心"or "社区门诊"or "卫生院"or "卫生室"or "基层医疗机构"or "基层医院"or "家庭医生"or "社区医生"or "社区药师"or "社区药房"or "全科医生"or "全科门诊"or "老年社区"or "诊所"or "居家")))

and

((摘要:( "老年"or "老龄"or "高龄"or "老人") or (题名:( "老年"or "老龄"or "高龄"or "老人")))

and

(摘要:( "不合理用药"or "不合理处方"or "不适当处方"or "不适当用药"or "高危用药"or "不规范处方"or "不规范用药"or "潜在风险处方"or "潜在有害药物"or "处方精简"or "处方优化"or "处方点评"or "处方审查"or "处方评估"or "Beers"or "STOPP"or "START")) or (题名:( "不合理用药"or "不合理处方"or "不适当处方"or "不适当用药"or "高危用药"or "不规范处方"or "不规范用药"or "潜在风险处方"or "潜在有害药物"or "处方精简"or "处方优化"or "处方点评"or "处方审查"or "处方评估"or "Beers"or "STOPP"or "START")))

and

(摘要:( "因素"or "分析"or "预测"or "情况"or "现况"or "现状"or "质性研究"or "定性研究"or "访谈"or "建议"or "主题分析"or "扎根理论"or "困难"or "挑战") or (题名:( "因素"or "分析"or "预测"or "情况"or "现况"or "现状"or "质性研究"or "定性研究"or "访谈"or "建议"or "主题分析"or "扎根理论"or "困难"or "挑战")))



**Table S2** Summary of included quantitative studies

First author (year)	JBİ score	Period studied	Setting	Participant information	Sample size	Tool	Prevalence of PIPs
<b>Cross-sectional Studies</b>							
Bradley (2012) <sup>25</sup>	7	2009-2010	Prescribing database, UK	Older adults (≥70y)	166,108	STOPP/START (version 1)	32.2%
Vatcharavongvan (2019) <sup>26</sup>	8	2016-2017	Primary care unit, Thailand	Older adults (>65y)	400	Beers criteria (version 2015), STOPP (version 2), Winit-Watjana	75.3%
Fialová (2005) <sup>27</sup>	7	2000-2003	AdHOC data set, Czech Republic, Denmark, Finland, Iceland, Italy, the Netherlands, Norway, France, Germany, Sweden, and UK.	Older adults (≥65y)	2,707	Beers criteria (version 1997&2003), Mcleod criteria (version 1997)	19.8%
Castillo-Páramo (2014) <sup>28</sup>	7	2011	Fifty-three health centers, Spain	Older adults (≥65y)	108,322	STOPP/START (version 1)	37.5-50.7%
Núñez-Montenegro (2019) <sup>29</sup>	7	NM	Primary care centers, Spain	Older adults (>65y)	425	STOPP/START (version 1)	45.2%
Wang (2019) <sup>30</sup>	6	2013-2015	Twenty-three community pharmacies, Taiwan	Older adults (≥65y)	13,873	Beers criteria (version 2015)	65.5%
Ble (2015) <sup>31</sup>	7	2003-2011	Five hundred and four general practices, UK	Older adults (≥65y)	13,900	Beers criteria (version 2012)	36.9-38.7%
Moriarty (2015) <sup>32</sup>	6	1999, 2002, 2007, and 2012	Pharmacy claims data, Ireland	Older adults (≥65y)	1,595,054	STOPP criteria (version 1)	28.6-37.3%
Lopez-Rodriguez (2020) <sup>33</sup>	7	2016-2017	38 healthcare centres, Spain	Older adults (65-74y), primary care physicians	593+38	Beers criteria (version 2015&2019), STOPP criteria (version 1&2),	43.6-94.1%

						MAI	
Cahir (2014) <sup>34</sup>	6	2007	Pharmacy claims database, Ireland	Older adults (≥70y) and general practitioners	338,725+1,938	STOPP criteria (version 1)	35.8%
Bradley (2014) <sup>35</sup>	6	2007	Clinical Practice Research Datalink, UK	Older adults (≥70y)	1,019,491	STOPP criteria (version 1)	29.0%
Lund (2012) <sup>36</sup>	6	2007	Veterans Affairs database, USA	Older adults (≥65y)	1,549,824	Zhan criteria (version 2001), Fick criteria (version 2003)	16.5-17.9%
Buck (2009) <sup>37</sup>	7	2006	Two outpatient primary care settings, USA	Older adults (≥65y)	61,251	Beers criteria (version 2002), Zhan criteria (version 2001)	16.6-23.2%
Cahir (2010) <sup>38</sup>	6	2007	Pharmacy claims database, Ireland	Older adults (≥70y)	338,801	STOPP criteria (version 1)	35.8%
Kovačević (2014) <sup>39</sup>	4	2012	Five community pharmacies, Serbia	Older adults (≥65y)	509	STOPP/START (version 1)	27.3%
Lin (2011) <sup>40</sup>	5	2008	One community health center, Taiwan	Older adults (≥65y)	327	Beers criteria (version 2003)	27.5%
Simões (2019) <sup>41</sup>	6	2018	Electronic prescription platform, Portugal	Older adults (≥65y)	757	Beers criteria (version 2015)	68.6%
Howard (2004) <sup>42</sup>	5	NM	Forty-eight family practices, Canada	Older adults (≥65y)	777	Beers criteria (version 1997)	16.3%
Zeenny (2017) <sup>43</sup>	5	2012	Community pharmacies, Lebanon	Older adults (≥65y)	248	Beers criteria (version 2012)	45.2%
Awad (2019) <sup>44</sup>	5	2016	Ten primary healthcare centers, Kuwait	Older adults (≥65y)	420	Beers criteria (version 2015), STOPP/START (version 2), 2014 FORTA list	44.3-55.7%
Gorup (2017) <sup>45</sup>	5	2014-2015	Thirty general practices, Slovenia	Older adults (>65y)	503	STOPP/START (version 1)	42.9%
Mand (2014) <sup>46</sup>	6	2000-2007	One hundred	Older adults (≥65y)	24,619	Beers criteria	10.4%

