Effectiveness, safety, and cost-effectiveness of pharmacist prescribing

An evidence review

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21 October 2025

Research. Evidence. Action.

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List of abbreviations

Abbreviation	Explanation
ARNI	angiotensin receptor/neprilysin inhibitor
AUD	Australian dollar
CAD	Canadian dollar
CENTRAL	Cochrane Central Register of Controlled Trials
CHEC list	Consensus Health Economic Criteria list
CHEERS	Consolidated Health Economic Evaluation Reporting Standards
CI	confidence interval
DALY	disability-adjusted life year
eGFR	estimated glomerular filtration rate
EQ-5D	European Quality of Life 5 Dimensions
GBP	Great British pound
GP	general practitioner
GRADE	Grading of Recommendations Assessment, Development, and Evaluation
HADS-A	Hospital Anxiety and Depression Scale-Anxiety
HADS-D	Hospital Anxiety and Depression Scale-Depression
HbA1c	haemoglobin A1c
HDL	high-density lipoprotein
ICER	incremental cost-effectiveness ratio
INR	international normalised ratio
IQR	interquartile range
LDL	low-density lipoprotein
MeSH	Medical Subject Headings
N/A	not applicable
NHLBI	National Heart, Lung, and Blood Institute
NHS	National Health Service
NIMS	National Incident Management System
OB/GYN	obstetrician gynaecologist
PICO	population, intervention, comparator, outcome
PRESS	Peer Review of Electronic Search Strategies
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
PRISMA-P	Preferred Reporting Items for Systematic reviews and Meta-Analyses Protocols
QALD	quality-adjusted life day
QALM	quality-adjusted life month
QALY	quality-adjusted life year
RCT	randomised controlled trial
RoB 2	Risk of Bias 2
ROBINS-I	Risk Of Bias In Non-Randomized Studies – of Interventions
robvis	Visualisation tool for risk of bias
SD	standard deviation
SE	standard error
SWiM	Synthesis Without Meta-analysis
UK	United Kingdom
USA	United States of America
USD	United States dollar

Glossary of terms

Term	Explanation
adverse event	An undesired effect or consequence of a drug or other type of treatment intervention. Adverse events can range from mild or moderate events to severe or life-threatening events and even death.
angiotensin receptor/neprilysin inhibitor (ARNI)	A combination drug therapy which is composed of two components – an angiotensin II receptor blocker and a neprilysin inhibitor – that work together to treat heart failure.
anticoagulant	A drug that prevents blood clots by slowing down the clotting process. These drugs are used to treat and prevent strokes, heart attacks, and other serious medical cardiovascular conditions.
blood pressure (systolic and diastolic)	The force of blood pushing against the walls of the arteries in the heart as blood is pumped throughout the body. There is systolic and diastolic blood pressure, which are commonly presented as a ratio, with systolic blood pressure on top. Systolic blood pressure is the force when the heart beats and diastolic blood pressure is the force when the heart rests between beats.
cholesterol	A type of fatty substance that helps digest food, helps produce certain hormones and vitamins, and helps cell membranes form protective layers. It connects with proteins or triglycerides to travel through the blood. Low-density lipoprotein (LDL) cholesterol particles are made up of mostly cholesterol and high levels can result in built up fatty deposits, raising the risk of heart attacks, strokes, or other conditions. High-density lipoprotein (HDL) cholesterol is made up mostly of protein; it helps take extra cholesterol out of the bloodstream and sends it to the liver where it is broken down. A higher HDL cholesterol value is ideal and may lower the risk of heart disease.
cohort study	A cohort study is a form of longitudinal (analytic observational) epidemiological study in which a group of subjects, called a cohort, is followed over a period of time, and data relating to predetermined exposures and outcomes are collected on two or more occasions over this time period. The incidence (new cases) of the outcome(s) of interest is calculated in the exposed people and compared with the incidence in the non-exposed people. The data for the cohort can be collected either by following the participants into the future (a prospective study) or by asking them about their past (a retrospective study). Cohort studies contribute to causality or disease aetiology and provide, at best, moderate-quality evidence for intervention studies
collaborative practice agreement/ collaborative prescribing	An agreement in which there is a cooperative relationship between the pharmacist and doctor where the doctor diagnoses and makes initial treatment decisions for the patient, while the pharmacist selects, monitors, modifies, continues, or discontinues the treatment, as appropriate.
cost-benefit analysis	A form of economic evaluation that evaluates two or more alternatives where both the costs and outcomes are expressed in monetary terms. It should include the preferences of those affected (i.e. one's willingness to pay).

Term	Explanation
cost-benefit ratio	A metric that compares the expected benefits of an intervention to its costs in order to evaluate whether it is worth investing in the intervention. A ratio of greater than 1 indicates that the benefits outweigh the costs.
cost-effectiveness analysis	A form of economic evaluation that compares two or more alternatives in terms of their relative costs and outcomes. Outcomes are a single unit (e.g. life years gained).
cost-minimisation analysis	A form of economic evaluation that compares the cost of two equally clinically effective interventions in order to determine which one is less expensive.
cost-utility analysis	A specific type of cost-effectiveness economic evaluation that compares the costs of an intervention with its health benefits and considers both mortality and morbidity (e.g. quality-adjusted life years). Results can help better allocate resources in order to get the best value for money.
deprescribing	The process of tapering, stopping, discontinuing, or withdrawing drugs, with the goal of managing polypharmacy and improving outcomes.
dependent prescribing	A type of prescribing in which pharmacists face more restrictions, limiting medication prescription according to set protocols or predefined lists of medications. Different types of dependent prescribing include supplementary prescribing, prescribing by formulary protocol, and repeat prescribing.
discounting	A common practice in economic evaluations that weights future gains and losses less heavily than those that occur in the present.
dominant strategy	The superior course of action in health economics that is the most effective and efficient use of resources.
estimated glomerular filtration rate (eGFR)	A blood test to determine how well the kidneys are working. It is often used to monitor common conditions that can affect the kidneys, such as diabetes or high blood pressure, and regular testing is done for people with chronic kidney disease.
formulary prescribing	A type of prescribing in which pharmacists may prescribe from a predefined list of medications for specific medical conditions. Medications not on the list may not be prescribed by pharmacists.
haemoglobin	A protein in red blood cells that contains iron and helps transport oxygen around the body. If it is too low, it can cause anaemia, extreme fatigue, or weakness. If it is too high, it can lead to things like headaches, jaundice, clots, heart attacks, or strokes.
haemoglobin A1c (HbA1c)	HbA1c is a blood test that measures the average blood sugar level over the past 2–3 months. It helps diagnose and monitor type 2 diabetes.
incremental cost-effectiveness ratio (ICER)	The difference in the cost between two interventions or therapies divided by the health gained or the quality-adjusted life years. This ratio gives the cost per additional quality-adjusted life year.

Term	Explanation
independent prescribing	A type of prescribing in which pharmacists have the greatest autonomy in prescribing medications and are responsible for the assessment, diagnosis, and clinical management of patients.
inferential statistics	Statistics used to make conclusions, predictions, or inferences about a population. Inferential statistics assume that the dataset is a sample of a larger population and use a variety of different statistical tests to test hypotheses and compare groups. Generally, they will provide an estimate of the size of an effect and some measure of uncertainty.
international normalised ratio (INR)	How long it takes the blood to clot. It is a ratio of a patient's prothrombin time to a normal (control) sample; this ratio is then raised to the power of the international sensitivity index to account for the variations between different types and batches used in the test reagent. The INR is used to monitor the effectiveness of the anticoagulant warfarin.
long-term care	Residential facilities, such as supportive living or nursing homes, that provide a range of supports and services to the older people who live there.
minor ailment scheme	A service provided by pharmacists in some countries where they are able to prescribe certain medicines to people who otherwise would visit a doctor to access such medications. This type of scheme is restricted to a variety of different minor ailments (also referred to as common conditions) such as earaches, diarrhoea, head lice, or minor skin infections.
partial thromboplastin time	How long it takes the blood to clot. A partial thromboplastin time test checks how well most of an individual's clotting factors work and is used in a variety of circumstances, such as to assist with dosing if the individual is receiving heparin, checking bleeding issues prior to medical procedures, or if there are clotting issues. This is also called 'activated partial thromboplastin time'.
payer perspective	The viewpoint of those who finance healthcare services and interventions, such as governments, insurance companies, or employers. All payers desire value for money and optimal resource allocation.
prothrombin time ratio	How long it takes the blood to clot. This is the ratio of an individual's measured prothrombin time (in seconds) to the normal laboratory reference prothrombin time. This has been replaced by the INR.
protocol prescribing	A type of prescribing in which a written guideline (protocol) describes the activities that pharmacists may perform in explicit detail. It includes a limited list of diseases and medication classes that pharmacists may prescribe, listing medications in preferential order, suggested doses, and recommendations for dose modification.
quality-adjusted life year (QALY)	A measure of the quality and quantity (length) of life. In health economics, it is used to help assess the value of an intervention. A QALY can range from 0 to 1, where 0 is dead and 1 is perfect health.
randomised controlled trial (RCT)	An RCT is an analytic interventional epidemiological study in which subjects are randomly assigned to one of at least two groups. The first group is the

Term	Explanation
	experimental group, which receives the intervention of interest, and the other group is the comparison or control group, which receives an alternative treatment (such as current conventional therapy or a placebo). The two groups are then followed up on to see if there are any differences between them with respect to the outcome(s) of interest. RCTs are the most stringent study design for evaluating the effect of an intervention on an outcome.
RCT – parallel design	A type of RCT where the participants are randomly allocated to one of two treatment groups and all of the participants in each group only receive one treatment for the entirety of the study. The researcher then measures and compares the outcomes in the two groups at the end of the study.
RCT – cluster design	A type of RCT where the unit of randomisation is not at the individual level. This study design is often used to evaluate a new standard of care, guideline, or other practice-, hospital-, or system-wide change that can affect patient outcomes. Cluster RCTs are helpful when there is a high risk of contamination, such as when members of the group that was not randomised to treatment could learn about and adopt parts of the intervention (e.g. in school or care home settings).
supplementary prescribing	A type of prescribing in which a voluntary partnership between the doctor and pharmacist exists, where the doctor undertakes the initial assessment of a patient and the pharmacist prescribes in line with the doctor's documented individualised care plan.
therapeutic proconvertin and prothrombin	Proconvertin and prothrombin are clotting factors that are used to monitor anticoagulant therapy. These were replaced by more standardised metrics such as the INR.
time horizon	The period of time over which the costs and effects of an intervention and comparator are calculated.
triglyceride	A type of fat found in the blood. Triglycerides are a major source of energy but if levels are too high, they can raise the risk of heart disease and other cardiovascular conditions.
usual care	The standard treatment that a study participant would be expected to receive in the ordinary course of normal practice. An experimental study may compare outcomes between an experimental group, which receives the intervention of interest, and a usual care group, which receives the standard care that would be provided if no experiment were being undertaken.

Executive summary

Context

In July 2024, the Expert Taskforce to Support the Expansion of the Role of Pharmacy, established by the Minister for Health in 2023, published its final report with recommendations to develop a stepwise plan to enable pharmacists to exercise independent prescriptive authority and to develop other models of pharmacist prescribing. Given current policy aims to expand the role of pharmacists across diverse healthcare settings, the Department of Health requested this evidence review on the safety, effectiveness, and cost-effectiveness of pharmacist prescribing interventions across primary, secondary, and tertiary healthcare settings.

Review questions

The review questions were:

1. Is pharmacist prescribing effective?
2. Is pharmacist prescribing safe?
3. Is pharmacist prescribing cost-effective?

Methods

This evidence review comprises a systematic review of primary quantitative studies to synthesise evidence on safety and effectiveness, and of full economic evaluations to synthesise evidence on cost-effectiveness. The methods used in this review are divided into five stages: (1) identifying research evidence, (2) screening of search results, (3) data extraction, (4) quality assessment, and (5) synthesis.

Identifying and screening research evidence

To identify information for this review, we performed two separate searches in July 2024 to identify all publications related to the three research questions. One search was conducted in five relevant databases to answer the questions on safety and effectiveness. The other search was conducted in three relevant databases and one online repository in order to answer the research question on cost-effectiveness. We also identified grey literature resources for all three questions. We conducted separate supplementary searches, which comprised a systematic review search as well as citation searching of grey literature references, identified systematic reviews, and included papers. We performed an updated search in February 2025.

Two independent reviewers conducted title and abstract and full-text double-screening in EPPI-Reviewer Web. Conflicts in double-screening were resolved by discussion or referral to a third reviewer where necessary.

Data extraction

One reviewer extracted data from each included study using a bespoke piloted data extraction form, and another validated the extracted data for accuracy and comprehensiveness. Disagreements were resolved by discussion or referral to a third reviewer where necessary. Data extraction included publication, study, and intervention details; measures of effect; and other relevant information.

Quality assessment

One reviewer conducted risk of bias/quality assessment independently, and another validated this assessment for accuracy. Conflicts were resolved by discussion or referral to a third reviewer where

necessary. We assessed the methodological quality of each study using relevant standards: Risk Of Bias In Non-Randomized Studies – of Interventions (ROBINS-I) for non-randomised studies, the Cochrane Risk of Bias 2 (RoB 2) tool for parallel randomised controlled trials (RCTs) and for cluster RCTs, and the Philips checklist for economic modelling studies.

We then assessed the quality or certainty of evidence for each outcome by health condition for the safety and effectiveness studies. We assessed the certainty of the evidence using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system, and scored it as high, moderate, low, or very low.

Synthesis

We have documented descriptive data on study characteristics in tables and presented results by health condition and outcome. For each outcome, we completed an assessment of the feasibility of meta-analysis following published guidance and found that it was not appropriate to proceed with meta-analysis for any of our outcomes. Therefore, we have presented a narrative synthesis.

Findings

After deduplication, screening of titles and abstracts and full texts, and citation chasing, we included 52 studies, of which 32 reported on effectiveness, 20 reported on safety, and 13 reported on cost-effectiveness outcomes.

Effectiveness

Effectiveness outcomes were reported for 13 health conditions (listed as subheadings below) across 32 studies. Seventeen of the studies were retrospective cohort studies, 8 were parallel RCTs, 4 were non-randomised trials, 1 was a prospective cohort study, and 2 were cluster RCTs. In total, 18 assessed collaborative practice agreements; 6 assessed protocol prescribing; 6 assessed independent prescribing; and 1 assessed formulary prescribing. Twelve were based in outpatient clinics, 10 were based in primary care, 3 were based in community retail pharmacies, 3 were based in long-term care, and 3 were based in inpatient settings. Twenty-two studies were based in the United States of America (USA), 4 were based in Canada, 4 were based in the United Kingdom (UK), and 2 were based in Singapore.

Diabetes

Eight studies assessed the effectiveness of pharmacist prescribing for people with diabetes. The effectiveness outcomes assessed were blood glucose, blood pressure, lipids, and health-related quality of life. There was a significant improvement or no significant difference in blood glucose outcomes in pharmacist prescribing groups compared with primary care provider prescribing groups and physician prescribing groups in six studies. There was no significant difference in blood pressure, lipids, or health-related quality of life between groups in three studies. The certainty of the evidence was very low for all outcomes.

Heart failure

Three studies assessed the effectiveness of pharmacist prescribing for people with heart failure. One retrospective cohort study reported significant improvement in 30-day all-cause readmission events in a pharmacist prescribing group and the endocrinologist prescribing group. There was no significant difference in 30-day heart failure readmission events between the pharmacist prescribing group and the endocrinologist prescribing group. No inferential statistics for other healthcare utilisation outcomes were reported by this study.

The proportion of patients achieving the angiotensin receptor/neprilysin inhibitor (ARNI) target dose was higher and the number of visits required to reach this target was lower in the pharmacist prescribing group compared with the clinician prescribing group in the second study. There was no significant difference in the average number of days to achieve the target ARNI dose between groups in the same study. In relation to the aspirin deprescribing outcome, there were significant improvements in the pharmacist prescribing group compared with the primary care provider prescribing group in the third study. The certainty of the evidence was very low for all outcomes.

Stroke

One RCT assessed the effectiveness of pharmacist prescribing compared with physician prescribing for people with stroke. The effectiveness outcomes assessed were blood pressure and lipid level goals achieved, systolic blood pressure levels, lipids, adherence, self-rated health, and health-related quality of life. No inferential statistics were reported for these outcomes. The certainty of the evidence was very low for all outcomes.

Dyslipidaemia

One cluster RCT assessed the effectiveness of pharmacist prescribing for people with dyslipidaemia. The effectiveness outcomes assessed were lipid levels, blood pressure, fasting blood glucose levels, healthcare utilisation, and adherence. There was significantly higher likelihood of achieving lipid target in the pharmacist prescribing group compared with the physician prescribing group. There was no significant difference in outcomes related to LDL cholesterol, HDL cholesterol, triglyceride levels, blood pressure, fasting blood glucose, or healthcare utilisation in the pharmacist prescribing group compared with the physician prescribing group. No inferential statistics were reported for the adherence outcome. The certainty of the evidence was very low for all outcomes.

Hypertension

Two studies assessed the effectiveness of pharmacist prescribing for people with hypertension. The effectiveness outcomes assessed were blood pressure, adherence, and health-related quality of life. There was either an improvement or no significant difference in the pharmacist prescribing groups compared with the physician prescribing groups across all blood pressure outcomes in both studies. There was no significant difference in the adherence or health-related quality of life outcomes between groups in one study. The certainty of the evidence was very low for all outcomes.

Coagulation disorders

Six studies assessed the effectiveness of pharmacist prescribing for people with coagulation disorders. The effectiveness outcomes assessed were related to blood clotting. There was either an improvement or no significant difference in the proportion of patients achieving international normalised ratio (INR) control in pharmacist prescribing groups compared with the physician prescribing or nurse prescribing groups in three studies. One study reported very low-certainty evidence indicating INR was in a therapeutic range for significantly higher percentage of time in the pharmacist prescribing group compared with the physician prescribing group.

No inferential statistics were reported in relation to average time to achieve therapeutic INR between the pharmacist prescribing group and the physician prescribing group, but no significant difference was reported for time achieve proconvertin and prothrombin between the pharmacist prescribing group and primary care provider prescribing group. No significant difference was reported in relation to partial thromboplastin time and prothrombin time ratio in the pharmacist prescribing groups compared with the physician prescribing groups in two studies. The certainty of the evidence was very low for all outcomes.

Chronic kidney disease

One study assessed the effectiveness of pharmacist prescribing for people with chronic kidney disease. The effectiveness outcome assessed was haemoglobin goal achieved. There was a significantly higher proportion of patients achieving their haemoglobin goals in the pharmacist prescribing group compared with both the clinic physician prescribing and the usual care groups. The certainty of the evidence was very low for all outcomes.

Urinary tract infection

One study assessed the effectiveness of pharmacist prescribing for women with urinary tract infections. The effectiveness outcomes assessed were clinical cure at 2 weeks, time to access care, and adherence. No statistically significant difference in clinical cure at 2 weeks was reported in the pharmacist prescribing group compared with the physician prescribing group. Significant improvements in both time to access care and adherence were reported in the pharmacist prescribing group compared with the physician prescribing group. The certainty of the evidence was very low for all outcomes.

Older people in long-term care

Three studies assessed the effectiveness of pharmacist prescribing for older people in long-term care. The effectiveness outcomes assessed were falls, drug burden, health-related quality of life, depression, anxiety, systolic blood pressure levels, and healthcare utilisation. There was either a significant improvement or no significant difference in pharmacist prescribing groups compared with primary care provider, physician, or medical internist prescribing groups for most outcomes. There was a significant improvement in the drug burden outcome reported in the pharmacist prescribing groups compared with the medical internist prescribing or primary care provider prescribing groups in two studies. In relation to falls, either no significant difference was reported, or no inferential statistics were reported between the pharmacist prescribing and primary care provider prescribing or physician prescribing groups in two studies. For health-related quality of life, there was a significant improvement in a pharmacist prescribing group compared with a primary care provider prescribing group in one study, and no significant difference between a pharmacist prescribing group and a physician prescribing group in another study. There was no significant difference in depression, anxiety, or healthcare utilisation outcomes between pharmacist prescribing groups and primary care provider prescribing, physician prescribing, or medical internist prescribing groups in all three studies. The certainty of the evidence was low or very low for hospitalisations and very low for all other outcomes.

Female contraceptive users

Two studies assessed the effectiveness of pharmacist prescribing for women seeking contraception. The effectiveness outcomes assessed were continuation and adherence. The studies found both a significant improvement and no significant difference in the pharmacist prescribing groups compared with the physician prescribing groups for both outcomes. The certainty of the evidence was very low for both outcomes.

Anaemia in pregnancy

One study assessed the effectiveness of pharmacist prescribing for women with anaemia in pregnancy. The effectiveness outcome assessed was related to achieving haemoglobin goals and mean haemoglobin levels. Significantly more patients achieved their target haemoglobin levels, and there was a significant improvement in mean haemoglobin levels, in the pharmacist prescribing group compared with the obstetrician gynaecologist (OB/GYN) prescribing group. The certainty of the evidence was very low for both outcomes.

Chronic pain conditions

One study assessed the effectiveness of pharmacist prescribing for people with chronic pain conditions. The effectiveness outcomes assessed were chronic pain, health-related quality of life, and mental health. No inferential statistics were reported for these outcomes. The certainty of the evidence was very low for all outcomes.

Mixed health conditions

Two studies assessed the effectiveness of pharmacist prescribing for people with mixed health conditions. The effectiveness outcomes assessed were healthcare utilisation, blood pressure goal achieved, low-density lipoprotein (LDL) cholesterol goal achieved, and haemoglobin A1c (HbA1c) goal achieved. There were significantly more ambulatory care visits in the pharmacist prescribing group compared with the physician prescribing group, but fewer hospitalisations in the pharmacist prescribing groups compared with the primary care provider prescribing or physician prescribing groups. Length of hospital stay was significantly shorter in the pharmacist prescribing group compared with the physician prescribing group in one study. Significantly fewer emergency department visits were reported in the pharmacist prescribing group compared with the primary care provider prescribing group, but no significant difference was reported between the pharmacist prescribing group and the physician prescribing group, in one study.

Significantly higher numbers of participants achieved their blood pressure goals in the pharmacist prescribing group compared with the primary care provider prescribing group, but no significant difference was reported between the pharmacist prescribing group and the physician prescribing group, in one study. There was no significant difference in the achievement of LDL cholesterol goals or HbA1c goals between the pharmacist prescribing group and the physician prescribing or primary care provider prescribing groups in one study.

Safety

Safety outcomes were reported for 12 health populations (listed as subheadings below) across 20 studies. Eight studies were retrospective cohort studies, five were parallel RCTs, four were non-randomised trials, two were cluster RCTs, and one was a prospective cohort study. Nine studies assessed collaborative practice agreements, 5 assessed independent prescribing, 4 assessed protocol prescribing, 1 assessed formulary prescribing, and 1 assessed supplementary prescribing. Seven studies were based in outpatient clinics, four studies were based in the community, three were based in long-term care, two were based in primary care, three were based in inpatient settings, and one was based in the emergency department. In relation to location, 11 studies were based in the USA, 5 were based in Canada, 2 were based in the UK, and 2 were based in Australia.

Heart failure

One study assessed safety outcomes in people with heart failure. The safety outcomes assessed were heart failure hospitalisations and all-cause death. No significant difference in hospitalisations due to heart failure was reported between the pharmacist prescribing group and the clinician prescribing group. Significantly fewer all-cause deaths were reported in the pharmacist prescribing group compared with the clinician prescribing group. The certainty of the evidence was very low for both outcomes.

Stroke

One study assessed the safety of pharmacist prescribing compared with physician prescribing for people with a recent minor ischaemic stroke or transient ischaemic attack. The safety outcomes assessed were mortality and adverse vascular events. No inferential statistics were reported for these outcomes. The certainty of the evidence was very low for both outcomes.

Dyslipidaemia

One study assessed the safety of pharmacist prescribing compared with physician prescribing for people with dyslipidaemia. The safety outcome assessed was adverse events, but no inferential statistics were reported. The certainty of the evidence was very low for this outcome.

Coagulation disorders

Four studies assessed the safety of pharmacist prescribing for people with coagulation disorders. The safety outcomes assessed were adverse events, and hospitalisations/emergency department visits due to adverse events. Significantly fewer anticoagulation-related adverse events, hospital admissions, and emergency department visits were reported in the pharmacist prescribing groups compared with the physician prescribing groups in two studies. One study reported significantly lower likelihood of warfarin-related hospitalisations/emergency department visits were reported in a pharmacist prescribing group compared with a nurse prescribing group. No significant difference in the number of bleeding or thromboembolic adverse events was reported between the pharmacist prescribing group and the physician prescribing group in one study. No inferential statistics were reported for a combined bleeding/adverse drug events outcome in one study. The certainty of the evidence was very low for all outcomes.

Chronic kidney disease

Two studies assessed the safety of pharmacist prescribing compared with usual care and physician prescribing for people with chronic kidney disease. The safety outcomes assessed were adverse events and prescribing errors. No inferential statistics were reported for these outcomes. The certainty of the evidence was very low for all outcomes.

Urinary tract infection

Two studies assessed the safety of pharmacist prescribing for people with urinary tract infections. The safety outcomes assessed were adverse events, physician or emergency department visits, and antimicrobial therapy guideline concordance. There was no significant difference in adverse events or physician/emergency department visits in the pharmacist prescribing groups compared with the physician prescribing groups in both studies. There was significantly improved antimicrobial therapy guideline concordance in the pharmacist prescribing group compared with the physician prescribing group in one study. The certainty of the evidence was very low for all outcomes.

Older people in long-term care

Three studies assessed the safety of pharmacist prescribing for older people in long-term care. The safety outcomes assessed were mortality and adverse events. There were significantly fewer deaths in the pharmacist prescribing group compared with the medical internist prescribing group in one study, and no significant difference in the number of deaths in the pharmacist prescribing group compared with the primary care provider prescribing group in a second study.

The third study reported was no significant difference between a pharmacist prescribing group compared with a physician prescribing group for the following adverse events: syncope, hypokalaemia, hyperkalaemia, hyponatraemia, orthostatic presyncope, and change in estimated glomerular filtration rate (eGFR). There were significantly more hypotension adverse events reported in the pharmacist prescribing group compared with the physician prescribing group. The certainty of the evidence was very low for all outcomes.

Female contraceptive users

Two studies assessed the safety of pharmacist prescribing for women prescribed contraception. One study reported no significant difference in medical contraindications between the pharmacist prescribing group and the physician prescribing group, whereas the other study did not report inferential statistics. The certainty of the evidence was very low for this outcome.

Emergency department patients

One study assessed the safety of pharmacist prescribing for people in the emergency department. Significantly fewer prescribing errors were reported in the pharmacist prescribing group compared with the physician prescribing group. The certainty of the evidence was very low for this outcome.

Surgery patients

One study assessed the safety of pharmacist prescribing for surgery patients. There were significantly fewer prescribing errors in the pharmacist prescribing and medication review group compared with the pharmacist medication review only group and the physician prescribing group across all outcomes. The certainty of the evidence was very low for all outcomes.

People at risk of drug-related problems

One study assessed the safety of pharmacist prescribing for people at risk of drug-related problems. There was no significant difference in mortality reported between the pharmacist prescribing and physician prescribing groups. The certainty of the evidence was very low for this outcome.

Mixed health conditions

One study assessed the safety of pharmacist prescribing for a population with mixed health conditions. There was no significant difference was reported in acute kidney injury events or gastrointestinal bleeding events between the pharmacist deprescribing group and the physician deprescribing group. Significantly fewer hospitalisations and emergency department visits due to adverse pain events were reported in the pharmacist deprescribing group compared with the physician deprescribing group. The certainty of evidence was very low for all outcomes.

Cost-effectiveness

Cost-effectiveness outcomes were reported for 8 healthcare populations (listed as subheadings below) across 13 studies. Ten were cost-utility studies, two were cost-minimisation analyses, and one was a cost-benefit study. Seven studies assessed collaborative practice agreements, while six assessed independent prescribing by pharmacists. Six studies were based in community pharmacies, four were based in primary care, and three were based in outpatient clinics. Seven were from a USA perspective, four were from a Canadian perspective, one was from a UK perspective, and one was from an Australian perspective.

The majority of the cost-effectiveness studies projected pharmacist prescribing models to be dominant (i.e. they had lower treatment costs and were more effective), to be cost saving (i.e. they had lower treatment costs and were equally effective), or to have a better cost-benefit ratio when compared with alternative scenarios. Only one study (on chronic pain) reported that usual care was dominant over a pharmacist prescribing model.

The studies reviewed were generally well conducted, with clear definitions of key components and strong data modelling. In some cases, we identified gaps in data identification, inconsistent reporting of time horizon and disease pathways, and incomplete uncertainty assessments. These limitations may affect the accuracy and reliability of the studies' projected cost-effectiveness and/or cost savings.

Diabetes

Three studies assessed the cost-effectiveness of pharmacist prescribing for diabetes in outpatient clinics and community pharmacy. All three cost-utility analyses (two from a USA payer perspective and one from a Canadian healthcare system perspective) projected pharmacist prescribing as the dominant strategy, with lower treatment costs and slightly higher quality-adjusted life years (QALYs).

Hypertension

Three studies assessed the cost-effectiveness of pharmacist prescribing for hypertension in primary care and community pharmacies. One cost-benefit analysis (from a USA payer perspective) projected pharmacist prescribing to be dominant, with lower treatment costs and downstream expenditure. Two cost-utility analyses (one from a USA third-party payer perspective and one from a Canadian public payer perspective) projected pharmacist prescribing to be the dominant strategy, with lower treatment costs and slightly more QALYs.

Chronic kidney disease

One study assessed the cost-effectiveness of pharmacist prescribing for chronic kidney disease in a primary care clinic. The cost-utility analysis (from a USA payer perspective) found a pharmacist-managed erythropoiesis-stimulating agent primary care clinic to be dominant, with lower treatment costs and slightly more QALYs.

Urinary tract infection

One study assessed the cost-effectiveness of pharmacist prescribing for urinary tract infection in community pharmacies. The cost-utility analysis (from a Canadian public healthcare system perspective) found pharmacist prescribing to be cost saving, with lower treatment costs and comparable quality-adjusted life months (QALMs).

Minor ailments

One study assessed the cost-effectiveness of pharmacist prescribing for minor ailments in a community pharmacy setting. The cost-minimisation analysis (from a Canadian public payer perspective) of pharmacist prescribing projected savings under two compensation models: a prescription-detached model (in which the pharmacist is compensated per consultation) and a prescription-attached model (in which the pharmacist is compensated per prescription).

Acute pharyngitis

One study assessed the cost-effectiveness of pharmacist prescribing for acute pharyngitis in a community pharmacy setting. The cost-minimisation analysis (from a USA payer perspective) found pharmacist prescribing to be the most cost-saving strategy compared with six physician-led alternatives.

Female contraceptive users

Two studies assessed the cost-effectiveness of pharmacist prescribing for female contraceptive users in community pharmacies. Two cost-utility analyses (one from an Australian healthcare system perspective and one from a USA Medicaid payer perspective) found pharmacist prescribing to be dominant, with lower treatment costs and slightly more QALYs.

Chronic pain conditions

One study assessed the cost-effectiveness of pharmacist prescribing for chronic pain conditions as part of a trial-based full economic evaluation in general practice. The cost-utility analysis (from a UK national

health system perspective) found that pharmacist prescribing had higher treatment costs per patient and comparable QALYs, making usual care by general practice teams the cost-saving strategy in this pilot trial.

Conclusions

This evidence review included 52 studies, of which 32 reported on effectiveness, 20 reported on safety, and 13 reported on cost-effectiveness outcomes. The remit of this evidence review was intentionally broad in order to provide evidence on pharmacist prescribing across a wide range of healthcare settings and healthcare conditions.

In relation to effectiveness and safety outcomes, all outcomes were graded as low to very low certainty, meaning that our confidence in the findings is limited. There was generally a significant improvement or no significant difference in pharmacist prescribing compared with usual care across the remaining effectiveness and safety outcomes. Out of the 167 outcomes related to safety and effectiveness, 51 outcomes were significantly improved with pharmacist prescribing. For 75 outcomes, no significant difference was reported indicating equivalence of care and outcomes between pharmacist prescribing and other prescribing groups including medical doctors. Inferential statistics were reported for 39 outcomes, meaning we cannot comment on the statistical significance of these outcomes.

Only two outcomes related to effectiveness and safety reported in favour of the non-pharmacist prescriber group. One study reported increased healthcare utilisation in relation to outpatient clinic visits, but fewer hospitalisations, in the pharmacist prescribing group compared with the usual care group. Another study reported significantly more hypotension adverse events in the pharmacist prescribing group compared with the physician prescribing group.

In relation to cost-effectiveness outcomes, most studies projected pharmacist prescribing models to be dominant (i.e. they had a lower treatment cost and were more effective), to be cost saving (i.e. they had a lower treatment cost and were equally effective), or to have a better cost-benefit ratio when compared with alternative scenarios. Only one study (on chronic pain) projected a current GP prescribing model to be cost saving compared with a pharmacist prescribing model.

Considering the projected cost-effectiveness, alongside the effectiveness and safety findings, there is evidence to support progressing Irish policy and legislation in this area. Expanding the role of pharmacists in prescribing could improve resource allocation while maintaining patient safety and treatment outcomes. Continued research and policy development will contribute to determining the benefits of pharmacist prescribing and facilitating its effective integration into the Irish healthcare system. Future research in the Irish context, based on public and patient preferences, would inform policy decisions related to resource allocation.

1 Introduction

1.1 Background

A variety of health workforce strategies are implemented to improve access to and efficiency of health services globally. Internationally, there is a growing demand for health services due to an ageing population and a rising burden of chronic diseases. One effective strategy to meet these increased health demands is through expanding the scope of practice within the health workforce, such as enabling healthcare providers other than medical doctors to prescribe medications [1].

Non-medical prescribers include nurses, pharmacists, other health professionals, and physician assistants. Prescribing by other healthcare professionals offers a more flexible system for the prescribing, supply, and administration of medications, enhancing patient access and easing the workload burden on general practitioners (GPs) and other medical doctors. Findings from a Cochrane review of 46 studies report that other healthcare prescribers achieve outcomes comparable to medical prescribers across various health metrics, including systolic blood pressure, glycated haemoglobin, low-density lipoprotein cholesterol levels, medication adherence, patient satisfaction, and health-related quality of life [2].

This review specifically focuses on prescribing by pharmacists. From a health system perspective, introducing pharmacist prescribing can lead to significant cost savings and cost avoidance in healthcare [3,4]. Pharmacists can reduce current spending by adapting treatments (such as switching from intravenous to oral therapy) and can prevent future expenses by deprescribing unnecessary or inappropriate medications, potentially avoiding adverse drug events and associated costs like GP referrals or hospital admissions. Research indicates that pharmacist involvement in prescribing practices reduces medication errors and inappropriate prescribing, significantly lowering healthcare costs through reduced hospital admissions and shorter stays [4–6]. Their involvement can enhance patient safety and overall cost efficiency in the healthcare system.

Shifting the management of common conditions (also referred to as minor ailments or common ambulatory conditions) from GPs to community pharmacists can alleviate the clinical and economic burden on higher-cost areas of the health service. In 2014, a United Kingdom (UK) report highlighted that GPs treating common conditions cost the National Health Service (NHS) 1 billion Great British pounds (GBP) annually [7]. Community pharmacy minor ailment schemes can save physician time by managing minor illnesses, facilitating GPs to focus on more complex cases, potentially reducing waiting times, decongesting GP surgeries, and improving patient access to services.

Different models of pharmacist prescribing have been described in the literature [1,8,9]. For the purposes of this evidence review, the types of pharmacist prescribing are defined as independent, collaborative, and dependent:

- Independent prescribing: Pharmacists have the greatest autonomy in prescribing medications and are responsible for the assessment, diagnosis, and clinical management of patients.
- Collaborative prescribing: There is a cooperative practice relationship between the pharmacist and doctor. The doctor diagnoses and makes initial treatment decisions for the patient, while the pharmacist selects, monitors, modifies, continues, or discontinues the treatment as appropriate.
- Dependent prescribing: Pharmacists face more restrictions, which limit medication prescription according to protocols or formularies.

Different types of dependent prescribing include supplementary prescribing, formulary prescribing, protocol prescribing, and repeat prescribing:

- Supplementary prescribing: A voluntary partnership between the doctor and pharmacist exists, where the doctor undertakes the initial assessment of a patient and the pharmacist prescribes medication in line with the doctor's documented individualised care plan.
- Formulary prescribing: Pharmacists may prescribe from a predefined list of medications for specific medical conditions. Medications not on the list may not be prescribed.
- Protocol prescribing: A written guideline (protocol) describes in explicit detail the activities that pharmacists may perform. It includes a limited list of diseases and medication classes that pharmacists may prescribe, listing medications in preferential order, suggested doses, and recommendations for dose modification.
- Repeat prescribing: A medication refill service where pharmacists in clinics prescribe for patients who require continuing prescriptions prior to their next available appointment with their doctor.

Figure 1 illustrates the increasing autonomy of pharmacists in the prescribing models described above.

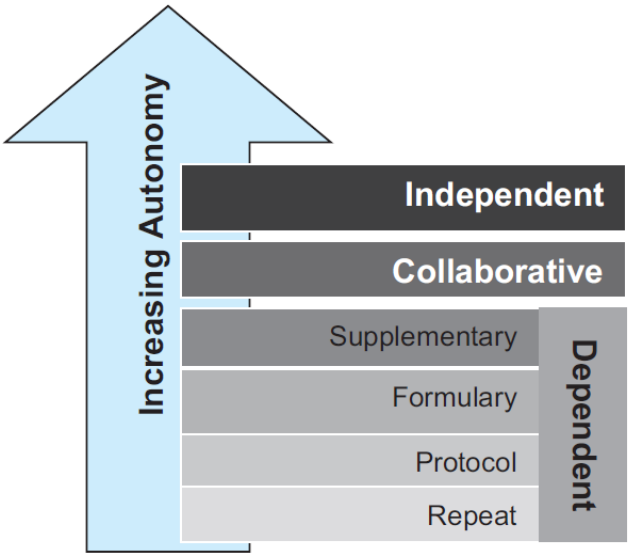

Figure 1: Increasing autonomy of pharmacist prescribing models

Source: Poh *et al.*, 2018 [1]

A limited supplementary prescribing right was introduced in the UK in 2003, followed by independent prescribing in 2006 [1,9]. In Ireland, pharmacists' prescribing rights are currently limited to extending pre-existing medical prescriptions for up to 12 months (increased from up to 6 months in March 2024) [10,11].

Extensive research has examined stakeholder views on pharmacist prescribing, offering important context alongside evidence on its safety, effectiveness, and cost-effectiveness. One systematic review of 65 studies explored perspectives from a range of stakeholders, including pharmacists, doctors, patients, and policy-makers [12]. It reported broadly positive views across implementation stages, including improved access to care, reduced physician workload, and better use of pharmacists' expertise. Concerns included limitations in diagnostic authority, legal accountability, and access to clinical records.

A separate review synthesised findings from 22 studies focused specifically on patient and public experiences [13]. This review reported high levels of satisfaction with access and communication, and general support for pharmacist prescribing for chronic conditions, minor ailments, and repeat prescribing. However, concerns were raised about privacy and the availability of resources to support safe prescribing. An umbrella review examining stakeholder perspectives, including public and patient views, across

various international models of pharmacist prescribing is currently being conducted by a separate group [14]. This umbrella review will identify additional insight and considerations for the development and scaling of pharmacist prescribing models in Ireland.

In Ireland, following recommendations from the Expert Taskforce to Support the Expansion of the Role of Pharmacy, the scope of practice of community pharmacists will be expanded to allow prescribing for eight common conditions (allergic rhinitis, cold sores, conjunctivitis, impetigo, oral thrush, shingles, uncomplicated urinary tract infection/cystitis, and vulvovaginal thrush). Future plans for the expansion of the role of pharmacists across diverse healthcare settings are also being considered [15]. The Department of Health requested this systematic review to synthesise existing research on the safety, effectiveness, and cost-effectiveness of pharmacist prescribing interventions.

We identified several systematic reviews assessing the effectiveness of non-medical prescribing aggregated across all healthcare professionals [2,5,16] or pharmacy services more specifically [3,4,6,17]. We identified two systematic reviews that focused specifically on pharmacist prescribing: one in hospital settings [1] and the other in minor ailment management schemes [18]. The former reported that pharmacists achieve prescribing standards comparable to physicians while reducing errors and omissions [1], and the latter reported significant cost savings associated with pharmacist prescribing for common conditions [18]. Although the existing systematic reviews in this area provide valuable insights, no systematic review has been conducted on the safety, effectiveness, and cost-effectiveness of pharmacist prescribing across multiple settings. Given current policy aims in Ireland, a systematic review on pharmacist prescribing across primary, secondary, and tertiary healthcare settings is needed.

1.2 Policy context

In July 2023, the Minister for Health established the Expert Taskforce to Support the Expansion of the Role of Pharmacy. The remit of the Taskforce was to identify and support the delivery of specific objectives, which will serve to align the services and practices that can be delivered by pharmacists (and pharmacies) with the needs of the health service and patients.

Over a 10-month period, the Taskforce met fortnightly to discuss the regulations, education, leadership, and governance required to the expand the role of pharmacy in Ireland. The final report of the Taskforce was published in July 2024 and included three overarching recommendations:

1. “That pharmacists be enabled to exercise independent, autonomous prescriptive authority within and related to the individual practitioner’s scope of practice and competence.
2. This should be implemented in a stepwise manner, commencing with the introduction of a common conditions service, with pharmacists provided with prescriptive authority linked to the service and its parameters.
3. The development, over the coming years, of models of pharmacist prescribing within primary and secondary care settings, recognising the requirements for specific enablers.” [15 p.13]

In order to support the implementation of these overarching recommendations, the Taskforce identified several key areas across eight additional categories:

1. patient and public involvement
2. regulatory framework and legislative amendments
3. leadership and governance
4. education and training

5. operational and infrastructure resourcing requirements
6. communication and engagement
7. research
8. review.

An evidence review on this topic is required to synthesise international evidence related to the safety, effectiveness, and cost-effectiveness of pharmacist prescribing across diverse healthcare environments. This review will support the work of the Department of Health and will provide valuable international evidence to inform the Taskforce's recommendations, including the following:

- "Recommendation 3.a: What outcomes – such as access to care, quality of care, healthcare utilisation, adverse outcomes, and patient experiences – should be measured to assess the effect and impact of expanding the role of the pharmacist, and how can existing health datasets be managed to optimise data collection for this research?
- Recommendation 3.b: What is the impact of the expanded role of the pharmacist on patient outcomes, including patient self-care and patient/carer medicine optimisation?
- Recommendation 3.c: What is the impact of the expanded role of the pharmacist, including cost-efficiencies and effectiveness, on the health service?
- Recommendation 3.d: What is the impact of the expanded role of the pharmacist on GPs', hospital doctors', and other prescribers' workload?"

1.3 Review questions

This evidence review addresses three research questions that were agreed in collaboration with the Department of Health:

1. Is pharmacist prescribing effective?
2. Is pharmacist prescribing safe?
3. Is pharmacist prescribing cost-effective?

In addition to the above three research questions, the DoH requested an overview of established pharmacist prescribing models in three regions (New Zealand, Scotland, Alberta). However, it was not possible to provide this information using evidence review methodology. Subsequently, it was agreed that a separate high-level summary document would be included as an appendix to the main review (Appendix A).

2 Methods

2.1 Review design

This evidence review comprised a systematic review of:

- primary quantitative studies to synthesise evidence on safety and effectiveness
- full economic evaluations to synthesise evidence on cost-effectiveness

This systematic review is reported according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) criteria [19] (Appendix B). We registered the study protocol, which is available to view on PROSPERO (CRD42024621602) [20].

To assess effectiveness and safety, a narrative systematic review of quantitative studies was used. A feasibility assessment summarised in Section 2.6.2 indicated meta-analysis was not appropriate given heterogeneity across included studies in population, intervention, comparator, outcome, and study design. To assess cost-effectiveness, a narrative systematic review of full economic evaluations was chosen. Full economic evaluations provide comparative analysis of costs and outcomes which is necessary to assess cost-effectiveness.

2.2 Eligibility criteria

In this evidence review, the eligibility criteria are structured by population, intervention, comparator, outcome, setting, date, and language. An overview of eligibility criteria for each research question is provided in Sections 2.2.1, 2.2.2, and 2.2.3. Across all research questions, a clear statement of pharmacists' prescriptive authority was required for study inclusion. Additional clarity surrounding the role of other healthcare professionals in the prescribing process was also required for inclusion.

2.2.1 Research question 1

Table 1 outlines the pre-specified eligibility criteria for including studies to answer research question 1 (Is pharmacist prescribing effective?).

Table 1: Eligibility criteria for research question 1: Is pharmacist prescribing effective?

Domain	Inclusion	Exclusion
Population	Human participants receiving pharmacist prescribing/deprescribing services	Animal studies
Intervention	Prescribing/deprescribing services provided by pharmacists, including: • independent prescribing/deprescribing • collaborative prescribing/deprescribing • supplementary prescribing/deprescribing • formulary prescribing/deprescribing • protocol prescribing/deprescribing • any mode of delivery (in-person, online, telephone).	Prescribing/deprescribing services provided by other healthcare professionals Co-interventions delivered by non-pharmacists Pharmacist services that do not include prescribing/deprescribing services, including: • medicine information • compliance, adherence, and/or concordance • disease screening • disease prevention • clinical intervention or identification and resolving drug-related problems • medication use reviews • disease state management

Domain	Inclusion	Exclusion
		• therapeutic decisions with medical practitioners.
Comparison	The following comparator groups met the inclusion criteria if provided by a non-pharmacist prescriber: • usual care • no intervention • partial intervention • alternative intervention • control series.	• No comparator group • Pharmacist prescriber comparator group
Outcomes	Effectiveness outcomes, including: • adherence • health-related quality of life • access to care • waiting times • healthcare utilisation. Clinical outcomes, including: • mortality • pain • mental health • hypertension • blood sugar control • cholesterol • lung function • anticoagulation • infection • surgery.	
Study design	• Randomised controlled trials • Non-randomised trials • Prospective cohort studies • Retrospective cohort studies in the same time period • Interrupted time series studies*	• Retrospective cohort studies in different time periods • Cross-sectional studies • Case studies • Opinion pieces • Qualitative studies • Reviews • Conference abstracts
Date	None	None

* Must include at least three observation points in the pre-intervention phase and three in the post-intervention phase.

