Table 3: Studies included in qualitative synthesis (n=29)[10-11, 20-46]

No.	Authors	Year	Country of origin	Study population	Study methods
1	AlRasheed MM, Alhawassi TM, Alanazi A et al.	2018	Saudi Arabia	Family medicine physicians (n=15)	Focus group dis
2	Anderson K, Stowasser D, Freeman C, Scott I	2014	-	Systematic review of studies (n=21)	Qualitative syst Scopus, PsycIN
3	Anderson K, Foster M, Freeman C et al.	2017	Australia	General practitioners (n=32), consultant pharmacists (n=15)	Focus group dis
4	Anthierens S, Tansens A, Petrovic M, Christiaens T	2010	Belgium	General practitioners (n=65)	Semi-structured
5	Bokhof B, Junius-Walker U	2016	-	Systematic review of studies (n=14)	Qualitative syst Library, Web o
6	Cadogan CA, Ryan C, Francis JJ et al.	2015	Northern Ireland	General practitioners (n=15), pharmacists (n=15)	Semi-structured
7	Cadogan CA, Ryan C, Gormley GJ et al.	2015	Northern Ireland	General practitioners (n=14)	Semi-structured
8	Carthy P, Harvey I, Brawn R, Watkins C	2000	United Kingdom	General practitioners (n=17)	Semi-structured
9	Clyne B, Cooper JA, Hughes CM et al.	2016	Ireland	General practitioners (n=17)	Semi-structured
10	Cullinan S, O'Mahony D, Fleming A, Byrne S.	2014	-	Systematic review of studies (n=7)	Qualitative syst CINAHL and W
11	Cullinan S, Hansen CR, Byrne S et al.	2017	-	-	Review article
12	Djatche L, Lee S, Singer D et al.	2018	Italy	Primary care physicians (n=160)	Questionnaire s
13	Fried TR, Tinetti ME, Iannone L	2011	United States of America (USA)	Primary care clinicians (n=40)	Focus group dis
14	Lee PR, Boyd C, Green A	2018	USA	Primary care physicians (n=12), specialist clinicians (n=8)	Semi-structured
15	Maio V, Jutkowitz E, Herrera K et al.	2011	Italy	Primary care physicians (n=155)	Questionnaire s
16	Mc Namara KP, Breken BD, Alzubaidi HT et al.	2017	Australia	Healthcare professionals (n=26) *medical, dentistry, nursing, pharmacy, allied health	Semi-structured
17	Milos V, Westerlund T, Midlov P, Strandberg EL	2014	Sweden	General practitioners (n=17)	Focus group dis

18	Moen J, Norrgard S, Antonov K et al.	2010	Sweden	General practitioners (n=31)	Focus group dis
19	Newby C, Venditto A	2014	-	-	Clinical vignett
20	Pohontsch NJ, Heser K, Loeffler A et al.	2017	Germany	General practitioners (n=47)	Semi-structured
21	Raae-Hansen C, Byrne S, O'Mahony D et al.	2017	-	Systematic review of studies (n=10)	Qualitative syst Academic Searc
22	Ramaswamy R, Maio V, Diamond JJ et al.	2011	USA	Residents and attending doctors (n=89) *Family Medicine, Internal Medicine, Geriatrics, Sports Medicine	Questionnaire s
23	Riordan DO, Byrne S, Fleming A et al.	2017	Ireland	General practitioners (n=16)	Semi-structured
24	Roumie CL, Elasy TA, Wallston KA et al.	2007	USA	Primary care providers (n=23)	Questionnaire s
25	Schuling J, Gebben H, Veehof LJG, Haaijer-Ruskamp FM	2012	The Netherlands	General practitioners (n=12)	Focus group dis
26	Sellappans R, Lai PS, Ng CJ	2015	Malaysia	Family Medicine trainees (n=14), service medical officers (n=5)	Focus group dis
27	Sinnige J, Korevaar JC, van Lieshout J et al.	2016	The Netherlands	General practitioners (n=12)	Focus group dis
28	Sinnott C, Mc Hugh S, Boyce MB, Bradley CP	2015	Ireland	General practitioners (n=20)	Semi-structured
29	Wallis KA, Andrews A, Henderson M	2017	New Zealand	Primary care physicians (n=24)	Semi-structured