			and forty-eight family practices, Germany				
Tommelein (2016) <sup>47</sup>	5	2013-2014	Two hundred and four community pharmacies, Belgium	Older adults (≥70y)	1,016	GheOP <sup>3</sup> S tool	97.1%
Sakr (2018) <sup>48</sup>	4	2016-2017	Twenty community pharmacies, Lebanon	Older adults (≥65y)	350	Beers criteria (version 2015), STOPP/START	29.4-60.0%
Hamano (2014) <sup>49</sup>	5	2013	One clinic, Japan	Older adults (≥65y)	89	STOPP/START (version 1)	40.4%
Zhang (2020) <sup>50</sup>	5	2018	Six community health centers, China	Older adults (≥65y)	968	Beers criteria (version 2015)	32.7%
Liu (2020) <sup>51</sup>	5	NM	One community health center, China	Older adults (≥65y)	360	Beers criteria (version 2015), STOPP/START (version 2)	22.2%
Rogero-Blan co (2020) <sup>52</sup>	5	2016-2017	Thirty-eight health care centers, Spain	Older adults (65-75y)	593	Beers criteria (version 2015), STOPP/START (version 2014)	72.8%
Bala (2019) <sup>53</sup>	5	2015	Database, New Zealand	Older adults (≥65y)	16,568	Beers criteria (version 2015)	41.3-57.7%
Alhmoud (2015) <sup>54</sup>	6	2013	Home Health Care Services, Qatar	Older adults (≥65y)	501	Beers criteria (version 2012)	38.2 %
Sayin (2020) <sup>55</sup>	4	2018-2019	Two community pharmacies, Turkey	Older adults (≥65y)	158	GheOP <sup>3</sup> S tool	83.5%
Imai (2007) <sup>56</sup>	6	1997-1998	Data warehouse, USA	Older adults (>65y) and primary care physicians	2,035+166	Beers criteria (version 1997)	26.1%
Brekke (2008) <sup>57</sup>	4	NM	Prescription database, Norway	Older adults (≥70y) and general practitioners	85, 836+454	Norwegian General Practice (NORGE) criteria	18.4%
le (2017) <sup>58</sup>	5	2015-2016	Family medicine practices, USA	Older adults (≥65y) and family physicians	932+61	Beers criteria (version 2015), STOPP criteria (version 2)	35.5%

Longitudinal Studies							
Amos (2015) <sup>59</sup>	5	2012	Administrative healthcare database, Italy	Older adults (≥65y) and general practitioners	868,277	Maio criteria (version 2011)	27.8%
Pugh (2011) <sup>60</sup>	7	2002-2006	Veterans Affairs outpatient clinics, USA	Older adults (≥65y)	1,567,467	HEDIS HRME	12.3-13.1%