2.2.2 Research question 2

Table 2 outlines the pre-specified eligibility criteria for including studies to answer research question 2 (Is pharmacist prescribing safe?).

Table 2: Eligibility criteria for research question 2: Is pharmacist prescribing safe?

Domain	Inclusion criteria	Exclusion criteria
Population	Human participants receiving pharmacist prescribing/deprescribing services	Animal studies
Intervention	Prescribing/deprescribing services provided by pharmacists, including: • independent prescribing/deprescribing • collaborative prescribing/deprescribing • supplementary prescribing/deprescribing • formulary prescribing/deprescribing • protocol prescribing/deprescribing • any mode of delivery (in-person, online, telephone).	Prescribing/deprescribing services provided by other healthcare professionals Co-interventions delivered by non-pharmacists Pharmacist services that do not include prescribing/deprescribing services, including: • medicine information • compliance, adherence, and/or concordance • disease screening • disease prevention • clinical intervention or identification and resolving drug-related problems • medication use reviews • disease state management • therapeutic decisions with medical practitioners.
Comparator	The following comparator groups met the inclusion criteria if provided by a non-pharmacist prescriber: • usual care • no intervention • partial intervention • alternative intervention • control series.	• No comparator group • Pharmacist prescriber comparator group
Outcomes	Medication-related outcomes, including: • overuse • underuse • medication appropriateness • clinically significant drug-to-drug interaction • prescribing errors • prescribing duplication • reduction in inappropriate polypharmacy. Patient adverse events, including: • drug-related hospital admissions • serious adverse drug reactions.	

Domain	Inclusion criteria	Exclusion criteria
Study design	• Randomised controlled trials • Non-randomised trials • Prospective cohort studies • Retrospective cohort studies within the same time period • Interrupted time series studies*	• Retrospective cohort studies in different time periods • Cross-sectional studies • Case studies • Opinion pieces • Qualitative studies • Reviews • Conference abstracts
Date	None	None

* Must include at least three observation points in the pre-intervention phase and three in the post-intervention phase.

2.2.3 Research question 3

Table 3 outlines the pre-specified eligibility criteria for including studies to answer research question 3 (Is pharmacist prescribing cost-effective?).

Table 3: Eligibility criteria for research question 3: Is pharmacist prescribing cost-effective?

Domain	Inclusion	Exclusion
Population	Human participants receiving pharmacist prescribing/deprescribing services	Animal studies
Intervention	Prescribing/deprescribing services provided by pharmacists, including: • independent prescribing/deprescribing • collaborative prescribing/deprescribing • supplementary prescribing/deprescribing • formulary prescribing/deprescribing • protocol prescribing/deprescribing • any mode of delivery (in-person, online, telephone).	Prescribing/deprescribing services provided by other healthcare professionals Co-interventions delivered by non-pharmacists Pharmacist services that do not include prescribing/deprescribing services, including: • medicine information • compliance, adherence, and/or concordance • disease screening • disease prevention • clinical intervention or identification and resolving drug-related problems • medication use reviews • disease state management • therapeutic decisions with medical practitioners.
Comparison	• Usual care • No intervention • Partial intervention • Alternative intervention • Control series	• No comparator group • Pharmacist prescriber comparator group
Outcomes	Cost-effectiveness outcomes, including: • quality-adjusted life years (QALYs) • disability-adjusted life years (DALYs)	• Cost analysis without reference to outcomes • Outcome analysis without reference to costs

Domain	Inclusion	Exclusion
	• average cost-effectiveness ratio • incremental cost-effectiveness ratio • net benefit • cost-benefit ratio • cost-minimisation analysis • cost-consequence analysis.	
Study design	Full economic evaluations, including: • cost-utility studies • cost-benefit studies • cost-consequence studies • cost-minimisation studies.	• Costing studies • Partial economic evaluations
Date	None	None

2.3 Information searches

2.3.1 Search approach

To identify evidence for this review, we undertook two separate structured systematic searches. The first structured systematic search was developed to identify evidence for the questions on safety and effectiveness and was conducted in five bibliographic databases (Embase, MEDLINE, SCiELO, Cochrane library, Epistemonikos). The second structured systematic search was developed to answer the research question on cost-effectiveness and was conducted in three bibliographic databases (Embase, MEDLINE, SCiELO). The search strategies are provided in Appendix C.

We identified grey literature resources for all three questions using the Google search engine. We carried out supplementary searches for research questions 1 and 2, and a separate supplementary search for question 3; these comprised a systematic review search, citation searching of included papers and identified systematic reviews, and grey literature reference chasing. We conducted an updated database search in February 2025 in advance of data synthesis to ensure the most comprehensive and up-to-date evidence was captured.

2.3.2 Search concepts

The concepts used to build the literature search relate to the population, intervention, comparator, outcome (PICO) framing of the research questions. The primary concepts for research questions 1 and 2 were ‘pharmacist prescribing’, ‘deprescribing’, and ‘study design’ (Figure 2). The primary concepts included in the search strategy for research question 3 were ‘pharmacist prescribing’, ‘deprescribing’, and ‘cost-effectiveness’ (Figure 3). The terminology for the concepts was broad, utilising Medical Subject Headings (MeSH) terms, synonyms, and natural language, to capture relevant research.

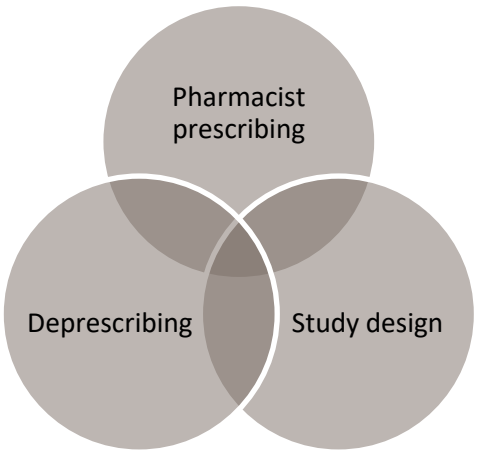

Figure 2: Search concepts for research questions 1 and 2

Figure 3: Search concepts for research question 3

The *Cochrane Handbook for Systematic Reviews of Interventions* [21] states that searching for every aspect of a review's clinical question is often unnecessary and may be undesirable, as certain elements (like outcomes or comparators) may not be well-indexed. Cochrane guidance suggests including terms for the population, intervention, and study design in searches. Therefore, we excluded outcomes from our search concepts to capture a broader range of relevant research.

2.3.3 Search resources and terminology

The language for the search strategy was derived from the material found during the scoping phase around pharmacist prescribing and, for language on costs, reviewing search language used in a previous Health Research Board review [22] and reviewing filters from Canada's Drug Agency (formerly the Canadian Agency for Drugs and Technologies in Health) [23] and the Academic Unit of Health Economics, University of Leeds [24].

We constructed the initial search strategy in MEDLINE (on the EBSCO platform) using MeSH thesaurus terms, natural language, and keywords. We reviewed title and abstract terms, along with author/subject index terms, for relevance and inclusion. We created search blocks for each concept and combined these with Boolean operators. No date, language, country, or age limits were applied.

We adapted the MEDLINE search strategy for other databases using MeSH or thesaurus terms where available. We translated the MEDLINE search strategy for the safety and effectiveness questions for use in Embase (Ovid), Dimensions AI, and Scientific Electronic Library Online (SCiELO). The search was further translated for use in Epistemonikos [25] and the Cochrane Library [26]. For the research question on costs, we translated the MEDLINE search strategy for use in Embase, Dimensions AI, and EconLit (EBSCO), an abstracting and indexing database.

For resources where structured searching was not possible, we used abbreviated searches – for example, the online repository, EconPapers [27]. A second information specialist (CL) peer-reviewed both MEDLINE search strategies, using the Peer Review of Electronic Search Strategies (PRESS) checklist in line with best practice [28].

2.3.4 Supplementary search strategies

2.3.4.1 Organisations

The Information Specialist (AF) conducted a broad search of national and international bodies. This information is available in Appendix D.

2.3.4.2 Citation searching

The primary database searches were supplemented by citation searching of a set of research papers that were included from the full-text screening stage of the database searches. We undertook a structured search in the Google search engine to identify key resources; details of this search are listed in Appendix D.

We used Google Scholar [29], Dimensions AI [30], and the citationchaser app [31] to retrieve reference lists from research papers where possible. We screened these references and citations using the same inclusion criteria as we used with the database search results.

The Terminology, Application, and Reporting of Citation Searching (TARCiS) statement [32] provided the team with methodological guidance on performing and reporting on the reference and citation searching ('citation searching') process of a systematic search. In this review, we use the recommended terminology, 'citation searching', which describes both backward citation searching (retrieving references cited in a paper) and forward citation chasing (retrieving papers that cite the papers of interest), to describe this type of supplemental searching.

We conducted citation searching of identified systematic reviews and screened search returns using the priority screening function in the EPPI-Reviewer Web software [33]. We also conducted citation searching across all articles included at full text across the three research questions. We dual-screened records retrieved from citation searching of relevant systematic reviews on title and abstract using the priority screening feature in the EPPI-Reviewer Web software. A priority screening graph of citation chasing records is included in Appendix E.

2.3.4.3 Systematic review databases

We conducted a supplemental search in systematic review databases. We searched the Cochrane Library and Epistemonikos; other relevant systematic reviews were captured during the title and abstract screening of database results as well.

2.3.4.4 Grey literature sources

We gathered a list of grey literature resources during the scoping phase and added to it during the formal Internet search. We used filters (document type, keywords, subject index, and title or abstract field) within websites. AF performed the structured search, and deduplicated and screened material in Zotero. Relevant material was then imported into EPPI-Reviewer Web software by AF and dual-screened in full-text by ÁT and MS. Grey literature searching took place between May 2024 and October 2024.

2.3.4.5 Team includes

'Team includes' describes material identified through hand searching of reference lists (of grey literature) or through iterative searching using the Googe search engine.

2.3.5 Study screening and selection

The screening process for this systematic review followed a multi-stage approach to ensure comprehensive and unbiased inclusion of relevant studies. We managed the screening process in the

EPPI-Reviewer Web software [33]. We deduplicated the results from the search process in EndNote [34] reference management software and uploaded them to EPPI-Reviewer Web.

Two reviewers (ÁT, MS) independently double-screened each title and abstract at the same time using the predefined inclusion/exclusion criteria identified in Section 2.2. Discrepancies in screening verdicts were captured within the EPPI-Reviewer Web screening mechanism and resolved through discussion or by consulting a third reviewer (AF). The full texts of studies that passed the title and abstract screening stage were retrieved for further evaluation. Two reviewers independently assessed the full texts against the predefined inclusion/exclusion criteria identified in Section 2.2.

After full-text screening, any research papers meeting the eligibility criteria were included. We used the included research papers for citation searching and screened the results from this process using the same screening criteria as we used for the first set of results.

We presented the review selection process in a complete PRISMA flow chart, outlining the numbers of research papers examined at each stage of the screening process [35].

2.4 Data extraction

We extracted data using standardised bespoke data extraction forms, which we piloted on a small sample of papers and adapted as necessary. To minimise bias and errors, data extraction was performed by one reviewer and checked by a second. Disagreements were resolved through discussion or referral to a third reviewer where necessary. The data extraction forms included the following information:

- Publication details: title, first author, year of publication
- Study details: country, study design, funders, study setting(s), target population, comparator(s)
- Intervention: aim, pharmacist prescriptive authority, mode of delivery, duration, outcome(s)
- Measure of effect:
  - Effectiveness and safety studies: time points measured, outcome definition, unit of measurement, upper and lower limits, outcome/tool validation, assumed risk estimate, power, number of missing participants, unit of analysis, statistical methods used
  - Cost-effectiveness studies: perspective for economic analysis, time horizon, base year for costing data, cost-effectiveness thresholds used, economic evaluation results (e.g. incremental costs, incremental effectiveness outcomes, incremental cost ratio), modelling information, type of uncertainty analysis conducted, key sources of uncertainty
- Other information: key conclusions of study authors, correspondence required for further study information (from whom, what, and when).

2.5 Risk of bias/quality assessment

Risk of bias/quality assessments were performed by one reviewer and checked by a second reviewer. Disagreements were resolved through discussion or referral to a third reviewer. As highlighted in Section 2.2, we included a range of study designs in this evidence review. Therefore, a range of risk of bias/quality assessment tools were required to assess each different study type, including randomised controlled trials (RCTs), non-randomised studies, full economic evaluation modelling studies, and trial-based full economic evaluations.

We assessed the methodological quality of each study using relevant standards: Risk Of Bias In Non-Randomized Studies – of Interventions (ROBINS-I) for non-randomised studies, the Cochrane Risk of Bias 2

(RoB 2) tool for parallel RCTs, the RoB 2 tool for cluster RCTs, and the Philips checklist for economic modelling studies, and the CHEC list for trial-based economic evaluations.

We conducted additional quality assessment using the National Heart, Lung, and Blood Institute's (NHLBI's) controlled studies tool and the NHLBI's cohort and observational studies tool. The NHLBI tools assess similar aspects as the Cochrane tools, to avoid repetitive reporting in the main report, we have provided the NHLBI assessments in Appendix F and Appendix G.

2.5.1 RCTs

For parallel and cluster RCTs, we assessed risk of bias using the RoB 2 tool for parallel RCTs and the RoB 2 tool for cluster RCTs [36]. These tools evaluated several domains, including bias arising from the randomisation process, deviations from the intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result.

Within each RoB 2 domain, signalling questions aim to elicit information about the features of an RCT that are relevant to risk of bias. A risk of bias judgement for each domain is generated by an algorithm based on answers to the signalling questions. The judgement can be 'low risk of bias', can express 'some concerns', or can be 'high risk of bias'. The overall risk of bias is generally determined by the highest risk domain rating. A high risk of bias in any domain results in a high risk of bias overall. If all domains are judged to be at low risk of bias except one with some concerns of bias, the overall rating is 'some concerns of bias'. However, if multiple domains have some concerns of bias, the overall rating may be upgraded to 'high risk of bias' due to these cumulative concerns. Domain and overall scores are presented in Appendix H and Appendix I. We visualised our overall judgements using the robvis tool (a visualisation tool for risk of bias assessments) and integrated these into the findings section [23].

2.5.2 Non-randomised studies

For non-randomised studies, two independent reviewers assessed the risk of bias using the ROBINS-I tool [37]. This tool addresses bias in seven domains: bias due to confounding, bias due to selection of participants, bias in classification of interventions, bias due to deviations from intended interventions, bias due to missing data, bias in measurement of outcomes, and bias in selection of the reported result. As required by ROBINS-I, we pre-specified and detailed confounders in our review protocol. The reviewers rated each domain as having a low, moderate, serious, or critical risk of bias. A risk of bias judgement for each domain is generated by an algorithm based on answers to the signalling questions. The overall risk of bias is generally determined by the highest risk domain rating. However, a risk of bias judgement may be upgraded due to cumulative concerns. Domain and overall scores are presented in Appendix J. We visualised our overall judgements using the robvis tool and integrated these into the findings section [23].

2.5.3 Economic evaluation modelling studies

We used the Philips checklist to quality assess full economic modelling studies [38]. The Philips checklist covers various methodological aspects in order to evaluate the reliability of economic evaluations used in healthcare decision-making. The checklist assesses domains such as model structure, data sources, model consistency, uncertainty analysis, and validation. Each item is assessed based on predefined criteria and categorised as 'Yes' (meets criteria), 'No' (does not meet criteria), 'Unclear' (insufficient information), or N/A (not applicable). Quality assessments for full economic evaluation modelling studies are presented in Appendix K.

We used the Consensus Health Economic Criteria list (CHEC list) to critically appraise one trial-based economic evaluation [39]. The CHEC list assesses 19 criteria, including study population, perspective, cost measurement, outcome identification, sensitivity analysis, and the generalisability of findings. Each item is

assessed based on predefined criteria and categorised as 'Yes' (meets criteria), 'No' (does not meet criteria), or N/A (not applicable). The quality assessment of the trial-based economic evaluation is presented in Appendix L.

2.6 Synthesis

2.6.1 Descriptive characteristics of included studies

As described in Section 2.4, we used a bespoke extraction sheet incorporating study characteristics, PICO criteria, intervention descriptions, and measure of effect details to extract descriptive characteristic data from each included study. We documented descriptive data from the included studies in the table of characteristics (Appendix M). We extracted all outcome data under three headings: effectiveness, safety, and cost-effectiveness. Under each heading, we categorised data by health condition. We then identified sub-outcome measures by health condition.

2.6.2 Feasibility assessment for meta-analysis

For each outcome of interest, we completed an assessment of the feasibility of meta-analysis following published guidance [40]. We first grouped studies by health condition and then by outcome. Following this, for each group of studies, we assessed comparability considering:

- number of studies (minimum three studies)
- study design
- study quality or risk of bias
- population
- intervention
- outcome measures

The feasibility assessment indicated that it was not appropriate to proceed with meta-analysis; details of the feasibility assessment are reported in Appendix N. As a supplementary exercise to validate the certainty of evidence domain judgements related to inconsistency and imprecision in Section 2.7, we conducted exploratory meta-analyses where only two studies were available using RevMan V5.4 [41]. These analyses were strictly exploratory in nature and did not meet the predefined criteria for inclusion in the results section. However, in the interest of transparency, these analyses are available in Appendix O.

2.6.3 Narrative synthesis

We applied a narrative approach following the Synthesis Without Meta-analysis (SWiM) guidelines [42]. We systematically extracted the data for narrative synthesis, focusing on study characteristics; key findings related to safety, effectiveness, and cost-effectiveness; and contextual factors such as setting, population, and intervention details. We grouped studies by relevant characteristics, including population demographics, type of intervention and comparator, outcomes measured, and study design. We created detailed tables summarising the key characteristics and findings of the included studies (Appendix M).

2.7 Certainty of evidence

We have assessed the certainty of evidence for effectiveness and safety studies using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system for each primary outcome of interest [43]. We employed the GRADE system to grade the quality of evidence and the strength of

recommendations across the study outcomes. Evidence related to each outcome received one of four grades: high, moderate, low, or very low.

Initial certainty of evidence is determined based on study design. Well-designed RCTs provide a high degree of certainty, while well-designed non-randomised studies provide a moderate or low degree of certainty. The level of certainty is downgraded based on five criteria:

1. Risk of bias: accounts for study design, hierarchy of evidence, and methodological quality
2. Inconsistency: considers clinical and statistical heterogeneity that cannot be controlled in the analysis
3. Indirectness: evaluates whether the comparator intervention is the current gold standard and considers population, intervention, and outcome relevance
4. Imprecision: assesses the variance size, optimal effect size, sample size, and number of events of interest
5. Publication bias: recognises the systematic underestimation or overestimation of effects due to selective publication of studies.

The certainty of evidence can be upgraded based on three criteria:

1. Large or very large effect estimates: significant magnitude of an intervention or exposure effect
2. Dose-response gradient: increases certainty in the findings of observational studies
3. Opposing bias and confounders: all plausible residual confounding increase or decrease the demonstrated effect if no effect was observed.

The decision to upgrade should only be made rarely and after full consideration of the reasons to downgrade. GRADE assessments were conducted using GRADEpro software [44] and are presented in Appendix Q.

There is no equivalent to GRADE for evaluating cost-effectiveness outcomes.

2.8 Differences between our protocol and review

This evidence review was conducted in full accordance with the pre-specified protocol.

3 Findings

3.1 Search results

3.1.1 Effectiveness and safety

Our initial searches of databases and registers identified 4,588 records, of which 167 were duplicates, leaving 4,421 records for title and abstract screening. Title and abstract screening were undertaken simultaneously. During title and abstract screening, we excluded 4,205 records, leaving 216 records for full-text screening. We could not retrieve 15 of those records, and we excluded a total of 176 records at the full-text screening stage, leaving 25 records for extraction. We identified an additional 14 records for extraction through supplemental and updated searches, resulting in a final search yield of 39 records.

Figure 4 outlines the flow of information throughout the searching and screening process for the effectiveness and safety questions. All studies excluded at the full-text screening stage, with their reason(s) for exclusion, are presented in Appendix R.

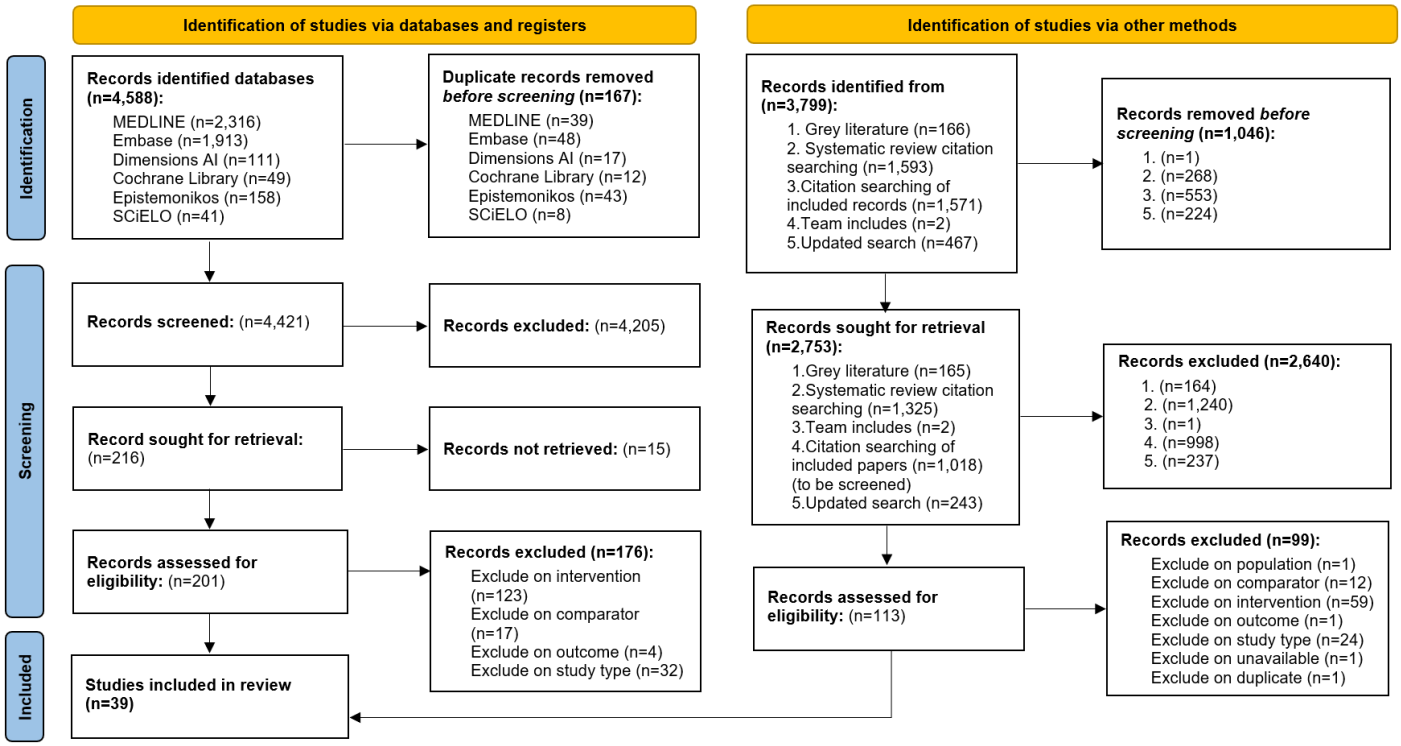

Figure 4: PRISMA flow diagram (effectiveness and safety)

Source: Page *et al.* 2021 [35]

3.1.2 Cost-effectiveness

Our initial searches of databases and registers identified 2,503 records, of which 148 were duplicates, leaving 2,355 records for title and abstract screening. During title and abstract screening, we excluded 2,285 records, leaving 70 records for full-text screening. We excluded a total of 60 records at the full-text screening stage, leaving 10 records for extraction. We identified 3 additional articles for extraction through supplemental searches, resulting in a final search yield of 13.

Figure 5 outlines the flow of information throughout the searching and screening process for the cost-effectiveness question. All studies excluded at the full-text screening stage, with their reason(s) for exclusion, are presented in Appendix R.

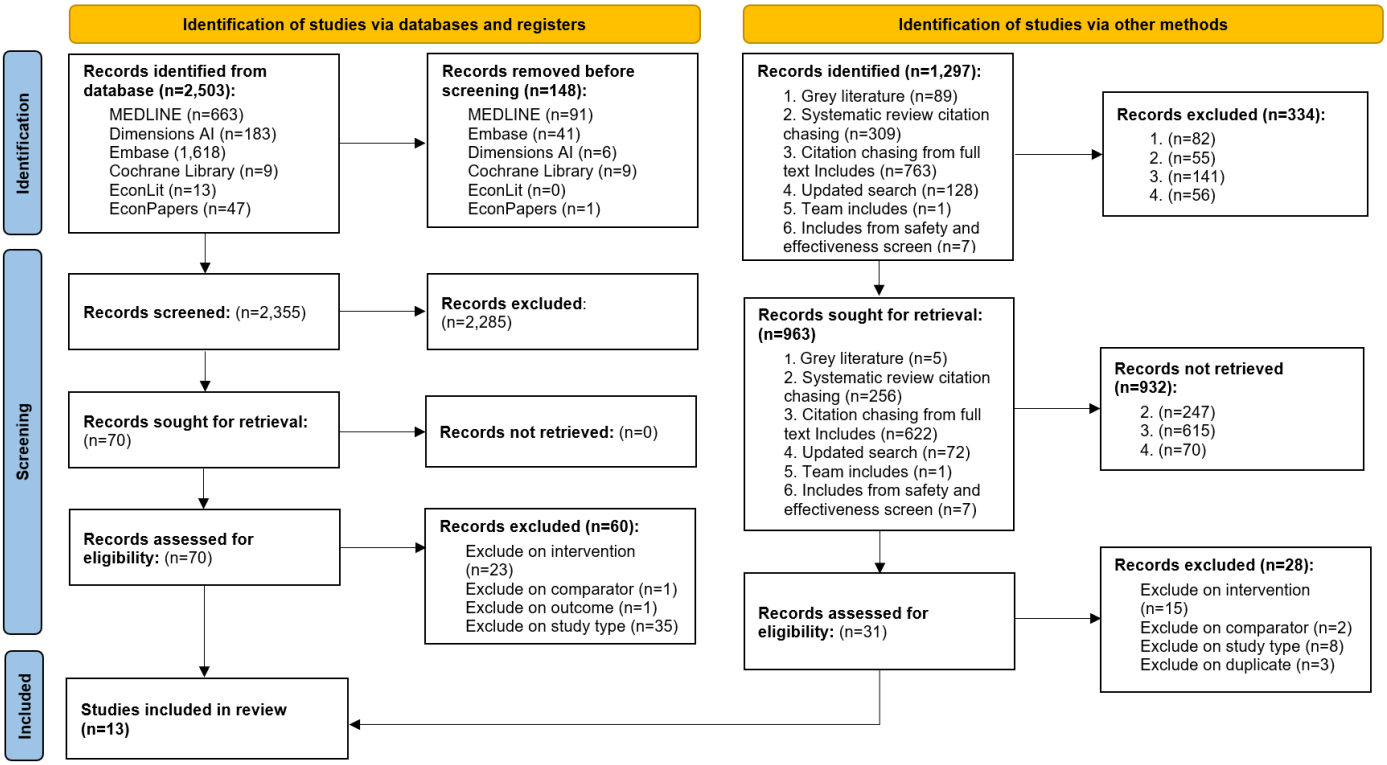

Figure 5: PRISMA flow diagram (cost-effectiveness)

Source: Page *et al*. 2021 [35]

3.2 Classification of studies

We have organised the findings under three headings: effectiveness, safety, and cost-effectiveness. Under each heading, we categorised the findings first by and then by outcome type. For this review, 'healthcare population' refers to a group of individuals who share characteristics that define how they receive or require healthcare (e.g. demographics, health-related needs, chronic conditions etc.). Of the 52 included studies, 32 primary research studies reported on effectiveness outcomes [45–76], 20 studies reported on safety outcomes [55,57,58,61,62,64,66–71,76–83], and 13 studies reported on cost-effectiveness outcomes [84–96].

We included 32 studies that reported effectiveness outcomes for 13 healthcare population categories: diabetes [46–53]; heart failure [54–56]; stroke [57]; dyslipidaemia [58]; hypertension [59,60]; coagulation disorders [61–66]; chronic kidney disease [67]; urinary tract infection [68]; older people in long-term care [69–71]; female contraceptive users [72,73]; anaemia in pregnancy [74]; chronic pain conditions [75]; and mixed health conditions [45,76].

We included 20 studies that reported safety outcomes for 12 healthcare population categories: heart failure [55]; stroke [57]; dyslipidaemia [58]; coagulation disorders [61,62,64,66]; chronic kidney disease [67,77]; urinary tract infection [68,78]; older people in long-term care [69–71]; female contraceptive users [80,81]; emergency department patients [82]; surgery patients [83]; people at risk of drug-related problems [76]; and mixed health conditions [79].

We included 13 studies that reported cost-effectiveness outcomes for 8 healthcare population categories: diabetes [85–87], hypertension [88–90], chronic kidney disease [96], urinary tract infection [84], common conditions [93], acute pharyngitis [94], female contraceptive users [91,92], and chronic pain conditions [95].

3.3 Characteristics of included studies

A full account of the characteristics of each included study is provided in Appendix M. Publication dates for the included studies ranged from 1983 to 2024. All included studies comprised adult populations.

Of the 32 studies assessing effectiveness, 16 were retrospective cohort studies, 2 were prospective cohort studies, 4 were non-randomised trials, 8 were parallel RCTs, and 2 were cluster RCTs. In relation to healthcare setting, 3 were based in community pharmacies, 12 were based in outpatient clinics, 10 were based in primary care, 3 were based in long-term care, and 4 were based in inpatient settings. The prescriptive authority varied: 18 studies assessed collaborative practice agreements, 7 assessed protocol prescribing, 1 assessed formulary prescribing, and 6 assessed independent prescribing. In relation to location, 22 studies were based in the United States of America (USA), 4 were based in Canada, 4 were based in the UK, and 2 were based in Singapore.

Of the 20 studies assessing safety, 8 were retrospective cohort studies, 1 was a prospective cohort study, 4 were non-randomised trials, 5 were parallel RCTs, and 2 were cluster RCTs. In relation to healthcare setting, four studies were based in community pharmacies, seven were based in outpatient clinics, two were based in primary care, three were based in long-term care, three were based in inpatient settings, and one was based in an emergency department. The prescriptive authority varied: nine studies assessed collaborative practice agreements, four assessed protocol prescribing, one assessed formulary prescribing, one assessed supplementary prescribing, and five assessed independent prescribing. In relation to location, 11 studies were based in the USA, 5 were based in Canada, 2 were based in the UK, and 2 were based in Australia.

Of the 13 studies assessing cost-effectiveness, 10 were cost-utility studies, 1 was a cost-benefit study, and 2 were cost-minimisation analyses. In relation to healthcare setting, six studies were based in community pharmacies, three were based in outpatient clinics, and four were based in primary care. The prescriptive authority varied: four studies assessed collaborative practice agreements, while nine assessed independent prescribing by pharmacists. Seven studies were from a USA perspective, four were from a Canadian perspective, one was from a UK perspective, and one was from an Australian perspective.

Please note that we have differentiated between ‘community pharmacy’ and ‘primary care’ and when presenting the characteristics of the included studies. In this report, community pharmacy refer to pharmacies operating as retail premises which are open to the public. In this report, primary care refers to all other community-based health or social care services including GPs, public health nurses, and other health professionals. Given the policy focus of this review, it was important to distinguish between community pharmacy and other primary care services.

3.4 Methodological quality of included studies

3.4.1 Parallel RCTs

We used the RoB 2 tool for parallel RCTs to assess risk of bias in 57 outcomes reported across the 9 included parallel RCTs. Figure 6 provides a summary of RoB 2 assessment by each domain across 57 outcomes.

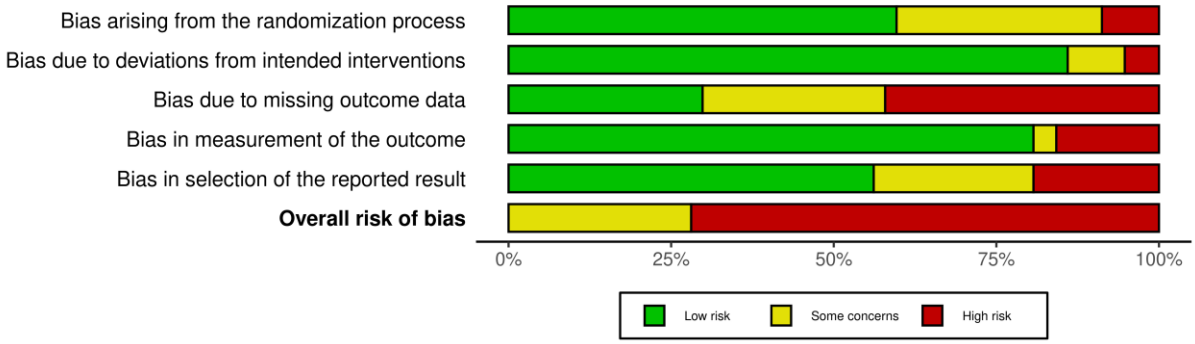

Figure 6 Summary of RoB 2 assessment for parallel RCTs

Guidance on interpreting these assessments is outlined in Section 2.5.1. The overall risk of bias assessments were scored as 'high risk of bias' in 41 outcomes and as 'some concerns of bias' in 16 outcomes. A full account of the RoB 2 assessment for parallel RCTs is provided in Appendix H.

3.4.2 Cluster RCTs

We used the RoB 2 tool for cluster RCTs to assess risk of bias in 15 outcomes reported across the 2 included cluster RCTs. Figure 7 provides a summary of RoB 2 assessment by each domain across 15 outcomes.

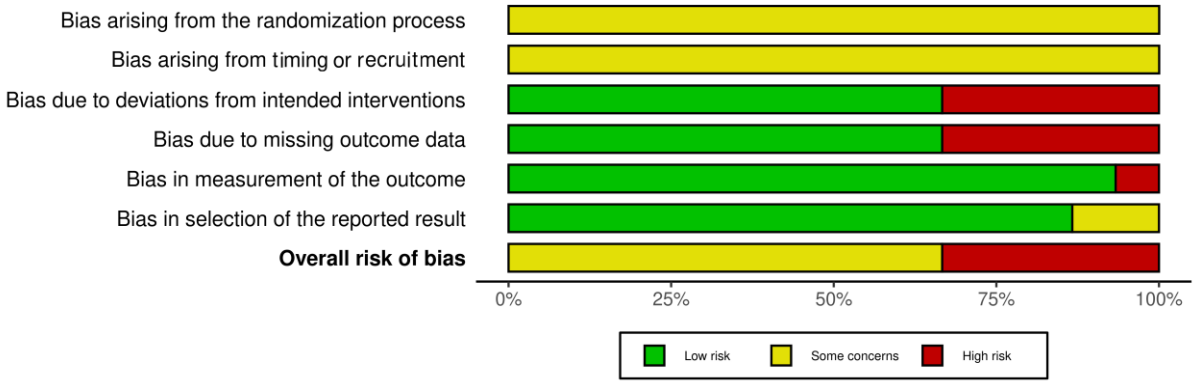

Figure 7 Summary of RoB 2 assessment for cluster RCTs

The overall assessments were scored as 'high risk of bias' in 5 outcomes and as 'some concerns of bias' in 10 outcomes. A full account of the RoB 2 assessment for cluster RCTs is provided in Appendix I.

3.4.3 Non-randomised studies

We used the ROBINS-I V2 tool to assess risk of bias in 95 outcomes reported across 28 non-randomised studies. Figure 8 provides a summary of the ROBINS-I V2 assessment by each domain across 95 outcomes.

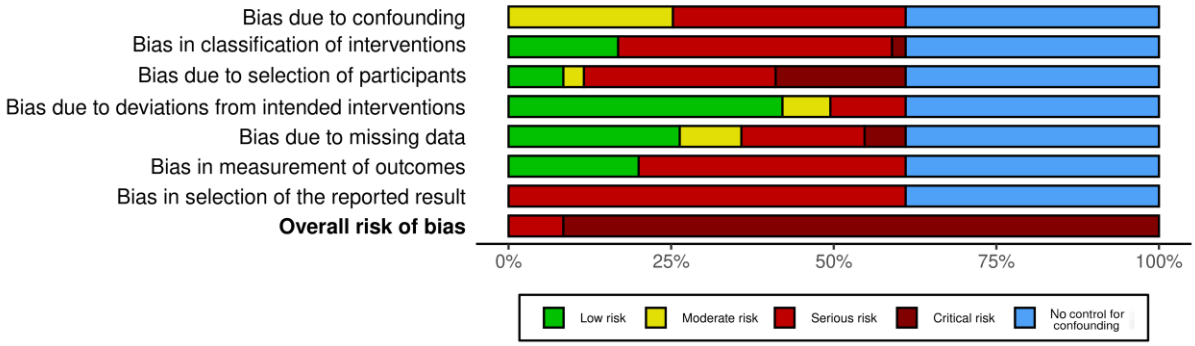

Figure 8 Summary of ROBINS-I assessment for non-randomised studies

The overall assessments were scored as 'critical risk of bias' in 87 outcomes and as 'serious risk of bias' in 8 outcomes. A full account of the ROBINS-I V2 assessment for non-randomised studies is provided in Appendix J.

3.4.4 Economic evaluations

We used the Philips checklist to critically assess 12 economic evaluations across 23 quality dimensions. A summary of our quality assessment judgements is provided in Section 3.5.3. A full account of the Philips checklist assessment for economic evaluations is provided in Appendix K. We used the CHEC list to assess 1 trial-based economic evaluation across 19 quality criteria. The quality assessment of the trial-based economic evaluation is presented in Section 3.5.3. and in Appendix L.

3.4.5 GRADE rating

We used the GRADE score as a summary indicator of the certainty of the evidence for each safety and effectiveness outcome. All evidence assessing effectiveness and safety outcomes was graded as low or very low certainty. A full account of the GRADE assessment is provided in Appendix Q.

This reflects a common pattern in evidence related to public health interventions. A methodological paper published in 2023 reported that over 65% of outcomes reported in systematic reviews of public health interventions were graded as 'low' or 'very low' certainty [97]. This is often attributable to unavoidable limitations in study designs based on real world evidence. In situations where policy-makers are required to develop policies based on lower levels of evidence, additional considerations should be made regarding potential benefits and harms.

The World Health Organization [98] recognise five GRADE paradigmatic situations where strong recommendations can be made based on low certainty evidence: 1. Lower certainty evidence suggests benefit in a life-threatening situation; 2. Lower certainty evidence suggests potential equivalence, but one option is clearly less risky or costly; 3. Uncertain benefit, certain harm; 4. High certainty in similar benefits, one option potentially more risky or costly; 5. Low to high certainty evidence suggests modest benefits and low/very low-quality evidence suggests possibility of catastrophic harm.

A recent Irish study [99] reported 63.6% of strong recommendations in National Clinical Guidelines were based on low or very low certainty evidence. Many of these were considered justifiable under one of five paradigmatic situations outlined above [99]. In these contexts, strong or conditional recommendations may be made despite lower certainty evidence, provided the potential benefits outweigh the risks and are supported by considered judgement.

3.5 Results

3.5.1 Effectiveness results

We included 32 studies that reported effectiveness outcomes for 13 healthcare population categories: diabetes [46–53]; heart failure [54–56]; stroke [57]; dyslipidaemia [58]; hypertension [59,60]; coagulation disorders [61–66]; chronic kidney disease [67]; urinary tract infection [68]; older people in long-term care [69–71]; female contraceptive users [72,73]; anaemia in pregnancy [74]; chronic pain conditions [75]; and mixed health conditions [45,76].

3.5.1.1 Diabetes

Eight studies assessed the effectiveness of pharmacist prescribing for people with diabetes [46–53]. The effectiveness outcomes assessed were blood glucose, blood pressure, lipids, and health-related quality of life.

3.5.1.1.1 Blood glucose

Eight studies assessed effectiveness outcomes related to blood glucose [46–53]. The findings are presented by outcome measure: haemoglobin A1c (HbA1c) goal achieved, mean HbA1c levels, mean change in HbA1c levels, achieved at least a 1% decrease in HbA1c levels, fasting blood glucose levels, and time to treatment intensification.

3.5.1.1.1.1 HbA1c goal achieved

Three retrospective cohort studies reported on whether HbA1c goals were reached in pharmacist prescribing compared with primary care provider prescribing groups [46,47,50]. Figure 9 presents the risk of bias assessment; all three studies were judged to have overall critical risk of bias scores for this outcome.

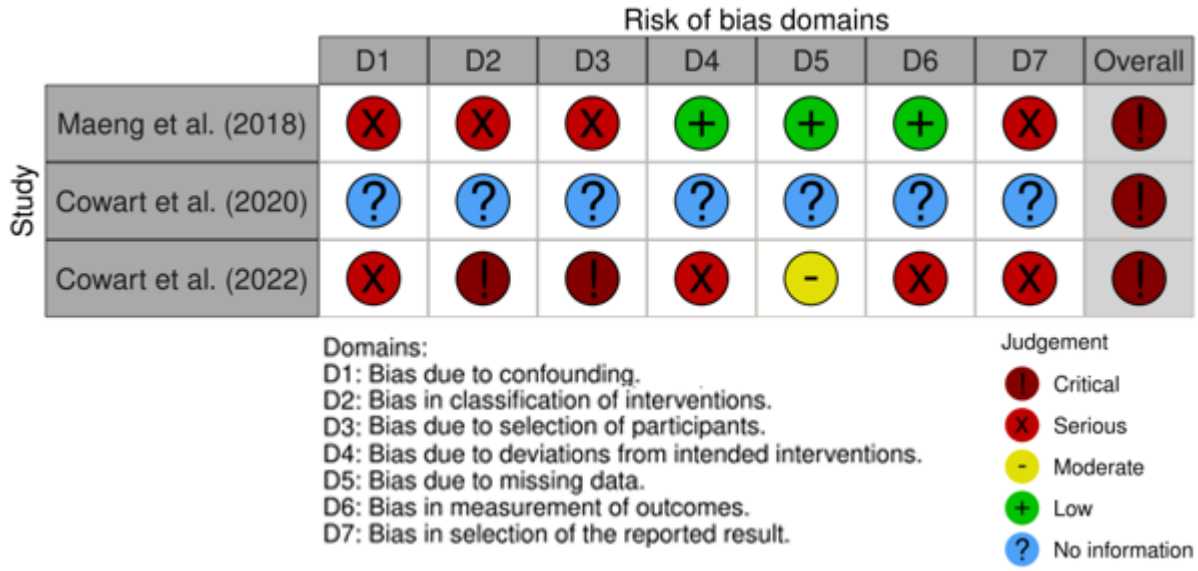

Figure 9: HbA1c goal achieved in people with diabetes (risk of bias assessment using ROBINS-I)

All three studies reported very low-certainty evidence. An overview of the evidence is provided in Table 4. One study reported a significantly higher proportion of participants achieving their HbA1c goals in the primary care provider prescribing group compared with the pharmacist prescribing group [50]. The other two studies reported no significant difference in participants achieving their HbA1c goals between the pharmacist prescribing and primary care provider prescribing groups [46,47].

Table 4: HbA1c goal achieved in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [50]	Collaborative practice agreement: generate prescription and manage medication	Pharmacist managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Number of events (%) 1,396/2,750 (50.8%) versus 1,564/2,750 (56.9%); *p*<0.0001	Primary care provider
Retrospective cohort study [46]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Advanced practice pharmacist–physician managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Number of events (%) 7/28 (25.0%) versus 5/28 (17.9%); *p*=0.61	No significant difference
Retrospective cohort study [47]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Advanced practice pharmacist–physician managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Number of events (%) 38/76 (50.0%) versus 78/181 (43.1%); *p*=0.31	No significant difference

3.5.1.1.1.2 Mean HbA1c levels

Two retrospective cohort studies reported mean HbA1c levels in pharmacist prescribing groups compared with primary care provider prescribing groups [49,50]. Figure 10 presents the risk of bias assessment; both studies were judged to have overall critical risk of bias scores for this outcome.