Table 4: Scoping Review – Barriers to Effective Prescribing in the Elderly

Domain	Constructs	Barriers to Effective Prescribing
Knowledge	• Scientific knowledge • Procedural knowledge • Knowledge of task environment	**[Physician] Medical complexity** • Multimorbidity, potential interactions between diseases and medications • Polypharmacy, which increases difficulty in rationalizing and deprescribing medications • Increased risk of ADEs or drug-drug interactions • Difficulty in distinguishing between new complaints and medication side effects • Clinical uncertainty • Uncertainty in weighing unmeasurable harms and benefits **[Physician] Lack of knowledge or awareness** • Lack of awareness of PIP or PIMs • Poor insight into the term and the process of deprescribing • Lack of awareness of prescribing cost differences between care settings • Physicians' shortcomings in their pharmacological knowledge • Doubts associated with potential ADEs and treatment of the elderly • Lack of formal education on prescribing for the elderly • Lack of up-to-date knowledge **[Patient] Lack of knowledge / poor healthcare literacy** • Patients do not understand what medications they are taking • Patients do not inform GPs about their medication intake or side effects • Patients may be more likely to report symptoms to hospital specialists rather than GPs • Unintentional withholding of ADEs because they attribute these to ageing rather than side effects of medications
Skills	• Skills • Skills development • Competence • Ability • Interpersonal skills • Practice	**[Physician] Lack of skills and confidence** • Physician not comfortable with deprescribing (particularly when not the original prescriber) • Lack of confidence and clinical experience in managing elderly patients

	• Skill assessment	• Lack of research, education and training to care for this specific group of patients **[Physician] Challenges to discussion with patients** • Physicians are reluctant to talk to patients about their life expectancy • Problems with incorporating patients' prognoses into decisions about therapy appropriateness • Difficulty in communicating risk to patients **[Patient] Non-adherence to medications or visits** • Lack of adherence to medications, or self-titration of medications • Usage of over-the-counter and traditional medications (often without informing the primary physician) • Non-adherence to clinic visits • Choosing to 'doctor hop' or 'pharmacy hop'
Social/Professional Role and Identity	• Professional identify • Professional role • Social identity • Identity / group identity • Professional boundaries • Professional confidence • Leadership • Organizational commitment	**[Physician] Paternalistic doctor-patient relationship** • Physicians imposing their own beliefs onto the patient without consideration for the latter **[Physician] [System] Role dilemma** • Dilemma between economic responsibility for both patients and society **[Physician] Concerns on inter-professional relationships** • Risk/fear of conflict or damaging the relationship between various healthcare providers • Unwillingness to change recommendations from secondary/tertiary care • Reluctance to interfere with and/or hesitation to discontinue medications that have been prescribed by a colleague or specialist • GPs may feel a lack of appreciation by secondary/tertiary care colleagues for their role as a GP • Respect for hierarchy **[Physician] Perceptions of pharmacists' expertise** • Varying perceptions of pharmacists' recommendations
Beliefs about Capabilities	• Self-confidence • Self-esteem • Self-efficacy • Perceived competence	**[Physician] Self-efficacy issues** • Lack of confidence and experience **[Physician] Discrepant beliefs and practice**

	• Beliefs	• Influence from prescriber's own beliefs, clinical experience and prescribing habits • Respecting prescriber's right to autonomy **[Patient] Patients' own expectations and beliefs** • Unrealistic expectations and/or demands from patients and families • Personal beliefs, demands and expectations about their own care and medications • Discrepancies between the patients' preferences and best practice recommendations • Patients are reluctant or disinclined to stop medications that they have used for a long time • Resistant to change and/or poor acceptance of alternatives • Resistant to non-pharmacological treatment alternatives • Some patients 'love taking medications' • Demanding specific medications and when refused, obtaining them from different physicians • Patient's and family's wishes for medications • Passive approach adopted by patients
Optimism	• Optimism • Pessimism	-
Beliefs about Consequences	• Beliefs • Outcome expectancies • Characteristics of outcome expectancies • Anticipated regret • Consequents	**[Physician] Clinical** • Feeling a sense of fear towards older patients in general owing to their frailty and comorbidities • Fear of causing potential harm by deprescribing • Fear of the unknown • Viewing the deprescribing process as a risk to be avoided • Anxiety when the GP's own conviction conflicts with either that of a specialty of the guidelines • Fear of 'giving up on the patient' • Fear of withdrawal effects (especially for the cessation of opioids and benzodiazepines) **[Physician] Social** • Fear of offending other doctors **[Physician] [System] Legal** • Fear of damage to reputation, accountability for adverse outcomes, malpractice or litigation • Litigation fears concerning withholding preventive medications