**Abbreviation**

NM: Not mentioned

**Table S3** Summary of included qualitative studies

First author (year)	JB score	Period studied	Setting	Participant information	N	Approach	General results
<b>Qualitative Studies</b>							
Rieckert (2018) <sup>61</sup>	9	2015-2016	GP practices, Germany	General practitioners	21	Semi-structured interviews	Barriers to deprescribing medications included the GP and/or the patient prioritised differently, the GP regarded the medication as necessary, the GP feared that changing medication could get complex, recommendation not applicable to the patient, and GP's unwillingness of interfering with medication prescribed by a colleague.
Clyne (2016) <sup>62</sup>	8	2013	GP practices, Ireland	General practitioners	17	Semi-structured interviews	Several inter-related factors that contribute to the occurrence of PIP including a complex prescribing environment, paternalistic doctor-patient relationships and limited relevance of the PIP concept for GPs.
Heser (2018) <sup>63</sup>	8	2014-2015	Germany	Elderly patients, General practitioners, and significant others of the patients	52+ 52+ 48	Semi-structured interviews	Barriers to deprescribing include that PIM is not rated as problematic medication; patient does not care about side effects of PIM; alternative treatments are not utilized; resistance against cessation of PIM; Dependency or failed discontinuation of the medicine; ageism by the patient.
Straßner (2017) <sup>64</sup>	8	2012-2014	Germany	General practitioners, specialists, pharmacists, nurses, medical assistants, and other professionals	24+ 4+1 +3+ 6+1 7	Thirty-eight semi-structured interviews and 2 focus groups	A much wider range of domains need to be addressed, such as communication skills, patient involvement and practice organization.
Pohontsch (2017) <sup>65</sup>	8	2014-2015	Germany	General practitioners	47	Semi-structured interviews	Prescription-, medication-, general practitioner-, patient- and system-related aspects related to the long-term use of PIM.
Heyworth (2013) <sup>66</sup>	8	2012	Veterans Affairs clinic facilities, USA	Primary care physicians, nurse practitioners or physician assistants	13+ 2	Semi-structured interviews	Providers highlighted a number of patient-level obstacles hindering high-quality medication reconciliation, emphasizing the difficulty in achieving accurate medication reconciliation among complex or elderly patients. Providers identified limited time and support for medication reconciliation as key barriers.
Anderson (2017) <sup>67</sup>	7	2014	Australia	General practitioners and consultant pharmacists	32+ 15	Five GP focus group interviews and two CP focus group interviews	Poorly developed interprofessional relationships and a lack of dedicated time and tacit knowledge/familiarity with patients for GPs and CPs, respectively, are important barriers to deprescribing for community-based older adults with polypharmacy. Well developed interprofessional relationships and less-siloed care will be critical to minimizing problematic polypharmacy and ultimately improving

							patient outcomes
Schuling (2012) <sup>68</sup>	7	2010-2011	The Netherlands	General practitioners	27	Three focus group interviews	A range of factors affecting the GPs' deprescribing for elderly patients with multimorbidity, including a lack of information on the benefit/risk ratio for preventive medication, poor communication to the patients, and difficulties in identifying ADEs, cooperation with prescribing medical specialists, etc.
Hansen (2018) <sup>69</sup>	7	2017	Community pharmacies, Ireland	Community pharmacists	18	Semi-structured interviews	Community pharmacists described challenges of overcoming social and environmental barriers, compounded by a lack of relevant guidelines for reducing PIP and education on the subject of PIP.
Wallis (2017) <sup>70</sup>	7	NM	New Zealand	Primary care physicians	24	Semi-structured interviews	Physicians described deprescribing as "swimming against the tide" of patient expectation, the medical culture of prescribing, and organizational constraints.
Weir (2019) <sup>71</sup>	7	NM	Australia	Pharmacists, older adults, and companions	11+ 17+ 4	Semi-structured interviews	Barriers to effective home medication reviews include gaps in inter-professional communication and factors related to patient involvement.
Magin (2015) <sup>72</sup>	7	2009-2010	Australia	General practitioners	22	Semi-structured interviews	The concept of 'appropriate' versus 'inappropriate' medications implicit in classification systems is at odds with complex considerations informing decision-making prescribing PIMs in older persons.
AlRasheed (2018) <sup>73</sup>	7	2016	Saudi Arabia	Family medicine specialists, residents, and general practitioners	15	Three focus group interviews	Barriers included lack of knowing the deprescribing term and process, patient comorbidities, risk/fear of conflict between physicians and clinical pharmacists, lack of documentation and communication, lack of time or crowded clinics, and patient resistance/acceptance.
Frich (2010) <sup>74</sup>	7	NM	Norway	General practitioners and tutors	39+ 20	Nine focus group interviews	Explanations for inappropriate prescriptions were with lack of knowledge, factors associated with patients, the GP's background, the practice, and other health professionals or health care facilities.

**Abbreviation**

CIR-G: number of cumulative illness rating scale for geriatric patients; CCI, Charlson comorbidity index;

NM: Not mentioned



**Table S4** Quality appraisal results

<b>Joanna Briggs Institute (JBI) scores for qualitative studies</b>												
Study	JBI score	Results of quality appraisal	Is there congruity between the stated philosophical perspective and the research methodology?	Is there congruity between the research methodology and the research question or objectives?	Is there congruity between the research methodology and the methods used to collect data?	Is there congruity between the research methodology and the representation and analysis of data?	Is there congruity between the research methodology and the interpretation of results?	Is there a statement locating the researcher culturally or theoretically?	Is the influence of the researcher on the research, and vice-versa, addressed?	Are participants, and their voices, adequately represented?	Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?
Rieckert (2018)	9	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clyne (2016)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Heser (2018)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Straßner (2017)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Pohontsch (2017)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Heyworth (2013)	8	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes
Anderson (2017)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes
Schuling	7	Low	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes

(2012)		quality										
Hansen (2018)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes
Wallis (2017)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes
Weir (2019)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	Yes
Magin (2015)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	Yes
AlRasheed (2018)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes	Yes	Yes
Frich (2010)	7	Low quality	Unclear	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes

Joanna Briggs Institute (JBI) scores for cross sectional studies										
Study	JBI score	Results of quality appraisal	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?
Bradley (2012)	7	High quality	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Vatcharavongvan (2019)	8	High quality	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fialová (2005)	7	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Castillo-Páramo (2014)	7	High quality	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Núñez-Montenegro (2019)	7	High quality	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Wang (2019)	6	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Ble (2015)	7	High quality	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes