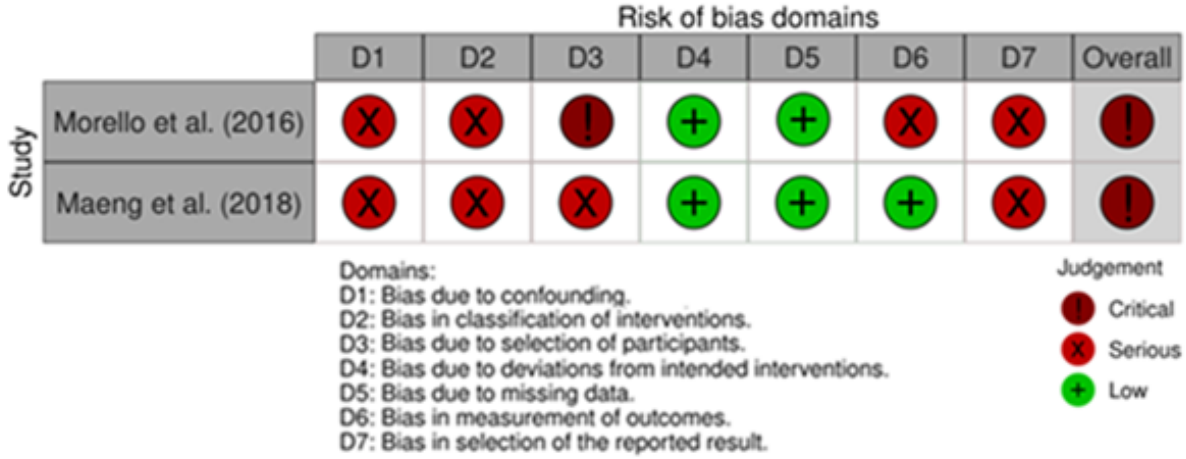

Figure 10: Mean HbA1c levels in people with diabetes (risk of bias assessment using ROBINS-I)

Both studies reported very low-certainty evidence, and both studies reported significantly improved HbA1c levels in the pharmacist prescribing groups compared with the primary care provider groups [49,50]. An overview of the evidence is provided in Table 5.

Table 5: Mean HbA1c levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [49]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Pharmacist–endocrinologist managed versus primary care provider managed	Outpatient: diabetes intense medical management clinic	Critical	Very low	Mean (standard deviation (SD)) 8.2% (1.9) versus 9.0% (1.5); *p*<0.001	Pharmacist prescribing
Retrospective cohort study [50]	Collaborative practice agreement: generate prescription and manage medication	Pharmacist managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Mean (SD) 8.3% (1.8) versus 8.0% (1.7); *p*<0.0001	Pharmacist prescribing

3.5.1.1.1.3 Mean change in HbA1c levels

Four studies (two RCTs and two retrospective cohort studies) analysed mean changes in HbA1c levels from baseline to follow-up in pharmacist prescribing compared with physician prescribing groups [48,51–53]. Figure 11 presents the risk of bias assessment for the RCTs; one trial was judged to have some concerns as its overall risk of bias score, and the other trial was judged to have an overall high risk of bias score for this outcome. Figure 12 presents the risk of bias assessment for the two retrospective cohort studies; both were judged to have critical risk of bias scores for this outcome.

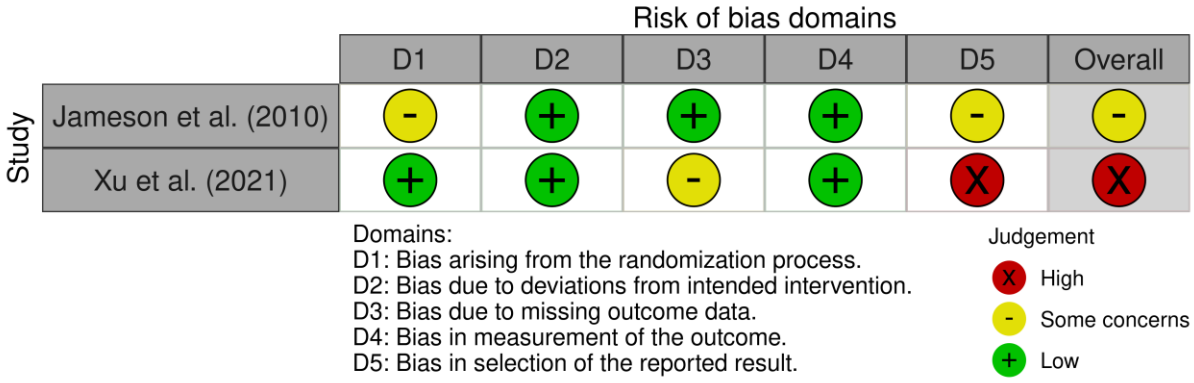

Figure 11: Mean change in HbA1c levels in people with diabetes (risk of bias assessment using RoB 2)

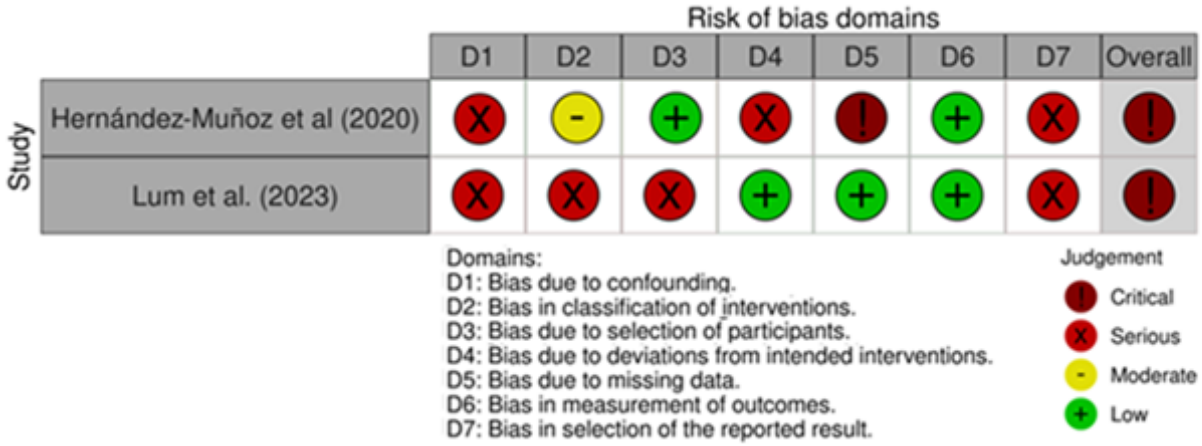

Figure 12: Mean change in HbA1c levels in people with diabetes (risk of bias assessment using ROBINS-I)

All studies reported very low-certainty evidence. One retrospective cohort study and one RCT reported no significant difference in patients' mean change in HbA1c levels between a pharmacist–endocrinologist prescribing group and an endocrinologist prescribing group, or between a pharmacist–physician prescribing group and a physician prescribing group [51,53]. The other retrospective cohort study and RCT reported significant improvements in mean change in HbA1c levels for a pharmacist–cardiologist prescribing group compared with a cardiologist prescribing group and for a pharmacist–physician prescribing group compared with a physician prescribing group [48,52]. An overview of the evidence is provided in Table 6.

Table 6: Mean change in HbA1c levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [51]	Collaborative practice agreement: adjust, substitute, and discontinue antidiabetic medications	Pharmacist–endocrinologist managed versus endocrinologist managed	Outpatient clinic	Critical	Very low	Mean (standard error (SE)) −0.2 (0.3); p<0.39 versus −0.02 (0.40); p=0.95	No significant difference
RCT [53]	Collaborative practice agreement: adjust dosage	Pharmacist–physician managed versus physician managed	Primary care	Some concerns	Very low	Median (interquartile range (IQR)) −1.50 (−0.03 to −2.68) versus −0.40 (0.50 to −2.10); p=0.06	No significant difference
Retrospective cohort study [48]	Collaborative practice agreement: furnish	Pharmacist–cardiologist managed versus	Outpatient clinic	Critical	Very low	Mean difference	Pharmacist prescribing

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
	prescription and adjust	cardiologist managed				−0.4% versus −0.2%; *p*<0.001	
RCT [52]	Collaborative practice agreement: furnish prescription; initiate, adjust, and substitute antidiabetic medications	Pharmacist–physician managed versus physician managed	Primary care	High	Very low	Mean (95% confidence interval (CI)) −0.50 (−0.24 to −0.75) versus −0.11 (−0.20 to 0.42); *p*=0.03	Pharmacist prescribing

3.5.1.1.1.4 Achieved at least a 1% decrease in HbA1c levels

One RCT reported on the proportion of participants who achieved at least a 1% decrease in HbA1c levels in people with diabetes in the pharmacist–physician prescribing group compared with the physician prescribing group [53]. Figure 13 presents the risk of bias assessment; the study was judged to have some concerns as its risk of bias score for this outcome.

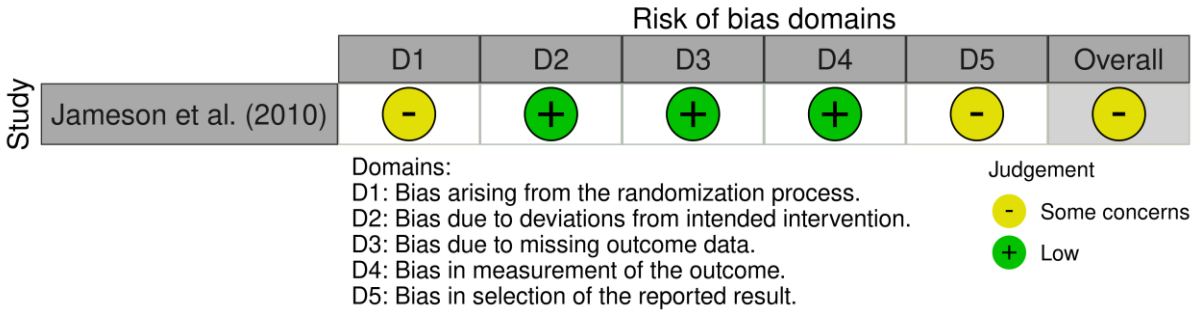

Figure 13: Achieved at least a 1% decrease in HbA1c levels in people with diabetes (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating a significantly higher proportion of participants achieving at least a 1% decrease in HbA1c levels in the pharmacist–physician prescribing group compared with the physician prescribing group [53]. An overview of the evidence is provided in Table 7.

Table 7: Achieved at least a 1% decrease in HbA1c levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [53]	Collaborative practice agreement: adjust insulin doses	Pharmacist–physician managed versus physician managed	Primary care	Some concerns	Very low	Number of events (%) 35/52 (67.3%) versus 21/51 (41.2%); *p*=0.02	Pharmacist prescribing

3.5.1.1.1.5 Fasting blood glucose levels

One retrospective cohort study reported on fasting blood glucose levels for people with diabetes in a pharmacist–endocrinologist prescribing group compared with a primary care provider prescribing group [49]. Figure 14 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

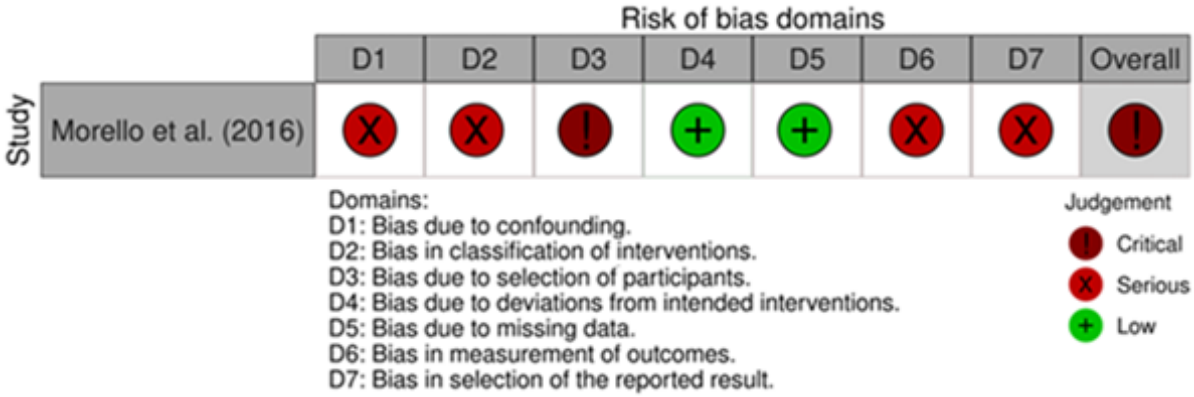

Figure 14: Fasting blood glucose levels in people with diabetes (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in fasting blood glucose levels between the pharmacist–endocrinologist prescribing group and the primary care provider prescribing group. An overview of the evidence is provided in Table 8.

Table 8: Fasting blood glucose levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [49]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Pharmacist–endocrinologist managed versus primary care provider managed	Outpatient: diabetes intense medical management clinic	Critical	Very low	Mean (SD) 159.0 (83.2) versus 194.3 (112); *p*=0.08	No significant difference

3.5.1.1.1.6 Time to treatment intensification

One retrospective cohort study reports on whether time to treatment intensification in a pharmacist prescribing compared with a primary care provider prescribing group [46]. Figure 15 presents the risk of bias assessment; this study was judged to have overall critical risk of bias scores for this outcome.

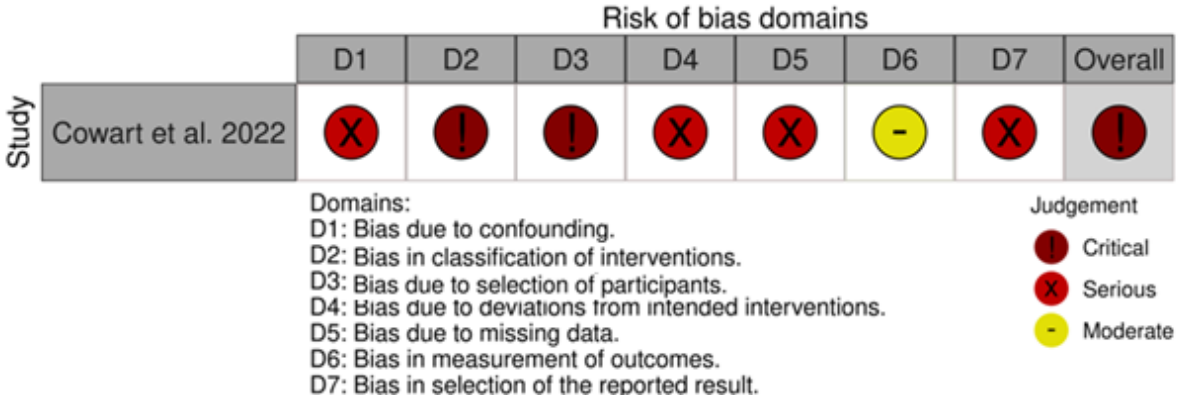

Figure 15: Time to treatment intensification in in people with diabetes (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence. An overview of the evidence is provided in Table 9. This study reported no significant difference in time to treatment intensification between the pharmacist prescribing and primary care provider prescribing groups [46,47].

Table 9: Time to treatment intensification in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [47]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Advanced practice pharmacist–physician managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Median (IQR) 37.5 (8 to 216.5) versus 142 (16 to 465), *p*=0.19	No significant difference

3.5.1.1.2 Blood pressure

Two studies assessed effectiveness outcomes related to blood pressure [49,50]. The findings are presented by outcome measure: blood pressure goal achieved, diastolic blood pressure levels, and systolic blood pressure levels.

3.5.1.1.2.1 Blood pressure goal achieved

One retrospective cohort study reported on the achievement of blood pressure goals in people with diabetes in a pharmacist prescribing group compared with a primary care provider prescribing group [50]. Figure 16 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

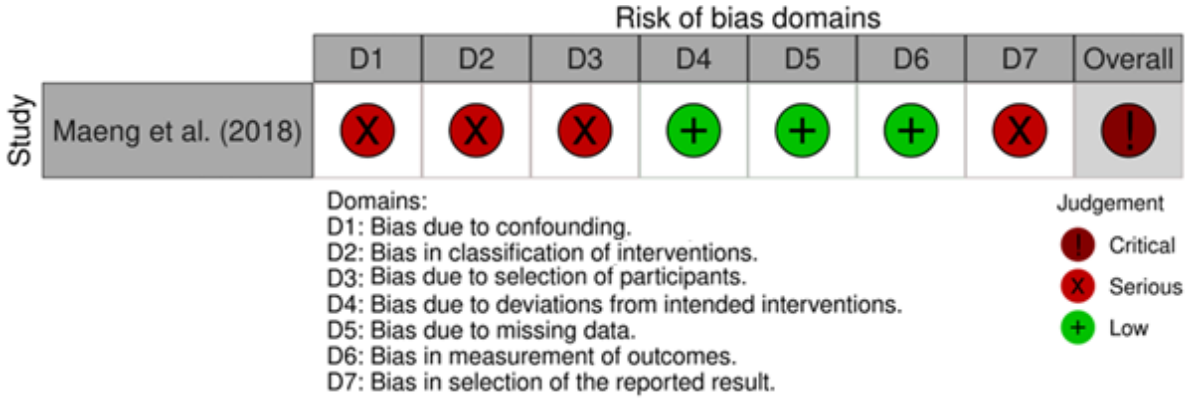

Figure 16: Blood pressure goal achieved in people with diabetes (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in the proportion of participants achieving their blood pressure goal between the pharmacist prescribing group and the primary care provider prescribing group [50]. An overview of the evidence is provided in Table 10.

Table 10: Blood pressure goal achieved in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [50]	Collaborative practice agreement: generate prescription and manage medication	Pharmacist managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Number of events (%) 1,287/2,750 (46.8%) versus 1,241/2,750 (45.1%); *p*=0.21	No significant difference

3.5.1.1.2.2 Diastolic blood pressure levels

Two retrospective cohort studies reported on mean diastolic blood pressure levels in people with diabetes in pharmacist prescribing groups compared with primary care provider prescribing groups [49,50]. Figure 17 presents the risk of bias assessment. One study was judged to have an overall critical risk of bias score for this outcome, and the other study was judged to have an overall serious risk of bias score.

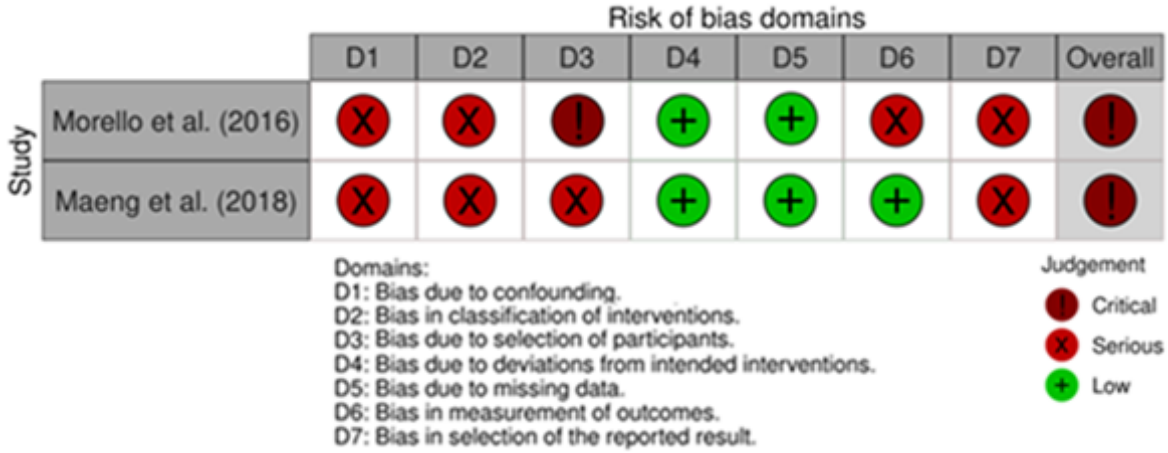

Figure 17: Diastolic blood pressure levels in people with diabetes (risk of bias assessment using ROBINS-I)

Both studies reported very low-certainty evidence indicating no significant difference in diastolic blood pressure levels between the pharmacist prescribing groups and the primary care provider groups. An overview of the evidence is provided in Table 11.

Table 11: Diastolic blood pressure levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [49]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Pharmacist–endocrinologist managed versus primary care provider managed	Outpatient: diabetes intense medical management clinic	Critical	Very low	Mean (SD) 71.8 (12.0) versus 74.5 (14.9); *p*=0.59	No significant difference
Retrospective cohort study [50]	Collaborative practice agreement: generate prescription and manage medication	Pharmacist managed versus primary care provider managed	Primary care team: diabetes clinic	Serious	Very low	Mean (SD) 72 (10) versus 73 (10); *p*=0.70	No significant difference

3.5.1.1.2.3 Systolic blood pressure levels

Two retrospective cohort studies reported on mean systolic blood pressure levels in people with diabetes in pharmacist prescribing groups compared with primary care provider prescribing groups [49,50]. Figure 18 presents the risk of bias assessment; both studies were judged to have overall critical risk of bias scores for this outcome.

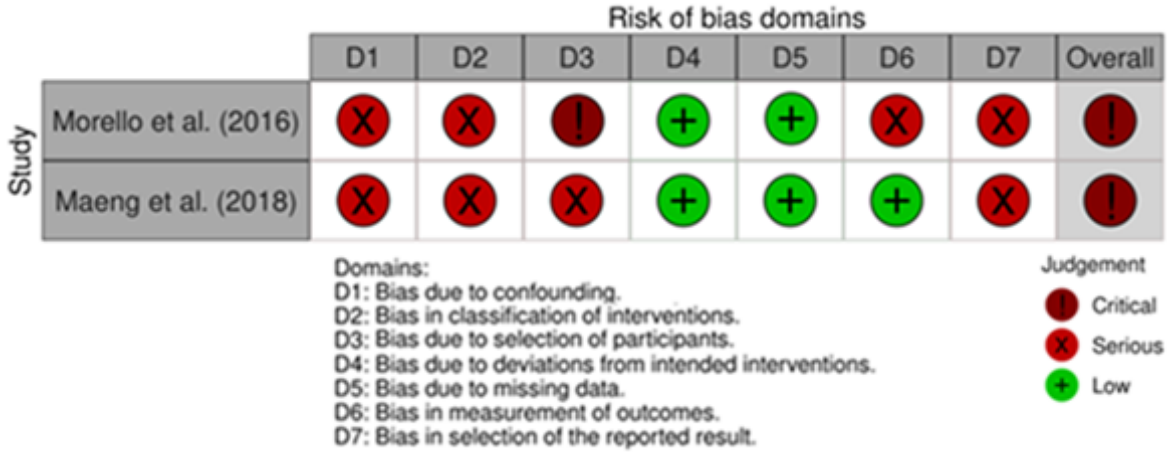

Figure 18: Systolic blood pressure levels in people with diabetes (risk of bias assessment using ROBINS-I)

These studies reported very low-certainty evidence indicating no significant difference in systolic blood pressure levels between the pharmacist prescribing groups and the primary care provider prescribing groups. An overview of the evidence is provided in Table 12.

Table 12: Systolic blood pressure levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [49]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Pharmacist–endocrinologist managed versus primary care provider managed	Outpatient: diabetes intense medical management clinic	Critical	Very low	Mean (SD) 127.0 (14.4) versus 136.7 (20.0); *p*=0.11	No significant difference
Retrospective cohort study [50]	Collaborative practice agreement: generate prescription and manage medication	Pharmacist managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Mean (SD) 129 (16) versus 129 (17); *p*=0.57	No significant difference

3.5.1.1.3 Lipids

3.5.1.1.3.1 LDL cholesterol goal achieved

One retrospective cohort study reported on the achievement of low-density lipoprotein (LDL) cholesterol goals in people with diabetes in the pharmacist prescribing group compared with the primary care provider prescribing group [50]. Figure 19 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

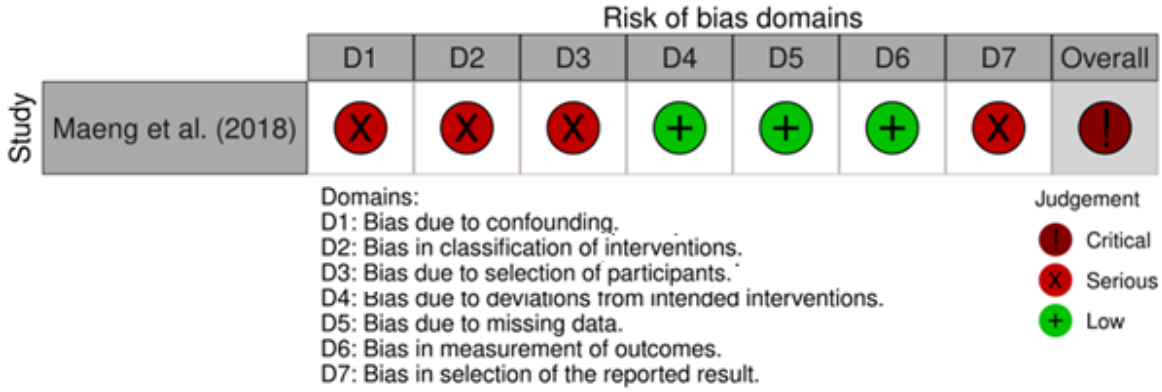

Figure 19: LDL cholesterol goal achieved in people with diabetes (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in the proportion of participants achieving their LDL cholesterol goals between the pharmacist prescribing and primary care provider prescribing groups. An overview of the evidence is provided in Table 13.

Table 13: LDL cholesterol goal achieved in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [50]	Collaborative practice agreement: generate prescription and manage medication	Pharmacist managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Number of events (%) 1,138/2,750 (41.4%) versus 1,078/2,750 (39.2%); *p*=0.08	No significant difference

3.5.1.1.3.2 LDL cholesterol levels

Two retrospective cohort studies reported on mean LDL cholesterol levels in people with diabetes in pharmacist prescribing groups compared with primary care provider prescribing groups [49,50]. Figure 20 presents the risk of bias assessment; both studies were judged to have overall critical risk of bias scores for this outcome.

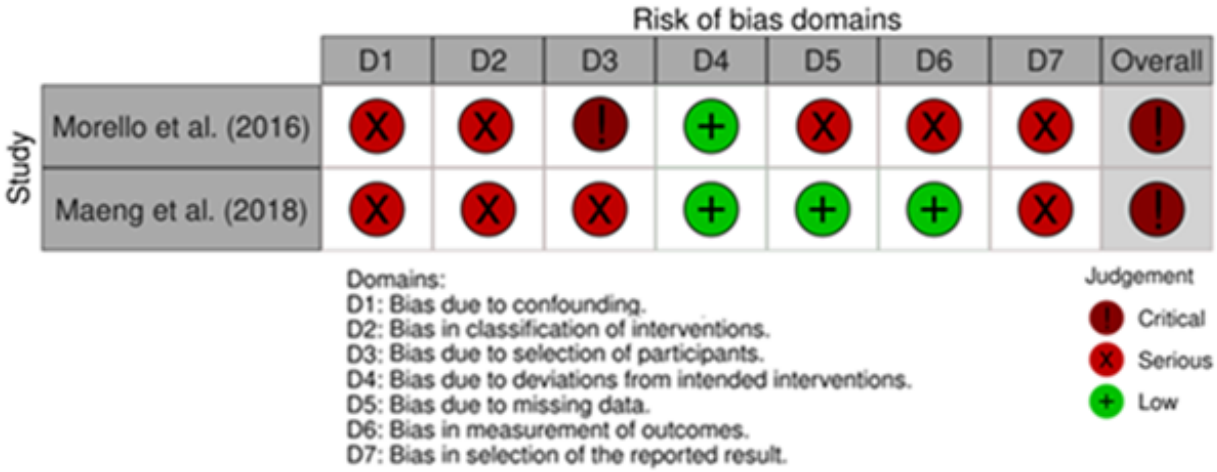

Figure 20: LDL cholesterol levels in people with diabetes (risk of bias assessment using ROBINS-I)

Both studies reported very low-certainty evidence indicating no significant difference in mean LDL cholesterol levels between the pharmacist prescribing groups and the primary care provider prescribing groups. An overview of the evidence is provided in Table 14.

Table 14: LDL cholesterol levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [49]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Pharmacist–endocrinologist managed versus primary care provider managed	Outpatient: diabetes intense medical management clinic	Critical	Very low	Mean (SD) 84.0 (28.6) versus 82.8 (32.0); *p*=0.58	No significant difference
Retrospective cohort study [50]	Collaborative practice agreement: generate prescription and manage medication	Pharmacist managed versus primary care provider managed	Primary care team: diabetes clinic	Critical	Very low	Mean (SD) 91 (37) versus 92 (36); *p*=0.47	No significant difference

3.5.1.1.3.3 HDL cholesterol levels

One retrospective cohort study reported on mean high-density lipoprotein (HDL) cholesterol levels in people with diabetes in the pharmacist–endocrinologist prescribing group compared with the primary care provider prescribing group [49]. Figure 21 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

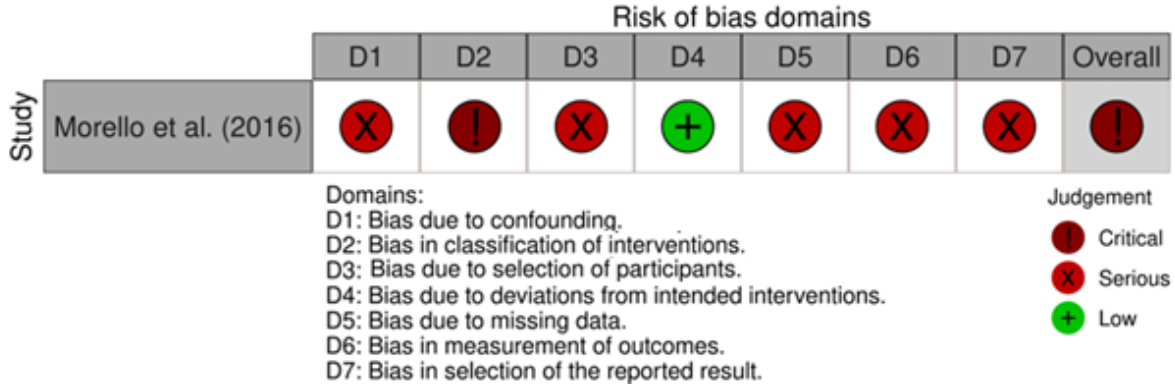

Figure 21: HDL cholesterol levels in people with diabetes (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in mean HDL cholesterol levels between the pharmacist–endocrinologist prescribing group and the primary care provider prescribing group. An overview of the evidence is provided in Table 15.

Table 15: HDL cholesterol levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [49]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Pharmacist–endocrinologist managed versus primary care provider managed	Outpatient: diabetes intense medical management clinic	Critical	Very low	Mean (SD) 40.7 (11.8) versus 42.9 (12.8), *p*=0.57	No significant difference

3.5.1.1.3.4 Triglyceride levels

One retrospective cohort study reported on mean triglyceride levels in people with diabetes in the pharmacist–endocrinologist prescribing group compared with the primary care provider prescribing group [49]. Figure 22 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

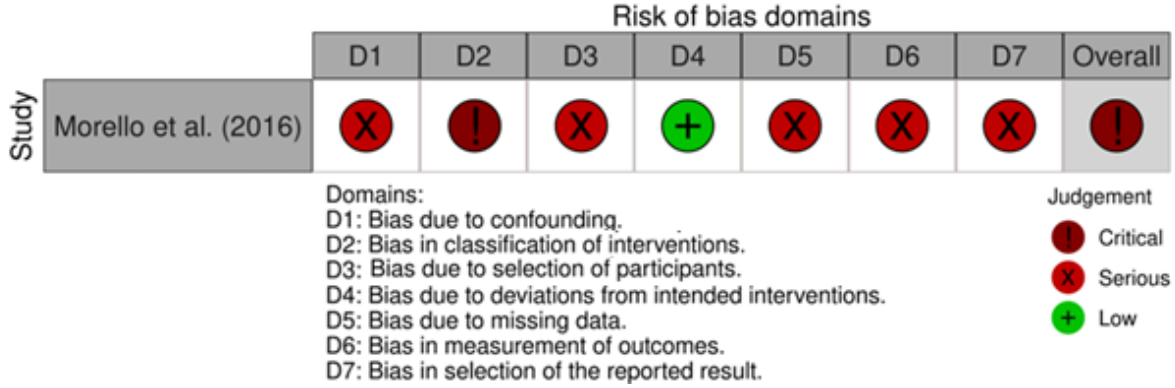

Figure 22: Triglyceride levels in people with diabetes (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in mean triglyceride levels between the pharmacist–endocrinologist prescribing group and the primary care provider prescribing group. An overview of the evidence is provided in Table 16.

Table 16: Triglyceride levels in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [49]	Collaborative practice agreement: initiate, adjust, and discontinue antidiabetic medications	Pharmacist–endocrinologist managed versus primary care provider managed	Outpatient: diabetes intense medical management clinic	Critical	Very low	Mean (SD) 185.9 (125.2) versus 189.2 (164.5), *p*=0.33	No significant difference

3.5.1.1.4 Health-related quality of life

One RCT reported on health-related quality of life in people with diabetes in the pharmacist–physician prescribing group compared with the physician prescribing group [52]. Figure 23 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

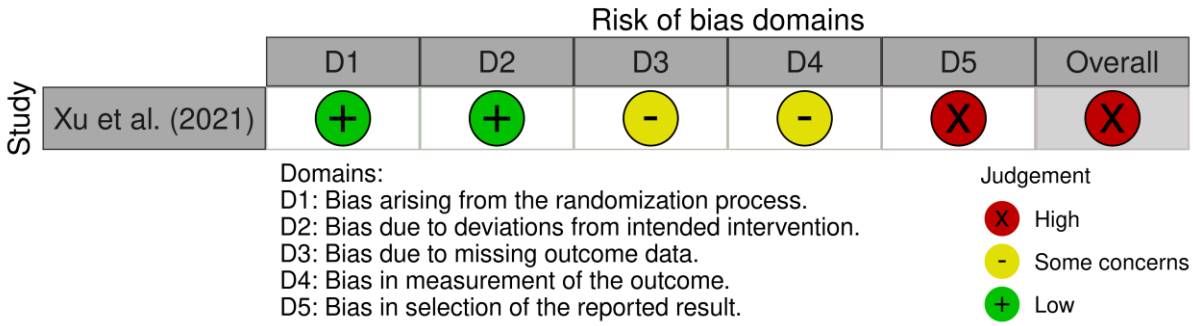

Figure 23: Health-related quality of life in people with diabetes (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in health-related quality of life between the pharmacist–physician prescribing group and the physician prescribing group [52]. An overview of the evidence is provided in Table 17.

Table 17: Health-related quality of life in people with diabetes

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [52]	Collaborative practice agreement: furnish prescription; initiate, adjust, and substitute	Pharmacist–physician managed versus physician managed	Primary care	High	Very low	Mean (SD) −2.95 (2.29) versus −2.88 (2.07)	No significant difference

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
	antidiabetic medications						

3.5.1.1.5 Summary of findings

Eight studies assessed the effectiveness of pharmacist prescribing for people with diabetes [46–53]. The effectiveness outcomes assessed were blood glucose, blood pressure, lipids, and health-related quality of life. There was significant improvement for three outcomes in pharmacist prescribing groups compared with primary care provider prescribing groups or physician prescribing groups. There was no significant difference between groups for the other 16 outcomes (Table 18).

Table 18: Summary of effectiveness findings for diabetes

Pharmacist prescribing compared with primary care provider and physician prescribing for diabetes

Patient or population group: Diabetes
Prescribing authority: Collaborative practice agreements
Setting: Outpatient diabetes clinics; primary care
Intervention: Pharmacist prescribing
Comparison: Primary care provider prescribing; physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
HbA1c goal achieved assessed with: Yes/No	One retrospective cohort study reported a significantly higher number of participants achieving their HbA1c goals in the primary care provider prescribing group compared with the pharmacist prescribing group. Two retrospective cohort studies reported no significant difference between the pharmacist prescribing and primary care provider prescribing groups.	5,815 (3 retrospective cohort studies)	⊕◯◯◯ Very low
HbA1c levels assessed with: Mean	Two retrospective cohort studies reported significant improvement in pharmacist prescribing groups compared with primary care provider prescribing groups.	1,400 (2 retrospective cohort studies)	⊕◯◯◯ Very low
Change in HbA1c levels assessed with: Mean change	One retrospective cohort study reported no significant difference between the pharmacist prescribing and physician prescribing groups. One retrospective cohort study reported significant improvement in the pharmacist prescribing group compared with the physician prescribing group.	541 (2 retrospective cohort studies)	⊕◯◯◯ Very low

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Change in HbA1c levels assessed with: Mean change	One RCT reported no significant difference between the pharmacist prescribing and physician prescribing groups. One RCT reported a significant improvement in the pharmacist prescribing group compared with the physician prescribing group.	351 (2 RCTs)	⊕◯◯◯ Very low
Time to achieve HbA1c goal assessed with: Mean days	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	257 (1 non-randomised trial)	⊕◯◯◯ Very low
Time to antidiabetic treatment intensification assessed with: Mean days	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	56 (1 non-randomised trial)	⊕◯◯◯ Very low
Achieved at least a 1% decrease in HbA1c levels assessed with: Yes/No	A significantly higher proportion of participants was reported to achieve at least a 1% decrease in HbA1c levels in the pharmacist prescribing group compared with the physician prescribing group.	103 (1 RCT)	⊕◯◯◯ Very low
Fasting blood glucose levels assessed with: Mean	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	154 (1 retrospective cohort study)	⊕◯◯◯ Very low
Blood pressure goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	5,500 (1 retrospective cohort study)	⊕◯◯◯ Very low
Diastolic blood pressure levels assessed with: Mean	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	5,655 (2 retrospective cohort studies)	⊕◯◯◯ Very low
Systolic blood pressure levels assessed with: Mean	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	5,655 (2 retrospective cohort studies)	⊕◯◯◯ Very low
LDL cholesterol levels assessed with: Mean	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	5,655 (2 retrospective cohort studies)	⊕◯◯◯ Very low
LDL cholesterol goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	5,500 (1 retrospective cohort study)	⊕◯◯◯ Very low
HDL cholesterol levels assessed with: Mean	No significant difference was reported between the pharmacist prescribing and primary care provider prescribing groups.	150 (1 retrospective cohort study)	⊕◯◯◯ Very low

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Triglyceride levels assessed with: Mean	No significant difference was reported between the pharmacist–endocrinologist prescribing and primary care provider prescribing groups.	142 (1 retrospective cohort study)	⊕◯◯◯ Very low
Health-related quality of life assessed with: Diabetes Dependent Quality of Life Scale	No significant difference was reported between the pharmacist–physician prescribing and the physician prescribing groups.	248 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.2 Heart failure

Three studies assessed the effectiveness of pharmacist prescribing for people with heart failure [54–56]. The effectiveness outcomes investigated were healthcare utilisation, target angiotensin receptor/neprilysin inhibitor (ARNI) dose achieved, and aspirin deprescribing.

3.5.1.2.1 Healthcare utilisation

One retrospective cohort study reported on healthcare utilisation for people with heart failure in a pharmacist prescribing group compared with two control groups (pharmacist medication review only and endocrinologist prescribing) [54]. This study reported on 30-day hospital readmission rates, 30-day heart failure readmission rates, and emergency department visits. Figure 24 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for the healthcare utilisation outcome.

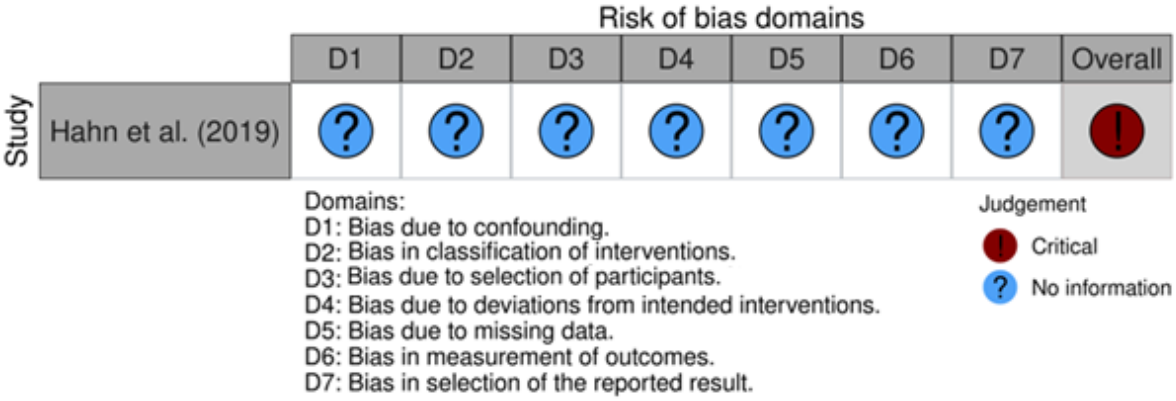

Figure 24: Healthcare utilisation in people with heart failure (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence comparing 30-day all-cause readmission events, 30-day heart failure readmission rates, and emergency department visits in the pharmacist prescribing group with the two comparator groups (pharmacist medication review only and endocrinologist prescribing) [54]. Significant improvement in 30-day all-cause readmission events was reported in the pharmacist prescribing group and the endocrinologist prescribing group. There was no significant difference in 30-day heart failure readmission events between the pharmacist prescribing group and the endocrinologist prescribing group.

No inferential statistics were reported for the other outcomes, so we cannot comment on the statistical significance of these findings; in addition, the number of events in each group is very small. An overview of the evidence is provided in Table 19.

Table 19: Healthcare utilisation in people with heart failure

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [54]	Collaborative practice agreement: initiate, adjust, and discontinue	Clinical pharmacist specialist versus endocrinologist	Outpatient clinic	Critical	Very low	Number of 30-day all-cause readmission events (%) 3/35 (8.6%) versus 9/35 (%); *p*=0.046	Significant improvement in pharmacist prescribing
Retrospective cohort study [54]	Collaborative practice agreement: initiate, adjust, and discontinue	Clinical pharmacist specialist versus pharmacist medication review	Outpatient clinic	Critical	Very low	Number of 30-day all-cause readmission events (%) 3/35 (8.6%) versus 2/28 (7.1%)	No inferential statistics reported
Retrospective cohort study [54]	Collaborative practice agreement: initiate, adjust, and discontinue	Clinical pharmacist specialist versus endocrinologist	Outpatient clinic	Critical	Very low	Number of 30-day heart failure readmission events (%) 1/35 (2.8%) versus 2/35 (8.0%), *p*=0.11	No significant difference
Retrospective cohort study [54]	Collaborative practice agreement: initiate, adjust, and discontinue	Clinical pharmacist specialist versus pharmacist medication review	Outpatient clinic	Critical	Very low	Number of 30-day heart failure readmission events (%) 1/35 (2.8%) versus 2/28 (7.1%)	No inferential statistics reported

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [54]	Collaborative practice agreement: initiate, adjust, and discontinue	Clinical pharmacist specialist versus endocrinologist	Outpatient clinic	Critical	Very low	Number of emergency department visit events (%) 5/35 (14.3%) versus 0/35 (0.0%)	No inferential statistics reported
Retrospective cohort study [54]	Collaborative practice agreement: initiate, adjust, and discontinue	Clinical pharmacist specialist versus pharmacist medication review	Outpatient clinic	Critical	Very low	Number of emergency department visit events (%) 5/35 (14.3%) versus 6/28 (21.4%)	No inferential statistics reported

3.5.1.2.2 Target ARNI dose achieved

One retrospective cohort study reported on the outcome of target ARNI dose achieved for people with heart failure in a pharmacist prescribing group compared with a clinician prescribing group [55]. This study reported on the likelihood of patients achieving their target ARNI dose, the number of visits required to achieve the target ARNI dose, and the number of days required to achieve the target/maximally tolerated ARNI dose. Figure 25 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

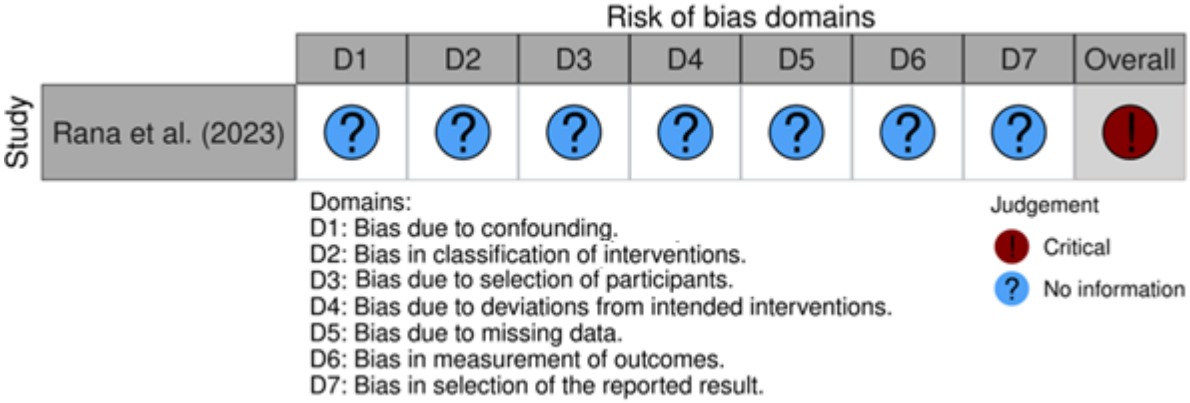

Figure 25: Percentage of people with heart failure achieving the target ARNI dose (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating a significantly higher likelihood of achieving the target ARNI dose in the pharmacist prescribing group compared with the clinician prescribing group [55]. Significantly fewer visits were required to achieve the target ARNI dose in the pharmacist prescribing group compared with the clinician prescribing group. This study reported no significant difference in the

number of days required to achieve the target/maximally tolerated ARNI dose. An overview of the evidence is provided in Table 20.