		• Fear of medicolegal repercussions or negative responses from patients and their next of kin if rationalizing medications led to clinical events **[Patient] Patients' own expectations and beliefs** • Unrealistic expectations and/or demands from patients and families • Personal beliefs, demands and expectations about their own care and medications • Discrepancies between the patients' preferences and best practice recommendations • Resistance to non-pharmacological treatment alternatives • Demanding specific medications and when refused, obtaining them from different physicians • Patient's and family's wishes for medications • Passive approach adopted by patients
Reinforcement	• Rewards, incentives • Punishment • Reinforcements • Contingencies, sanctions	- Similar to 'Legal' concerns in the above 'Beliefs about Consequences' domain -
Intentions	• Stability of intentions • Stages of change model • Transtheoretical model and stages of change	**[Physician] Inertia and maintaining the status quo** • Differing treatment decisions or changes to the next visit • Easier to maintain the status quo rather than interfere with drug regimes in a stable patient
Goals	• Goal / target setting • Goal priority • Action planning	**-**
Memory, Attention and Decision Processes	• Memory • Attention • Attention control • Decision making • Cognitive overload / tiredness	**[Physician] Prescribing challenges** • Feeling forced to prescribe • Limited availability of alternatives to medications • Inability to gauge the efficacy effectiveness of a drug for individual patients • Ethical concerns around denying treatments • Need to meet patient expectations • Managing complex drug regimens and side effects • Hesitancy in changing medications that have been prescribed in their current dosage for a long period, or when prescribed by a medical specialist

Environmental Context and Resources	• Environmental stressors • Resources / material resources • Organizational culture / climate • Salient events / critical incidents • Person to environment interaction • Barriers and facilitators	**[Physician] [System] Time constraints** • Lack of time to perform medication reviews during the clinic consultation visit • Crowded clinics (workload), unable to spend too much time with a single patient • Competing demands of practice (i.e. prioritizing other aspects of care rather than deprescribing) • Insufficient time and reimbursement (e.g. to perform medication reviews) **[Physician] [System] Lack of resources** • Lack of access to a pharmacist (to assist with medication review) • Limited alternative medications • Limited prescribing support (formularies and computer decision support have limited adaptability and flexibility with multiple conditions) • Lack of resources to assist family caregivers with challenging symptoms (e.g. incontinence) **[System] Lack of inter-professional communication and support** • Lack of communication between prescribers before adding on new drugs • Lack of support from secondary/tertiary care especially with the management of complex patients in general practice **[Physician] [System] Challenges with evidence-based guidelines** • Feeling pressured by guidelines to prescribe medications (including preventive drugs) • Less comfortable in deprescribing guideline-recommended therapeutic medications (as compared to deprescribing preventive medications) in patients with poor life expectancy • Easier to pile on the recommendations of one guideline onto another instead of prioritizing • Difficulty in implementing guidelines to elderly patients with multimorbidity • Exclusion of older adults with multimorbidity in clinical trials • Lack of data for outcomes most important to patients (e.g. improvement in pain control) • Difficulty in applying guidelines because of the heterogeneity of the patients

		[System] Fragmentation of care • Multiple healthcare providers or prescribers • Patients follow up with multiple hospitals and receive medications from multiple providers • Increased specialization in healthcare • Choosing to focus on subspecialty-based care instead of overall management • Fragmentation of care, lack of a specific or unified physician to follow up with • Lack of ownership to assume responsibility for optimizing a specific patient's care plans **[System] Poor coordination of care** • Lack of coordination/communication between transitions and various levels of care • Lack of access to patients' clinical data from other healthcare settings • Tough job for coordinating physician • Specialists' lack of a holistic or geriatric view on elderly patients • Lack of relational continuity of care (lack of specific/unified physician to follow with) • Attribution of medication management responsibility to other physicians **[System] Information access and documentation** • Lack of coordination of information before adding on new drugs • Lack of or inadequate documentation • Incomplete medication reviews and/or outdated medication lists • Lack of access to information on patients' current medications • Poor acquisition and documentation of patients' medication lists • Difficulty in obtaining colleagues' reasons for prescription • Data lost in the transition from written notes to electronic prescriptions • Lack of access to expert advice and user-friendly decision support (e.g. computer prompts or alerts to notify prescribers of PIMs) **[System] Policy and regulatory issues**