Moriarty (2015)	6	High quality	Yes	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes
Lopez-Rodriguez (2020)	7	High quality	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Cahir (2014)	6	High quality	Unclear	Yes	Yes	Unclear	Yes	Yes	Yes	Yes
Bradley (2014)	6	High quality	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Lund (2012)	6	High quality	Yes	Yes	Yes	Not applicable	Yes	Yes	Unclear	Yes
Buck (2009)	7	High quality	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes
Cahir (2010)	6	High quality	Unclear	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes
Kovačević (2014)	4	Low quality	Yes	Yes	Yes	No	No	No	Unclear	Yes
Lin (2011)	5	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes
Simões (2019)	6	Low quality	No	Yes	Yes	Yes	Yes	Yes	Unclear	Yes
Howard (2004)	5	Low quality	Unclear	Yes	Yes	No	Yes	Yes	Unclear	Yes
Zeenny (2017)	5	Low quality	Unclear	Yes	Yes	No	Yes	Yes	Unclear	Yes

Awad (2019)	5	Low quality	Unclear	Yes	Yes	No	Yes	No	Yes	Yes
Gorup (2017)	5	Low quality	Yes	Yes	Yes	No	No	No	Unclear	Yes
Mand (2014)	6	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Yes	Yes
Tommelein (2016)	5	Low quality	Unclear	Yes	Yes	Yes	No	No	Yes	Yes
Sakr (2018)	4	Low quality	Unclear	Yes	Yes	Unclear	Yes	No	Unclear	Yes
Hamano	5	Low quality	Unclear	Yes	Yes	Unclear	Yes	Yes	Unclear	Yes
Zhang (2020)	5	Low quality	Yes	Yes	Yes	No	Yes	No	Unclear	Yes
Liu (2020)	5	Low quality	Unclear	Yes	Yes	Yes	Yes	No	Unclear	Yes
Rogero-Bla nco (2020)	5	Low quality	Yes	Yes	Yes	Unclear	Yes	No	Unclear	Yes
Bala (2019)	5	Low quality	Unclear	Yes	Yes	No	Yes	Yes	Unclear	Yes
Alhmoud (2015)	6	Low quality	Yes	Yes	Yes	No	Yes	Yes	Unclear	Yes
Sayin (2020)	4	Low quality	Unclear	Yes	Yes	No	Yes	No	Unclear	Yes

Imai (2007)	6	High quality	Yes	Yes	Yes	Not applicable	Yes	Yes	Unclear	Yes
Brekke (2008)	4	Low quality	Unclear	Yes	Yes	Unclear	Yes	No	Unclear	Yes
le (2017)	5	Low quality	Unclear	Yes	Yes	No	Yes	Yes	Unclear	Yes

Joanna Briggs Institute (JBI) scores for cohort studies													
Study	JBI score	Results of quality appraisal	Were the two groups similar and recruited from the same population?	Were the exposures measured similarly to assign people to both exposed and unexposed groups?	Was the exposure measured in a valid and reliable way?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	Were the outcomes measured in a valid and reliable way?	Was the follow up time reported and sufficient to be long enough for outcomes to occur?	Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	Were strategies to address incomplete follow up utilized?	Was appropriate statistical analysis used?
Pugh (2011)	6	High quality	Yes	Yes	Yes	Yes	No	Not applicable	Yes	Not applicable	Not applicable	Not applicable	Yes
Amos (2015)	7	High quality	Yes	Yes	Yes	Yes	Yes	Not applicable	Yes	Not applicable	Not applicable	Not applicable	Yes