Table 20: ARNI target dose achieved in people with heart failure

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [55]	Collaborative practice agreement: initiate, titrate, and monitor	Pharmacist prescribing versus clinician prescribing	Outpatient cardiac clinic	Critical	Very low	Target ARNI dose achieved Odds ratio 2.38; *p*<0.0001	Pharmacist prescribing
Retrospective cohort study [55]	Collaborative practice agreement: initiate, titrate, and monitor	Pharmacist prescribing versus clinician prescribing	Outpatient cardiac clinic	Critical	Very low	Mean number of visits 4.16 versus 12.94; *p*<0.0001	Pharmacist prescribing
Retrospective cohort study [55]	Collaborative practice agreement: initiate, titrate, and monitor	Pharmacist prescribing versus clinician prescribing	Outpatient cardiac clinic	Critical	Very low	Mean number of days 279.32 days versus 333.66 days; *p*=0.091	No significant difference

3.5.1.2.3 Aspirin deprescribing

One prospective cohort study reported on the proportion of aspirin deprescribing in a pharmacist–primary care provider prescribing group compared with a primary care provider prescribing group. Figure 26 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

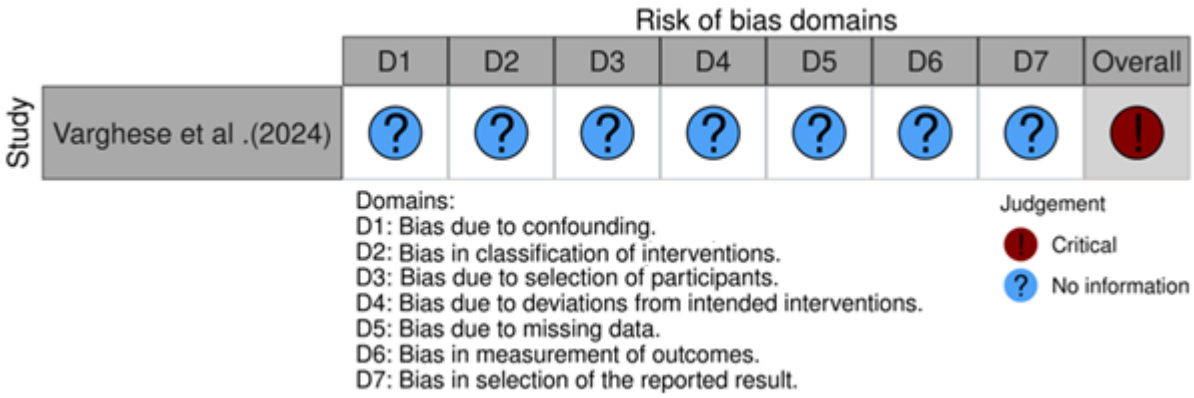

Figure 26: Proportion of aspirin deprescribing in people with heart failure (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating significantly higher rates of aspirin deprescribing in the pharmacist–primary care provider prescribing group compared with the primary care provider prescribing group [56]. An overview of the evidence is provided in Table 21.

Table 21: Proportion of aspirin deprescribing in people with heart failure

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Prospective cohort study [56]	Protocol: deprescribe	Pharmacist–primary care provider versus primary care provider	Primary care	Critical	Very low	Number of events (%) 35/65 (53.8%) versus 10/57 (17.5%); *p*=0.0001	Pharmacist prescribing

3.5.1.2.4 Summary of findings

Three studies assessed the effectiveness of pharmacist prescribing for people with heart failure [54–56]. Significant improvement in 30-day all-cause readmission events was reported in the pharmacist prescribing group and the endocrinologist prescribing group. There was no significant difference in 30-day heart failure readmission events between the pharmacist prescribing group and the endocrinologist prescribing group. No inferential statistics were reported for the other outcomes related to healthcare utilisation.

In relation to the target ARNI dose achieved and aspirin deprescribing outcomes, the difference between groups for one outcome were non-significant, and three outcomes showed significant improvements in favour of pharmacist prescribing compared with clinician prescribing (Table 22).

Table 22: Summary of effectiveness findings for heart failure

Pharmacist prescribing compared with pharmacist medication review only, clinician prescribing, and primary care provider prescribing for heart failure

Patient or population group: Heart failure
Prescribing authority: Collaborative practice agreements; protocol
Setting: Outpatient clinics; primary care
Intervention: Pharmacist prescribing
Comparison: Pharmacist medication review only; clinician prescribing; primary care provider prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
30-day all-cause readmission events assessed with: Number of events	One retrospective cohort study reported significantly lower all-cause readmission were reported in the pharmacist prescribing group compared with the endocrinologist prescribing group.	70 (1 retrospective cohort study)	⊕◯◯◯ Very low

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
30-day all-cause readmission events assessed with: Number of events	As no inferential statistics were reported, we cannot comment on the statistical significance of this finding (pharmacist prescribing compared with pharmacist medication review).	63 (1 retrospective cohort study)	⊕◯◯◯ Very low
30-day heart failure readmission events assessed with: Number of events	One retrospective cohort study reported no significant difference in heart failure readmission in the pharmacist prescribing group compared with the endocrinologist prescribing group.	70 (1 retrospective cohort study)	⊕◯◯◯ Very low
30-day heart failure readmission events assessed with: Number of events	As no inferential statistics were reported, we cannot comment on the statistical significance of this finding (pharmacist prescribing group versus the pharmacist medication review only group).	63 (1 retrospective cohort study)	⊕◯◯◯ Very low
Emergency department visit events assessed with: Number of events	As no inferential statistics were reported, we cannot comment on the statistical significance of this finding (pharmacist prescribing group versus the endocrinologist prescribing group).	70 (1 retrospective cohort study)	⊕◯◯◯ Very low
Emergency department visit events assessed with: Number of events	As no inferential statistics were reported, we cannot comment on the statistical significance of this finding (pharmacist prescribing group versus the pharmacist medication review only group).	63 (1 retrospective cohort study)	⊕◯◯◯ Very low
Target ARNI dose achieved assessed with: Yes/No	There was a significantly higher likelihood of achieving the target ARNI dose in the pharmacist prescribing group compared with the clinician prescribing group.	791 (1 retrospective cohort study)	⊕◯◯◯ Very low
Number of visits required to achieve target ARNI dose assessed with: Mean	Significantly fewer visits were required to achieve the target ARNI dose in the pharmacist prescribing group compared with the clinician prescribing group.	791 (1 retrospective cohort study)	⊕◯◯◯ Very low
Number of days required to achieve target/maximally tolerated ARNI dose assessed with: Mean	There was no significant difference in the number of days required to achieve the target/maximally tolerated ARNI dose in the pharmacist prescribing group compared with the clinician prescribing group.	791 (1 retrospective cohort study)	⊕◯◯◯ Very low
Aspirin deprescribing assessed with: Yes/No	There were significantly higher rates of aspirin deprescribing in the pharmacist prescribing group compared with the primary care provider prescribing group.	122 (1 prospective cohort study)	⊕◯◯◯ Very low

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.3 Stroke

One RCT assessed the effectiveness of pharmacist prescribing for people with a recent minor ischaemic stroke or transient ischaemic attack [57]. The effectiveness outcomes assessed were blood pressure and lipid level goals achieved, systolic blood pressure levels, lipids, adherence, self-rated health, and health-related quality of life.

3.5.1.3.1 Blood pressure and lipid level goals achieved

One RCT reported on whether blood pressure and lipid level goals were achieved in people with a recent stroke in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 27 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

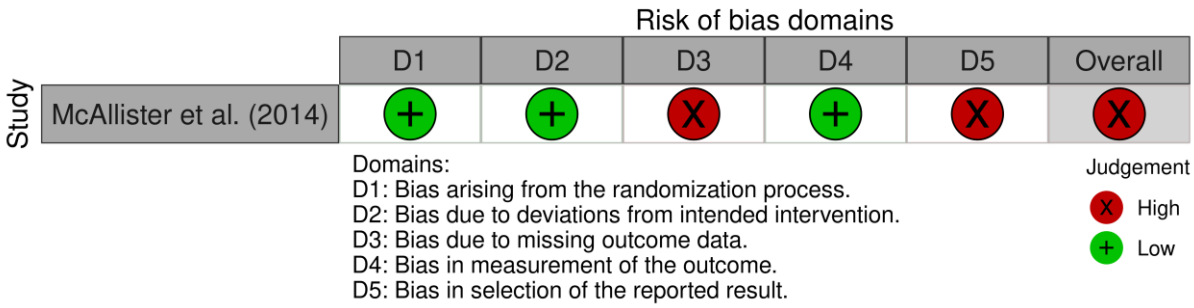

Figure 27: Blood pressure and lipid level goals achieved in people with a recent stroke (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [57]. As no inferential statistics were reported, we cannot comment on the statistical significance of these findings. An overview of the evidence is provided in Table 23.

Table 23: Blood pressure and lipid level goals achieved in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement:	Pharmacist prescribing versus	Primary care	High	Very low	Number of events (%) 62/143 (43.4%)	No inferential statistics reported

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
	initiate and titrate	physician prescribing				versus 42/136 (30.9%) Findings appear different	

3.5.1.3.2 Systolic blood pressure levels

One RCT reported on systolic blood pressure levels in people with a recent stroke in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 28 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

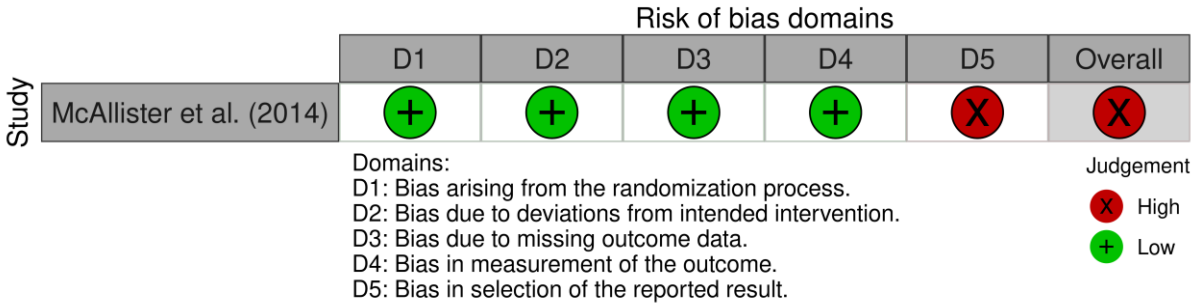

Figure 28: Systolic blood pressure levels in people with a recent stroke (risk of bias assessment using RoB 2)

This RCT reported very low-certainty evidence [57]. As no inferential statistics were reported, we cannot comment on statistical significance of these findings. An overview of the evidence is provided in Table 24.

Table 24: Systolic blood pressure levels in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement: initiate and titrate	Pharmacist prescribing versus physician prescribing	Primary care	High	Very low	Mean (SD) 126.5 (17.9) versus 122.2 (13.0) Similar findings	No inferential statistics reported

3.5.1.3.3 Lipids

One RCT assessed effectiveness outcomes related to lipids [57]. The findings are presented by outcome measure: LDL cholesterol levels and change in HDL cholesterol.

3.5.1.3.3.1 LDL cholesterol levels

One RCT reported on LDL cholesterol levels in people with a recent stroke in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 29 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

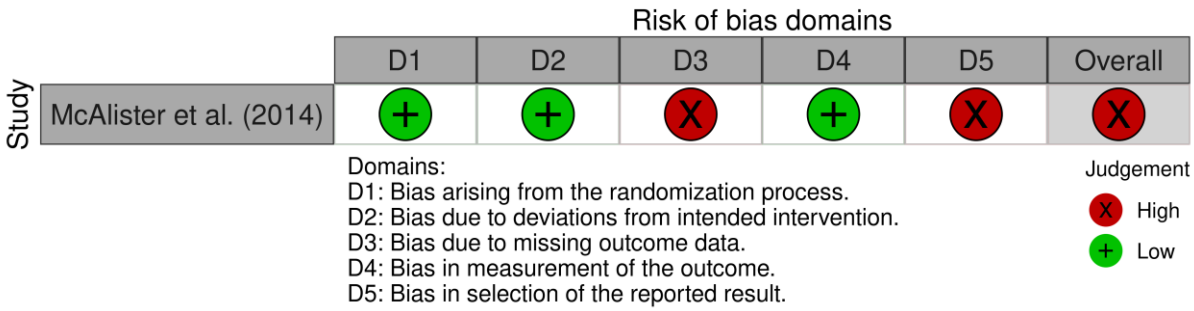

Figure 29: LDL cholesterol levels in people with a recent stroke (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [57]. As no inferential statistics were reported, we cannot comment on the statistical significance of these findings. An overview of the evidence is provided in Table 25.

Table 25: LDL cholesterol levels in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement: initiate and titrate	Pharmacist prescribing versus physician prescribing	Primary care	High	Very low	Mean (SD) 2.21 (0.73) versus 2.35 (0.81) Similar findings	No inferential statistics reported

3.5.1.3.3.2 Change in HDL cholesterol levels

One RCT reported on changes in HDL cholesterol levels in people with a recent stroke in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 30 presents the risk of bias assessment; this study was judged to have an overall high risk of bias score for this outcome.

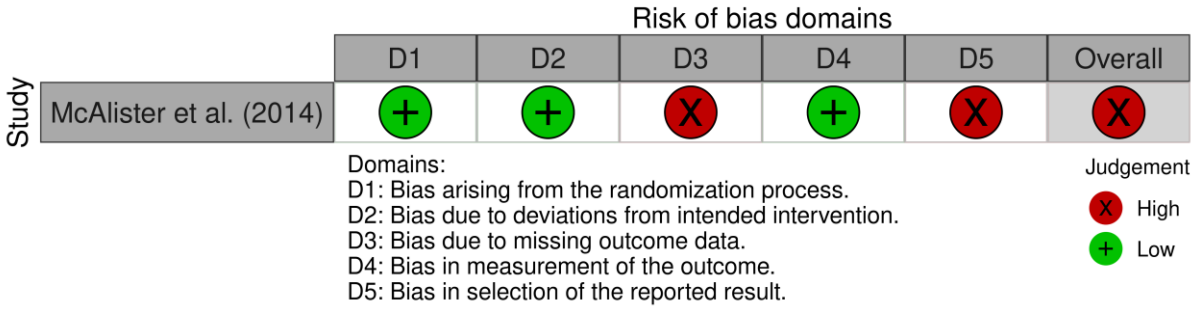

Figure 30: Change in HDL cholesterol levels in people with a recent stroke (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence on changes in HDL cholesterol levels in the pharmacist prescribing group compared with the physician prescribing group [57]. As no inferential statistics were reported, we cannot comment on the statistical significance of these findings. An overview of the evidence is provided in Table 26.

Table 26: Change in HDL cholesterol levels in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement: initiate and titrate	Pharmacist prescribing versus physician prescribing	Primary care	High	Very low	Mean change (SD) −0.01 (0.23) versus −0.04 (0.19) Similar findings	No inferential statistics reported

3.5.1.3.4 Adherence

One RCT reported on self-reported adherence of 75% or higher to blood pressure or lipid-lowering medications in people with a recent stroke in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 31 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

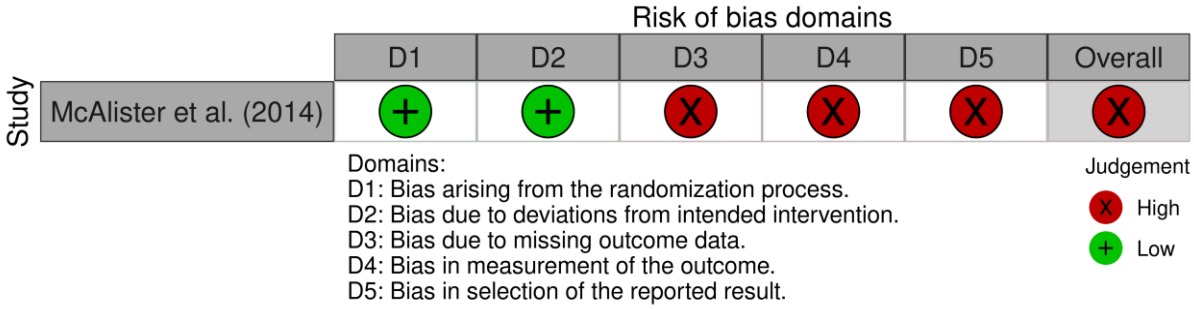

Figure 31: Adherence in people with a recent stroke (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [57]. As no inferential statistics were reported, we cannot comment on the statistical significance of these findings. An overview of the evidence is provided in Table 27.

Table 27: Adherence in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement: initiate and titrate	Pharmacist prescribing versus physician prescribing	Primary care	High	Very low	Number of events (%) 138/143 (96.5%) versus 132/136 (97.1%) Similar findings	No inferential statistics reported

3.5.1.3.5 Self-rated health

One RCT reported on self-rated health in people with a recent stroke in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 32 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

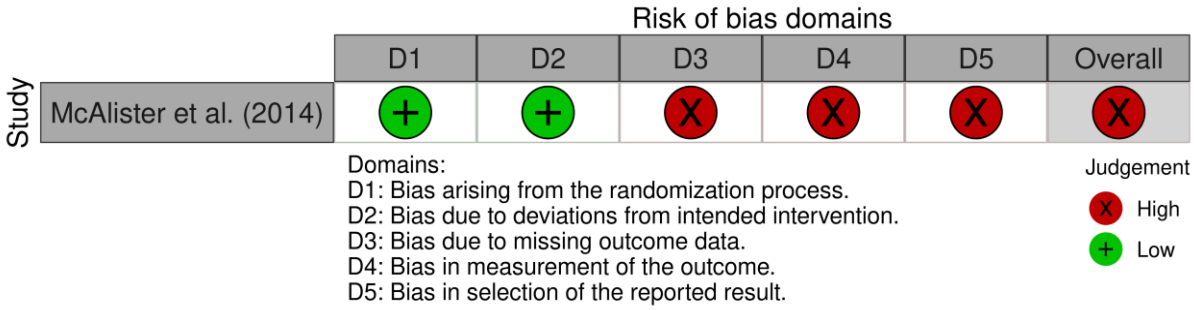

Figure 32: Self-rated health in people with a recent stroke (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [57]. As no inferential statistics were reported, we cannot comment on the statistical significance of these findings. An overview of the evidence is provided in Table 28.

Table 28: Self-rated health in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement: initiate and titrate	Pharmacist prescribing versus physician prescribing	Primary care	High	Very low	Mean (SD) 3.5 (0.9) versus 3.4 (0.8) Similar findings	No inferential statistics reported

3.5.1.3.6 Health-related quality of life

One RCT reported on health-related quality of life in people with a recent stroke in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 33 presents the risk of bias assessment; this study was judged to have an overall high risk of bias score for this outcome.

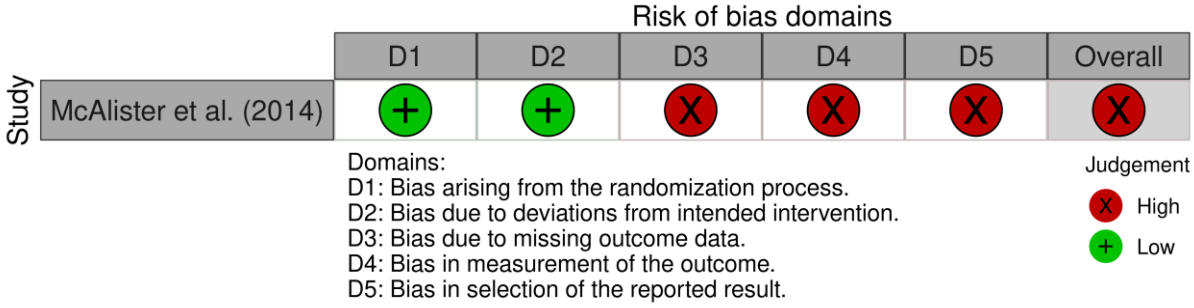

Figure 33: Health-related quality of life in people with a recent stroke (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [57]. As no inferential statistics were reported, we cannot comment on the statistical significance of these findings. An overview of the evidence is provided in Table 29.

Table 29: Health-related quality of life in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement: initiate and titrate	Pharmacist prescribing versus physician prescribing	Primary care	High	Very low	Mean (SD) 0.84 (0.15) versus 0.86 (0.17) Similar findings	No inferential statistics reported

3.5.1.3.7 Summary of findings

One RCT assessed the effectiveness of pharmacist prescribing for people with a recent minor ischaemic stroke or transient ischaemic attack [57]. The effectiveness outcomes assessed were blood pressure and lipid level goals achieved, systolic blood pressure levels, lipids, adherence, self-rated health, and health-related quality of life. No inferential statistics were reported for these outcomes (Table 30).

Table 30: Summary of effectiveness findings for stroke

Pharmacist prescribing compared with physician prescribing for stroke

Patient or population group: Stroke
Prescribing authority: Collaborative practice agreement
Setting: Primary care
Intervention: Pharmacist prescribing
Comparison: Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Blood pressure and lipid level goals achieved Assessed with: Yes/No	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	279 (1 RCT)	⊕◯◯◯ Very low
Systolic blood pressure levels assessed with: Mean	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	279 (1 RCT)	⊕◯◯◯ Very low
LDL cholesterol levels assessed with: Mean	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	279 (1 RCT)	⊕◯◯◯ Very low
Change in HDL cholesterol levels assessed with: Mean change	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	279 (1 RCT)	⊕◯◯◯ Very low

Adherence assessed with: Yes/No, self-reported adherence of 75% or higher to blood pressure or lipid-lowering medications	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	279 (1 RCT)	⨁◯◯◯ Very low
Self-rated health assessed with: Mean	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	279 (1 RCT)	⨁◯◯◯ Very low
Health-related quality of life assessed with: European Quality of Life 5 Dimensions (EQ-5D)	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	279 (1 RCT)	⨁◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.4 Dyslipidaemia

One cluster RCT assessed the effectiveness of pharmacist prescribing for people with dyslipidaemia [58]. The effectiveness outcomes assessed were lipid levels, blood pressure, fasting blood glucose levels, healthcare utilisation, and adherence.

3.5.1.4.1 Lipid levels

One cluster RCT reported on lipid levels in people with dyslipidaemia in a pharmacist prescribing group compared with a physician prescribing group [58]. This study reported on the proportion of patients achieving their target lipid levels; LDL cholesterol levels; mean HDL cholesterol levels; and mean triglyceride levels. Figure 34 presents the risk of bias assessment; this study was judged to have some concerns as its overall risk of bias score for this outcome.

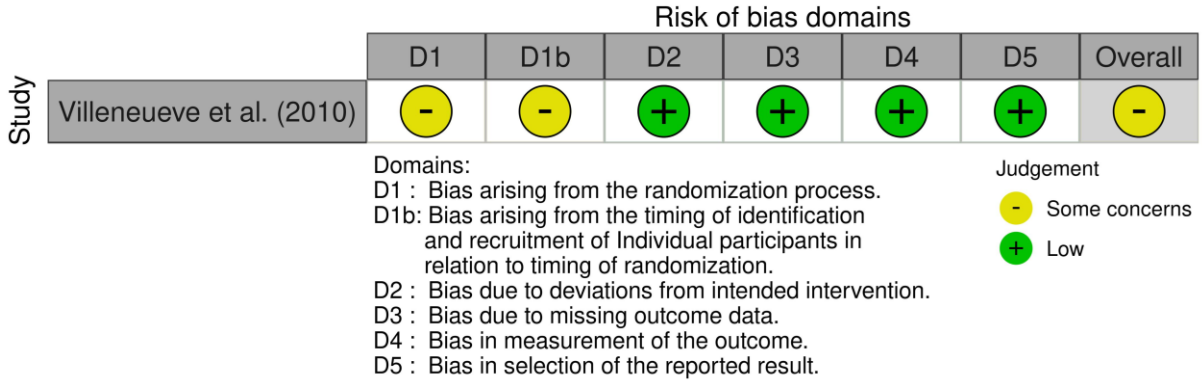

Figure 34 Lipid levels in people with dyslipidaemia (risk of bias assessment using RoB 2 for cluster RCTs)

This cluster RCT reported very low-certainty evidence indicating a significantly higher likelihood of patients achieving their target lipid levels in the pharmacist prescribing group compared with the physician prescribing group. There was no significant difference in changes in mean changes in LDL

cholesterol levels, HDL cholesterol levels, or triglyceride levels in the pharmacist prescribing group compared with the physician prescribing group [58]. An overview of the evidence is provided in Table 31.

Table 31: Lipid levels in people with dyslipidaemia

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	Proportion achieving target lipid levels Relative risk (95% CI) 1.16 (1.01–1.34)	Pharmacist prescribing
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	LDL cholesterol levels Mean difference (SD) –0.05 (–0.3 to 0.2)	No significant difference
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	HDL cholesterol levels Mean difference (95% CI) 0.02 (−0.03 to 0.07)	No significant difference
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	Triglyceride levels Mean difference (95% CI) −0.03 (−0.2 to 0.1)	No significant difference

3.5.1.4.2 Blood pressure

One cluster RCT reported on blood pressure outcomes in people with dyslipidaemia in a pharmacist prescribing group compared with a physician prescribing group [58]. This study reported no significant difference in mean changes in systolic and diastolic blood pressure levels between the pharmacist prescribing group and the physician prescribing group. Figure 35 presents the risk of bias assessment; the study was judged to have some concerns as its overall risk of bias score for this outcome.

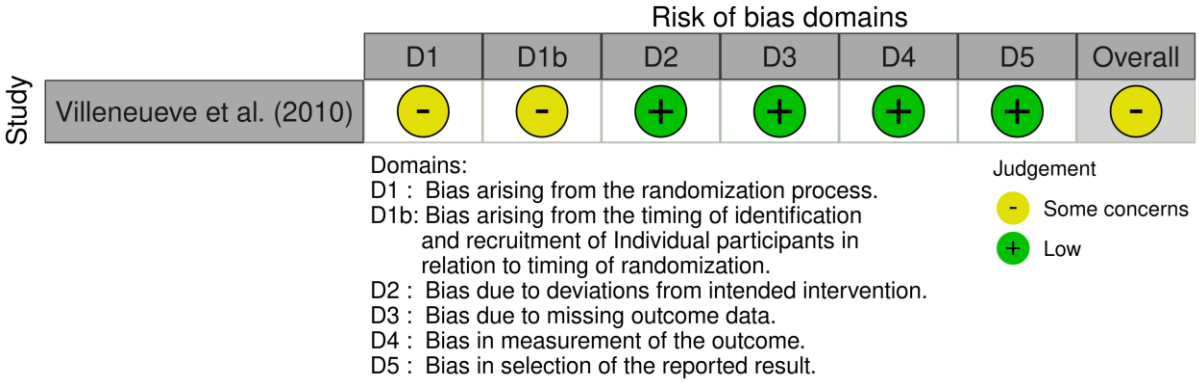

Figure 35: Mean difference in blood pressure levels in people with dyslipidaemia (risk of bias assessment using RoB 2 for cluster RCTs)

This cluster RCT reported very low-certainty evidence [58]. There was no significant difference in changes in blood pressure levels in the pharmacist prescribing group compared with the physician prescribing group. An overview of the evidence is provided in Table 32.

Table 32: Mean difference in blood pressure levels in people with dyslipidaemia

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	Systolic blood pressure levels Mean difference (95% CI) −1.3 (−6.4 to 3.8)	No significant difference
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	Diastolic blood pressure levels Mean difference (95% CI) −1.8 (−5.0 to 1.4)	No significant difference

3.5.1.4.3 Fasting blood glucose levels

One cluster RCT reported on fasting blood glucose levels in people with dyslipidaemia in a pharmacist prescribing group compared with a physician prescribing group. Figure 36 presents the risk of bias assessment; the study was judged to have some concerns as its overall risk of bias score for this outcome.

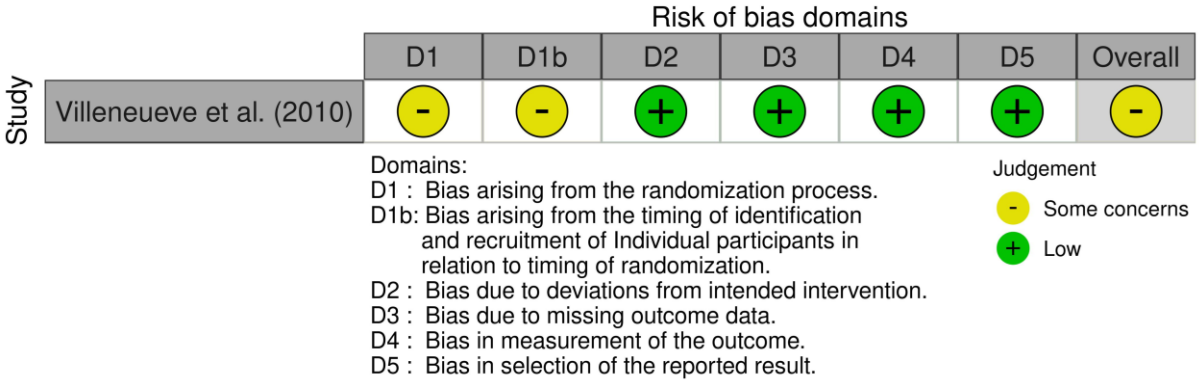

Figure 36: Mean fasting blood glucose levels in people with dyslipidaemia (risk of bias assessment using RoB 2 for cluster RCTs)

This study reported very low-certainty evidence [58]. There was no significant difference in changes in fasting blood glucose levels the pharmacist prescribing group compared with the physician prescribing group. An overview of the evidence is provided in Table 33.

Table 33: Mean fasting blood glucose levels in people with dyslipidaemia

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	Mean difference (95% CI) −0.1 (−0.6 to 0.4)	No significant difference

3.5.1.4.4 Healthcare utilisation

One cluster RCT reported on the number of physician visits in people with dyslipidaemia in a pharmacist prescribing group compared with a physician prescribing group. Figure 37 presents the risk of bias assessment; the study was judged to have some concerns as its overall risk of bias score for this outcome.

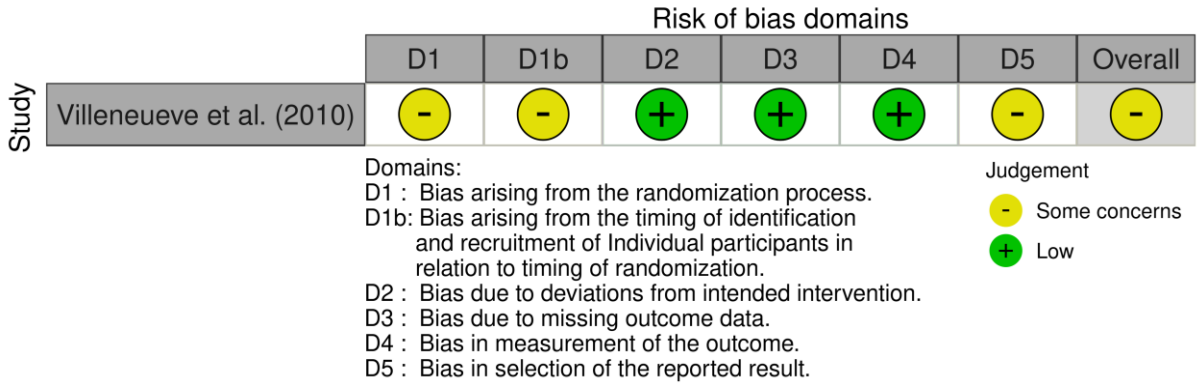

Figure 37: Number of physician visits in people with dyslipidaemia (risk of bias assessment using RoB 2 for cluster RCTs)

This study reported very low-certainty evidence indicating no significant difference in the number of physician visits between the pharmacist prescribing and the physician prescribing groups. An overview of the evidence is provided in Table 34.

Table 34: Number of physician visits in people with dyslipidaemia

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	Relative risk (95% CI) −0.45 (−1.48 to 0.58)	No significant difference

3.5.1.4.5 Adherence

One cluster RCT reported on patient adherence to medication in people with dyslipidaemia in a pharmacist prescribing group compared with a physician prescribing group. Figure 38 presents the risk of bias assessment; this study was judged to have some concerns as its overall risk of bias score for this outcome.

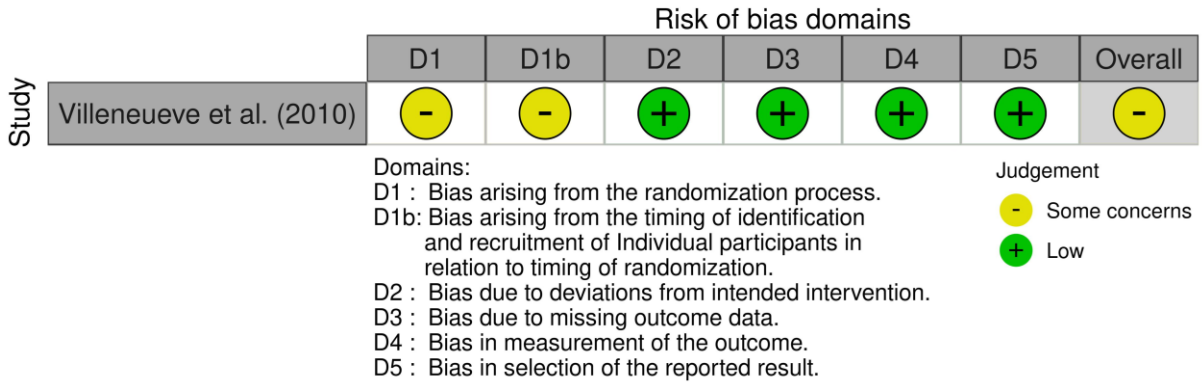

Figure 38: Medication adherence in people with dyslipidaemia (risk of bias assessment using RoB 2 for cluster RCTs)

This cluster RCT reported very low-certainty evidence comparing patient adherence to medication between the pharmacist prescribing group and the physician prescribing group [58]. As no inferential statistics were reported, we cannot comment on the statistical significance of these findings. An overview of the evidence is provided in Table 35.

Table 35: Medication adherence in people with dyslipidaemia

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	Number of events (%) 78/108 (72.2%) versus 79/117 (67.5%) Findings appear different	No inferential statistics reported

*Pharmacist prescribing versus physician prescribing

3.5.1.4.6 Summary of findings

One cluster RCT assessed the effectiveness of pharmacist prescribing for people with dyslipidaemia [58]. The effectiveness outcomes assessed were lipid levels, blood pressure, fasting blood glucose levels, healthcare utilisation, and adherence. There was significantly higher likelihood of achieving lipid target in the pharmacist prescribing group compared with the physician prescribing group. There was no significant difference in outcomes related to LDL cholesterol, HDL cholesterol, triglyceride levels, blood pressure, fasting blood glucose, or healthcare utilisation in the pharmacist prescribing group compared with the physician prescribing group. No inferential statistics were reported for the adherence outcome (Table 36).

Table 36: Summary of effectiveness findings for dyslipidaemia

Pharmacist prescribing compared with physician prescribing for dyslipidaemia

Patient or population group: Dyslipidaemia
Prescribing authority: Collaborative practice agreement
Setting: Primary care
Intervention: Pharmacist prescribing
Comparison: Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Target lipid levels achieved assessed with: Yes/No	Significantly higher likelihood of achieving target lipid levels was reported in the pharmacist prescribing groups compared with the physician prescribing group.	225 (1 cluster RCT)	⊕◯◯◯ Very low
LDL cholesterol levels assessed with: Relative risk	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	225 (1 cluster RCT)	⊕◯◯◯ Very low
HDL cholesterol levels assessed with: Mean difference	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	225 (1 cluster RCT)	⊕◯◯◯ Very low
Triglyceride levels assessed with: Mean difference	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	225 (1 cluster RCT)	⊕◯◯◯ Very low
Systolic blood pressure levels assessed with: Mean difference	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	225 (1 cluster RCT)	⊕◯◯◯ Very low
Diastolic blood pressure levels Assessed with: Mean difference	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	225 (1 cluster RCT)	⊕◯◯◯ Very low
Fasting blood glucose levels Assessed with: Mean difference	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	225 (1 cluster RCT)	⊕◯◯◯ Very low

Healthcare utilisation (number of physician visits) assessed with: Relative risk	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	225 (1 cluster RCT)	⊕◯◯◯ Very low
Adherence assessed with: Number of events	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	225 (1 cluster RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.5 Hypertension

Two studies (one retrospective cohort study and one non-randomised trial) assessed the effectiveness of pharmacist prescribing for people with hypertension [59,60]. The effectiveness outcomes assessed were blood pressure, adherence, and health-related quality of life.

3.5.1.5.1 Blood pressure

Two studies (one retrospective cohort study and one RCT) assessed effectiveness outcomes related to blood pressure [59,60]. Outcome measures assessed were blood pressure goal achieved, systolic blood pressure levels, change in systolic blood pressure, diastolic blood pressure levels, and change in diastolic blood pressure.

3.5.1.5.1.1 Blood pressure goal achieved

Two studies (one retrospective cohort study and one RCT) reported on the achievement of blood pressure goals in people with hypertension in pharmacist prescribing groups compared with physician prescribing groups [59,60]. Figure 39 presents the risk of bias assessment for the retrospective cohort study; the study was judged to have an overall critical risk of bias score for this outcome. Figure 40 presents the risk of bias assessment for the RCT; this study was judged to have an overall high risk of bias score for this outcome.

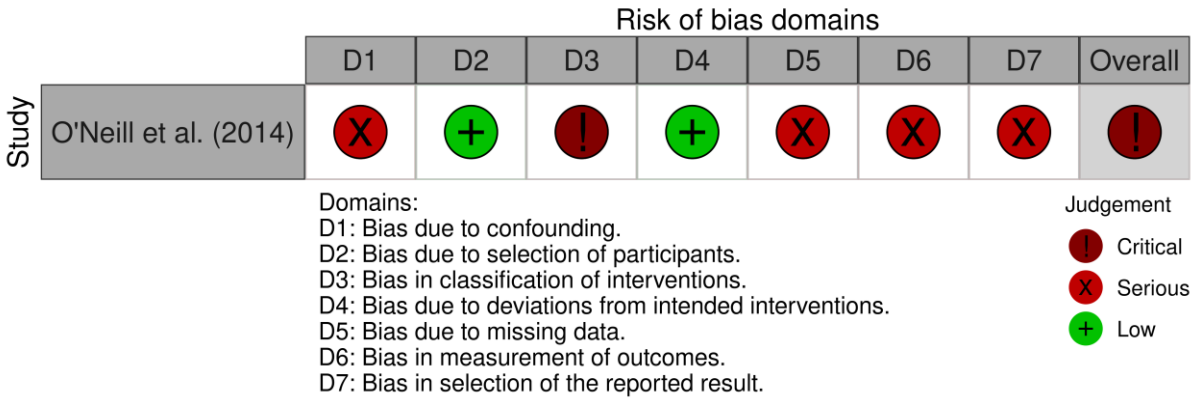

Figure 39: Blood pressure goal achieved in people with hypertension (risk of bias assessment using ROBINS-I)

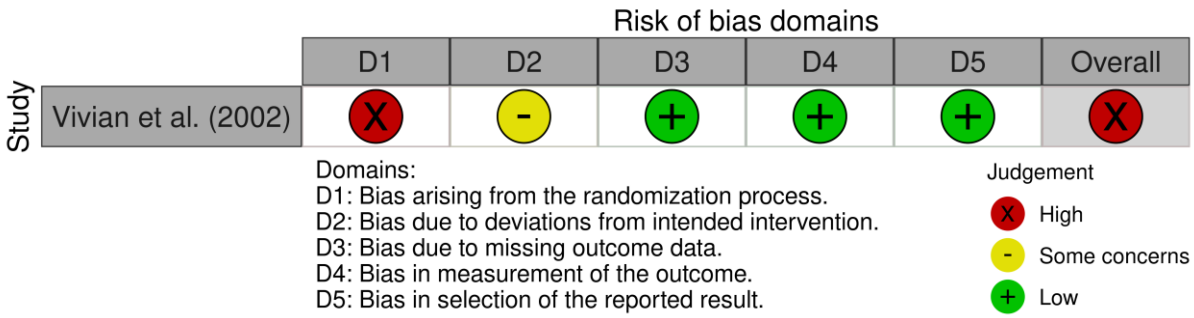

Figure 40: Blood pressure goal achieved in people with hypertension (risk of bias assessment using RoB 2)

The retrospective cohort study reported very low-certainty evidence indicating no significant difference in the achievement of blood pressure goals between the pharmacist prescribing and physician prescribing groups [59]. The RCT reported very low-certainty evidence indicating a significant improvement in achieving blood pressure goals in the pharmacist prescribing group compared with the physician prescribing group [60]. An overview of the evidence is provided in Table 37.

Table 37: Blood pressure goal achieved in people with hypertension

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [59]	Collaborative practice agreement: change medication	Pharmacist prescribing versus physician prescribing	Outpatient	Critical	Very low	Number of events (%) 41/63 (65%) versus 44/63 (70%); *p*=0.57 Adjusted odds ratio (95% CI) 0.95 (0.40–2.26); *p*=0.24	No significant difference
RCT [60]	Protocol	Pharmacist prescribing versus physician prescribing	Outpatient	High	Very low	Number of events (%) 21/26 (81%) versus 8/27 (30%); *p*=0.001	Pharmacist prescribing

3.5.1.5.1.2 Systolic blood pressure levels

One RCT reported on systolic blood pressure levels in people with hypertension in a pharmacist prescribing group compared with a physician prescribing group [60]. Figure 41 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

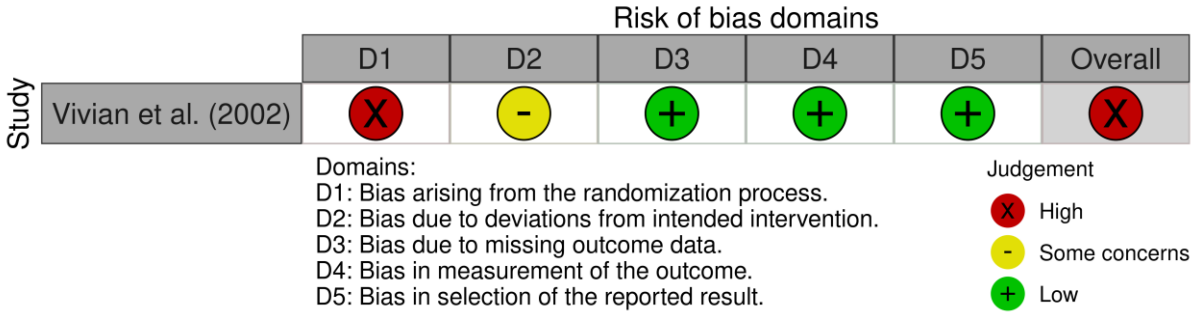

Figure 41: Systolic blood pressure levels in people with hypertension (risk of bias assessment using RoB 2)

This RCT reported very low-certainty evidence indicating a significant improvement in systolic blood pressure levels in the pharmacist prescribing group compared with the physician prescribing group [60]. An overview of the evidence is provided in Table 38.

Table 38: Systolic blood pressure levels in people with hypertension

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [60]	Protocol	Pharmacist prescribing versus physician prescribing	Outpatient	High	Very low	Mean (SD) 130.5 (13.2) versus 148.4 (21.0); *p*=0.0002	Pharmacist prescribing

3.5.1.5.1.3 Change in systolic blood pressure

Two studies (one retrospective cohort study and one RCT) reported on change in systolic blood pressure in people with hypertension in pharmacist prescribing compared with physician prescribing groups [59,60]. Figure 42 presents the risk of bias assessment for the retrospective cohort study; the study was judged to have an overall critical risk of bias score for this outcome. Figure 43 presents the risk of bias assessment for the RCT; the RCT was judged to have an overall high risk of bias score for this outcome.

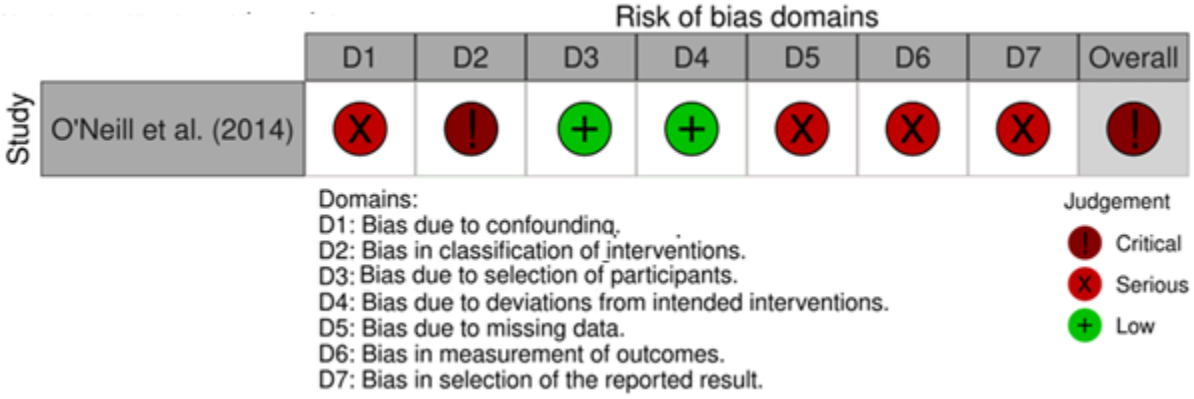

Figure 42: Change in systolic blood pressure in people with hypertension (risk of bias assessment using ROBINS-I)

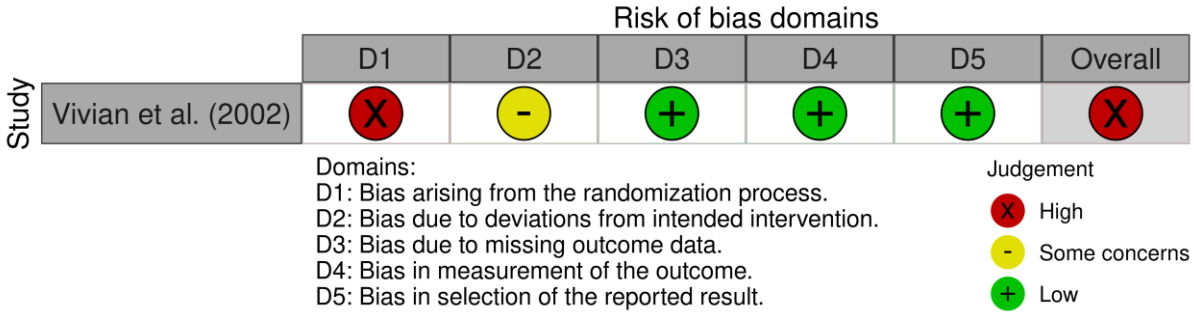

Figure 43: Change in systolic blood pressure in people with hypertension (risk of bias assessment using RoB 2)

The retrospective cohort study reported very low-certainty evidence indicating no significant difference in systolic blood pressure between the pharmacist prescribing and physician prescribing groups [59]. The RCT reported very low-certainty evidence indicating a significant improvement in systolic blood pressure in the pharmacist prescribing group compared with the physician prescribing group [60]. An overview of the evidence is provided in Table 39.