		• Insufficient reimbursement • Influences of prescribing policy (perception of managerial meddling and cost cutting) • Quality measure-driven care **[System] Cost issues** • Limited options on insurance formularies **[System] Influences of the pharmaceutical industry** • Widespread marketing of medications in mainstream media • Difficulty in managing direct-to-consumer commercials about drugs and their impact on patients • Physicians themselves may be influenced by pharmaceutical drug representatives
Social Influences	• Social pressure and norms • Group conformity / identity • Social comparisons • Group norms • Social support • Power • Intergroup conflict • Alienation • Modelling	**[Patient] Social factors** • Patient's social context and access to healthcare and resources • Patients who change living or care arrangements may be accompanied by different caregivers to visits, which may result in inconsistent reports from the family and/or lack of continuity of care • Socioeconomic status **[Physician] Health beliefs and culture** • Culture to prescribe more • Prescribing validates illness
Emotion	• Fear • Anxiety • Affect • Stress • Depression • Burnout	**[Physician] Anxiety or fear** • Feeling a sense of fear towards older patients in general owing to their frailty and comorbidities • Fear of causing potential harm by deprescribing • Fear of the unknown • Viewing the deprescribing process as a risk to be avoided • Anxiety when the GP's own conviction conflicts with either that of a specialty or the guidelines • Fear of damage to reputation, accountability for adverse outcomes, malpractice or litigation • Fear of 'giving up on the patient' • Fear of offending other doctors • Fear of withdrawal effects (especially for the cessation of opioids and benzodiazepines) • Litigation fears concerning withholding preventative medications

		• Fear of medico-legal repercussions or negative responses from patients and their next of kin if rationalizing medications led to clinical events **[Physician] Fear of damaging the patient-doctor relationship** • Choosing the maintain the patient-doctor relationship rather than enforce changes or recommendations and threatening that relationship
Behavioural Regulation	• Self-monitoring • Breaking habit • Action planning	-

*ADE = adverse drug reaction; GP = general practitioner; PIM = potentially inappropriate medications; PIP = potentially inappropriate prescribing.

Table 5: Barriers to Effective Prescribing in the Elderly – A Summary based on Stakeholders involved

Stakeholder	Domain	Barriers
Patient	**1) Knowledge** **2) Skills** **3) Beliefs about Capabilities** **4) Beliefs about Consequences** **5) Social Influences**	• Lack of knowledge about medications they are taking • Poor healthcare literacy • Non-adherence to medications or visits • Patient's own expectations and beliefs (e.g. reluctance to discontinue medications, resistance to non-pharmacological treatment) • Social factors (e.g. socioeconomic status, access to healthcare)

Physician	**1) Knowledge** **2) Skills** **3) Social/Professional Role and Identity** **4) Beliefs about Capabilities** **5) Beliefs about Consequences** **6) Reinforcement** **7) Intentions** **8) Memory, Attention and Decision Processes** **9) Environmental Context and Resources** **10) Social Influences** **11) Emotion**	• Medical complexity (e.g. multimorbidity, polypharmacy, increased risk of ADEs) • Lack of knowledge or awareness about PIP • Lack of skills and confidence • Challenges to discussion with patient s (e.g. regarding risk, prognosis and life expectancy) • Paternalistic doctor-patient relationship • Role dilemma (e.g. between economic responsibility for both patients vs. society) • Concerns on inter-professional relationships • Perceptions of pharmacists' expertise • Self-efficacy issues • Discrepant beliefs and practice • Clinical – fear of causing harm, 'giving up on the patient', or withdrawal effects • Social – fear of offending other prescribers • Legal – damage to reputation, accountability issues, medicolegal implications • Inertia and maintaining the status quo • Prescribing challenges (e.g. limited alternatives, managing complex drug regimes) • Time constraints • Lack of resources (e.g. limited alternative medications) • Challenges with applicability of evidence-based guidelines in the elderly population • Health beliefs and culture (e.g. culture to prescribe more) • Anxiety or fear (e.g. fear of the unknown, fear of medicolegal implications) • Fear of damaging the patient-doctor relationship
Healthcare System	**1) Environmental Context and Resources**	• Time constraints • Lack of resources (e.g. access to pharmacist, limited prescribing support) • Lack of inter-professional communication and support

		• Challenges with applicability of evidence-based guidelines in the elderly population • Fragmentation of care (e.g. increased specialisation, multiple healthcare providers or prescribers) • Poor coordination of care • Information access and documentation (e.g. lack of access to electronic prescriptions) • Policy and regulatory issues (e.g. insufficient reimbursement for medication reviews) • Cost issues (e.g. limited options on insurance formularies) • Influences of the pharmaceutical industry

*ADE = adverse drug reaction; PIP = potentially inappropriate prescribing.