**Table S5** Illustrative quotations for barrier themes and subthemes

Themes & subthemes (reference)	Quotations from participants in primary study	Interpretations of findings offered by authors
<b>Prescriber-related factors</b>		
inadequate knowledge (61-64, 66-67, 70-73)	What do you mean by deprescribing? The term? I don't know <sup>73</sup>	The FPs lacked the knowledge of deprescribing in a safe and effective manner <sup>73</sup>
	Inappropriate connotes carelessness, and I think very few of us are careless... <sup>62</sup>	The term "potentially inappropriate prescribing" evoked mixed reactions in the GPs, with six of them reporting that they found the term particularly negative, value-laden and accusatory and did not incorporate the difficulties of prescribing for older patients faced by the GPs <sup>62</sup>
	In our practice all this happens automatically already and this is why there was nothing that needed changed <sup>64</sup>	Several statements suggested that the participants were not aware of the care problem or the deficiencies in their own practice and therefore saw no need to implement the recommendations <sup>64</sup>
concerns of adverse consequences (61, 64, 65, 67, 69, 70, 73, 74)	Fear, that they'll have a negative outcome from you reducing some of these medicines <sup>67</sup>	the fear of contributing to a worse outcome, possibly death, as a result of deprescribing was part of the justification for maintaining the status quo <sup>67</sup>
	You could be viewed as being neglectful, as being a bad doctor, as being not competent, if you're taking medications away and someone has an event <sup>70</sup>	they feared reputational damage (being seen to be a "bad doctor"—GP-5), accountability repercussions, and moral blame and shame ("feeling terrible"—GP-2) <sup>70</sup>
clinical inertia (61, 63, 65, 70, 72-74)	And that is simply a drug that the patient is using for 30 years now and under which she is well managed concerning her blood levels...I would not touch it, that is [a case of] "never change a winning team", therefore these are things I wouldn't change <sup>61</sup>	Frequently they had been prescribing the medication for years and lacked motivation to reconsider it or did not want to diverge too far from a standard of therapy (guidelines) <sup>61</sup>
	Sometimes the medication is prescribed under another treating team, so I ignore it <sup>73</sup>	The FPs in our study were reluctant to deprescribe medications that had been prescribed by a specialist or another practitioner. This study also illustrates that FPs feel pressured into continuing the prescription of certain medicines initiated by specialists <sup>73</sup>
	He prescribed it to me anyway and then he always said afterwards "Ah, do you know what? Shall we cancel that? No" he said, "we won't do that. You are so old now, it doesn't matter anymore. Just go on taking it" <sup>63</sup>	Some patients reported that their age was used as an argument against PIM discontinuation or for continuation by their GPs <sup>63</sup>
lack of communication (62, 63, 65, 68, 71, 73)	People may then get the feeling, "Don't I count anymore, am I not important?" <sup>68</sup>	GPs are reluctant to initiate a discussion about stopping medication because they are concerned that patients may interpret this as a sign of being given up on <sup>68</sup>
	I call them and it is prescribed (laughs). [...] They know that I, the girls know that I don't come around regularly because I can't <sup>63</sup>	Some patients reported that they obtain prescriptions for their PIM without regular personal contact. For example, a rather uncomplicated request by phone was described for benzodiazepines and other PIM <sup>63</sup>
<b>Patient-related factors</b>		
limited understandings (62-64, 66, 68, 69-71, 73)	What I quite always have then, dry mouth, dry eyes, stuff like that, you know? That should also be caused by the medication, but I don't certainly know <sup>63</sup>	A lack of knowledge might contribute to the chronic usage of PIM as patients are probably hindered to initiate its cessation <sup>63</sup>
	Part of the problem is that patients do not dare to say: I have not understood this! Communicating on an equal level is not so well developed in many cases. The patients sits there reverently and nods <sup>64</sup>	Some patients had limited understanding about their medicines and were not interested to know more <sup>71</sup>
patient nonadherence (61-64, 68)	Because sometimes, if a tablet is upsetting them, some of them [patients] can be embarrassed to tell you, and they just don't take them, and they end up with a stock pile, so I ask them to bring everything in <sup>62</sup>	However, it is unclear if this paternalistic model was employed by choice, or if GPs felt compelled to take responsibility where patients adopted a more passive approach to their medication management <sup>62</sup>
	And she doesn't like doing that, because she just says "It damages your brain". What can you damage in mine anymore, I'm going to be ninety years old soon <sup>63</sup>	Some patients made fatalistic statements that implied ageism as they reported that different medication-based efforts or alterations were not worthwhile due to their own age or due to already established impairments <sup>63</sup>