Table 39: Change in systolic blood pressure in people with hypertension

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [59]	Collaborative practice agreement: change medication	Pharmacist prescribing versus physician prescribing	Outpatient	Critical	Very low	Mean change (SD) 14 (13) versus 10 (11); *p*=0.04 Adjusted p-value; *p*=0.42	No significant difference
RCT [60]	Protocol	Pharmacist prescribing versus physician prescribing	Outpatient	High	Very low	Mean change (95% CI) −18.4 (−26.3 to 10.5) versus −3.98 (−11.8 to 3.79); *p*=0.01	Pharmacist prescribing

3.5.1.5.1.4 Diastolic blood pressure levels

One RCT reported on diastolic blood pressure levels in people with hypertension in a pharmacist prescribing group compared with a physician prescribing group [60]. Figure 44 presents the risk of bias assessment; this trial was judged to have an overall high risk of bias score for this outcome.

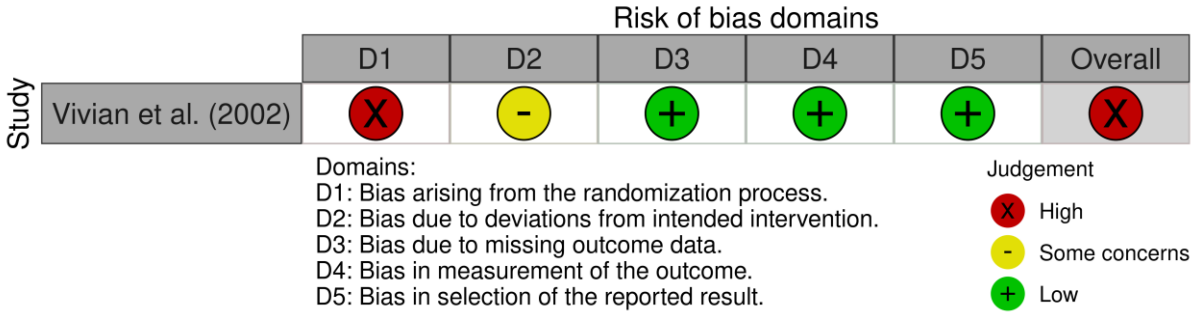

Figure 44: Diastolic blood pressure levels in people with hypertension (risk of bias assessment using RoB 2)

This RCT reported very low-certainty evidence indicating no significant difference in diastolic blood pressure levels between the pharmacist prescribing group and the physician prescribing group [60]. An overview of the evidence is provided in Table 40.

Table 40: Diastolic blood pressure levels in people with hypertension

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [60]	Protocol	Pharmacist prescribing versus physician prescribing	Outpatient	High	Very low	Mean (SD) 77.5 (10.7) versus 80.4 (11.4); *p*=0.259	No significant difference

3.5.1.5.1.5 Change in diastolic blood pressure

Two studies (one retrospective cohort study and one RCT) reported on change in diastolic blood pressure in people with hypertension in pharmacist prescribing compared with physician prescribing groups [59,60]. Figure 45 presents the risk of bias assessment for the retrospective cohort study; the study was judged to have an overall critical risk of bias score for this outcome. Figure 46 presents the risk of bias assessment for the RCT; the trial was judged to have an overall high risk of bias score for this outcome.

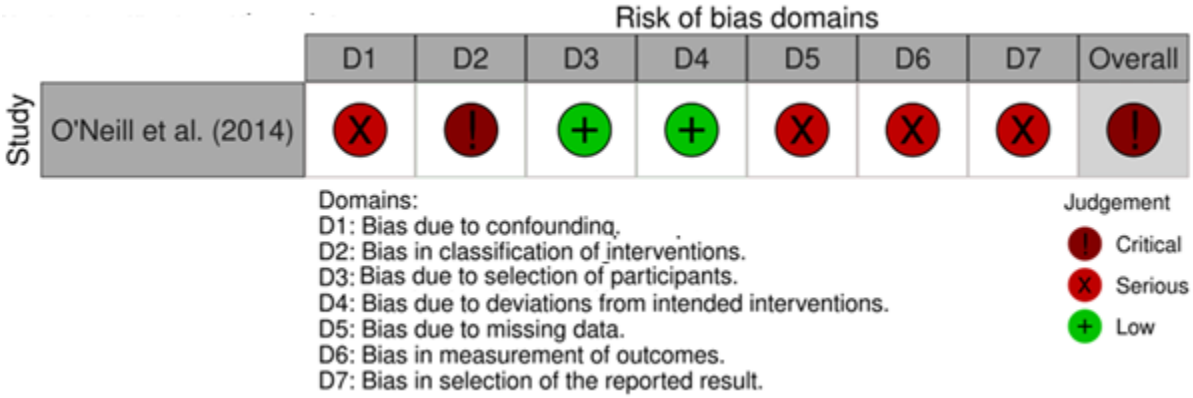

Figure 45: Change in diastolic blood pressure in people with hypertension (risk of bias assessment using ROBINS-I)

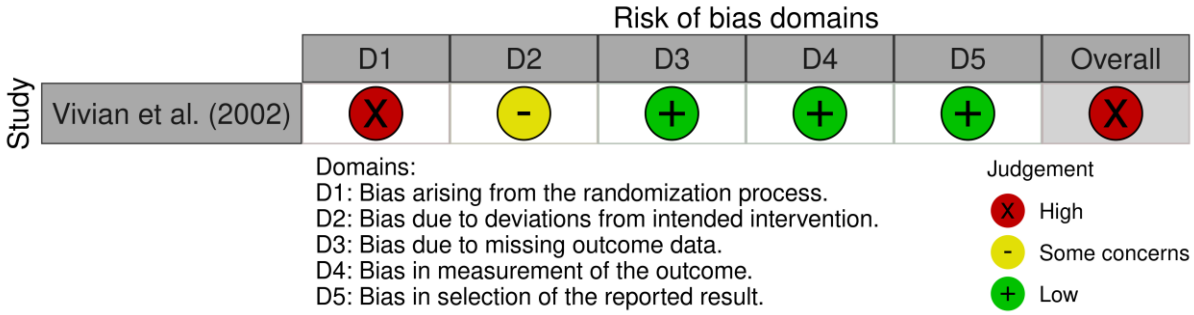

Figure 46: Change in diastolic blood pressure in people with hypertension (risk of bias assessment using RoB 2)

One study reported very low-certainty evidence indicating no significant difference in diastolic blood pressure between the pharmacist prescribing group and the physician prescribing group [59]. The other study reported very low-certainty evidence indicating a significant improvement in diastolic blood pressure in the pharmacist prescribing group compared with the physician prescribing group [60]. An overview of the evidence is provided in Table 41.

Table 41: Change in diastolic blood pressure in people with hypertension

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [59]	Collaborative practice agreement: change medication	Pharmacist prescribing versus physician prescribing	Outpatient	Critical	Very low	Mean difference (SD) 6 (10) versus 6 (7); *p*=0.90 Adjusted *p*=0.93	No significant difference
RCT [60]	Protocol	Pharmacist prescribing versus physician prescribing	Outpatient	High	Very low	Mean change (95% CI) −12.38 (−16.49 to −8.28) versus 2.54 (−1.49 to 6.57); *p*=0.001	Pharmacist prescribing

3.5.1.5.2 Adherence

One RCT reported on medication adherence in people with hypertension in a pharmacist prescribing group compared with a physician prescribing group [60]. Figure 47 presents the risk of bias assessment for the RCT; the trial was judged to have an overall high risk of bias score for this outcome.

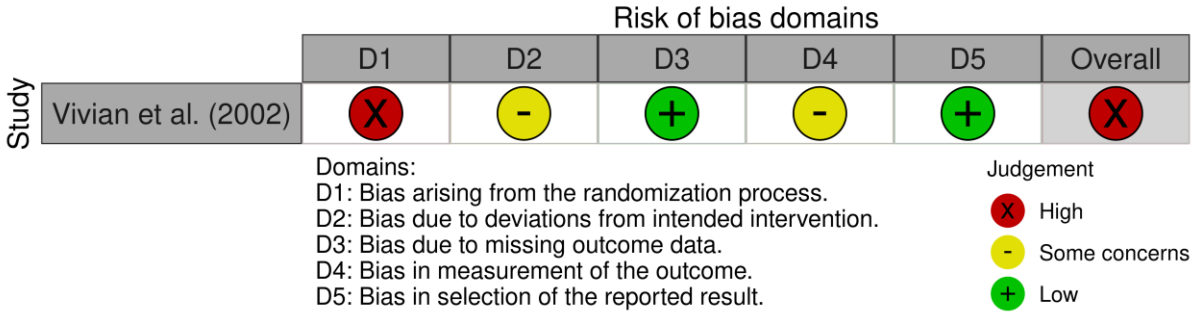

Figure 47: Adherence in people with hypertension (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in medication adherence between the pharmacist prescribing group and the physician prescribing group [60]. An overview of the evidence is provided in Table 42.

Table 42: Adherence in people with hypertension

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [60]	Protocol	Pharmacist prescribing versus physician prescribing	Outpatient	High	Very low	$p>0.25$	No significant difference

3.5.1.5.3 Health-related quality of life

One RCT reported on health-related quality of life in people with hypertension in a pharmacist prescribing group compared with a physician prescribing group [60]. Figure 48 presents the risk of bias assessment for the RCT; this study was judged to have an overall high risk of bias score for this outcome.

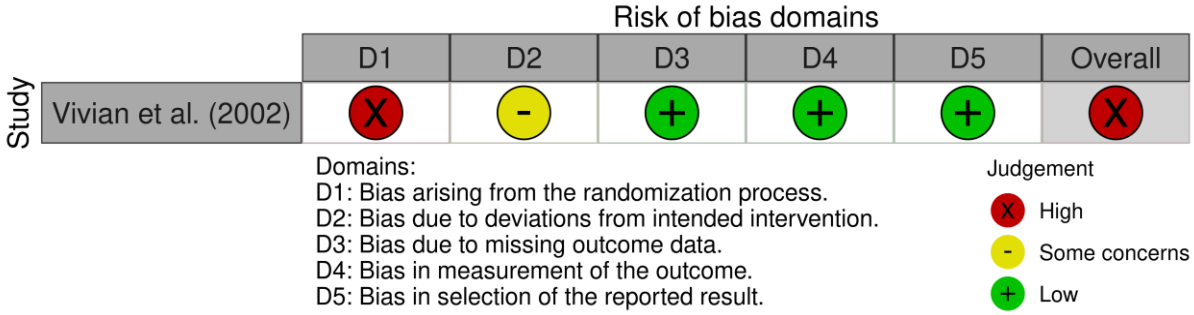

Figure 48: Health-related quality of life in people with hypertension (risk of bias assessment using RoB 2)

This RCT reported very low-certainty evidence indicating no significant difference in health-related quality of life in the pharmacist prescribing group compared with the physician prescribing group [60]. An overview of the evidence is provided in Table 43.

Table 43: Health-related quality of life in people with hypertension

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [60]	Protocol	Pharmacist prescribing versus physician prescribing	Outpatient	High	Very low	$p>0.2$	No significant difference

3.5.1.5.4 Summary of findings

Two studies assessed the effectiveness of pharmacist prescribing for people with hypertension [59,60]. The effectiveness outcomes assessed were blood pressure, adherence, and health-related quality of life. There was an improvement for four outcomes in favour of the pharmacist prescribing compared with the physician prescribing groups; there was no significant difference between the pharmacist prescribing and physician prescribing groups for the other six outcomes (Table 44).

Table 44: Summary of effectiveness findings for hypertension

Pharmacist prescribing compared with physician prescribing for hypertension

Patient or population group: Hypertension
Prescribing authority: Collaborative practice agreement; protocol
Setting: Outpatient
Intervention: Pharmacist prescribing
Comparison: Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Blood pressure goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	126 (1 retrospective cohort study)	⊕◯◯◯ Very low
Blood pressure goal achieved assessed with: Yes/No	A significant improvement was reported in the pharmacist prescribing group compared with the physician prescribing group.	53 (1 RCT)	⊕◯◯◯ Very low
Systolic blood pressure levels assessed with: Mean	A significant improvement was reported in the pharmacist prescribing group compared with the physician prescribing group.	53 (1 RCT)	⊕◯◯◯ Very low
Change in systolic blood pressure assessed with: Mean change	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	126 (1 retrospective cohort study)	⊕◯◯◯ Very low

Change in systolic blood pressure assessed with: Mean change	A significant improvement was reported in the pharmacist prescribing group compared with the physician prescribing group.	53 (1 RCT)	⊕◯◯◯ Very low
Diastolic blood pressure levels assessed with: Mean	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	53 (1 RCT)	⊕◯◯◯ Very low
Change in diastolic blood pressure assessed with: Mean difference	A significant improvement was reported in the pharmacist prescribing group compared with the physician prescribing group.	53 (1 RCT)	⊕◯◯◯ Very low
Change in diastolic blood pressure assessed with: Mean	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	126 (1 retrospective cohort study)	⊕◯◯◯ Very low
Adherence assessed with: Number of refills	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	53 (1 RCT)	⊕◯◯◯ Very low
Health-related quality of life assessed with: Mean	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	52 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.6 Coagulation disorders

Six studies (three retrospective cohort studies, one RCT, and two non-randomised trial) assessed effectiveness outcomes related to coagulation disorders [61–66]. The outcome measures assessed were related to blood clotting.

3.5.1.6.1 Blood clotting

Six studies (three retrospective cohort studies, one RCT, and two non-randomised trial) assessed the effectiveness of pharmacist prescribing for people with coagulation disorders [61–66]. The effectiveness outcomes assessed were related to blood clotting and included international normalised ratio (INR) control achieved, percentage of time that INR was within the therapeutic range, average time to therapeutic INR, average time to achieve therapeutic proconvertin and prothrombin levels, partial thromboplastin time, and prothrombin time ratio in the therapeutic range.

3.5.1.6.1.1 INR control achieved

One non-randomised trial and two retrospective cohort studies reported on the proportion of participants with coagulation disorders achieving INR control in pharmacist prescribing compared with physician prescribing or nurse prescribing groups [63,64,66]. Figure 49 presents the risk of bias assessment for these studies. The two retrospective cohort studies were judged to have overall critical

risk of bias scores for this outcome, and the non-randomised trial was judged to have an overall serious risk of bias score.

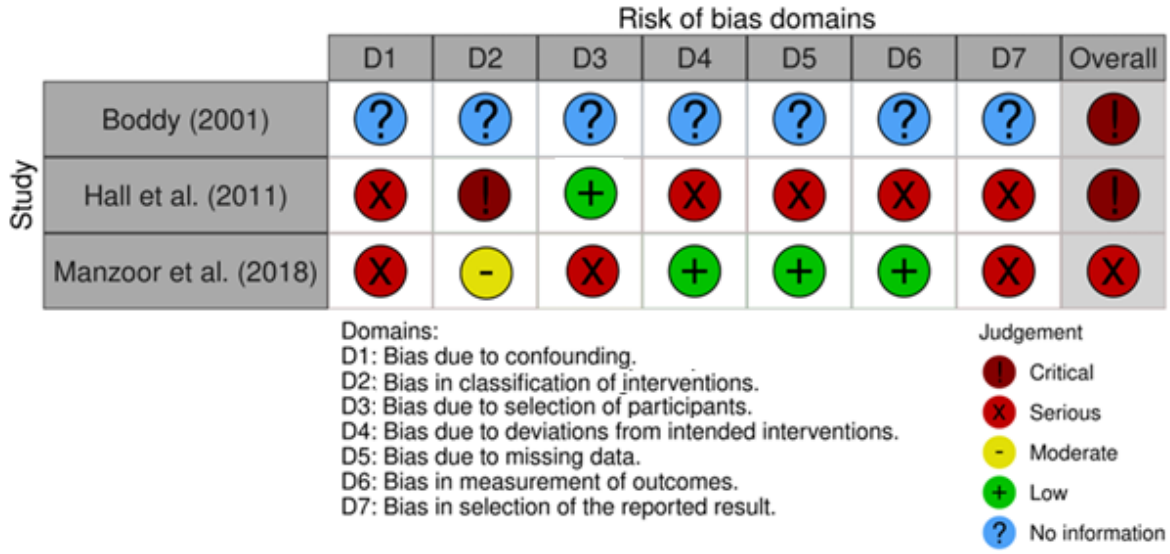

Figure 49: INR control achieved in patients receiving anticoagulation therapy (risk of bias assessment using ROBINS-I)

Two of the studies reported very low-certainty evidence indicating a significantly higher proportion of participants achieving INR control in the pharmacist prescribing groups compared with the physician prescribing groups [63,64]. One study reported no significant difference in the proportion of participants achieving INR control between the pharmacist prescribing group and the nurse prescribing group [66]. An overview of the evidence is provided in Table 45.

Table 45: INR control achieved in patients receiving anticoagulation therapy

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Non-randomised trial [63]	Protocol: dose warfarin	Pharmacist led versus physician led	Inpatient	Critical	Very low	Number of events (%) 43/74 (58.1%) versus 12/64 (18.8%); *p*<0.001	Pharmacist prescribing
Retrospective cohort study [64]	Collaborative practice agreement: bridge with heparin, modify drug therapy	Pharmacist managed versus physician managed	Outpatient	Critical	Very low	Number of events (%) 118/175 (67.4%) versus 96/175 (54.9%); *p*<0.0001	Pharmacist prescribing
Retrospective cohort study [66]	Collaborative practice agreement: dose and	Pharmacist managed versus nurse managed	Outpatient	Serious	Very low	Mean difference in events	No significant difference

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
	manage warfarin					between groups −8.41; *p*=0.07	

3.5.1.6.1.2 Percentage of time that INR was within the therapeutic range

One retrospective cohort study reported on the percentage of time that participants' INR was within the therapeutic range in a pharmacist prescribing group compared with a physician prescribing group. Participants comprised patients receiving anticoagulation therapy [64]. Figure 50 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

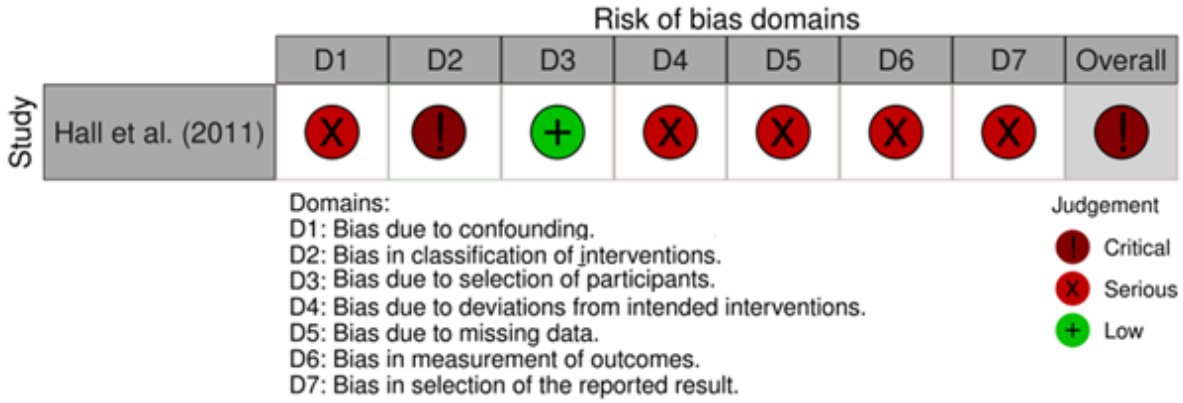

Figure 50: Percentage of time INR was in the therapeutic range in patients receiving anticoagulation therapy (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating INR was in a therapeutic range for significantly higher percentage of time in the pharmacist prescribing group compared with the physician prescribing group [64]. An overview of the evidence is provided in Table 46.

Table 46: Percentage of time INR was in the therapeutic range in patients receiving anticoagulation therapy

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [64]	Collaborative practice agreement: bridge with heparin, modify drug therapy	Pharmacist managed versus physician managed	Outpatient	Critical	Very low	Percentage of time 73.7% versus 61.1%; *p*<0.0001	Pharmacist prescribing

3.5.1.6.1.3 Average time to therapeutic INR

One non-randomised trial compared the mean number of days for participants receiving anticoagulation therapy to achieve therapeutic INR in a pharmacist prescribing group compared with a primary care

provider prescribing group [62]. Figure 51 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

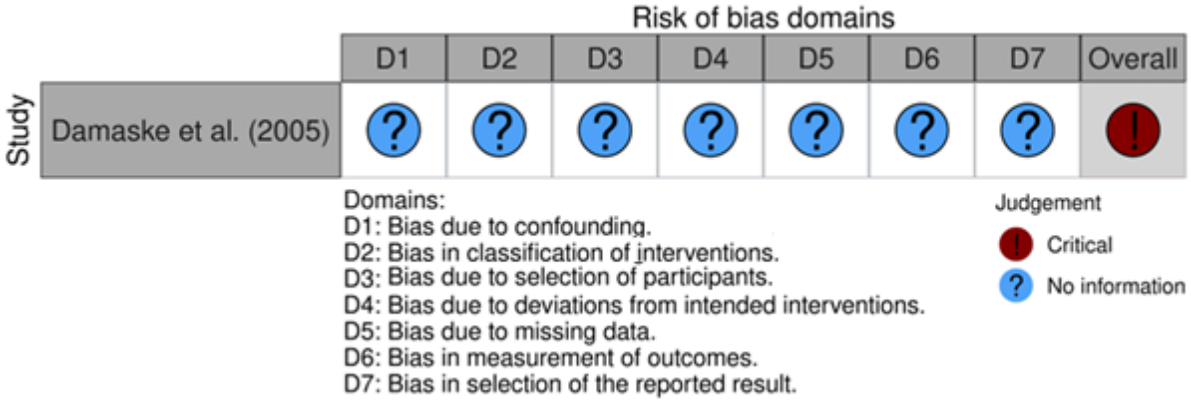

Figure 51: Average time to therapeutic INR in patients receiving anticoagulation therapy (risk of bias assessment using ROBINS-I)

The non-randomised trial reported very low-certainty evidence comparing the mean number of days for participants to achieve therapeutic INR in the pharmacist prescribing group compared with the primary care provider prescribing group [62]. As no inferential statistics were reported, we cannot comment on the statistical significance of these findings. An overview of the evidence is provided in Table 47.

Table 47: Average time to therapeutic INR in patients receiving anticoagulation therapy

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Non-randomised trial [62]	Protocol: dose warfarin	Pharmacist management versus primary care provider management	Inpatient	Critical	Very low	Mean number of days (range) 5.6 (4–11) versus 6.0 (4–11) Similar findings	No inferential statistics reported

3.5.1.6.1.4 Average time to achieve therapeutic proconvertin and prothrombin levels

One RCT reported the average time for patients receiving anticoagulation therapy to achieve proconvertin and prothrombin levels within the therapeutic range in a pharmacist prescribing group compared with a physician prescribing group [65]. Figure 52 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

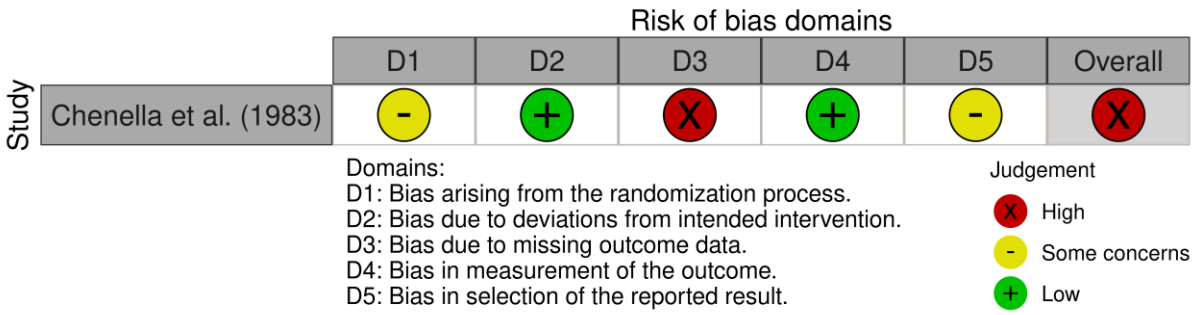

Figure 52: Average time to achieve therapeutic proconvertin and prothrombin levels in patients receiving anticoagulation therapy (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in the mean number of days to achieve therapeutic proconvertin and prothrombin levels in the pharmacist prescribing group compared with the physician prescribing group [65]. An overview of the evidence is provided in Table 48.

Table 48: Average time to achieve therapeutic proconvertin and prothrombin levels in patients receiving anticoagulation therapy

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [65]	Independent prescribing: dose heparin and warfarin	Pharmacist managed versus physician managed	Inpatient	High	Very low	Mean number of days (SD) 5.7 (1.4) versus 5.8 (1.4); *p*>0.05	No significant difference

3.5.1.6.1.5 Partial thromboplastin time

One RCT reported on the partial thromboplastin time range for patients receiving anticoagulation therapy in a pharmacist prescribing group compared with a physician prescribing group [65]. Figure 53 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

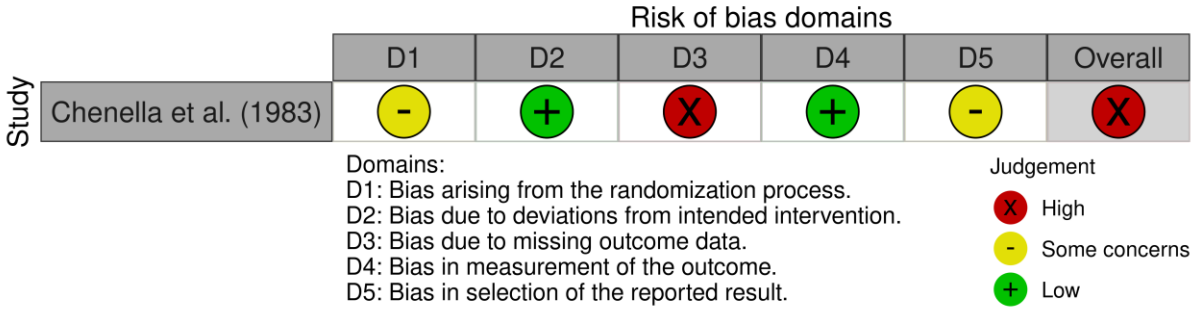

Figure 53: Partial thromboplastin time in patients receiving anticoagulation therapy (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in partial thromboplastin time between the pharmacist prescribing group and the physician prescribing group [65]. An overview of the evidence is provided in Table 49.

Table 49: Partial thromboplastin time in patients receiving anticoagulation therapy

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [65]	Independent prescribing: dose heparin and warfarin	Pharmacist managed versus physician managed	Inpatient	High	Very low	Mean number of seconds (SD) 82.0 (14) versus 84.0 (17); *p*>0.05	No significant difference

3.5.1.6.1.6 Prothrombin time ratio in the therapeutic range

One retrospective cohort study reported on the average time that prothrombin remained within the therapeutic range for patients receiving anticoagulation therapy in a pharmacist prescribing group compared with a physician prescribing group [61]. Figure 54 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

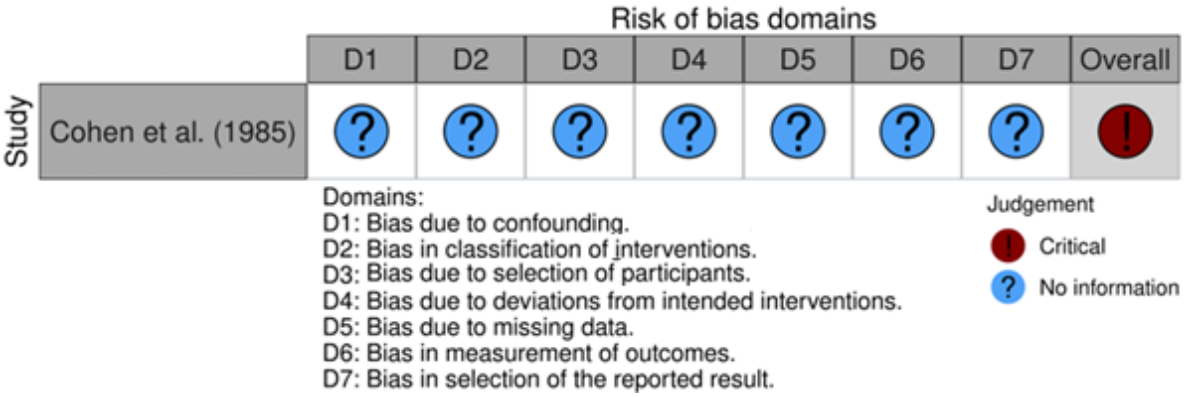

Figure 54: Prothrombin time ratio in the therapeutic range in patients receiving anticoagulation therapy (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in the average time that prothrombin remained within the therapeutic range between the pharmacist prescribing group and the physician prescribing group [61]. An overview of the evidence is provided in Table 50.

Table 50: Prothrombin time ratio in the therapeutic range in patients receiving anticoagulation therapy

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [61]	Protocol: dose warfarin	Pharmacist managed versus physician managed	Outpatient Veterans Affairs clinic	Critical	Very low	Proportion of participants (%) 68/78 (87.0%) versus 14/17	No significant difference

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
						(82.4%); *p*>0.05	

3.5.1.6.2 Summary of findings

Six studies assessed the effectiveness of pharmacist prescribing for people with coagulation disorders [61–66]. The effectiveness outcomes assessed were related to blood clotting. For three outcomes, there was an improvement in blood clotting measures associated with pharmacist prescribing groups compared with physician and nurse prescribing groups, while there was no significant difference for four outcomes. No inferential statistics were reported for one outcome (average time to therapeutic INR) (Table 51).

Table 51: Summary of effectiveness findings for coagulation disorders

Pharmacist prescribing compared with physician prescribing and nurse prescribing for coagulation disorders

Patient or population group: Coagulation disorders
Prescribing authority: Protocol; collaborative practice agreement; independent
Setting: Outpatient clinics; hospitals
Intervention: Pharmacist prescribing
Comparison: Physician prescribing; nurse prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
INR control achieved assessed with: Number of events	A significantly higher proportion of participants reported achieving INR control in the pharmacist prescribing group compared with the physician prescribing group.	138 (1 non-randomised trial)	⊕◯◯◯ Very low
INR control achieved assessed with: Number of events	A significantly higher proportion of participants reported achieving INR control in the pharmacist prescribing group compared with the physician prescribing group.	350 (1 retrospective cohort study)	⊕◯◯◯ Very low
Mean difference in INR control achieved assessed with: Mean difference	There was no significant difference between the pharmacist prescribing group and the nurse prescribing group.	200 (1 retrospective cohort study)	⊕◯◯◯ Very low
Percentage of time INR was within the therapeutic range assessed with: Yes/No	A significantly higher proportion of participants reported achieving INR control in the pharmacist prescribing group compared with the physician prescribing group.	350 (1 retrospective cohort study)	⊕◯◯◯ Very low

Average time to achieve therapeutic INR assessed with: Mean number of days	As no inferential statistics were reported, we cannot comment on the statistical significance of these findings.	51 (1 non-randomised trial)	⊕◯◯◯ Very low
Average time to achieve therapeutic proconvertin and prothrombin levels assessed with: Mean number of days	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	81 (1 RCT)	⊕◯◯◯ Very low
Partial thromboplastin time assessed with: Mean	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	81 (1 RCT)	⊕◯◯◯ Very low
Prothrombin time ratio in the therapeutic range assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	81 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.7 Chronic kidney disease

One retrospective cohort study assessed effectiveness outcomes related to coagulation disorders [67]. The outcome measure assessed was the proportion of participants achieving haemoglobin goals.

3.5.1.7.1 Haemoglobin goal achieved

One retrospective cohort study reported on patients with chronic kidney disease achieving their haemoglobin goals in a pharmacist prescribing group compared with two comparator groups (physician prescribing and usual care) [67]. Figure 55 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

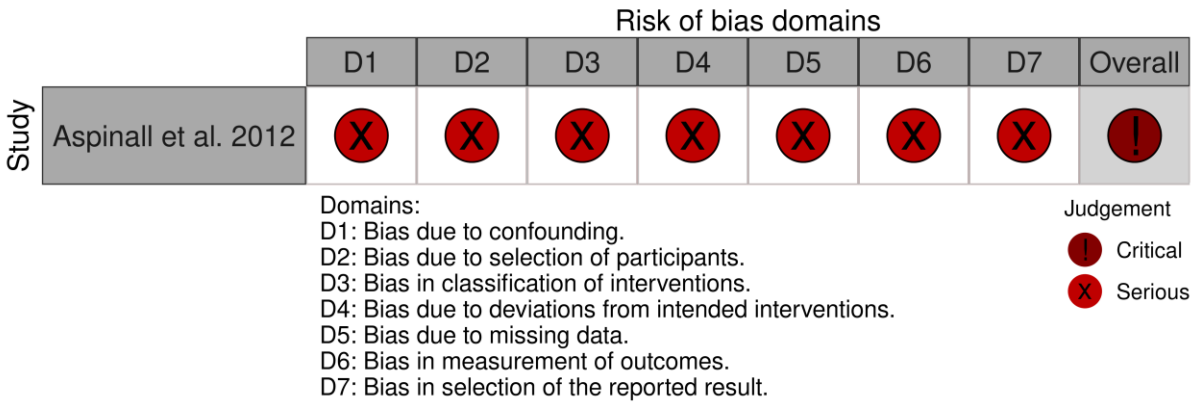

Figure 55: Haemoglobin goal achieved in people with chronic kidney disease (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence of a significantly higher proportion of patients achieving their haemoglobin goals in the pharmacist prescribing group compared with both the physician prescribing and usual care groups [67]. An overview of the evidence is provided in Table 52.

Table 52: Haemoglobin goal achieved in people with chronic kidney disease

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [67]	Collaborative practice agreement: dose and monitor	Pharmacist managed versus physician managed	Outpatient erythropoiesis-stimulating agent clinic	Critical	Very low	Number of events (%) 1,284/1,807 (71.1%) versus 179/346 (51.7%); *p*<0.001	Pharmacist prescribing
Retrospective cohort study [67]	Collaborative practice agreement: dose and monitor	Pharmacist managed versus usual care	Outpatient erythropoiesis-stimulating agent clinic	Critical	Very low	Number of events (%) 1,284/1,807 (71.1%) versus 345/606 (56.9%); *p*<0.001	Pharmacist prescribing

3.5.1.7.2 Summary of findings

One study assessed the effectiveness of pharmacist prescribing for people with chronic kidney disease [67]. The effectiveness outcome assessed was haemoglobin goal achieved. There was a significantly higher proportion of patients achieving their haemoglobin goals in the pharmacist prescribing group compared with both the clinic physician prescribing and the usual care groups (Table 53).

Table 53: Summary of effectiveness findings for chronic kidney disease

Pharmacist prescribing compared with clinic physician prescribing or usual care for chronic kidney disease

Patient or population group: Chronic kidney disease
Prescribing authority: Collaborative practice agreements
Setting: Outpatient erythropoiesis-stimulating agent clinic
Intervention: Pharmacist prescribing
Comparison: Clinic physician prescribing; usual care

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Haemoglobin goal achieved assessed with: Yes/No	A significantly higher proportion of patients achieved their haemoglobin goals in the pharmacist prescribing group compared with the clinic physician prescribing group.	405 (1 retrospective cohort study)	⊕◯◯◯ Very low

Haemoglobin goal achieved assessed with: Yes/No	A significantly higher proportion of patients achieved their haemoglobin goals in the pharmacist prescribing group compared with the usual care group.	481 (1 retrospective cohort study)	⨁◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.8 Urinary tract infection

One non-randomised trial assessed the effectiveness of pharmacist prescribing for women with urinary tract infections [68]. The effectiveness outcomes assessed were clinical cure at 2 weeks, time to access care, and adherence.

3.5.1.8.1 Clinical cure at 2 weeks

The non-randomised trial reported on whether there was a clinical cure at 2 weeks (sustained resolution of symptoms) in women with urinary tract infections in a pharmacist prescribing group compared with a physician prescribing group [68]. Figure 56 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

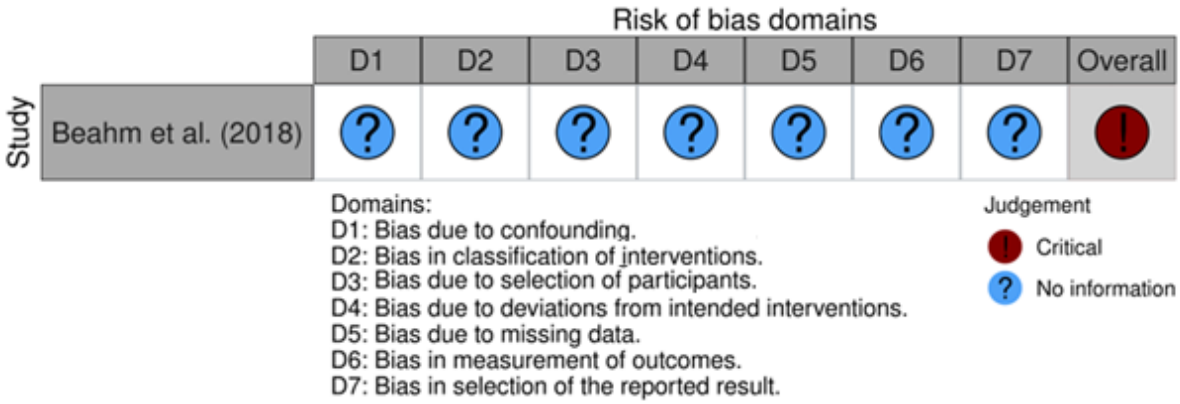

Figure 56: Clinical cure at 2 weeks in women with urinary tract infections (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in clinical cure at 2 weeks between the pharmacist prescribing group and the physician prescribing group [68]. An overview of the evidence is provided in Table 54.

Table 54: Clinical cure at 2 weeks in women with urinary tract infections

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Non-randomised trial [68]	Independent prescribing: prescribe and modify	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of events (%) 528/596 (88.6%)	No significant difference

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
						versus 82/90 (91.1%); *p*>0.99	

3.5.1.8.2 Time to access care

One non-randomised trial reported on whether there was a difference in the time it took to access care for women with urinary tract infections in a pharmacist prescribing group compared with a physician prescribing group [68]. Figure 57 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

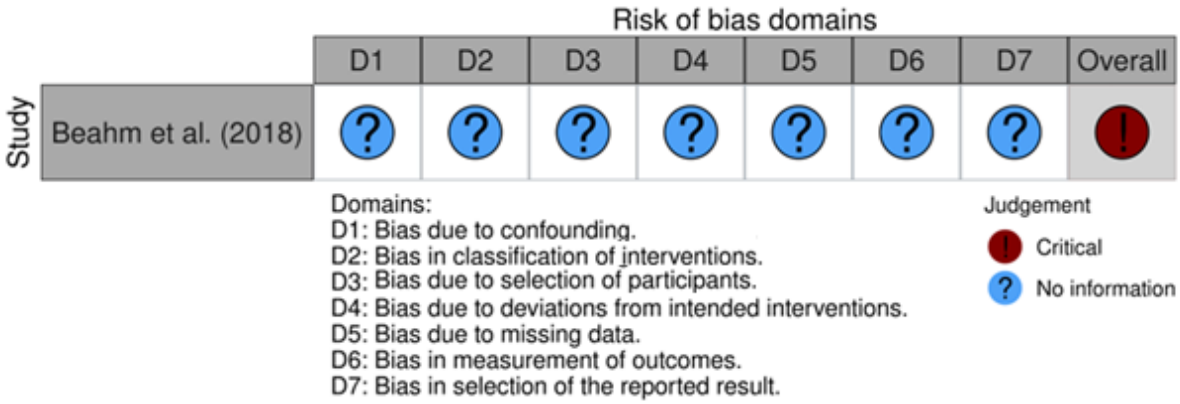

Figure 57: Time to access care for women with urinary tract infections (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating a significantly shorter time to access care in the pharmacist prescribing group compared with the physician prescribing group [68]. An overview of the evidence is provided in Table 55.

Table 55: Time to access care for women with urinary tract infections

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Non-randomised trial [68]	Independent prescribing: prescribe and modify	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Mean number of days (SD) 1.7 (2.4) versus 2.8 (3.8); *p*>0.0153	Pharmacist prescribing

3.5.1.8.3 Adherence

One non-randomised trial reported on whether there was a difference in treatment adherence by women with urinary tract infections in a pharmacist prescribing group compared with a physician prescribing

group [68]. Figure 58 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

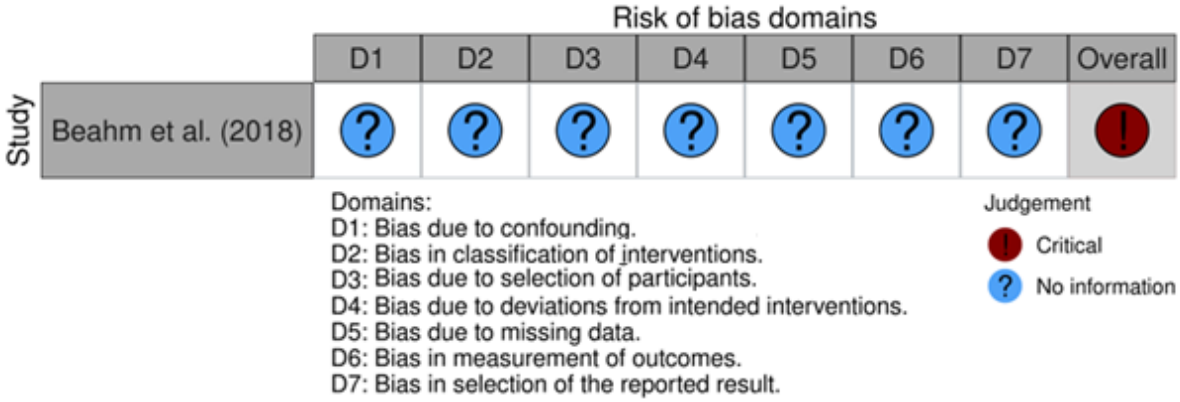

Figure 58: Adherence in women with urinary tract infections (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating a significantly higher treatment adherence in the pharmacist prescribing group compared with the physician prescribing group [68]. An overview of the evidence is provided in Table 56.

Table 56: Adherence in women with urinary tract infections

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Non-randomised trial [68]	Independent prescribing: prescribe and modify	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of events (%) 575/596 (96.5%) versus 81/90 (90%); *p*=0.0008	Pharmacist prescribing

3.5.1.8.4 Summary of findings

One study assessed the effectiveness of pharmacist prescribing for women with urinary tract infections [68]. The effectiveness outcomes assessed were clinical cure at 2 weeks, time to access care, and adherence. No statistically significant difference in clinical cure at 2 weeks was reported between the pharmacist prescribing and physician prescribing groups. Significant improvements in both time to access care and adherence were reported in the pharmacist prescribing group compared with the physician prescribing group (Table 57).

Table 57: Summary of effectiveness findings for urinary tract infection

Pharmacist prescribing compared with physician prescribing for urinary tract infection
Patient or population group: Urinary tract infection **Prescribing authority:** Independent **Setting:** Community pharmacy **Intervention:** Pharmacist prescribing **Comparison:** Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Clinical cure at 2 weeks assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	686 (1 non-randomised trial)	⊕◯◯◯ Very low
Time to access care assessed with: Mean number of days to access care	A significant improvement was reported in the pharmacist prescribing group compared with the physician prescribing group.	750 (1 non-randomised trial)	⊕◯◯◯ Very low
Adherence assessed with: Yes/No	A significant improvement was reported in the pharmacist prescribing group compared with the physician prescribing group.	686 (1 non-randomised trial)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.9 Older people in long-term care

Three studies assessed the effectiveness of pharmacist prescribing for older people in long-term care [69–71]. The effectiveness outcomes investigated were falls, drug burden, health-related quality of life, depression, anxiety, systolic blood pressure levels, and healthcare utilisation.

3.5.1.9.1 Falls

Two studies (one cluster RCT and one RCT) assessed the incidence of falls among older people in long-term care in pharmacist prescribing groups compared with primary care provider prescribing or physician prescribing groups [69,70]. Figure 59 presents the risk of bias assessment for the cluster RCT; the study was judged to have an overall high risk of bias score for this outcome. Figure 60 presents the risk of bias assessment for the RCT; the study was judged to have some concerns as its overall risk of bias score for this outcome.

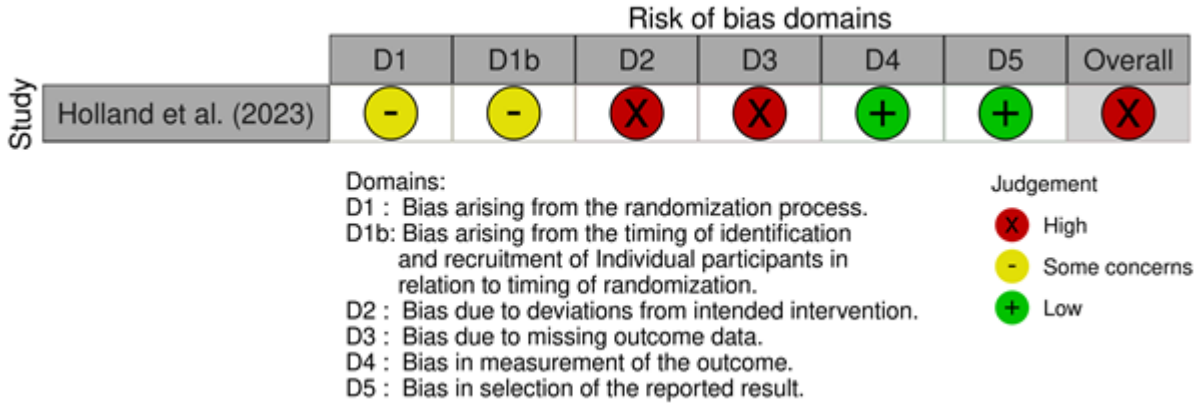

Figure 59: Falls requiring medical attention in older people in long-term care (risk of bias assessment using RoB 2 for cluster RCTs)

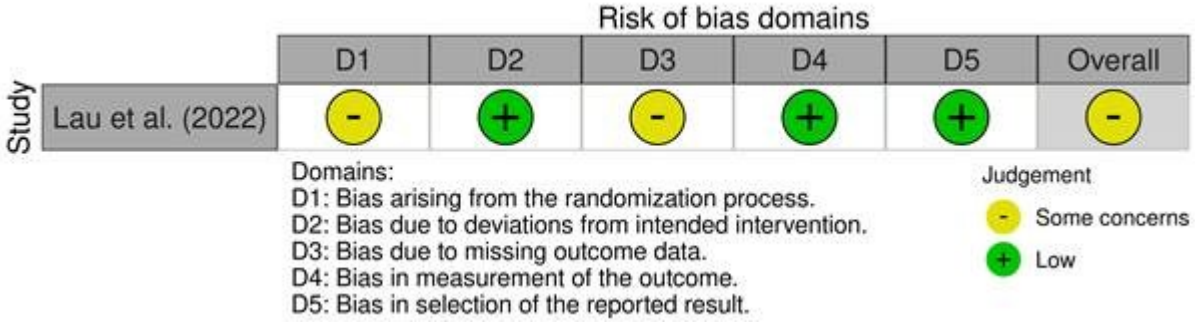

Figure 60: Fall rate per person in older people in long-term care (risk of bias assessment using RoB 2)

Both studies reported very low-certainty evidence. The cluster RCT reported no significant difference in the number of falls requiring medical attention among older people in long-term care between the pharmacist prescribing group and the primary care provider prescribing group [69]. As the RCT did not provide inferential statistics, we cannot comment on the statistical significance of these findings [70]. An overview of the evidence is provided in Table 58.

Table 58: Falls in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [69]	Independent prescribing: optimise therapy	Pharmacist prescribing versus primary care provider prescribing	Long-term care	High	Very low	Number of events (%) 1.26/449 (0.3%) versus 1.55/427 (0.4%); *p*=0.58	No significant difference
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Number of events (%) 9/47 (19.1%) versus 9/45 (20.0%)	No inferential statistics reported

						Similar findings	

3.5.1.9.2 Drug burden

One cluster RCT and one non-randomised trial reported on drug burden in older people in long-term care in pharmacist prescribing groups compared with primary care provider prescribing or medical internist prescribing groups [69,71]. Figure 61 presents the risk of bias assessment for the cluster RCT; the study was judged to have an overall high risk of bias score for this outcome. Figure 62 presents the risk of bias assessment for the non-randomised trial; the study was judged to have an overall critical risk of bias score for this outcome.

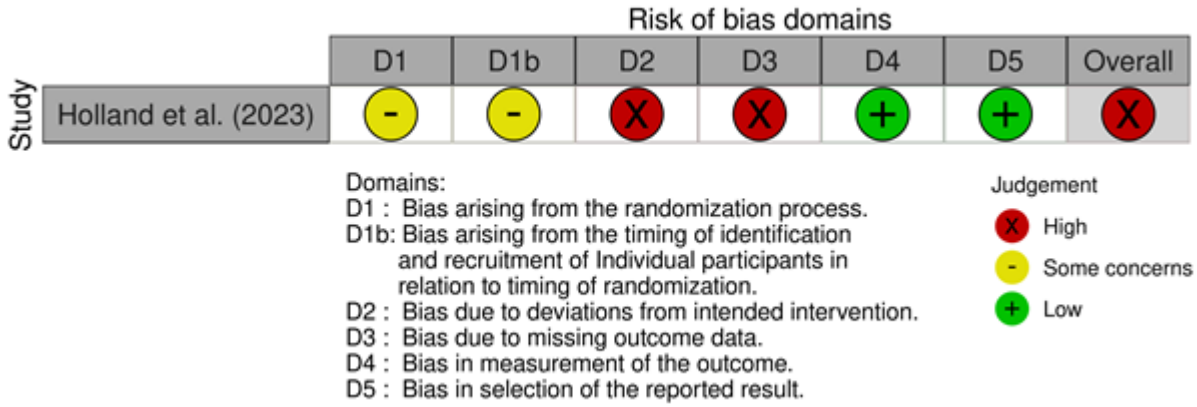

Figure 61: Drug burden in older people in long-term care (risk of bias assessment using RoB 2 for cluster RCTs)

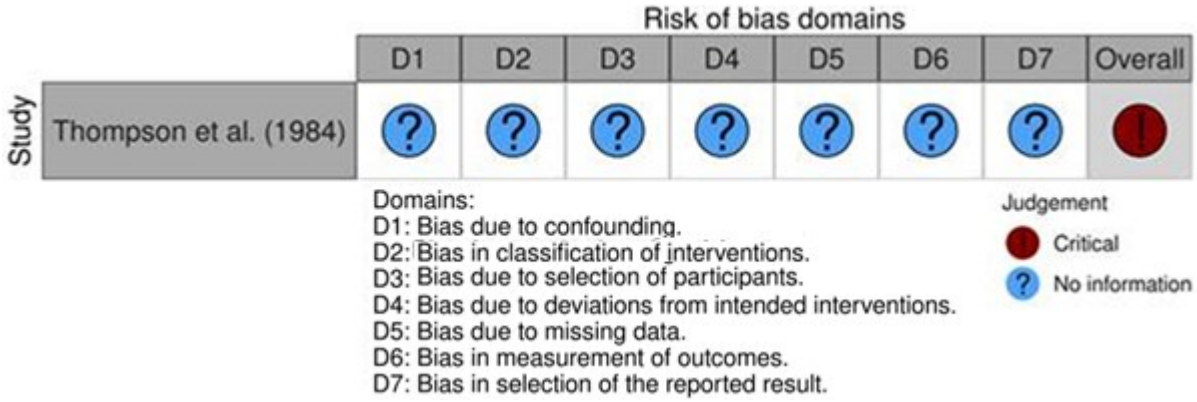

Figure 62: Drug burden in older people in long-term care (risk of bias assessment using ROBINS-I)

Both studies reported very low-certainty evidence indicating a significantly lower drug burden among older people in long-term care in the pharmacist prescribing groups compared with the primary care provider prescribing or the medical internist prescribing groups [69,71]. An overview of the evidence is provided in Table 59.

Table 59: Drug burden in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [69]	Independent prescribing: optimise therapy	Pharmacist prescribing versus primary care provider prescribing	Long-term care	High	Very low	Mean (SD) 0.66 (0.74) versus 0.73 (0.69); *p*<0.001	Pharmacist prescribing
Non-randomised trial [71]	Formulary prescribing: change medications	Pharmacist prescribing versus medical internist prescribing	Long-term care	Critical	Very low	Mean (SD) 5.7 (3.29) versus 7.1 (13.65); *p*=0.04	Pharmacist prescribing

3.5.1.9.3 Health-related quality of life

Two studies (one cluster RCT and one RCT) compared health-related quality of life among older people in long-term care in pharmacist prescribing groups compared with primary care provider prescribing or physician prescribing groups [69,70]. Figure 63 presents the risk of bias assessment for the cluster RCT; the study was judged to have an overall high risk of bias score for this outcome. Figure 64 presents the risk of bias assessment for the RCT; the study was judged to have some concerns as its overall risk of bias score for this outcome.

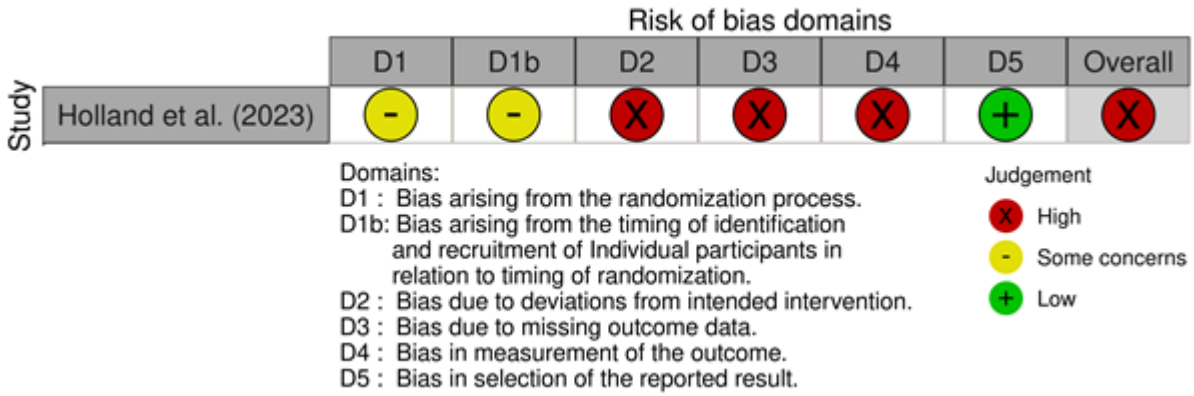

Figure 63: Health-related quality of life in older people in long-term care (risk of bias assessment using RoB 2 for cluster RCTs)

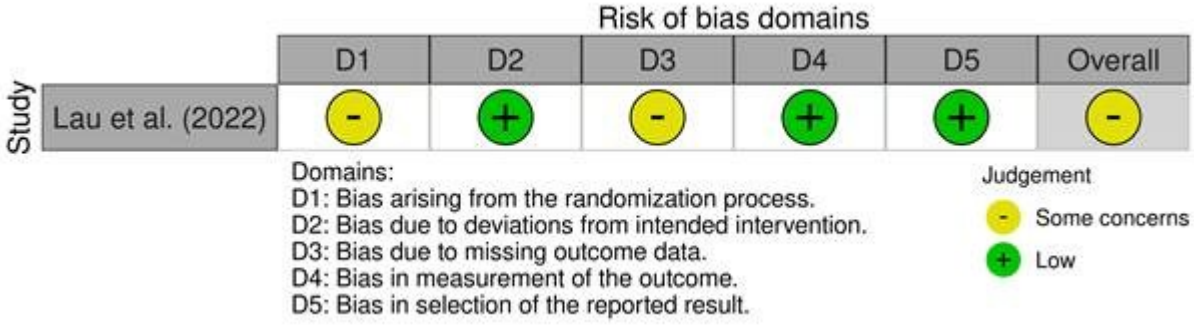

Figure 64: Health-related quality of life in older people in long-term care (risk of bias assessment using RoB 2)

Both studies reported very low-certainty evidence. The cluster RCT reported significantly higher health-related quality of life scores among older people in long-term care in the pharmacist prescribing group compared with the primary care provider prescribing group. The RCT reported no significant difference in health-related quality of life scores among older people in long-term care between the pharmacist prescribing group and the physician prescribing group. An overview of the evidence is provided in Table 60.

Table 60: Health-related quality of life in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [69]	Independent prescribing: optimise therapy	Pharmacist prescribing versus primary care provider prescribing	Long-term care	High	Very low	Mean (SD) 0.26 (0.35) versus 0.21 (0.33); *p*=0.042	Pharmacist prescribing
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Mean change (SD) −0.0 (0.4) versus 0.0 (0.1); *p*=0.574	No significant difference

3.5.1.9.4 Depression

One RCT reported on depression among older people in long-term care in a pharmacist prescribing group compared with a physician prescribing group [70]. Figure 65 presents the risk of bias assessment; the study was judged to have some concerns as its overall risk of bias score for this outcome.

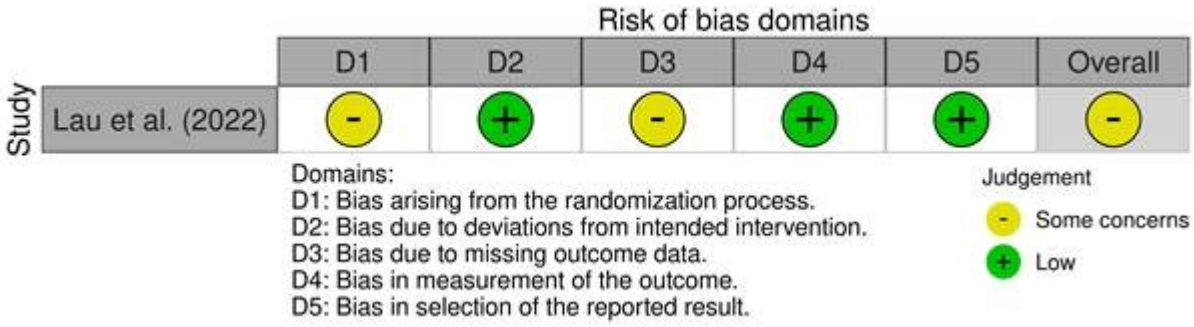

Figure 65: Depression in older people in long-term care (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in depression among older people in long-term care in the pharmacist prescribing group compared with the physician prescribing group [70]. An overview of the evidence is provided in Table 61

Table 61: Depression in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Mean change in depression scores (SD) 1.0 (3.8) versus 1.2 (3.1); *p*=0.924	No significant difference

3.5.1.9.5 Anxiety

One RCT reported on anxiety among older people in long-term care in a pharmacist prescribing group compared with a physician prescribing group [70]. Figure 66 presents the risk of bias assessment; the study was judged to have some concerns as its overall risk of bias score for this outcome.

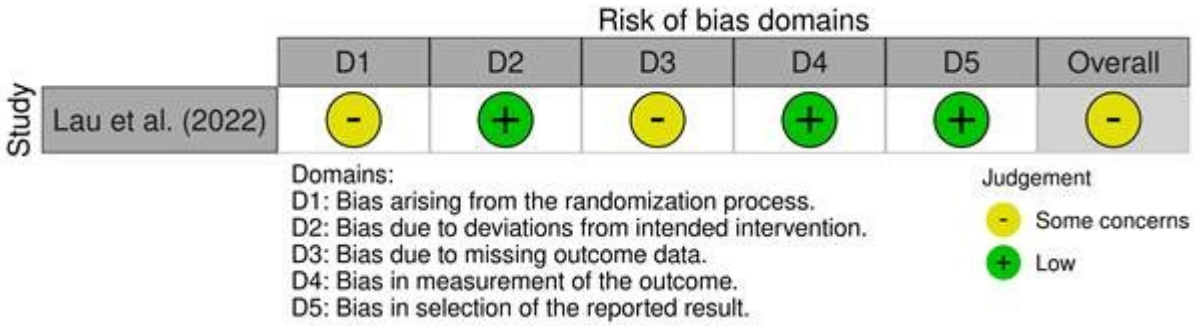

Figure 66: Anxiety in older people in long-term care (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in anxiety among older people in long-term care in the pharmacist prescribing group compared with the physician prescribing group [70]. An overview of the evidence is provided in Table 62

Table 62: Anxiety in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Mean change (SD) 0.4 (1.8) versus 0.1 (1.4); *p*=0.43	No significant difference

3.5.1.9.6 Systolic blood pressure levels

One RCT reported on the proportion of older people in long-term care achieving systolic blood pressure targets on 24-hour ambulatory blood pressure monitoring in a pharmacist prescribing group compared

with a physician prescribing group [70]. Figure 67 presents the risk of bias assessment; the study was judged to have some concerns as its overall risk of bias score for this outcome.

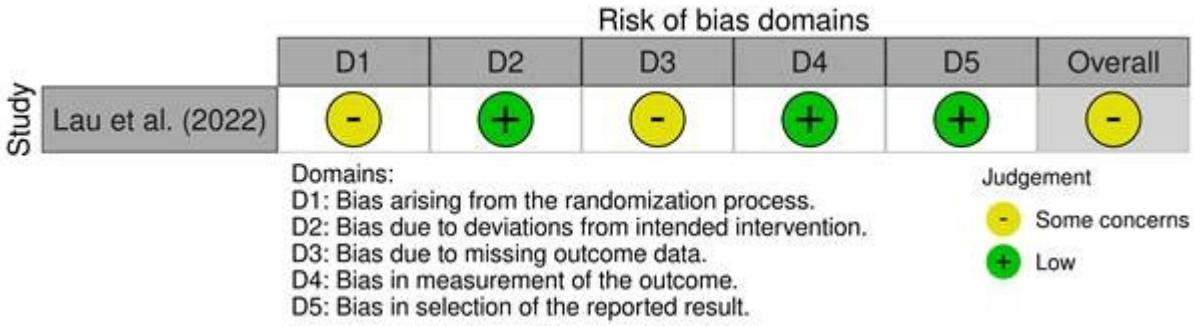

Figure 67: Systolic blood pressure in older people in long-term care (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in systolic blood pressure among older people in long-term care in the pharmacist prescribing group compared with the physician prescribing group [70]. An overview of the evidence is provided in Table 63

Table 63: Systolic blood pressure in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Number of events (%) 31/47 (66%) versus 25/45 (55.5%); *p*=0.153	No significant difference

3.5.1.9.7 Healthcare utilisation

Three studies assessed effectiveness outcomes related to healthcare utilisation among older people in long-term care [69–71]. Findings are presented by the outcome measures hospitalisations and emergency department admissions.

3.5.1.9.7.1 Hospitalisations

Three studies (one non-randomised trial, one RCT, and one cluster RCT) reported on hospitalisations among older people in long-term care in pharmacist prescribing groups compared with primary care provider prescribing, physician prescribing, or medical internist prescribing groups [69–71]. Figure 68 presents the risk of bias assessment for the cluster RCT; the study was judged to have an overall high risk of bias score for this outcome. Figure 69 presents the risk of bias assessment for the RCT; the study was judged to have some concerns as its overall risk of bias score for this outcome. Figure 70 presents the risk of bias assessment for the non-randomised trial; the study was judged to have an overall critical risk of bias score for this outcome.

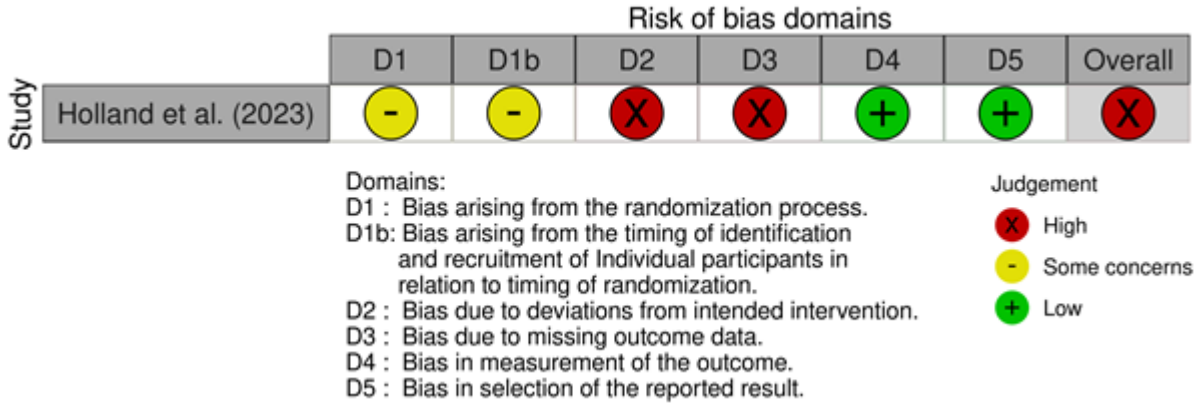

Figure 68: Hospitalisations in older people in long-term care (risk of bias assessment using RoB 2 for cluster RCTs)

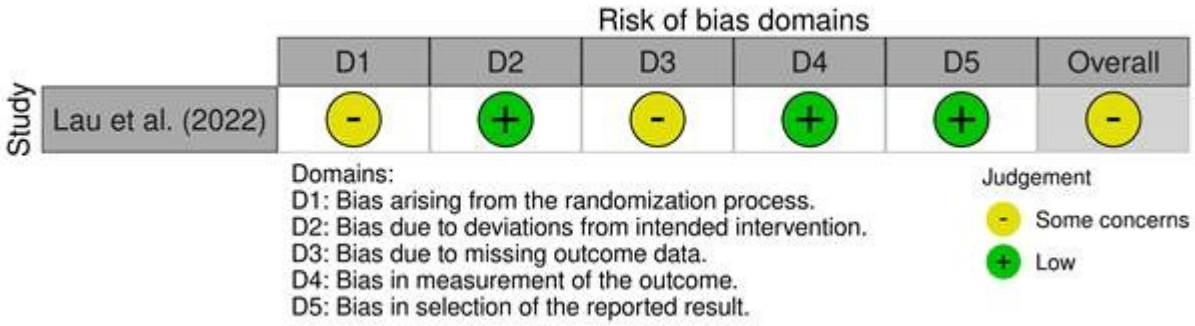

Figure 69: Hospitalisations in older people in long-term care (risk of bias assessment using RoB 2)

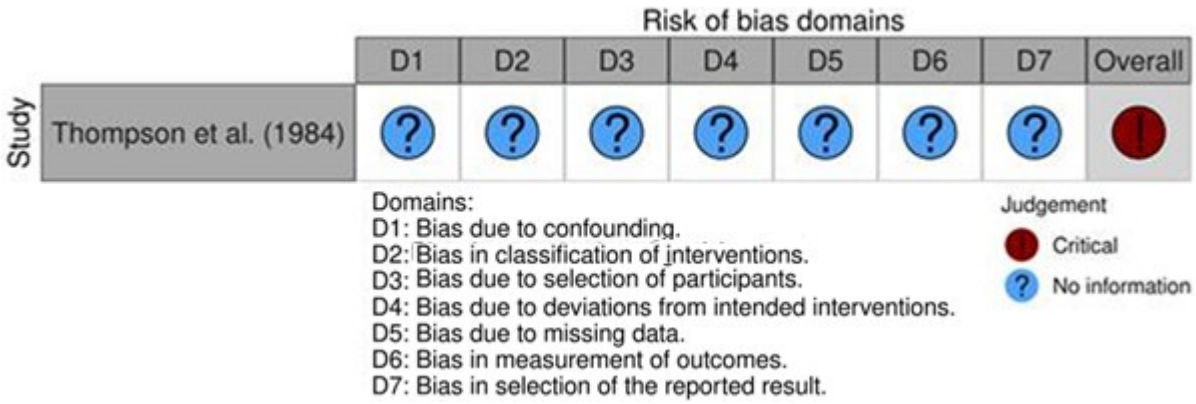

Figure 70: Hospitalisations in older people in long-term care (risk of bias assessment using ROBINS-I)

All three studies reported low- to very low-certainty evidence of no significant difference in hospitalisations among older people in long-term care between the pharmacist prescribing groups and the primary care provider, physician, or medical internist prescribing groups [69–71]. An overview of the evidence is provided in Table 64

Table 64: Hospitalisations in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [69]	Independent prescribing: optimise therapy	Pharmacist prescribing versus primary care provider prescribing	Long-term care	High	Low	Mean (SD) 0.19 (0.5) versus 0.18 (0.47); *p*=0.57	No significant difference
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Low	Mean change (SD) 0.31 (0.70) versus 0.24 (0.73); *p*=0.569	No significant difference
Non-randomised trial [71]	Formulary prescribing: change medications	Pharmacist prescribing versus medical internist prescribing	Long-term care	Critical	Very low	Number of events (%) 2/67 (3.0%) versus 8/72 (11.1%); *p*=0.06	No significant difference

3.5.1.9.7.2 Emergency department admissions

One RCT reported on emergency department admissions among older people in long-term care in a pharmacist prescribing group compared with a physician prescribing group [70]. Figure 71 presents the risk of bias assessment; the RCT was judged to have some concerns as its overall risk of bias score for this outcome.

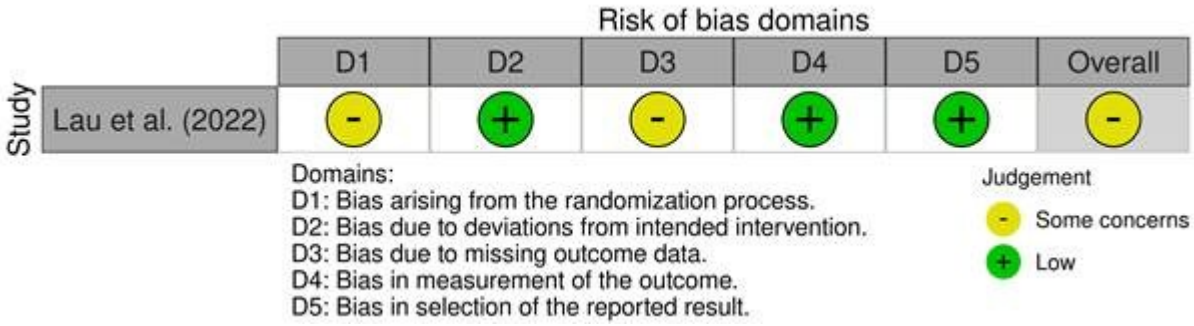

Figure 71: Emergency department admissions in older people in long-term care (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in emergency department admissions among older people in long-term care between the pharmacist prescribing group and the physician prescribing group [70]. An overview of the evidence is provided in Table 65.

Table 65: Emergency department admissions in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Mean (SD) 0.59 (1.19) versus 0.39 (0.77); *p*=0.276	No significant difference

3.5.1.9.8 Summary of findings

Three studies assessed the effectiveness of pharmacist prescribing for older people in long-term care [69–71]. The effectiveness outcomes assessed were falls, drug burden, health-related quality of life, depression, anxiety, systolic blood pressure levels, and healthcare utilisation. In relation to falls, either no significant difference was reported, or no inferential statistics were reported between the pharmacist prescribing and primary care provider prescribing or physician prescribing groups in two studies. There was a significant improvement in the drug burden outcome reported in the pharmacist prescribing groups compared with the medical internist prescribing or primary care provider prescribing groups in two studies.

For health-related quality of life, there was a significant improvement in a pharmacist prescribing group compared with a primary care provider prescribing group in one study, and no significant difference between a pharmacist prescribing group and a physician prescribing group in another study. There was no significant difference in depression, anxiety, or healthcare utilisation outcomes between pharmacist prescribing groups and primary care provider prescribing, physician prescribing, or medical internist prescribing groups in all three studies (Table 66).

Table 66: Summary of effectiveness findings for older people in long-term care

Pharmacist prescribing compared with primary care provider, physician, or medical internist prescribing for older people in long-term care

Patient or population group: Older people in long-term care
Prescribing authority: Protocol; independent; formulary
Setting: Long-term care
Intervention: Pharmacist prescribing
Comparison: Primary care provider prescribing; physician prescribing; medical internist prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Falls assessed with: Mean	One cluster RCT reported no significant difference between the pharmacist prescribing and primary care provider prescribing groups. One RCT did not report inferential statistics; therefore, we cannot comment on the significance of these findings.	968 (1 RCT; 1 cluster RCT)	⊕◯◯◯ Very low

Systolic blood pressure goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	92 (1 RCT)	⊕◯◯◯ Very low
Drug burden assessed with: Drug burden index	A significant improvement was reported in the pharmacist prescribing group compared with the primary care provider prescribing group.	449 (1 cluster RCT)	⊕◯◯◯ Very low
Drug burden assessed with: Mean number of drugs per patient	A significant improvement was reported in the pharmacist prescribing group compared with the medical internist prescribing group.	139 (1 non-randomised trial)	⊕◯◯◯ Very low
Health-related quality of life assessed with: European Quality of Life 5 Dimensions (EQ-5D)	One cluster RCT reported a significant improvement in the pharmacist prescribing group compared with the primary care provider prescribing group. One RCT reported no significant difference between the pharmacist prescribing and physician prescribing groups.	968 (1 RCT; 1 cluster RCT)	⊕◯◯◯ Very low
Depression assessed with: Hospital Anxiety and Depression Scale – Depression subscale (HADS-D)	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	92 (1 RCT)	⊕◯◯◯ Very low
Anxiety assessed with: Hospital Anxiety and Depression Scale – Anxiety subscale (HADS-A)	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	92 (1 RCT)	⊕◯◯◯ Very low
Hospitalisations assessed with: Mean	No significant difference was reported between the pharmacist prescribing groups and the primary care provider or physician prescribing groups.	968 (1 RCT; 1 cluster RCT)	⊕⊕◯◯ Low
Hospitalisations assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing and medical internist prescribing groups.	139 (1 non-randomised trial)	⊕◯◯◯ Very low
Emergency department admissions assessed with: Mean	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	92 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.10 Female contraceptive users

Two studies (one prospective cohort study and one retrospective cohort study) assessed the effectiveness of pharmacist prescribing of contraception for women. The effectiveness outcomes assessed were continuation and adherence [72,73].

3.5.1.10.1 Continuation

Two studies (one prospective cohort study and one retrospective cohort study) reported on 12-month continuation rates among women prescribed contraception in pharmacist prescribing groups compared with physician prescribing groups [72,73]. Figure 72 presents the risk of bias assessment; both studies were judged to have an overall serious risk of bias score for this outcome.

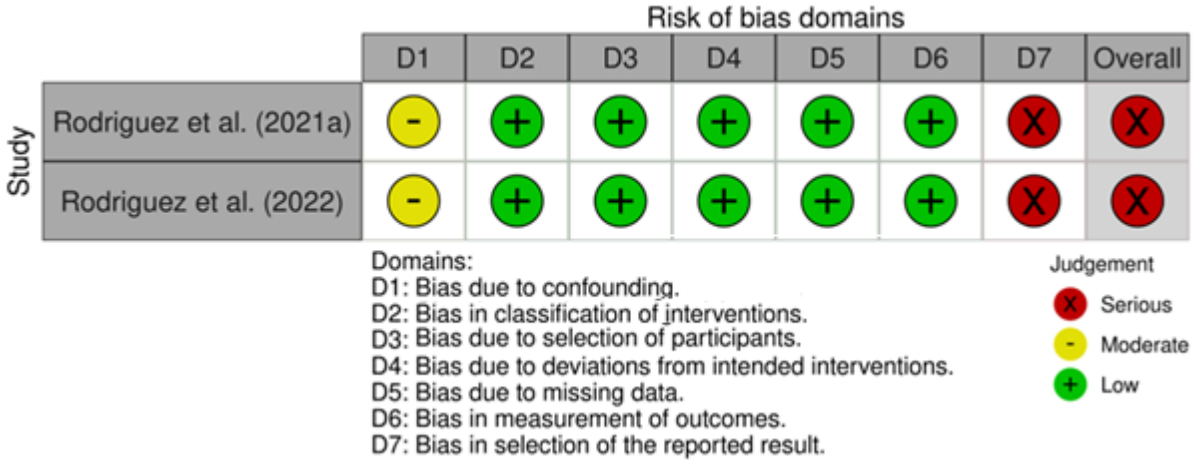

Figure 72: 12-month continuation rates in women prescribed contraception (risk of bias assessment using ROBINS-I)

Both studies reported very low-certainty evidence. The prospective cohort study reported no significant difference in 12-month continuation rates in women prescribed contraception between the pharmacist prescribing and physician prescribing groups [72]. The retrospective cohort study reported significantly higher continuation rates in the pharmacist prescribing group compared with the physician prescribing group [73]. An overview of the evidence is provided in Table 67.

Table 67 12-month continuation rates in women prescribed contraception

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Prospective cohort study [72]	Independent prescribing	Pharmacist prescribing versus physician prescribing	Community pharmacy	Serious	Very low	Odds ratio (95% CI) 0.70 (0.28–1.71)	No significant difference
Retrospective cohort study [73]	Independent prescribing	Pharmacist prescribing versus physician prescribing	Community pharmacy	Serious	Very low	Number of events (%) 519 (34.3%) versus 1,512 (21.0%); *p*<0.05	Pharmacist prescribing

3.5.1.10.2 Adherence

Two studies (one prospective cohort study and one retrospective cohort study) reported on adherence rates among women prescribed contraception in pharmacist prescribing groups compared with physician prescribing groups [72,73]. Figure 73 presents the risk of bias assessment; both studies were judged to have overall serious risk of bias scores for this outcome.

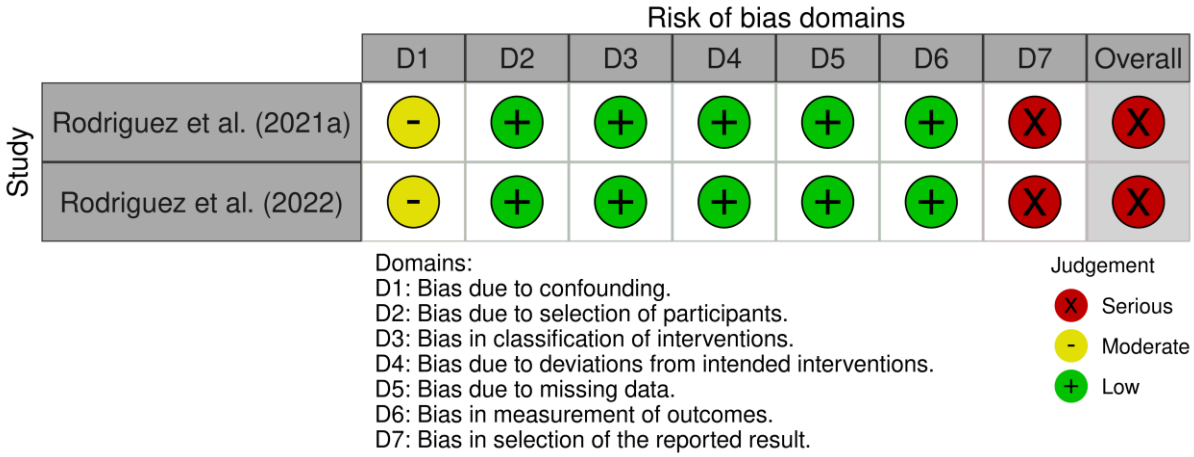

Figure 73: Adherence rates in women prescribed contraception (risk of bias assessment using ROBINS-I)

Both studies reported very low-certainty evidence. The prospective cohort reported significantly improved adherence rates in the pharmacist prescribing group compared with the physician prescribing group. The retrospective cohort study reported no significant difference between the pharmacist prescribing and the physician prescribing groups. An overview of the evidence is provided in Table 68.

Table 68: Adherence rates in women prescribed contraception

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Prospective cohort study [72]	Independent prescribing	Pharmacist prescribing versus physician prescribing	Community pharmacy	Serious	Very low	Adjusted odds ratio (95% CI) 0.87 (0.51–1.48)	Pharmacist prescribing
Retrospective cohort study [73]	Independent prescribing	Pharmacist prescribing versus physician prescribing	Community pharmacy	Serious	Very low	Number of events (%) 548 (61.6%) versus 42,182 (61.9%); *p*=0.89	No significant difference

3.5.1.10.3 Summary of findings

Two studies assessed the effectiveness of pharmacist prescribing for women seeking contraception. The effectiveness outcomes assessed were continuation and adherence [72,73]. The studies found both a significant improvement and no significant difference in the pharmacist prescribing groups compared with the physician prescribing groups for both outcomes (Table 69).

Table 69: Summary of effectiveness findings for female contraceptive users

Pharmacist prescribing compared with physician prescribing for female contraceptive users

Patient or population group: Female contraceptive users
Prescribing authority: Independent prescribing
Setting: Community pharmacy
Intervention: Pharmacist prescribing
Comparison: Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Continuation assessed with: Yes/No	One prospective cohort study reported no significant difference in the likelihood of 12-month continuation between the pharmacist prescribing group and the physician prescribing group. One retrospective cohort study reported significantly higher continuation rates in the pharmacist prescribing group compared with the physician prescribing group.	172,665 (1 prospective cohort study; 1 retrospective cohort study)	⨁◯◯◯ Very low
Adherence assessed with: Yes/No	One prospective cohort study reported significantly likelihood of higher adherence in the pharmacist prescribing group compared with the physician prescribing group. One retrospective cohort study reported no significant difference in adherence between the pharmacist prescribing group and the physician prescribing group.	172,665 (1 prospective cohort study; 1 retrospective cohort study)	⨁◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.11 Anaemia in pregnancy

One retrospective cohort study assessed effectiveness outcomes related to anaemia in pregnancy [74]. The outcome measure assessed was haemoglobin levels.

3.5.1.11.1 Haemoglobin levels

One retrospective cohort study reported on haemoglobin levels for anaemia in pregnancy in a pharmacist prescribing group compared with an obstetrician gynaecologist (OB/GYN) prescribing group [74]. Figure

74 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

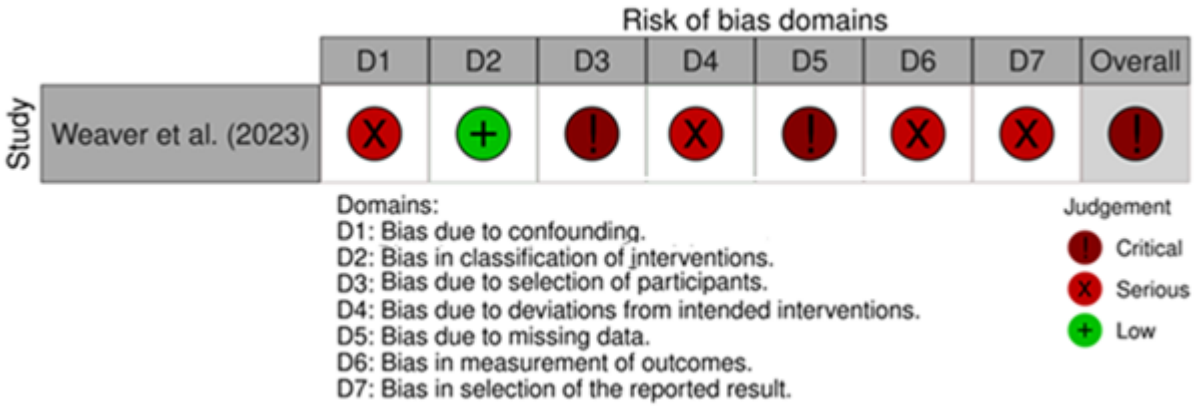

Figure 74: Haemoglobin goal achieved/mean haemoglobin levels for anaemia in pregnancy (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating a significantly higher number of participants with anaemia achieving their target haemoglobin levels, and significantly improved mean haemoglobin levels, in the pharmacist prescribing group compared with the OB/GYN prescribing group [74]. An overview of the evidence is provided in Table 70.

Table 70: Haemoglobin goal achieved/mean haemoglobin levels for anaemia in pregnancy

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [74]	Collaborative practice agreement: initiate and adjust iron therapies	Pharmacist managed versus OB/GYN managed	Telephone-based outpatient clinic	Critical	Very low	Haemoglobin goal achieved Number of events (%) 87/100 (87.0%) versus 71/100 (71.0%); *p*<0.01	Pharmacist prescribing
Retrospective cohort study [74]	Collaborative practice agreement: initiate and adjust iron therapies	Pharmacist managed versus OB/GYN managed	Telephone-based outpatient clinic	Critical	Very low	Mean haemoglobin levels (SD) 12.1 (1.0) grams per decilitre (g/dL) versus 11.6 (1.1) g/dL; *p*<0.01	Pharmacist prescribing

3.5.1.11.2 Summary of findings

One study assessed the effectiveness of pharmacist prescribing for women with anaemia in pregnancy. The effectiveness outcome assessed was related to achieving haemoglobin goals and mean haemoglobin

levels [74]. Significantly more patients achieved their target haemoglobin levels, and there was a significant improvement in mean haemoglobin levels, in the pharmacist prescribing group compared with the OB/GYN prescribing group (Table 71).

Table 71: Summary of effectiveness findings for anaemia in pregnancy

Pharmacist prescribing compared with OB/GYN prescribing for anaemia in pregnancy

Patient or population group: Anaemia in pregnancy
Prescribing authority: Collaborative practice agreement
Setting: Telephone-based outpatient clinic
Intervention: Pharmacist prescribing
Comparison: OB/GYN prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Haemoglobin goal achieved assessed with: Yes/No	A significantly higher number of participants achieved their haemoglobin goals in the pharmacist prescribing group compared with the OB/GYN prescribing group.	200 (1 retrospective cohort study)	⨁◯◯◯ Very low
Haemoglobin levels assessed: Mean	Significant improvements were reported in the pharmacist prescribing group compared with the OB/GYN prescribing group.	200 (1 retrospective cohort study)	⨁◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.12 Chronic pain conditions

One RCT assessed the effectiveness of pharmacist prescribing for people with chronic pain conditions [75]. The outcomes assessed were chronic pain intensity, chronic pain disability, health-related quality of life (physical component score), health-related quality of life (physical component score), depression, and anxiety.

3.5.1.12.1 Chronic pain intensity

One RCT reported on chronic pain intensity in a pharmacist prescribing group compared with pharmacist medication review and GP prescribing groups [75]. Figure 75 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

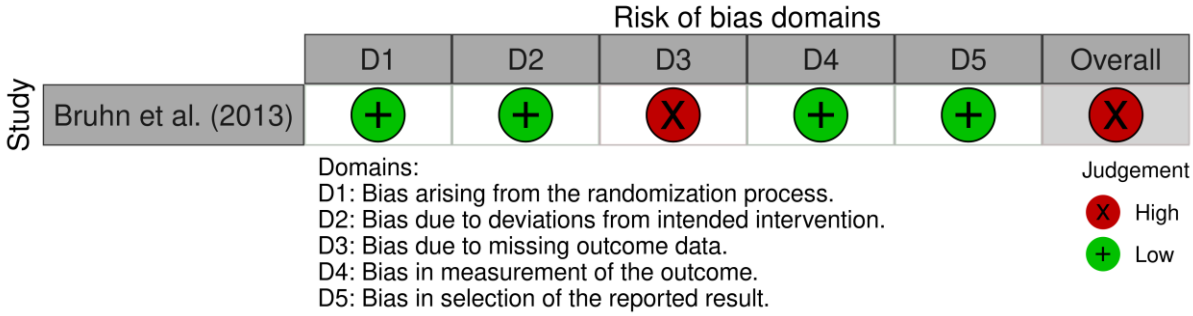

Figure 75: Chronic pain intensity in people with chronic pain conditions (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [75]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 72.

Table 72: Chronic pain intensity in people with chronic pain conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus pharmacist medication review	Primary care	High	Very low	Mean (SD) 58.1 (19.5) versus 67.4 (21.7) Findings appear different	No inferential statistics reported between arms*
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus GP prescribing	Primary care	High	Very low	Mean (SD) 58.1 (19.5) versus 65.6 (19.6) Findings appear different	No inferential statistics reported between arms*

3.5.1.12.2 Chronic pain disability

One RCT reported on whether chronic pain disability was improved in a pharmacist prescribing group compared with pharmacist medication review and GP prescribing groups [75]. Figure 76 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

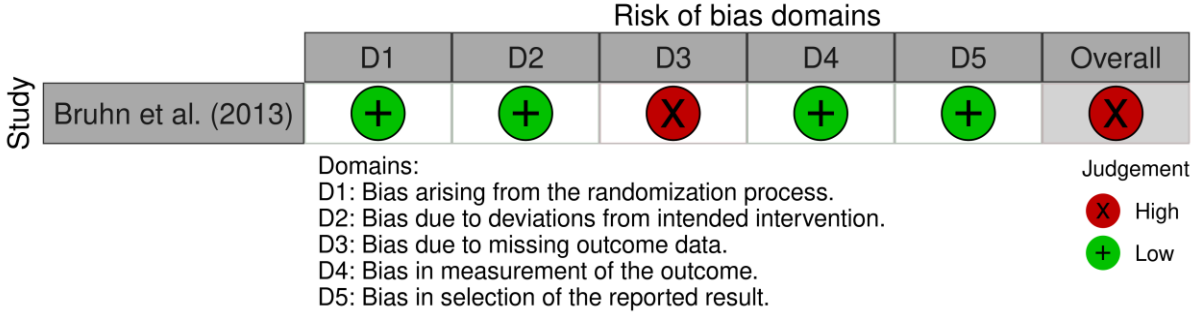

Figure 76: Chronic pain disability in people with chronic pain conditions (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [75]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 73.

Table 73: Chronic pain disability in people with chronic pain conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus pharmacist medication review	Primary care	High	Very low	Median (interquartile range (IQR)) 40.0 (20.0–60.0) versus 53.3 (29.2–73.3) Findings appear different	No inferential statistics reported between arms
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus GP prescribing	Primary care	High	Very low	Median (IQR) 40.0 (20.0–60.1) versus 50.0 (25.0–80.0) Findings appear different	No inferential statistics reported between arms

3.5.1.12.1 Health-related quality of life (physical component score)

One RCT reported on health-related quality of life (physical component score) in people with chronic pain conditions in a pharmacist prescribing group compared with pharmacist medication review and GP prescribing groups [75]. Figure 77 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

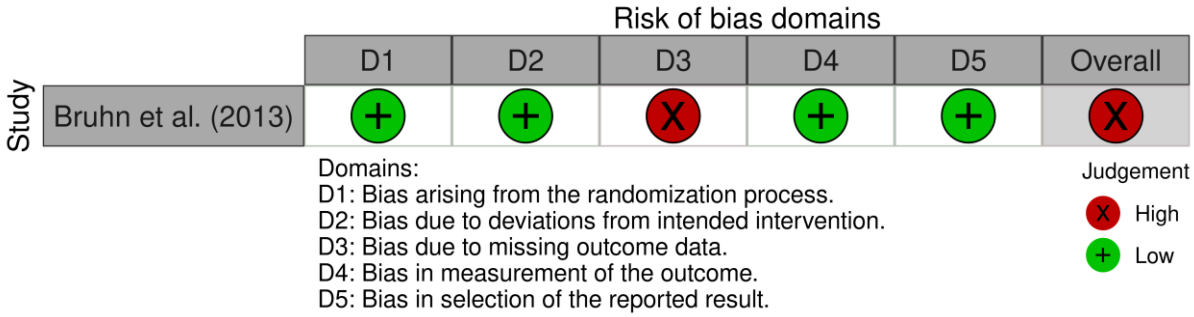

Figure 77: Health-related quality of life (physical component score) in people with chronic pain conditions (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence on health-related quality of life (physical component score) between the pharmacist prescribing group and the pharmacist medication review and GP

prescribing groups [75]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 74.