	I'm sometimes a little bit insecure then, you know? [...] But I made arrangements therefore, I know exactly where my slippers are, [...] So, that's working well <sup>63</sup>	The intensity and valence of these side effects varied and side effects did not affect the patients in a sufficiently strong way to create a wish to stop the intake <sup>63</sup>
	[Patients say] "I don't really know why the doctor's wanting me to do this", they'll get all defensive and just go, "I'm fine, I can manage my medication fine" <sup>71</sup>	patients can feel as if they are being tested or their GP thinks they have done something wrong <sup>71</sup>
drug dependency (61, 63-65, 68, 69, 73, 74)	I was demanding that. I said [to him] "My wife always got your prescription for that [drug]", and then I said "and she always fell asleep immediately" <sup>63</sup>	Patient demands and their relative interest in medication were noted to strongly influence the changing or discontinuation of medication. Some patients were described as demanding treatment and not being content to adjust their medication due to fear of change or loyalty to the doctors' prescription orders <sup>69</sup>
	Some patients love his or her medications even more than their kids, even if you recommend something better they resist to change <sup>73</sup>	Patients may not always be willing to stop or change medicines they have been taking for a long time, despite the physician's recommendations <sup>73</sup>
	I don't know, if it is psychogenic or, but I do think so, that it is being addicted <sup>63</sup>	Several patients that chronically used benzodiazepines or hypnotics in particular reported some sort of dependency on the drug <sup>63</sup>
<b>Environment-related factors</b>		
lack of integrated care (61, 62, 64-71, 73, 74)	A lot of the time when we get the prescriptions, it's from an outpatient clinic. It might be in good cases 2 weeks later, in other cases, 5 or 6 months later when we get a letter of explanation for why the changes were made, ok, so do we ignore the prescription until we get an explanation for it <sup>62</sup>	Communication between primary and secondary care was identified as problematic in both directions. However, for the study participants, the most salient issue was that changes made in hospital/outpatient settings were often not communicated in a timely manner to inform decision making <sup>62</sup>
	I think a lot ends up falling on primary care...we're often called upon to reconcile things that we're not necessarily managing. So it has to be something that the whole medical center buys into so that we can get the help of subspecialists...we might not be able to resolve the discrepancies ourselves <sup>66</sup>	Many providers acknowledged a lack of support staff to assist with medication reconciliation, primarily taking on this task alone <sup>66</sup>
	All doctors should speak with one voice. Different stories provoke distrust <sup>68</sup>	Contacting the specialist to change medication, however, took additional effort and GPs feared that it would be difficult to reach a consensus as the specialists often have a different viewpoint <sup>61</sup>
	A classic is of course Ibuprofen. Well, Diclofenac, NSAIDs which are taken very, very often. [...] I always try to include the orthopaedist, [...] they very, very quickly recommend [...] this group [of medications] without asking themselves, "Is there a pre-existing internal condition?" <sup>65</sup>	Compared with the GP, they know much less about the patients concerning comorbidities, established medications or other specifics (e.g. medication sensitivity, changed metabolism) and may, therefore, consider risks and benefits less <sup>65</sup>
insufficient investment (61, 64, 66, 71)	This actually is a relatively long process, as I don't have internet access here. [...] I print it [the CMR] and make notes. [...] Then I wait until the patient comes again. But I have [a study patient] who doesn't come very often and then it's difficult <sup>61</sup>	The functions of the practice software were another issue because not all systems allowed easy adaption of the template for medication lists, and compatibility with the systems in hospitals or other practices was usually not given <sup>64</sup>
	It's a very difficult system to use. It's often...not working and it's not easy to get into...If I need to use secure messaging...I have to look [the patient] up and wait and wait for the delay <sup>66</sup>	The functions of the practice software were another issue because not all systems allowed easy adaption of the template for medication lists, and compatibility with the systems in hospitals or other practices was usually not given <sup>64</sup>
	Some of it has been abused ... it's really deplorable, but I think that is probably a reflection of the status of what the [pharmacy] profession is in. They're trying to re-invent themselves in another way because ... everything's so badly paid <sup>71</sup>	Pharmacists talked about the financial difficulties related to the monthly cap on HMRs – that remuneration was not enough for the time spent with patients and on HMR paperwork – and how this may have led to a subset of pharmacists over-servicing HMRs <sup>71</sup>
time constrains (61, 64-67, 69, 70, 73)	There is no time ... [You've got] complicated, complex patients and you never have more than 15 minutes and sometimes its double booked. There's never time to spend on this <sup>70</sup>	The FPs reported lack of time as one of the barriers, as time constraints may stop them from addressing all of the patients' concerns, which may lead to suboptimal medicine management <sup>73</sup>
	Well it's just, I guess, everybody's busy. Ehm, things maybe are not reviewed as often as they should be (...). So, you know, it does not, it just flies by and you know, you have got a number of other reasons, which are far more immediate in terms of inappropriate	Being busy with serving many patients and doing administrative work were believed to restrict time to do medication reviews and to have follow-up contact with prescribers to discuss potential changes <sup>69</sup>

	prescribing, that you need to look out for <sup>69</sup>	
<b>Technology-related factors</b>		
complexity of implementation (62, 63, 66-68, 70, 72, 73)	These elderly people who have a lot of symptomatic illnesses as well, you know, attend me, and I have less and less options <sup>62</sup>	GPs felt that polypharmacy, multimorbidity, and patient heterogeneity, all contributed to complexity at the patient level. Potential side-effects and drug interactions, and perceived poor patient medication adherence, further compounded these difficulties from the GP perspective <sup>62</sup>
	The problem is that you are trying to weigh up unmeasurable harm quite often against unmeasurable benefit. We are trying to do that in our minds and trying to work out—Is it more likely to be doing benefit or more likely to harm? <sup>67</sup>	The process of making a decision in a patient with potentially inappropriate polypharmacy involved trying to estimate and weigh up the harms and benefits of therapeutic options in the face of many unknowns in this diverse and complex patient group <sup>67</sup>
	It's harder to access other services. Non-pharmaceutical options are often a lot harder to access than medications <sup>70</sup>	These alternative treatments either were not effective or they were used in addition to the intake of the PIM <sup>63</sup>
	A very cognitively impaired person, who's living independently, is going to take a lot more time, because we are going to look in the bottles and potentially do some pill counts to check <sup>66</sup>	Participants in the GP focus groups viewed deprescribing as a time and resource intensive process, requiring not just an up-front, but ongoing commitment of effort, particularly when there are competing clinical priorities <sup>67</sup>
inapplicable guidance (61, 62, 64, 65, 67-70, 72-74)	To me, the guidelines are kind of a hindrance. At the moment they do not cater for older patients <sup>68</sup>	Sometimes GPs found the new recommendations not comprehensible or considered the recommendations as not applicable to the individual patient who was perceived biologically younger <sup>61</sup>
	So you have to ultimately stick to the general guidelines, because if you go there now radically, then you contravened the guidelines of the professional societies. It's difficult <sup>61</sup>	Discrepancy between guidelines' recommendations and lack thereof for older patients <sup>73</sup>
	I think, therefore, sometimes you are doing it without the really significant evidence-based security—or at least I don't even know <sup>67</sup>	The lack of scientific evidence presented difficulties for professional accountability <sup>67</sup>