Table 74: Health-related quality of life (physical component score) in people with chronic pain conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus pharmacist medication review	Primary care	High	Very low	Mean (SD) 35.3 (10.8) versus 34.62 (11.26) Similar findings	No inferential statistics reported between arms
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus GP prescribing	Primary care	High	Very low	Mean (SD) 35.3 (10.8) versus 32.59 (9.14) Similar findings	No inferential statistics reported between arms

3.5.1.12.2 Health-related quality of life (mental component score)

One RCT reported on health-related quality of life (mental component score) in people with chronic pain conditions in a pharmacist prescribing group compared with pharmacist medication review and GP prescribing groups [75]. Figure 78 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

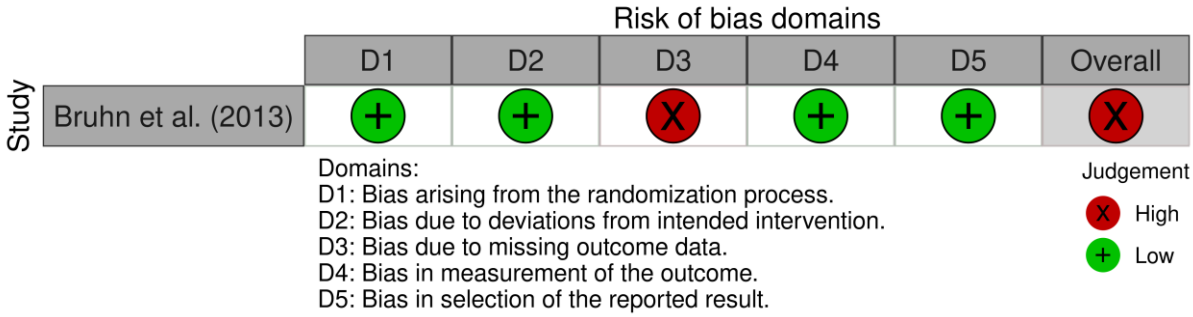

Figure 78: Health-related quality of life (mental component score) in people with chronic pain conditions (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [75]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 75.

Table 75: Health-related quality of life (mental component score) in people with chronic pain conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [75]	Independent prescribing:	Pharmacist prescribing versus	Primary care	High	Very low	Median (IQR)	No inferential statistics

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
	generate prescription	pharmacist medication review				49.6 (42.8–58.1) versus 47.9 (38.9–56.2) Similar findings	reported between arms
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus GP prescribing	Primary care	High	Very low	Median (IQR) 49.6 (42.8–58.2) versus 51.5 (41.3–60.7) Similar findings	No inferential statistics reported between arms

3.5.1.12.1 Depression

One RCT reported on change in depression scores in people with chronic pain conditions in a pharmacist prescribing group compared with pharmacist medication review and GP prescribing groups [75]. Figure 79 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

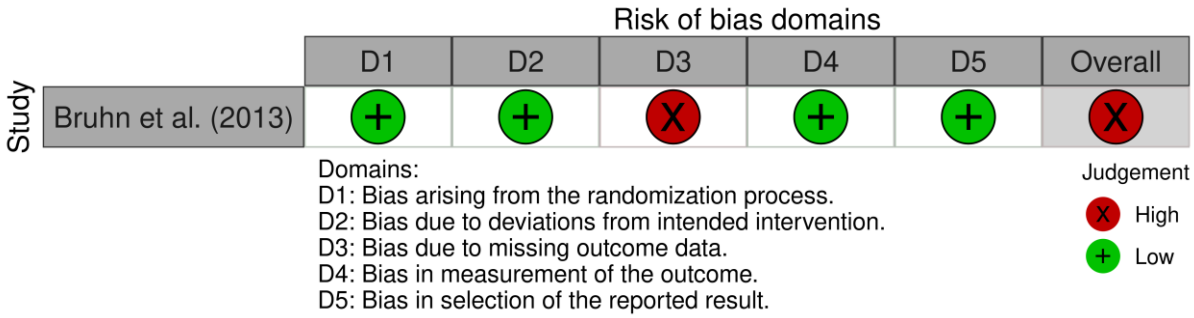

Figure 79: Depression in people with chronic pain conditions (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [75]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 76.

Table 76: Depression in people with chronic pain conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus pharmacist medication review	Primary care	High	Very low	Median (IQR) 4.0 (2.0–8.0) versus 5.0 (2.0–8.8)	No inferential statistics reported between arms

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
						Similar findings	
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus GP prescribing	Primary care	High	Very low	Median (IQR) 4.0 (2.0–8.0) versus 5.0 (2.0–10.0) Similar findings	No inferential statistics reported between arms

3.5.1.12.2 Anxiety

One RCT reported on change in anxiety scores in people with chronic pain conditions in a pharmacist prescribing group compared with pharmacist medication review and GP prescribing groups [75]. Figure 80 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

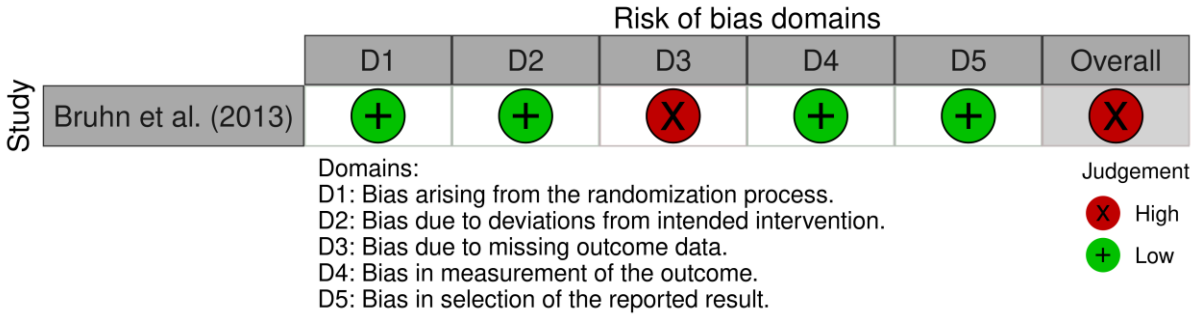

Figure 80: Anxiety in people with chronic pain conditions (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [75]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 77.

Table 77: Anxiety in people with chronic pain conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [75]	Independent prescribing: generate prescription	Pharmacist prescribing versus pharmacist medication review	Primary care	High	Very low	Median (IQR) 5.0 (2.3–9.8) versus 5.0 (3.0–10.0) Similar findings	No inferential statistics reported between arms
RCT [75]	Independent prescribing:	Pharmacist prescribing	Primary care	High	Very low	Median (IQR)	No inferential statistics

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
	generate prescription	versus GP prescribing				5.0 (2.3–9.8) versus 6.0 (3.0–9.0) Similar findings	reported between arms

3.5.1.12.3 Summary of findings

One study assessed the effectiveness of pharmacist prescribing for people with chronic pain conditions [75]. The outcomes assessed were chronic pain intensity, chronic pain disability, health-related quality of life (physical component score), health-related quality of life (physical component score), depression, and anxiety (Table 78).

Table 78: Summary of effectiveness findings for chronic pain conditions

Pharmacist prescribing compared with pharmacist medication review and GP prescribing groups for chronic pain conditions

Patient or population group: Chronic pain conditions
Prescribing authority: Independent
Setting: Primary care
Intervention: Pharmacist prescribing
Comparison: Pharmacist medication review; GP prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Chronic pain intensity assessed with: Chronic Pain Scale	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	89 (1 RCT)	⊕◯◯◯ Very low
Chronic pain intensity assessed with: Chronic Pain Scale	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	97 (1 RCT)	⊕◯◯◯ Very low
Chronic pain disability assessed with: Chronic Pain Scale	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	94 (1 RCT)	⊕◯◯◯ Very low
Chronic pain disability assessed with: Chronic Pain Scale	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	101 (1 RCT)	⊕◯◯◯ Very low
Health-related quality of life (physical) assessed with: EQ-5D	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	84 (1 RCT)	⊕◯◯◯ Very low
Health-related quality of life (physical) assessed with: EQ-5D	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	86 (1 RCT)	⊕◯◯◯ Very low

Health-related quality of life (mental) assessed with: EQ-5D	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	85 (1 RCT)	⊕◯◯◯ Very low
Health-related quality of life (mental) assessed with: EQ-5D	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	87 (1 RCT)	⊕◯◯◯ Very low
Depression assessed with: HADS-D	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	86 (1 RCT)	⊕◯◯◯ Very low
Depression assessed with: HADS-D	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	93 (1 RCT)	⊕◯◯◯ Very low
Anxiety assessed with: HADS-A	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	87 (1 RCT)	⊕◯◯◯ Very low
Anxiety assessed with: HADS-A	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	92 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.1.13 Mixed health conditions

Two studies (one retrospective cohort study and one RCT) assessed the effectiveness of pharmacist prescribing for people with mixed health conditions [45,76]. The effectiveness outcomes assessed were healthcare utilisation, blood pressure goal achieved, low-density lipoprotein (LDL) cholesterol goal achieved, and haemoglobin A1c (HbA1c) goal achieved.

3.5.1.13.1 Healthcare utilisation

Two studies (one retrospective cohort study and one RCT) assessed effectiveness outcomes related to healthcare utilisation among people with mixed health conditions [45,76]. Outcome measures assessed were ambulatory care visits, emergency department visits, length of hospital stay, hospital readmission, and hospitalisations.

3.5.1.13.1.1 Ambulatory care visits

One retrospective cohort study reported on ambulatory care visits in people with mixed health conditions in a pharmacist prescribing group compared with physician prescribing or primary care provider prescribing groups [45]. Figure 81 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

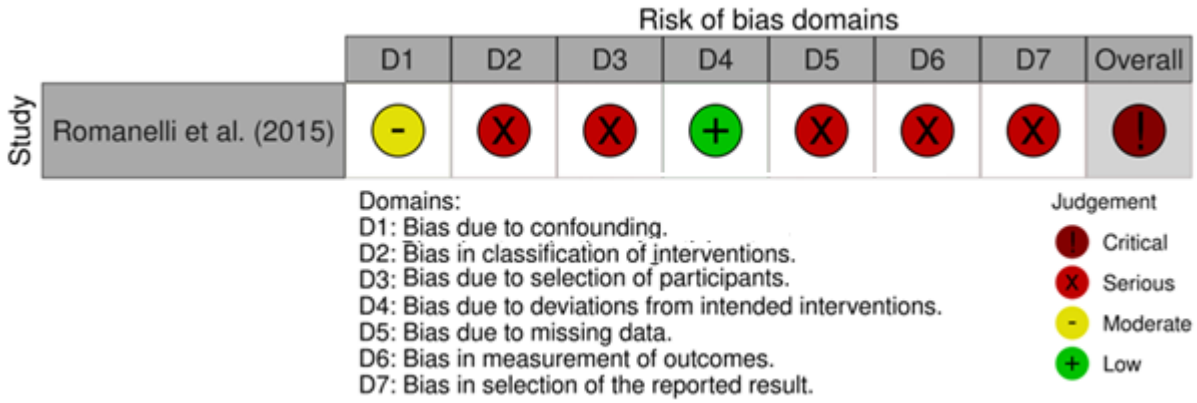

Figure 81: Ambulatory care visits in people with mixed health conditions (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating significantly more ambulatory care visits in the pharmacist prescribing group compared with the physician prescribing group. There was no significant difference in the number of ambulatory care visits between the pharmacist prescribing group and the primary care provider prescribing group [45]. An overview of the evidence is provided in Table 79.

Table 79: Ambulatory care visits in people with mixed health conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus physician prescribing	Primary care (medical home)	Critical	Very low	Adjusted incidence rate ratio (95% CI) 1.19 (1.06–1.33); *p*=0.004	Physician prescribing
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus primary care provider prescribing	Primary care (medical home)	Critical	Very low	Adjusted incidence rate ratio (95% CI) 1.04 (0.92–1.18); *p*=0.479	No significant difference

3.5.1.13.1.2 Emergency department visits

One retrospective cohort study reported on emergency department visits in people with mixed health conditions in a pharmacist prescribing group compared with physician prescribing or primary care provider prescribing groups [45]. Figure 82 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

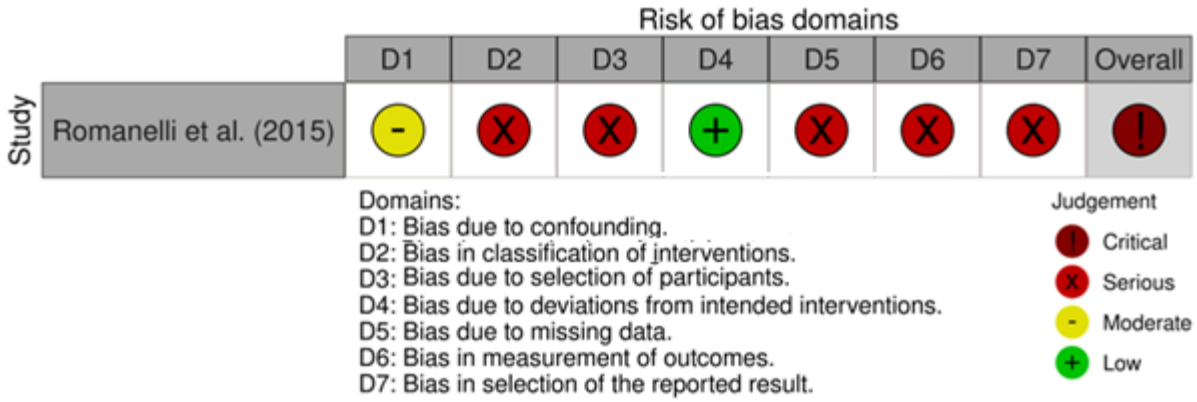

Figure 82: Emergency department visits in people with mixed health conditions (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence [45]. There was no significant difference in the percentage of emergency department visits in the pharmacist prescribing group compared with the physician prescribing group. There were significantly fewer emergency department visits in the pharmacist prescribing group compared with the primary care provider prescribing group. An overview of the evidence is provided in Table 80.

Table 80: Emergency department visits in people with mixed health conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus physician prescribing	Primary care (medical home)	Critical	Very low	Adjusted incidence rate ratio (95% CI) 0.79 (0.58–1.07); *p*=0.124	No significant difference
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus primary care provider prescribing	Primary care (medical home)	Critical	Very low	Adjusted incidence rate ratio (95% CI) 0.70 (0.53–0.93); *p*=0.014	Pharmacist prescribing

3.5.1.13.1.3 Length of hospital stay

One RCT reported on length of hospital stay for people with mixed health conditions in a pharmacist prescribing group compared with a physician prescribing group [76]. Figure 83 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

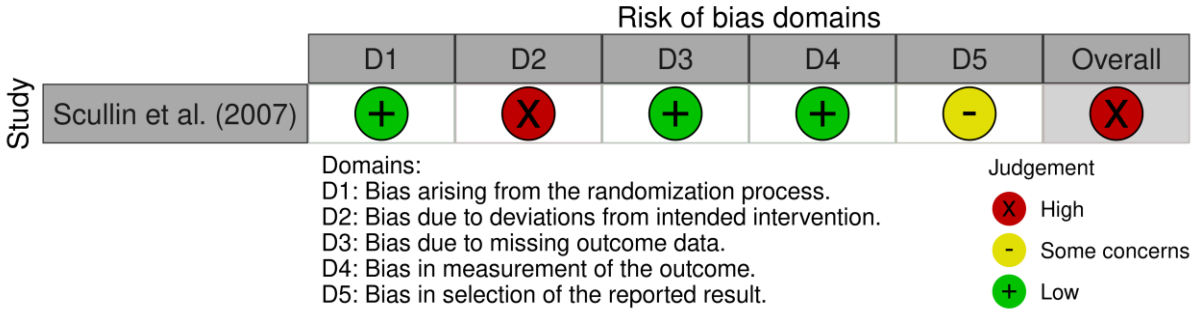

Figure 83: Length of hospital stay in people with mixed health conditions (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence that the length of hospital stay was significantly shorter in the pharmacist prescribing group compared with the physician prescribing group [76]. An overview of the evidence is provided in Table 81.

Table 81: Length of hospital stay in people with mixed health conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [76]	Protocol prescribing: discharge prescriptions	Pharmacist prescribing versus physician prescribing	Inpatient	High	Very low	Mean (95% CI) 7.8 (7.1–8.6) versus 9.8 (8.8–10.9); *p*=0.003	Pharmacist prescribing

3.5.1.13.1.4 Hospital readmission

One RCT reported on hospital readmission among people with mixed health conditions in a pharmacist prescribing group compared with a physician prescribing group [76]. Figure 84 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

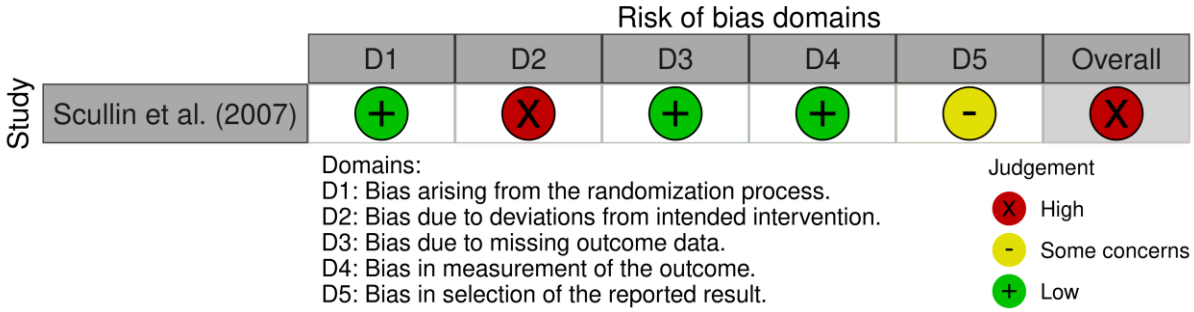

Figure 84: Hospital readmission in people with mixed health conditions (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating significantly fewer hospital readmissions in the pharmacist prescribing group compared with the physician prescribing group [76]. An overview of the evidence is provided in Table 82.

Table 82: Hospital readmission in people with mixed health conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [76]	Protocol prescribing: discharge prescriptions	Pharmacist prescribing versus physician prescribing	Inpatient	High	Very low	Number of events (%) 141/370 (38%) versus 172/383 (45%); *p*=0.027	Pharmacist prescribing

3.5.1.13.1.5 Hospitalisations

One retrospective cohort study reported on hospitalisations in people with mixed health conditions in a pharmacist prescribing group compared with physician prescribing or primary care provider prescribing groups [45]. Figure 85 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

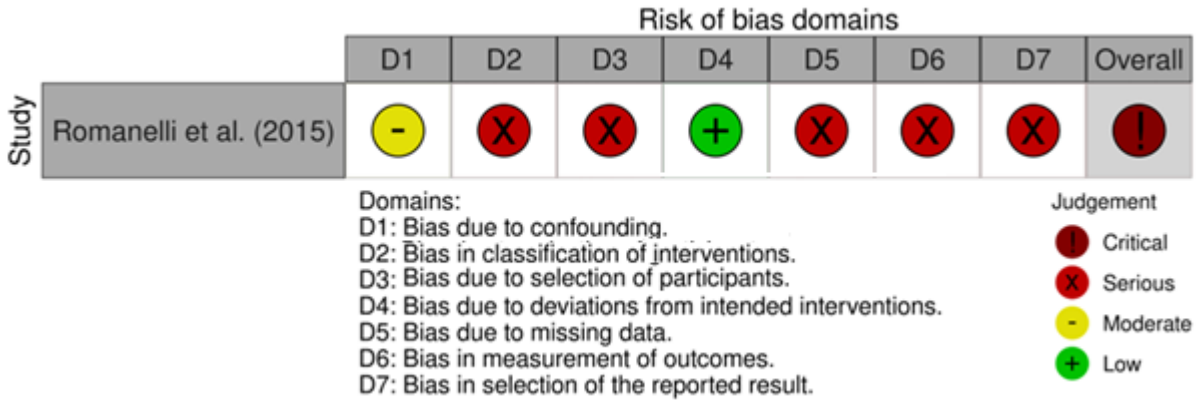

Figure 85: Hospitalisations in people with mixed health conditions (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating significantly fewer hospitalisations in the pharmacist prescribing group compared with the physician prescribing group or the primary care provider prescribing group [45]. An overview of the evidence is provided in Table 83.

Table 83: Hospitalisations in people with mixed health conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus physician prescribing	Primary care (medical home)	Critical	Very low	Adjusted incidence rate ratio (95% CI) 0.48 (0.30–0.78); *p*=0.003	Pharmacist prescribing
Retrospective cohort study [45]	Collaborative practice agreement: manage	Pharmacist prescribing versus primary care provider prescribing	Primary care (medical home)	Critical	Very low	Adjusted incidence rate ratio (95% CI) 0.40 (0.25–0.63); *p*<0.001	Pharmacist prescribing

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
	medication therapy						

3.5.1.13.2 Blood pressure goal achieved

One retrospective cohort study reported on the percentage of people with mixed health conditions who achieved their blood pressure goals in a pharmacist prescribing group compared with physician prescribing or primary care provider prescribing groups [45]. Figure 86 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

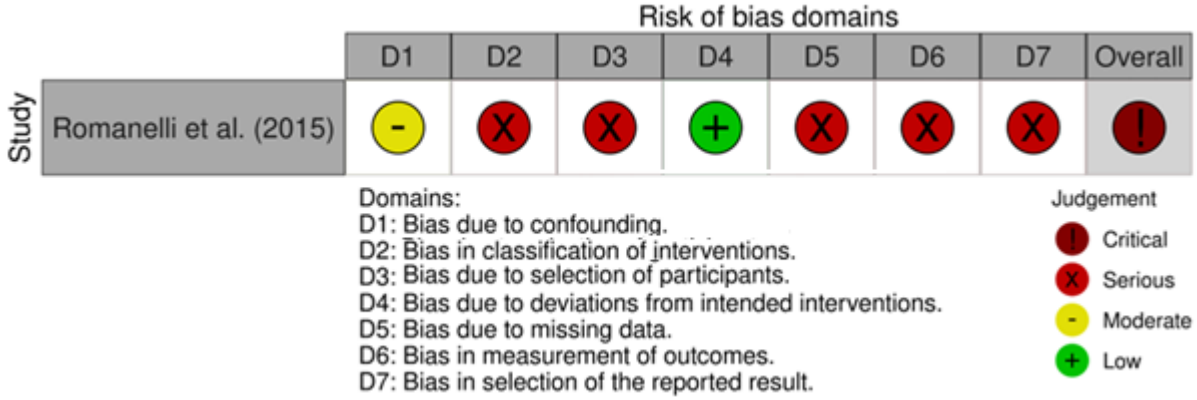

Figure 86: Blood pressure goal achieved in people with mixed health conditions (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence. There was no significant difference between the percentage of patients achieving their blood pressure goals in the pharmacist prescribing group compared with the physician prescribing group. A higher percentage of patients achieved their blood pressure goals in the pharmacist prescribing group compared with the primary care provider prescribing group [45]. An overview of the evidence is provided in Table 84.

Table 84: Blood pressure goal achieved in people with mixed health conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus physician prescribing	Primary care (medical home)	Critical	Very low	Adjusted odds ratio (95% CI) 1.16 (0.79–1.71); *p*=0.454	No significant difference
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus primary care provider prescribing	Primary care (medical home)	Critical	Very low	Adjusted odds ratio (95% CI) 1.47 (1.00–2.16); *p*=0.052	Pharmacist prescribing

3.5.1.13.3 LDL cholesterol goal achieved

One retrospective cohort study reported on the percentage of people with mixed health conditions who achieved their LDL cholesterol goals in a pharmacist prescribing group compared with physician prescribing or primary care provider prescribing groups [45]. Figure 87 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

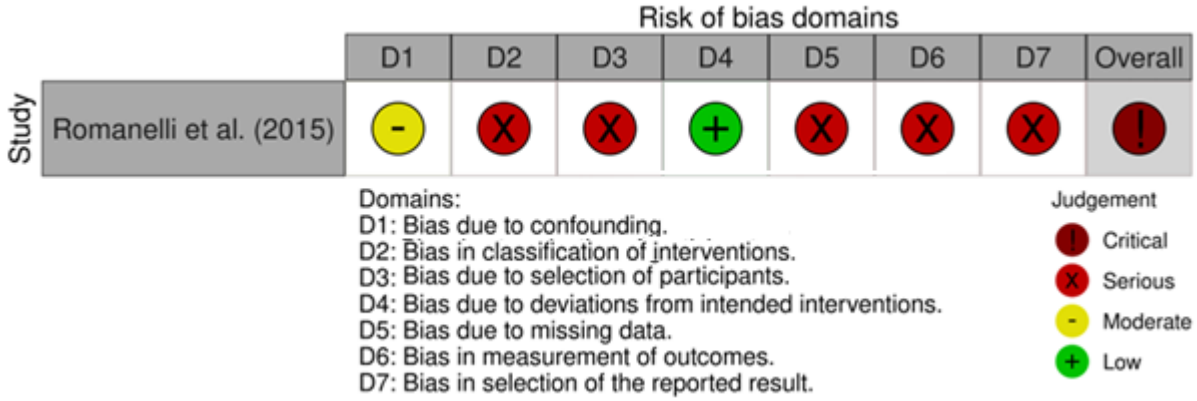

Figure 87: LDL cholesterol goal achieved in people with mixed health conditions (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference between the pharmacist prescribing group and the physician prescribing or primary care provider prescribing groups [45]. An overview of the evidence is provided in Table 85.

Table 85: LDL cholesterol goal achieved in people with mixed health conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus physician prescribing	Primary care (medical home)	Critical	Very low	Adjusted odds ratio (95% CI) 1.32 (0.70–2.46); *p*=0.390	No significant difference
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus primary care provider prescribing	Primary care (medical home)	Critical	Very low	Adjusted odds ratio (95% CI) 0.83 (0.45–1.54); *p*=0.565	No significant difference

3.5.1.13.4 HbA1c goal achieved

One retrospective cohort study reported on the percentage of people with mixed health conditions who achieved their HbA1c goals in a pharmacist prescribing group compared with physician prescribing or primary care provider prescribing groups [45]. Figure 88 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

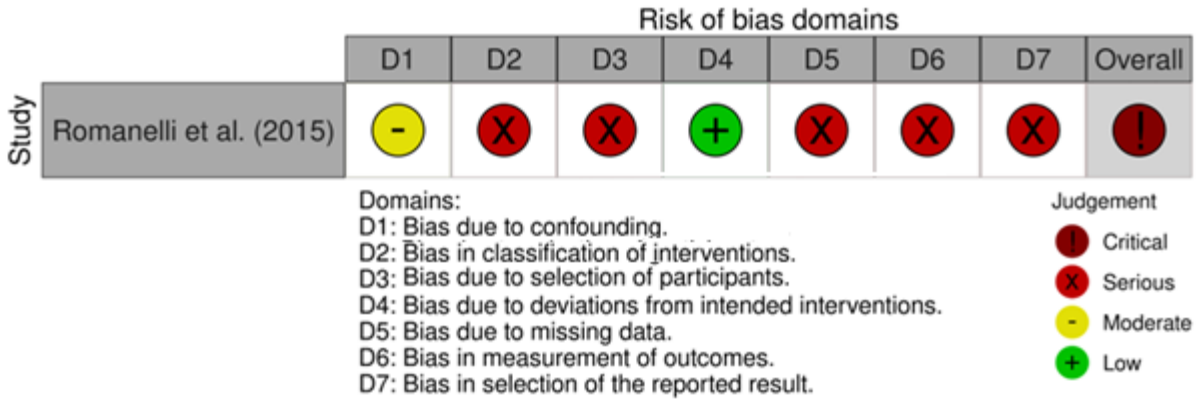

Figure 88: HbA1c goal achieved in people with mixed health conditions (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in the percentage of patients achieving their HbA1c goals in the pharmacist prescribing group compared with the physician prescribing or primary care provider prescribing groups [45]. An overview of the evidence is provided in Table 86.

Table 86: HbA1c goal achieved in people with mixed health conditions

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus physician prescribing	Primary care (medical home)	Critical	Very low	Adjusted odds ratio (95% CI) 0.61 (0.25–1.49); *p*=0.278	No significant difference
Retrospective cohort study [45]	Collaborative practice agreement: manage medication therapy	Pharmacist prescribing versus primary care provider prescribing	Primary care (medical home)	Critical	Very low	Adjusted odds ratio (95% CI) 0.44 (0.18–1.08); *p*=0.074	No significant difference

3.5.1.13.5 Summary of findings

Two studies assessed the effectiveness of pharmacist prescribing for people with mixed health conditions [45,76]. The effectiveness outcomes assessed were healthcare utilisation, blood pressure goal achieved, LDL cholesterol goal achieved, and HbA1c goal achieved.

There was a significant improvement or no significant difference in the pharmacist prescribing groups compared with the physician or primary care provider prescribing groups for most outcomes. There were significantly more ambulatory care visits, but fewer hospitalisations and no significant difference in emergency department visits, in the pharmacist prescribing group compared with the physician prescribing group. There was no significant difference in the number of ambulatory care visits, but fewer hospitalisations and emergency department visits, in the pharmacist prescribing group compared with the primary care provider prescribing group (Table 87).

Table 87: Summary of effectiveness findings for mixed health conditions

Pharmacist prescribing compared with primary care provider prescribing and physician prescribing for mixed health conditions

Patient or population group: Mixed health conditions
Prescribing authority: Collaborative practice agreement; protocol
Setting: Primary care; inpatient
Intervention: Pharmacist prescribing
Comparison: Primary care provider prescribing; physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Ambulatory care visits assessed with: Number of events	Significantly more ambulatory clinic visits were reported in the pharmacist prescribing group compared with the physician prescribing group.	605 (1 retrospective cohort study)	⊕◯◯◯ Very low
Ambulatory care visits assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the primary care provider prescribing group.	614 (1 retrospective cohort study)	⊕◯◯◯ Very low
Hospitalisations assessed with: Number of events	Significantly fewer hospitalisations were reported in the pharmacist prescribing group compared with the physician prescribing group.	605 (1 retrospective cohort study)	⊕◯◯◯ Very low
Hospitalisations assessed with: Number of events	Significantly fewer hospitalisations were reported in the pharmacist prescribing group compared with the primary care provider prescribing group.	614 (1 retrospective cohort study)	⊕◯◯◯ Very low
Hospital readmission assessed with: Number of events	Significantly fewer hospital readmissions were reported in the pharmacist prescribing group compared with the physician prescribing group.	753 (1 RCT)	⊕◯◯◯ Very low
Length of hospital stay assessed with: Mean number of days	A significantly shorter length of hospital stay was reported in the pharmacist prescribing group compared with the physician prescribing group.	762 (1 RCT)	⊕◯◯◯ Very low
Emergency department visits assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	605 (1 retrospective cohort study)	⊕◯◯◯ Very low
Emergency department visits assessed with: Relative risk	Significantly fewer emergency department visits were reported in the pharmacist prescribing group compared with the primary care provider prescribing group.	614 (1 retrospective cohort study)	⊕◯◯◯ Very low
HbA1c goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	215 (1 retrospective cohort study)	⊕◯◯◯ Very low

HbA1c goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the primary care provider prescribing group.	235 (1 retrospective cohort study)	⊕◯◯◯ Very low
Blood pressure goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	605 (1 retrospective cohort study)	⊕◯◯◯ Very low
Blood pressure goal achieved assessed with: Yes/No	Significantly higher numbers of participants achieving their blood pressure goals were reported in the pharmacist prescribing group compared with the primary care provider prescribing group.	614 (1 retrospective cohort study)	⊕◯◯◯ Very low
LDL cholesterol goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	314 (1 retrospective cohort study)	⊕◯◯◯ Very low
LDL cholesterol goal achieved assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the primary care provider prescribing group.	325 (1 retrospective cohort study)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2 Safety results

We included 20 studies that reported safety outcomes for 12 healthcare population categories: heart failure [55]; stroke [57]; dyslipidaemia [58]; coagulation disorders [61,62,64,66]; chronic kidney disease [67,77]; urinary tract infection [68,78]; older people in long-term care [69–71]; female contraceptive users [80,81]; emergency department patients [82]; surgery patients [83]; people at risk of drug-related problems [76]; and mixed health conditions [79].

3.5.2.1 Heart failure

One retrospective cohort study compared safety outcomes in people with heart failure in a pharmacist prescribing group compared with a clinician prescribing group [55]. The safety outcomes assessed were heart failure hospitalisations and all-cause death.

3.5.2.1.1 Heart failure hospitalisations

One retrospective cohort study reported on heart failure hospitalisations in people with heart failure in a pharmacist prescribing group compared with a clinician prescribing group [55]. Figure 89 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

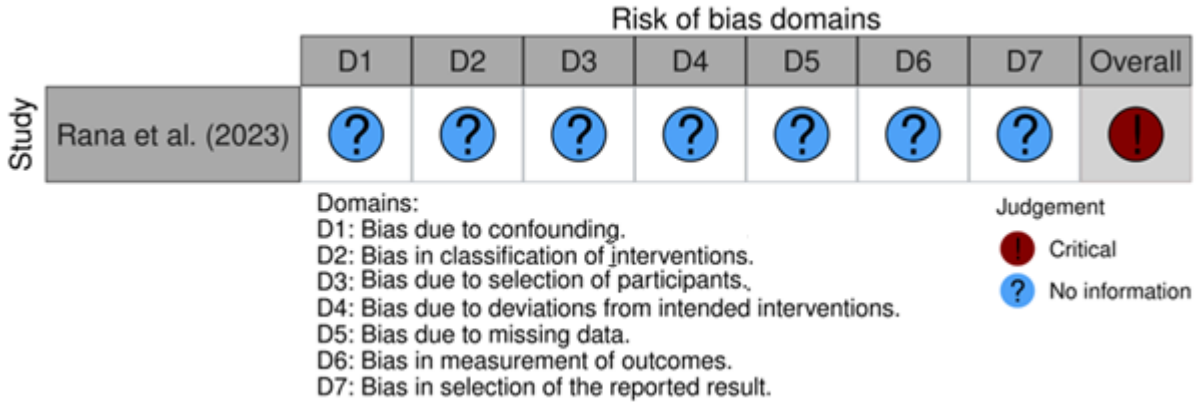

Figure 89: Heart failure hospitalisations in people with heart failure (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in heart failure hospitalisations between the pharmacist prescribing group and the clinician prescribing group [55]. An overview of the evidence is provided in Table 88.

Table 88: Heart failure hospitalisations in people with heart failure

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [55]	Collaborative practice agreement: initiate, titrate, and monitor	Pharmacist prescribing versus clinician prescribing	Outpatient cardiac clinic	Critical	Very low	Number of events (%) 33/64 (51.6%) versus 398/727 (54.7%); *p* =0.73	No significant difference

3.5.2.1.2 All-cause death

One retrospective cohort study reported on all-cause deaths in people with heart failure in a pharmacist prescribing group compared with a clinician prescribing group [55]. Figure 90 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

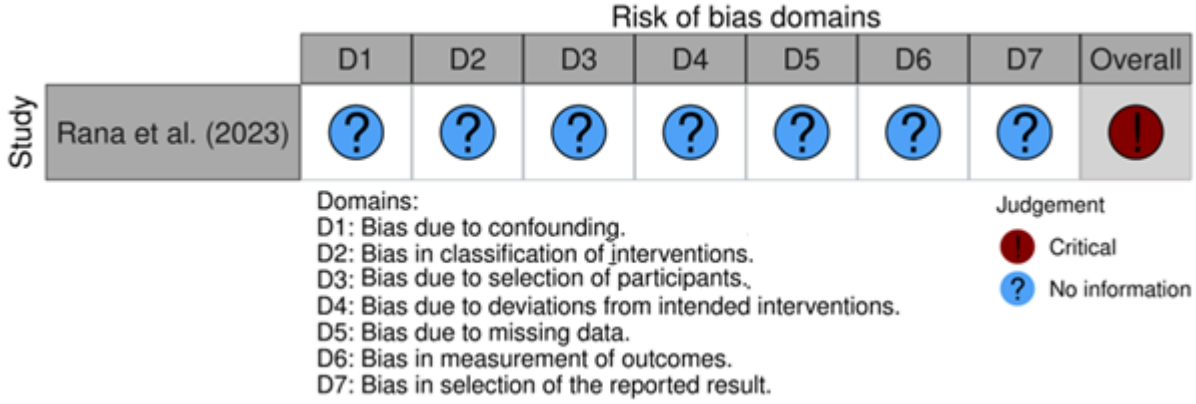

Figure 90: All-cause death in people with heart failure (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating significantly fewer all-cause deaths in the pharmacist prescribing group compared with the clinician prescribing group [55]. An overview of the evidence is provided in Table 89.

Table 89: All-cause death in people with heart failure

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [55]	Collaborative practice agreement: initiate, titrate, and monitor	Pharmacist prescribing versus clinician prescribing	Outpatient cardiac clinic	Critical	Very low	Number of events (%) 0/64 (0%) versus 47/727 (6.5%); *p*=0.036	Pharmacist prescribing

3.5.2.1.3 Summary of findings

One study assessed safety outcomes in people with heart failure [55]. The safety outcomes assessed were heart failure hospitalisations and all-cause death. No significant difference in hospitalisations due to heart failure was reported between the pharmacist prescribing group and the clinician prescribing group. Significantly fewer all-cause deaths were reported in the pharmacist prescribing group compared with the clinician prescribing group (Table 90).

Table 90: Summary of safety findings for heart failure

Pharmacist prescribing compared with clinician prescribing for heart failure

Patient or population group: Heart failure
Prescribing authority: Collaborative practice agreement
Setting: Outpatient cardiac clinic
Intervention: Pharmacist prescribing
Comparison: Clinician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Hospitalisations due to heart failure assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the clinician prescribing group.	791 (1 retrospective cohort study)	⊕◯◯◯ Very low
All-cause deaths assessed with: Number of events	Significantly fewer deaths were reported in the pharmacist prescribing group compared with the clinician prescribing group.	791 (1 retrospective cohort study)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.2 Stroke

One study assessed safety outcomes in people with a recent minor ischaemic stroke or transient ischaemic attack [57]. The safety outcomes assessed were mortality and adverse vascular events.

3.5.2.2.1 Mortality

One RCT reported on mortality in people with a recent minor ischaemic stroke or transient ischaemic attack in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 91 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

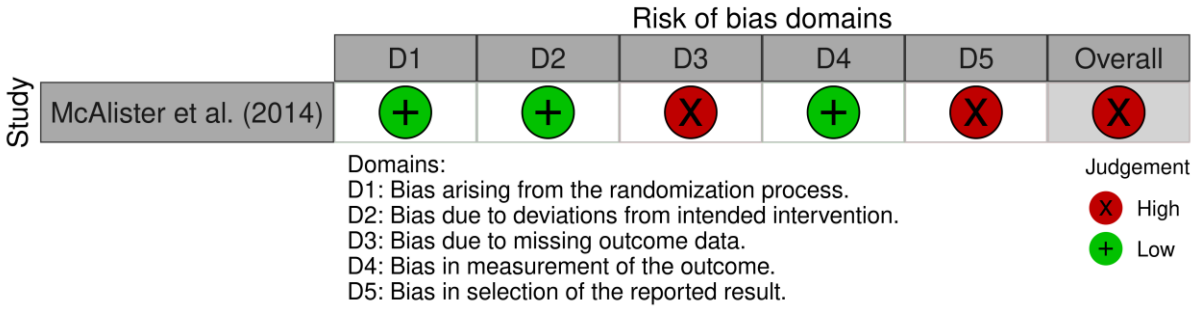

Figure 91: Mortality in people with a recent stroke (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence [57]. As no inferential statistics were reported, we cannot comment on the significance of the findings. In addition, the number of deaths in each group was very small. An overview of the evidence is provided in Table 91.

Table 91: Mortality in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement: initiate and titrate	Pharmacist prescribing versus physician prescribing	Primary care	High	Very low	Number of events (%) 0/143 (0.0%) versus 1/136 (0.7%)	No inferential statistics reported

3.5.2.2.2 Adverse vascular events

One RCT reported on adverse vascular events in people with a recent minor ischaemic stroke or transient ischaemic attack in a pharmacist prescribing group compared with a physician prescribing group [57]. Figure 92 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

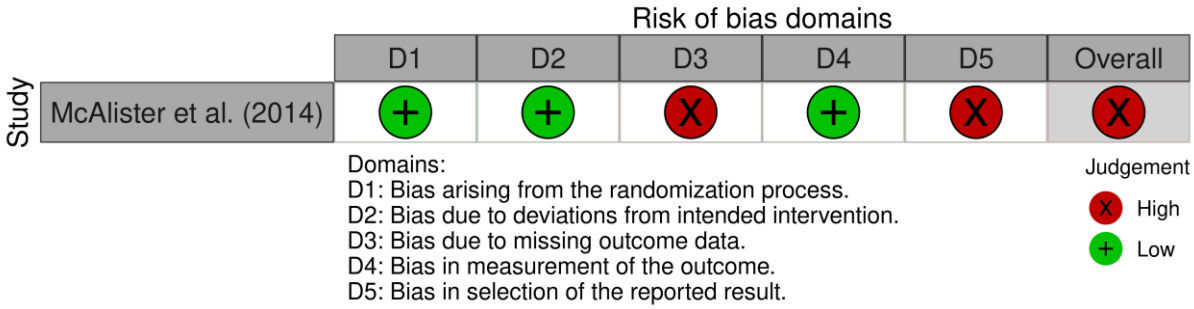

Figure 92: Adverse vascular events in people with a recent stroke (risk of bias assessment using RoB 2)

This RCT reported very low-certainty evidence [57]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 92.

Table 92: Adverse vascular events in people with a recent stroke

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [57]	Collaborative practice agreement: initiate and titrate	Pharmacist prescribing versus physician prescribing	Primary care	High	Very low	Number of adverse vascular events (%) 9/143 (6.3%) versus 8/136 (5.9%) Similar findings	No inferential statistics reported

3.5.2.2.3 Summary of findings

One study assessed the safety of pharmacist prescribing for people with a recent minor ischaemic stroke or transient ischaemic attack [57]. The safety outcomes assessed were mortality and adverse vascular events. No inferential statistics were reported for these outcomes (Table 93).

Table 93: Summary of safety findings for stroke

Pharmacist prescribing compared with physician prescribing for stroke
Patient or population group: People with a recent minor ischaemic stroke or transient ischaemic attack **Prescribing authority:** Collaborative practice agreement **Setting:** Primary care **Intervention:** Pharmacist prescribing **Comparison:** Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Mortality assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	279 (1 RCT)	⊕◯◯◯ Very low
Adverse vascular events assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	279 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.3 Dyslipidaemia

One cluster RCT assessed the safety of pharmacist prescribing for people with dyslipidaemia [58]. The safety outcome assessed was adverse events.

3.5.2.3.1 Adverse events

One cluster RCT reported on adverse events in people with dyslipidaemia in a pharmacist prescribing group compared with a physician prescribing group [58]. Figure 93 presents the risk of bias assessment; the study was judged to have some concerns as its overall risk of bias score for this outcome.

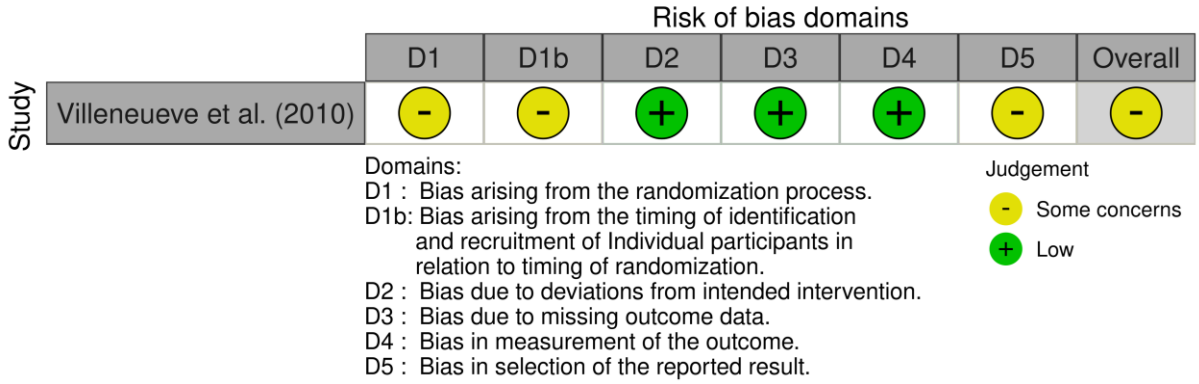

Figure 93: Adverse events in people with dyslipidaemia (risk of bias assessment using RoB 2 for cluster RCTs)

This cluster RCT reported very low-certainty evidence [58]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 94.