**Table S6** Illustrative quotations for recommendation themes and subthemes

Themes & subthemes	Quotations from participants in primary study	Interpretations of findings offered by authors
<b>Prescriber-related factors</b>		
implementation techniques (67,72)	Straightaway my first thought was what are the low flying ones that we can get rid of <sup>67</sup>	Strategies included targeting medicines that are easier to deprescribe in the first instance, adopting a gradual approach to changing medicine regimens and deferring to patients in making a deprescribing decision <sup>67</sup>
	When people first come, I don't usually go OK well we need to stop this, this, this, this and this. I mean, you've got to gain some sort of confidence that you know what you are doing <sup>72</sup>	A common response was to take a conservative approach, deferring any attempt to intervene and cease PIMs until the circumstances were most favourable for obtaining patient engagement <sup>72</sup>
	It means that you wouldn't also stop some medicine that protects their bones, alendronate, cholecalciferol, Caltrate. Even (if) the Caltrate is contributing to the constipation, find something else to blame <sup>67</sup>	The more unstable or ill the patient or the more complicated the issues, the better to find an alternative path to avoid creating a more serious risk, especially among patients who express no desire or expectation for change in their medicines <sup>67</sup>
repeated positive experience (67, 68)	I think, as you get older, you realize that is not really true because you have done it so many times and they have not had a stroke the next week <sup>67</sup>	The exchange between these participants demonstrates how repeated positive experiences can shift the risk frame. It also again reinforces the desire for better evidence that deprescribing is safe and effective <sup>67</sup>
professional training (66, 69, 70, 74)	Maybe if there was some sort of training about how to review those [PIP] that would be good [...] and some sort of training so then it makes us aware that 'right, we are going to look out for' you know <sup>69</sup>	The participating GPs experienced the CME group meetings as an important arena for learning. They reported picking up good advice from others and learning practical alternatives to drugs that should not be used <sup>73</sup>
	If it [medication reviews] could be incorporated into your CPD [continuing professional development], I know pharmacists who would be much more inclined to do it because we are all trying to clock up our CPD hours <sup>69</sup>	Pharmacists believed their pharmacology/therapeutics knowledge to be sufficient to identify PIP but stressed the need for continuing professional education to bring their knowledge in line with new medications and most up-to-date guidelines <sup>69</sup>
reflective in decision-making (74)	The whole point is to reflect more, that you think twice, and with respect to this it has been a good project. It should have been done within other areas too <sup>74</sup>	One important outcome for the GPs was an experience of being more reflective in decision-making about prescriptions <sup>74</sup>
clinical monitoring (65, 72)	Before I start anybody [on NSAIDs] I always check their renal function make sure their eGFR is good <sup>72</sup>	Risk stratification of potential harm could be conducted for some PIMs prior to commencement of therapy and, once a PIM was being used, monitoring of side-effects could be instituted <sup>72</sup>
<b>Patient-related factors</b>		
public health campaigns (69)	Well those IPU [Irish Pharmacy Union] and HSE [Health Services Executive] campaigns about generic medications for example, have been very successful. I think a similar campaign along the lines of 'do you need everything you are taking?'. Or encouraging patients to go to their doctor <sup>69</sup>	Suggested initiatives were campaigns from health authorities to patients and/or healthcare providers (Table 1). The purpose of these campaigns should be to inform patients or GP about particularly problematic drug classes and raise awareness <sup>69</sup>
caregiver assistance (66)	It helps if there's a caregiver or someone in the family who comes with them [...] sometimes you can't complete medication reconciliation with the veteran themselves in that situation, so you have to rely on caregivers <sup>66</sup>	Presence of a caregiver or someone who had knowledge of the patient's medication administration in this situation was felt to be very helpful in achieving accurate medication reconciliation <sup>66</sup>
Improved patient-physician interaction (63-65, 67, 70, 71, 73)	I take the decision and we don't know if there will be a side effect, but they have to trust me that the medication is right for them. They are not able to understand all this, I don't even know if they understand me <sup>64</sup>	GPs communication skills (e.g. the ability to use patient-centred language or to structure the conversation) and attitude towards shared decision-making were determinants on a healthcare-professional level <sup>64</sup>
	Given an education to the patient <sup>73</sup>	Patient counseling/education In the present study, the FPs also highlighted the need for improving patients' awareness on such issues <sup>73</sup>
	But that's the starting point — to establish what the relationship is. I guess that's my point. So, until you know what the relationship is — whether it is an ongoing relationship or whether it's an episodic one; then that would lead to where you take the consultation and if it's appropriate. That's the starting point: who the person's	An underpinning element to working through uncertainties with regard to deprescribing was the consideration of relationships. For GP participants, a continuous therapeutic relationship with a patient was critical to better assessing harms and benefits and committing to the potentially protracted process of deprescribing <sup>67</sup>

	primary GP is <sup>67</sup>	
	The electronic communication is wonderful. It avoids the whole issue of phone tag. It avoids the whole issue of someone having to give their message to another person, which often distorts the meaning of the request. The asynchronous communication makes all communication easier <sup>66</sup>	The direct patient contact via SM reduced time spent in “phone tag” (ie, leaving messages for the patient to call back) and providers reported feeling like communication was easier and often more descriptive <sup>66</sup>
	A recall that sends out something to the patient every year and says, “Next time you’re at the doctor make sure to look over the pills.” <sup>70</sup>	activating patients to become more involved in medicines management and alert to the possibility that less might be better <sup>70</sup>
<b>Environment-related factors</b>		
financial remuneration (69, 70)	I suppose it’s [PIP] a bit under the radar in a lot of my daily work because you are not incentivised to look for it [...] Well it’s really a case of your incentives. You know, you are not incentivised to do it. It does not really benefit you directly at all <sup>69</sup>	State reimbursement, or professional acknowledgement, for doing medication reviews was both considered to be motivating factors to do medication reviews <sup>69</sup>
cross-disciplinary collaboration (64, 66-70, 73)	I would love [for pharmacists] to review the prescriptions with the patient after the visit. If there was...a real problem patient... If I could say to them, look I’m really having a problem with this patient. He brought all his medications in but he’s also in congestive heart failure or he’s worse or whatever problem I might need to deal with that day, could you go over his meds with him <sup>66</sup>	A majority of providers envisioned a scenario where a pharmacist or clinical staff member performed detailed medication reconciliation prior to the provider’s visit. This could minimize the time necessary for medication reconciliation by the provider, freeing up time to discuss clinical issues <sup>66</sup>
	That strategy of phoning specialists there and then, in front of them — we collaborate on this and this is what we are doing <sup>67</sup>	Good working relationships, that is, between GPs and CPs or in the following case between a GP and specialist, facilitated timely, collaborative deprescribing decisions <sup>67</sup>
	The channels need to be a bit more open. Sometimes they are very closed and if they [the doctors] were a bit more open and a bit more receptive to what our [pharmacists] role as like a professional could be <sup>69</sup>	Suggested improvements included more direct lines of communication and willingness to collaborate from all parties. Geographic proximity and face-to-face interaction were believed to be key facilitators of a good collaborative relationship <sup>69</sup>
workflow optimisation (64, 66, 69, 70)	I think it can also get to the point of it much more succinctly. Not to be antisocial, but you don’t have to deal with the niceties of ‘How are you feeling today?’ They write you with whatever is the concern and you respond to it <sup>66</sup>	The team-based model of SM triage means that providers never saw many of the messages that patients addressed to them, as team members were able to answer and fulfill requests by SM with minimal or no provider input, something providers appreciated <sup>66</sup>
	You need some funded time with the patient so that you can bring the patient in and say “This is a special appointment that’s not to talk about your current medical problems, it’s specifically about managing your medicines better.” <sup>70</sup>	Protected time to review medications facilitated by extra pharmacist staff was a suggested solution <sup>69</sup>
<b>Technology-related factors</b>		
electronic health record optimisation (66, 70, 73)	An alert would give you a little bit of courage to do it, or give you more reassurance, or give you a way to bring it up with the patient like, “Look, you see, the computer has noticed you’re on too many medications, maybe we can reduce it” <sup>70</sup>	Providers imagined a variety of approaches to improve medication reconciliation, many involving streamlining the EHR to identify errors and interactions <sup>66</sup>
	I feel that must have a chat in the system between the physicians <sup>73</sup>	A need for technology and/or a system: better communication between physicians and health care providers <sup>73</sup>
advanced technical aids (65-67, 70, 73)	It would be good to have some figures so—there is going to be a big push to be not prescribing statins forever—so some figures to back it up <sup>67</sup>	Better evidence that deprescribing is safe and effective and decision support provided in a format that is easily accessible at the point of care (e.g., integrated into the practice software) for use in discussion with patients was offered by participants as a key facilitative strategy <sup>67</sup>
	I’ve recently come across an app, which I have on my iPad [MedStopper], and you can put in the medication list there and it will prioritize them for you. So, that’s a really neat little tool <sup>70</sup>	Improved access to expert advice and user-friendly decision support <sup>70</sup>
	I think we need multi-morbidity guidelines, the commonest multi-morbidities like chronic pain from arthritis and heart	Updating guidelines to include advice on when to consider stopping medicines, developing new guidelines for the

	failure and diabetes together <sup>70</sup>	management of common comorbidities, tools and resources to assist in the communication of risk to patients <sup>70</sup>
	I simply find it better to have concrete recommendations made for the elderly. [...] I would prefer something with a positive formulation <sup>65</sup>	Rather than having a black- list “banning” certain medications, they would prefer a whitelist indicating which medications can be safely used for elderly patients <sup>65</sup>