Table 94: Adverse events in people with dyslipidaemia

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [58]	Collaborative practice agreement: titrate and adjust	Pharmacist prescribing versus physician prescribing	Primary care	Some concerns	Very low	Number of events (%) 8/101 (7.9%) versus 8/110 (7.3%) Similar findings	No inferential statistics reported

3.5.2.3.2 Summary of findings

One study assessed the safety of pharmacist prescribing for people with dyslipidaemia [58]. The safety outcome assessed was adverse events, but no inferential statistics were reported (Table 95).

Table 95: Summary of safety findings for dyslipidaemia

Pharmacist prescribing compared with physician prescribing for dyslipidaemia

Patient or population group: Dyslipidaemia
Prescribing authority: Collaborative practice agreement
Setting: Primary care
Intervention: Pharmacist prescribing
Comparison: Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Adverse events assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	211 (1 cluster RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.4 Coagulation disorders

Four studies assessed the safety of pharmacist prescribing for people with coagulation disorders [61,62,64,66]. The safety outcomes assessed were adverse events, and hospitalisations/emergency department visits due to adverse events.

3.5.2.4.1 Adverse events

Two retrospective cohort studies and one non-randomised trial reported on adverse events in people with coagulation disorders in a pharmacist prescribing group compared with a physician prescribing group [61,62,64]. Figure 94 presents the risk of bias assessment; all three studies were judged to have an overall critical risk of bias score for this outcome.

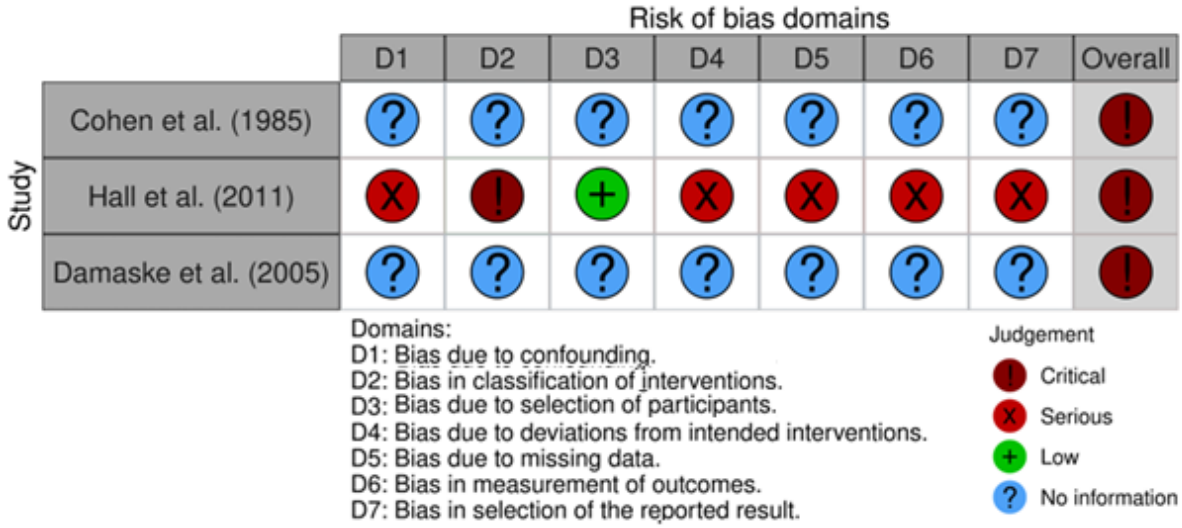

Figure 94: Adverse events in people with coagulation disorders (risk of bias assessment using ROBINS-I)

All three studies reported very low-certainty evidence. One retrospective cohort study reported no significant difference in the number of bleeding or thromboembolic adverse events between the pharmacist prescribing group and the physician prescribing group [61]. Another retrospective cohort study reported significantly fewer anticoagulation-related adverse events in the pharmacist prescribing group compared with the physician prescribing group [64]. The non-randomised trial did not report inferential statistics [62]. An overview of the evidence is provided in Table 96.

Table 96: Adverse events in people with coagulation disorders

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [61]	Protocol: dose warfarin	Pharmacist managed versus physician managed	Outpatient Veterans Affairs clinic	Critical	Very low	Number of bleeding adverse events (%) 4/78 (5.1%) versus 1/17 (5.9%); *p*>0.05	No significant difference
Retrospective cohort study [61]	Protocol: dose warfarin	Pharmacist managed versus physician managed	Outpatient Veterans Affairs clinic	Critical	Very low	Number of thromboembolic adverse events (%) 2/78 (2.6%) versus 0/17 (0.0%); *p*>0.05	No significant difference

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [64]	Collaborative practice agreement: bridge with heparin, modify drug therapy	Pharmacist managed versus physician managed	Outpatient	Critical	Very low	Number of anticoagulation-related adverse events (%) 14/175 (8.0%) versus 41/175 (23.4%); *p*<0.0001	Pharmacist prescribing
Non-randomised trial [62]	Protocol: dose warfarin	Pharmacist management versus physician management	Inpatient	Critical	Very low	Number of bleeding/adverse drug events (%) 2/22 (9.1%) versus 3/29 (10.3%) Similar findings	No inferential statistics reported

3.5.2.4.2 Hospitalisations/emergency department visits due to adverse events

Two retrospective cohort studies reported on hospitalisations and emergency department visits due to adverse events in people with coagulation disorders in a pharmacist prescribing group compared with a physician prescribing group or a nurse prescribing group [64,66]. Figure 95 presents the risk of bias assessment; the first study was judged to have an overall critical risk of bias score for this outcome, and the second study was judged to have an overall serious risk of bias score for this outcome.

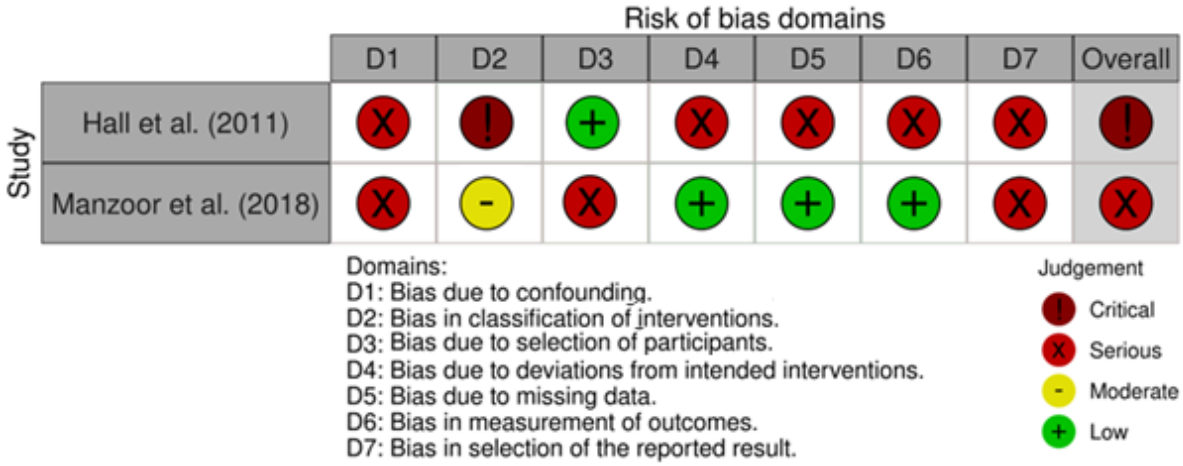

Figure 95: Hospitalisations and emergency department visits due to adverse events in people with coagulation disorders (risk of bias assessment using ROBINS-I)

Both retrospective cohort studies reported very low-certainty evidence. One study reported significantly fewer hospitalisations and emergency department visits in the pharmacist prescribing group compared with the physician prescribing group [64]. The other study reported a significantly lower likelihood of hospitalisations/emergency department visits due to adverse events in the pharmacist prescribing group compared with the nurse prescribing group [66]. An overview of the evidence is provided in Table 97.

Table 97: Hospitalisations and emergency department visits due to adverse events in people with coagulation disorders

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [64]	Collaborative practice agreement: bridge with heparin, modify drug therapy	Pharmacist managed versus physician managed	Outpatient	Critical	Very low	Number of hospitalisations (%) 58/175 (33.1%) versus 134/175 (76.6%); *p*<0.0001	Pharmacist prescribing
Retrospective cohort study [64]	Collaborative practice agreement: bridge with heparin, modify drug therapy	Pharmacist managed versus physician managed	Outpatient	Critical	Very low	Number of emergency department visits (%) 3/175 (1.7%) versus 14/175 (8.0%); *p*<0.0001	Pharmacist prescribing
Retrospective cohort study [66]	Collaborative practice agreement: warfarin dosing and warfarin management	Pharmacist managed versus nurse managed	Outpatient	Serious	Very low	Warfarin-related hospitalisations/emergency department visits Odds ratio (95% CI) 7.68 (1.06–55.94)	Pharmacist prescribing

3.5.2.4.3 Summary of findings

Four studies assessed the safety of pharmacist prescribing for people with coagulation disorders [61,62,64,66]. The safety outcomes assessed were adverse events, and hospitalisations/emergency department visits due to adverse events. For most outcomes, there were significantly fewer adverse events in the pharmacist prescribing groups compared with the physician or nurse prescribing groups, or no significant difference between groups. No inferential statistics were reported for a combined bleeding/adverse drug events outcome (Table 98).

Table 98: Summary of safety findings for coagulation disorders

Pharmacist prescribing compared with physician prescribing or nurse prescribing for coagulation disorders

Patient or population group: Coagulation disorders
Prescribing authority: Collaborative practice agreement; protocol
Setting: Outpatient clinics; hospitals
Intervention: Pharmacist prescribing
Comparison: Physician prescribing; nurse prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence

Bleeding adverse events assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and physician prescribing group.	95 (1 retrospective cohort study)	⊕◯◯◯ Very low
Thromboembolic adverse events assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	95 (1 retrospective cohort study)	⊕◯◯◯ Very low
Anticoagulation-related adverse events assessed with: Number of events	Significantly fewer adverse events were reported in the pharmacist prescribing group compared with the physician prescribing group.	350 (1 retrospective cohort study)	⊕◯◯◯ Very low
Bleeding/adverse drug events assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	51 (1 non-randomised trial)	⊕◯◯◯ Very low
Anticoagulation-related hospital admissions assessed with: Number of events	Significantly fewer hospital admissions were reported in the pharmacist prescribing group compared with the physician prescribing group.	350 (1 retrospective cohort study)	⊕◯◯◯ Very low
Anticoagulation-related emergency department visits assessed with: Number of events	Significantly fewer emergency department visits were reported in the pharmacist prescribing group compared with the physician prescribing group.	350 (1 retrospective cohort study)	⊕◯◯◯ Very low
Warfarin-related hospitalisations/emergency department visits assessed with: Number of events	There was a significantly lower likelihood of warfarin-related hospitalisations/emergency department visits in the pharmacist prescribing group compared with the nurse prescribing group.	200 (1 retrospective cohort study)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.5 Chronic kidney disease

Two retrospective cohort studies assessed safety outcomes in people with chronic kidney disease for pharmacist prescribing compared with physician prescribing and usual care [67,77]. The safety outcomes assessed were adverse events and prescribing errors.

3.5.2.5.1 Adverse events

One retrospective cohort study reported on adverse events for people with chronic kidney disease in a pharmacist prescribing group compared with a physician prescribing group or a usual care group [67]. Adverse event outcomes included thromboembolic adverse events, heart failure adverse events, and

uncontrolled hypertension adverse events. Figure 96 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

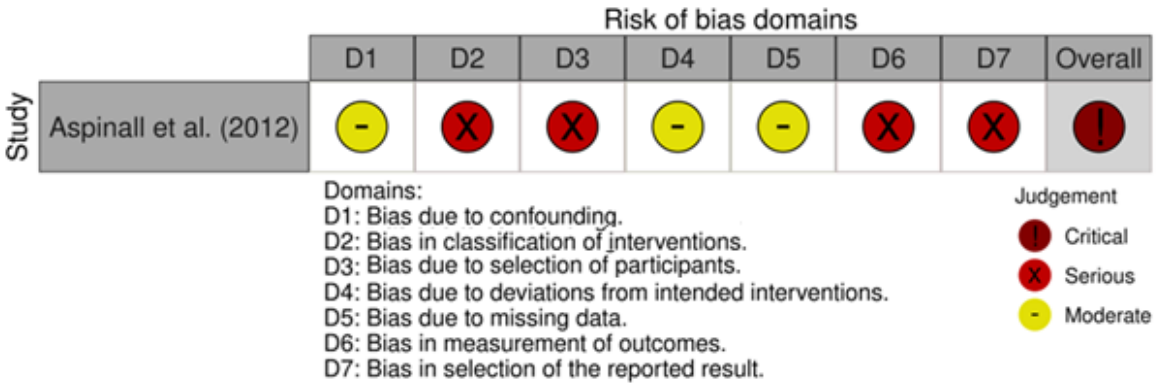

Figure 96: Adverse events in people with chronic kidney disease (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence [67]. As no inferential statistics were reported, we cannot comment on the significance of the findings. An overview of the evidence is provided in Table 99.

Table 99: Adverse events in people with chronic kidney disease

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [67]	Collaborative practice agreement: dose and monitor	Pharmacist prescribing versus physician prescribing	Outpatient clinic	Critical	Very low	Number of thromboembolic adverse events (rate per 180 days) 6 (0.02) versus 3 (0.04) More events in pharmacist group	No inferential statistics reported
Retrospective cohort study [67]	Collaborative practice agreement: dose and monitor	Pharmacist prescribing versus usual care	Outpatient clinic	Critical	Very low	Number of thromboembolic adverse events (rate per 180 days) 6 (0.02) versus 7 (0.05) More events in usual care group	No inferential statistics reported
Retrospective cohort study [67]	Collaborative practice agreement: dose and monitor	Pharmacist prescribing versus physician prescribing	Outpatient clinic	Critical	Very low	Number of heart failure adverse events (rate per 180 days) 18 (0.06) versus 7 (0.10)	No inferential statistics reported

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
						More events in pharmacist group	
Retrospective cohort study [67]	Collaborative practice agreement: dose and monitor	Pharmacist prescribing versus usual care	Outpatient clinic	Critical	Very low	Number of heart failure adverse events (rate per 180 days) 18 (0.06) versus 9 (0.06) More events in pharmacist group	No inferential statistics reported
Retrospective cohort study [67]	Collaborative practice agreement: dose and monitor	Pharmacist prescribing versus physician prescribing	Outpatient clinic	Critical	Very low	Number of uncontrolled hypertension adverse events (rate per 180 days) 185 (0.66) versus 50 (0.69) More events in pharmacist group	No inferential statistics reported
Retrospective cohort study [67]	Collaborative practice agreement: dose and monitor	Pharmacist prescribing versus usual care	Outpatient clinic	Critical	Very low	Number of uncontrolled hypertension adverse events (rate per 180 days) 185 (0.66) versus 73 (0.48) More events in pharmacist group	No inferential statistics reported

3.5.2.5.2 Prescribing errors

One retrospective cohort study reported on prescribing errors (rates of inappropriate initial dosing) for people with chronic kidney disease in a pharmacist prescribing group compared with a usual care group [77]. Figure 97 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

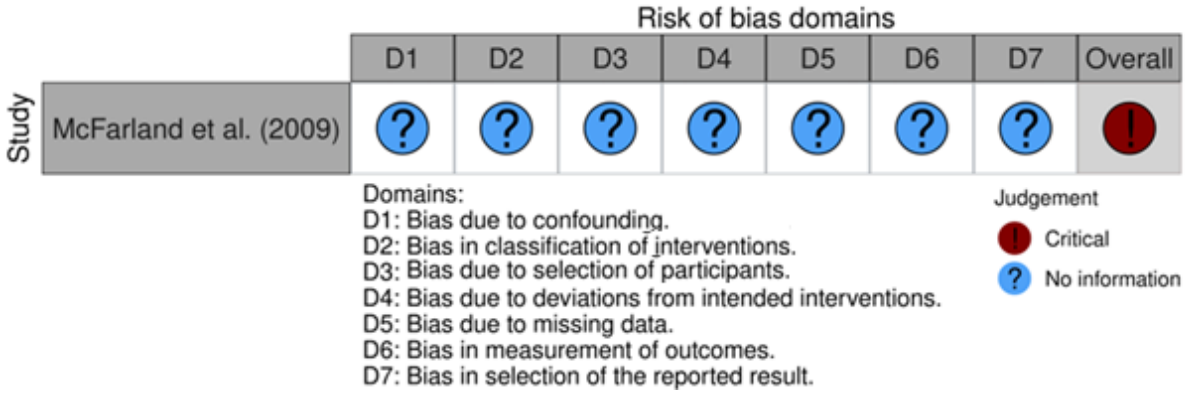

Figure 97: Prescribing errors in people with chronic kidney disease (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence [77]. As no inferential statistics were reported, we cannot comment on the significance of these findings. An overview of the evidence is provided in Table 100.

Table 100: Prescribing errors in people with chronic kidney disease

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [77]	Collaborative practice agreement: initiate	Pharmacist prescribing versus physician prescribing	Outpatient clinic	Critical	Very low	Number of events (%) 1/158 (0.6%) versus 34/132 (25.8%) More events in physician group	No inferential statistics reported

3.5.2.5.3 Summary of findings

Two studies assessed safety outcomes in people with chronic kidney disease for pharmacist prescribing compared with usual care and physician prescribing groups [67,77]. The safety outcomes assessed were adverse events and prescribing errors. No inferential statistics were reported for these outcomes (Table 101).

Table 101: Summary of safety findings for chronic kidney disease

Pharmacist prescribing compared with physician prescribing or usual care for chronic kidney disease

Patient or population group: Chronic kidney disease
Prescribing authority: Collaborative practice agreement
Setting: Outpatient clinic
Intervention: Pharmacist prescribing
Comparison: Physician prescribing; usual care

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence

Thromboembolic adverse events assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	405 (1 retrospective cohort study)	⊕◯◯◯ Very low
Thromboembolic adverse events assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	481 (1 retrospective cohort study)	⊕◯◯◯ Very low
Heart failure adverse events assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	405 (1 retrospective cohort study)	⊕◯◯◯ Very low
Heart failure adverse event assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	481 (1 retrospective cohort study)	⊕◯◯◯ Very low
Uncontrolled hypertension adverse events assessed with: Number of events	No inferential statistics were reported, therefore we cannot comment on the significance of this finding.	405 (1 retrospective cohort study)	⊕◯◯◯ Very low
Uncontrolled hypertension adverse events assessed with: Number of events	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	481 (1 retrospective cohort study)	⊕◯◯◯ Very low
Prescribing errors assessed with: Rates of inappropriate initial dosing	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	290 (1 retrospective cohort study)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.6 Urinary tract infection

Two studies assessed safety outcomes of pharmacist prescribing for people with urinary tract infections [68,78]. The safety outcomes assessed were adverse events, physician/emergency department visits due to adverse events, and antimicrobial therapy guideline concordance.

3.5.2.6.1 Adverse events

One non-randomised trial reported on adverse events in women with urinary tract infections in a pharmacist prescribing group compared with a physician prescribing group [68]. Adverse event outcomes included gastrointestinal adverse events, vaginal candidiasis adverse events, headache adverse events, other adverse events, and all adverse events combined. Figure 98 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

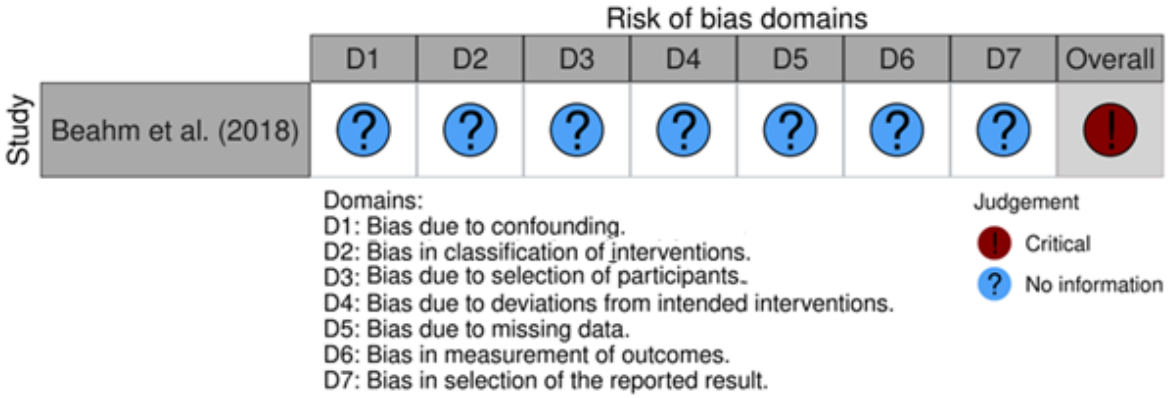

Figure 98: Adverse events in women with urinary tract infections (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in the number of gastrointestinal, vaginal candidiasis, headache, or other adverse events between the pharmacist prescribing group and the physician prescribing group. As no inferential statistics were reported for the overall number of adverse events, we cannot comment on the significance of this finding. An overview of the evidence is provided in Table 102.

Table 102: Adverse events in women with urinary tract infections

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Non-randomised trial [68]	Independent prescribing: prescribe and modify	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of adverse events (%) 44/596 (7.4%) versus 10/90 (11.1%) Lower proportion of events in pharmacist group	No inferential statistics reported
Non-randomised trial [68]	Independent prescribing: prescribe and modify	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of gastrointestinal adverse events (%) 27/596 (4.5%) versus 5/90 (5.5%); *p*=0.79	No significant difference
Non-randomised trial [68]	Independent prescribing: prescribe and modify	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of vaginal candidiasis adverse events (%)	No significant difference

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
						5/596 (0.8%) versus 3/90 (3.3%); *p*=0.11	
Non-randomised trial [68]	Independent prescribing: prescribe and modify	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of headache adverse events (%) 90/596 (15.1%) versus 0/90 (0.0%); *p*=0.7551	No significant difference
Non-randomised trial [68]	Independent prescribing: prescribe and modify	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of other adverse events (%) 6/596 (1.0%) versus 2/90 (2.2%); *p*=0.5963	No significant difference

3.5.2.6.2 Physician/emergency department visits due to adverse events

One non-randomised trial reported on physician or emergency department visits among women with urinary tract infections in a pharmacist prescribing group compared with a physician prescribing group [68]. Figure 99 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

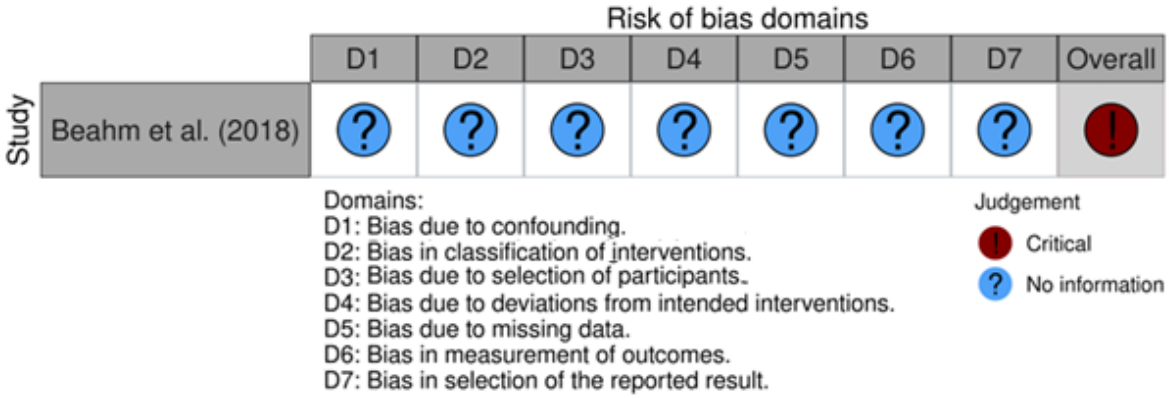

Figure 99: Physician or emergency department visits in women with urinary tract infections (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating no significant difference in the number of physician or emergency department visits between the pharmacist prescribing group and the physician prescribing group [68]. An overview of the evidence is provided in Table 103.

Table 103: Physician or emergency department visits in women with urinary tract infections

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Non-randomised trial [68]	Independent prescribing: assess, prescribe, modify, and educate	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of events (%) 3/596 (0.005%) versus 2/90 (0.2%); *p*=0.2273	No significant difference

3.5.2.6.3 Antimicrobial therapy guideline concordance

One non-randomised trial reported on antimicrobial therapy guideline concordance among women with urinary tract infections in a pharmacist prescribing group compared with a physician prescribing group [78]. Figure 100 presents the risk of bias assessment; the study was judged to have an overall critical risk of bias score for this outcome.

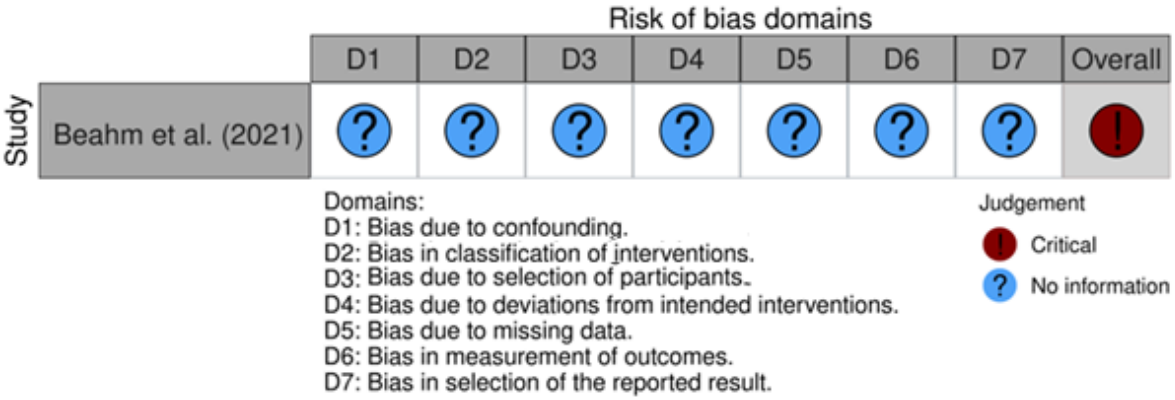

Figure 100: Antimicrobial therapy guideline concordance in women with urinary tract infections (risk of bias assessment using ROBINS-I)

This study reported very low-certainty evidence indicating significantly higher antimicrobial therapy guideline concordance in the pharmacist prescribing group compared with the physician prescribing group [78]. An overview of the evidence is provided in Table 104.

Table 104: Antimicrobial therapy guideline concordance in women with urinary tract infections

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Non-randomised trial [78]	Independent prescribing: assess, prescribe, modify, and educate	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of events (%) 624/656 (95.1%) versus 33/94 (35.1%); *p*<0.001	Pharmacist prescribing

3.5.2.6.4 Summary of findings

Two studies assessed safety outcomes of pharmacist prescribing for people with urinary tract infections [68,78]. The safety outcomes assessed were adverse events, physician or emergency department visits, and antimicrobial therapy guideline concordance. There was no significant difference in adverse events or related physician/emergency department visits in the pharmacist prescribing groups compared with the physician prescribing groups in both studies. There was significantly improved antimicrobial therapy guideline concordance in the pharmacist prescribing group compared with the physician prescribing group in one study (Table 105).

Table 105: Summary of safety findings for urinary tract infection

Pharmacist prescribing compared with physician prescribing for urinary tract infection

Patient or population group: Urinary tract infection
Prescribing authority: Independent
Setting: Community pharmacy
Intervention: Pharmacist prescribing
Comparison: Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
All adverse events assessed with: Yes/No	No inferential statistics were reported; therefore, we cannot comment on the significance of this finding.	686 (1 non-randomised trial)	⊕◯◯◯ Very low
Gastrointestinal adverse events assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	686 (1 non-randomised trial)	⊕◯◯◯ Very low
Vaginal candidiasis adverse events assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	686 (1 non-randomised trial)	⊕◯◯◯ Very low
Headache adverse events assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	686 (1 non-randomised trial)	⊕◯◯◯ Very low
Other adverse events assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	686 (1 non-randomised trial)	⊕◯◯◯ Very low
Physician/emergency department visits due to adverse events assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	686 (1 non-randomised trial)	⊕◯◯◯ Very low
Antimicrobial therapy guideline concordance assessed with: Yes/No	There was significantly improved antimicrobial therapy guideline concordance in the pharmacist prescribing group compared with the physician prescribing group.	686 (1 non-randomised trial)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.7 Older people in long-term care

Three studies (one non-randomised trial, one RCT, and one cluster RCT) assessed safety outcomes of pharmacist prescribing for older people in long-term care [69–71]. The safety outcomes assessed were mortality and adverse events.

3.5.2.7.1 Mortality

Two studies (one non-randomised trial and one cluster RCT) assessed mortality among older people in long-term care in pharmacist prescribing groups compared with primary care provider prescribing or medical internist prescribing groups [69,71]. Figure 101 presents the risk of bias assessment for the non-randomised trial; the study was judged to have an overall critical risk of bias score for this outcome. Figure 102 presents the risk of bias assessment for the cluster RCT; the study was judged to have an overall high risk of bias score for this outcome.

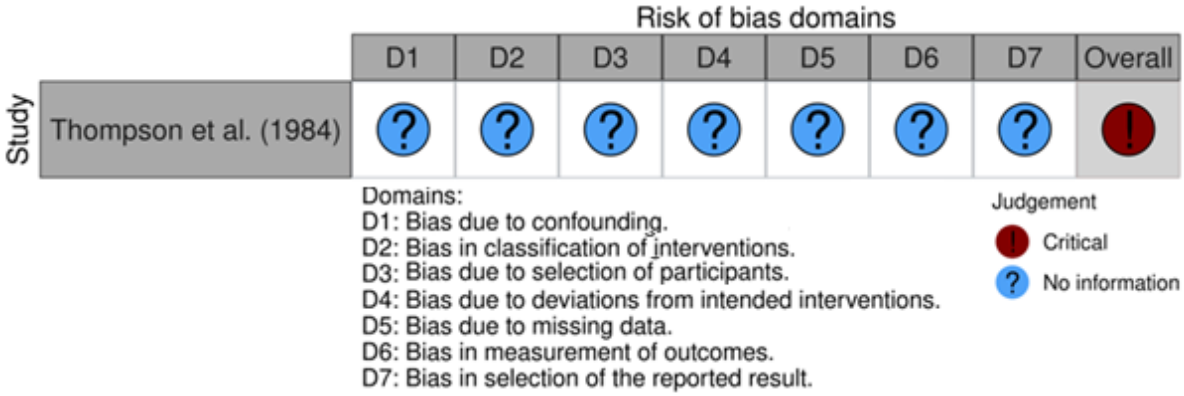

Figure 101: Mortality in older people in long-term care (risk of bias assessment using ROBINS-I)

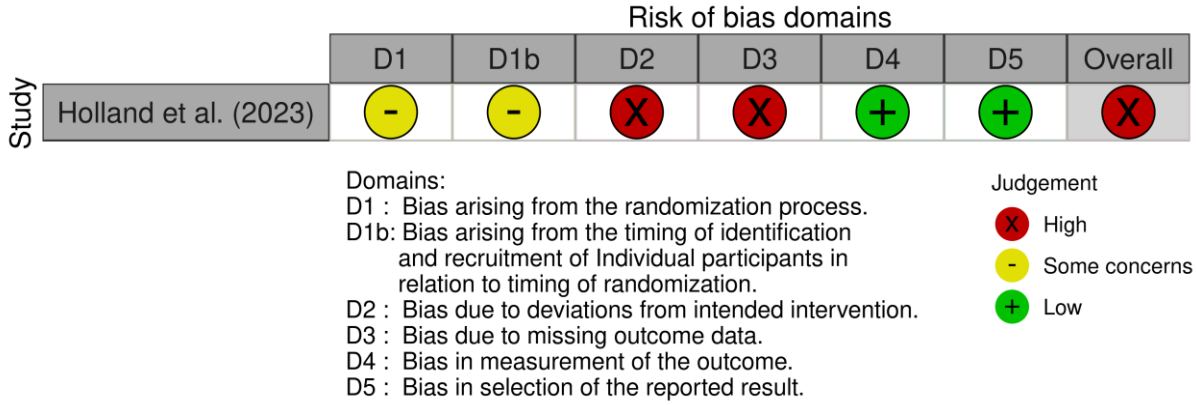

Figure 102: Mortality in older people in long-term care (risk of bias assessment using RoB 2 for cluster RCTs)

The cluster RCT reported very low-certainty evidence that mortality did not significantly differ in the pharmacist prescribing group compared with the primary care provider prescribing group [69]. The non-randomised trial reported very low-certainty evidence indicating significantly fewer deaths in the pharmacist prescribing group compared with the medical internist prescribing group [71]. An overview of the evidence is provided in Table 106.

Table 106: Mortality in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Cluster RCT [69]	Independent prescribing: optimise therapy	Pharmacist prescribing versus primary care provider prescribing	Long-term care	High	Very low	Number of events (%) 66/449 (14.7%) versus 71/427 (16.6%); *p*=0.68	No significant difference
Non-randomised trial [71]	Formulary prescribing: change medications	Pharmacist prescribing versus medical internist prescribing	Long-term care	Critical	Very low	Number of events (%) 3/67 (4.5%) versus 10/72 (13.9%); *p*=0.05	Pharmacist prescribing

3.5.2.7.2 Adverse events

One RCT assessed adverse events for pharmacist prescribing among older people in long-term care [70]. The adverse events included syncope events, hypotension events, hypokalaemia events, hyperkalaemia events, hyponatraemia events, orthostatic presyncope events, and change in estimated glomerular filtration rate (eGFR). Figure 103 presents the risk of bias assessment for the RCT; the study was judged to have some concerns as its overall risk of bias score for this outcome.

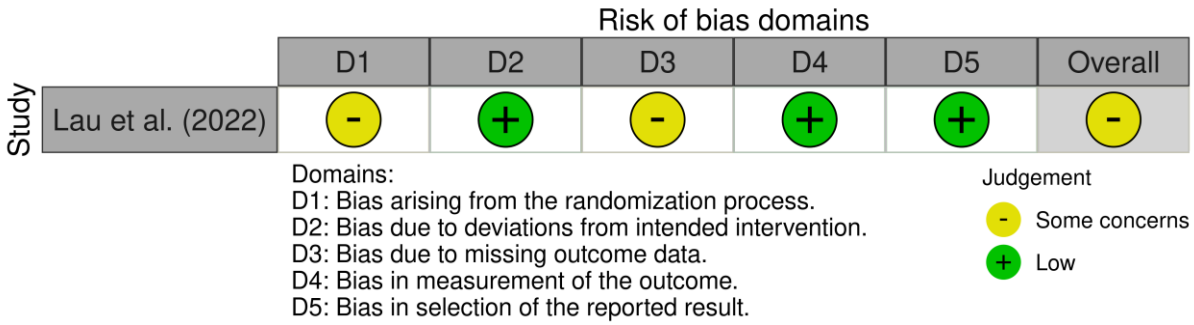

Figure 103: Adverse events in older people in long-term care (risk of bias assessment using RoB 2)

This RCT reported very low-certainty evidence indicating no significant difference in the number of syncope, hypokalaemia, hyperkalaemia, hyponatraemia, or orthostatic presyncope events, or in change in eGFR, between the pharmacist prescribing and physician prescribing groups. However, there were significantly more hypotension events in the pharmacist prescribing group compared with the physician prescribing group [70]. An overview of the evidence is provided in Table 107.

Table 107: Adverse events in older people in long-term care

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Number of syncope events (%) 11/47 (23.4%) versus 9/45 (20.0%); *p*=0.683	No significant difference
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Number of hypotension events (%) 13/47 (27.7%) versus 3/45 (6.7%); *p*=0.009	Physician prescribing
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Number of hypokalaemia events (%) 3/47 (6.4%) versus 5/45 (11.1%); *p*=0.435	No significant difference
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Number of hyperkalaemia events (%) 6/47 (12.8%) versus 4/45 (8.9%); *p*=0.545	No significant difference
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Number of hyponatraemia events (%) 1/47 (2.1%) versus 2/45 (4.4%); *p*=0.539	No significant difference
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Number of orthostatic presyncope events (%) 7/47 (14.9%) versus 5/45 (11.1%); *p*=0.59	No significant difference
RCT [70]	Protocol prescribing: adjust medications	Pharmacist prescribing versus physician prescribing	Long-term care	Some concerns	Very low	Mean change (SD) in eGFR 2.68 (8.75) versus −1.05 (9.14); *p*=0.381	No significant difference

3.5.2.7.3 Summary of findings

Three studies assessed safety outcomes of pharmacist prescribing for older people in long-term care settings [69–71]. The safety outcomes assessed were mortality and adverse events. Two studies reported on mortality. One study reported no significant difference between a pharmacist prescribing group and a primary care provider prescribing group, the other reported significant improvement in a pharmacist prescribing group compared with a medical internist group.

No significant difference across six adverse event outcomes was reported between a pharmacist prescribing group and a physician prescribing group. However, significantly higher numbers of hypotension adverse events were reported in a pharmacist prescribing group compared with a physician prescribing group (Table 108).

Table 108: Summary of safety findings for older people in long-term care

Pharmacist prescribing compared with primary care provider, medical internist, or physician prescribing for older people in long-term care

Patient or population group: Older people in long-term care
Prescribing authority: Independent; formulary; protocol
Setting: Long-term care
Intervention: Pharmacist prescribing/deprescribing
Comparison: Primary care provider prescribing; medical internist prescribing; physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Mortality assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the primary care provider prescribing group.	876 (1 cluster RCT)	⊕◯◯◯ Very low
Mortality assessed with: Number of events	Significantly fewer deaths were reported in the pharmacist prescribing group compared with the medical internist prescribing group.	139 (1 non-randomised trial)	⊕◯◯◯ Very low
Syncope assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	92 (1 RCT)	⊕◯◯◯ Very low
Hypotension assessed with: Number of events	A significantly higher number of hypotension adverse events was reported in the pharmacist prescribing group compared with the physician prescribing group.	92 (1 RCT)	⊕◯◯◯ Very low
Hypokalaemia assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	92 (1 RCT)	⊕◯◯◯ Very low
Hyperkalaemia assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	92 (1 RCT)	⊕◯◯◯ Very low

Hyponatraemia assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	92 (1 RCT)	⊕◯◯◯ Very low
Orthostatic presyncope assessed with: Number of events	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	92 (1 RCT)	⊕◯◯◯ Very low
Change in eGFR assessed with: Mean change	No significant difference was reported between the pharmacist prescribing group and the physician prescribing group.	92 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.8 Female contraceptive users

Two studies (one prospective cohort study and one retrospective cohort study) reported on the safety of pharmacist prescribing for women prescribed contraception [80,81]. The safety outcome assessed was medical contraindications.

3.5.2.8.1 Medication contraindications

Two studies (one prospective cohort study and one retrospective cohort study) reported on medical contraindications among women prescribed contraception in pharmacist prescribing groups compared with physician prescribing groups [80,81]. Figure 104 presents the risk of bias assessment for these studies. The prospective cohort study was judged to have an overall serious risk of bias score for this outcome, and the retrospective cohort study was judged to have an overall critical risk of bias score for this outcome.

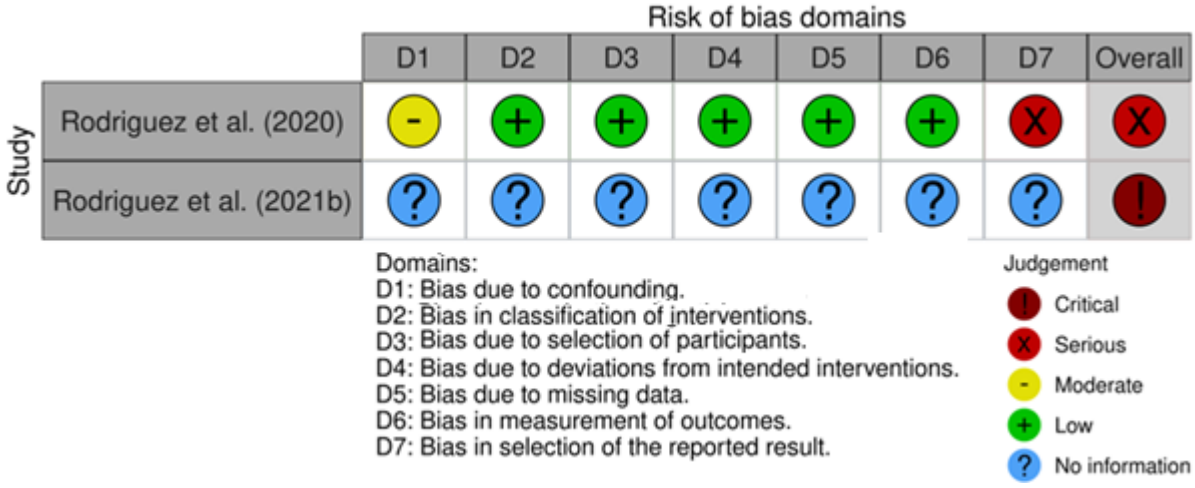

Figure 104: Medical contraindications in women prescribed contraception (risk of bias assessment using ROBINS-I)

Both studies reported very low-certainty evidence. The prospective cohort study reported no significant difference in medical contraindications between the pharmacist prescribing and physician prescribing

groups [80]. The retrospective cohort study did not report inferential statistics; therefore, we cannot comment on the significance of the findings [81]. An overview of the evidence is provided in Table 109.

Table 109: Medical contraindications in women prescribed contraception

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Prospective cohort study [80]	Independent prescribing	Pharmacist prescribing versus physician prescribing	Community pharmacy	Serious	Very low	Number of events (%) 14/20 (70%) versus 32/40 (80%); *p*=0.52	No significant difference
Retrospective cohort study [81]	Independent prescribing	Pharmacist prescribing versus physician prescribing	Community pharmacy	Critical	Very low	Number of events (%) 28/3,782 (0.8%) versus 9,392/18,490 (2.2%) Slightly higher proportion in the physician prescribing group	No inferential statistics reported

3.5.2.8.2 Summary of findings

Two studies reported on the safety of pharmacist prescribing for women prescribed contraception [80,81]. One study reported no significant difference in medical contraindications between the pharmacist prescribing group and the physician prescribing group, whereas the other study did not report inferential statistics (Table 110).

Table 110: Summary of safety findings for female contraceptive users

Pharmacist prescribing compared with physician prescribing for female contraceptive users			
Patient or population group: Female contraceptive users **Prescribing authority:** Independent **Setting:** Community pharmacy **Intervention:** Pharmacist prescribing **Comparison:** Physician prescribing			
Outcomes	**Findings**	**Number of participants (number of studies)**	**Certainty of the evidence**

Medical contraindications assessed with: Yes/No	The prospective cohort study reported no significant difference between the pharmacist prescribing group and the physician prescribing group. The retrospective cohort study did not report inferential statistics; therefore, we cannot comment on the significance of this finding.	439,650 (1 prospective cohort study; 1 retrospective cohort study)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.9 Emergency department patients

One RCT assessed the safety of pharmacist prescribing for people in the emergency department [82]. The safety outcome assessed was prescribing errors.

3.5.2.9.1 Prescribing errors

One RCT reported on prescribing errors among people in the emergency department in a pharmacist prescribing group compared with a physician prescribing group [82]. Figure 105 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

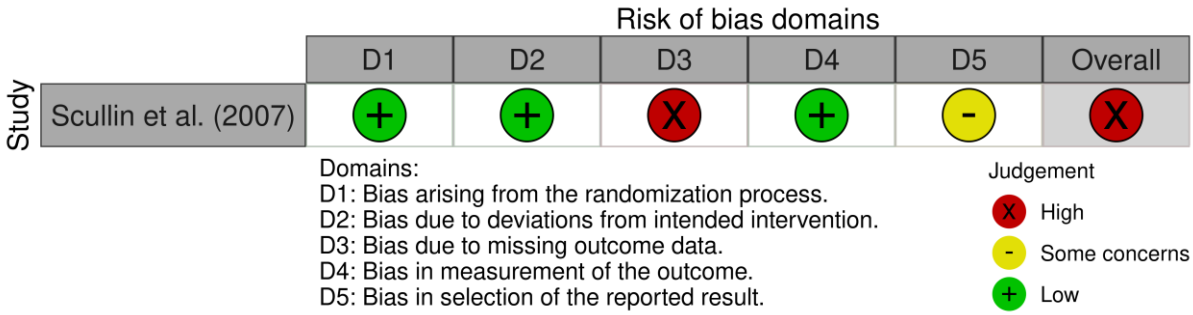

Figure 105: Prescribing errors in emergency department patients (risk of bias assessment using RoB 2)

The RCT reported very low-certainty evidence indicating significantly fewer prescribing errors in the pharmacist prescribing group compared with the physician prescribing group [82]. An overview of the evidence is provided in Table 111.

Table 111: Prescribing errors in emergency department patients

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [82]	Collaborative practice agreement: optimise,	Pharmacist prescribing versus	Emergency department	High	Very low	Error rate (%) 68/412 (16.5%)	Pharmacist prescribing

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
	prescribe, withhold, and continue medication treatment	physician prescribing				versus 279/357 patients) (78.2%); *p*<0.001	

3.5.2.9.2 Summary of findings

One study assessed the safety of pharmacist prescribing for people in the emergency department [82]. Significantly fewer prescribing errors were reported in the pharmacist prescribing group compared with the physician prescribing group (Table 112).

Table 112: Summary of safety findings for emergency department patients

Pharmacist prescribing compared with physician prescribing for emergency department patients

Patient or population group: Emergency department patients
Prescribing authority: Collaborative practice agreement
Setting: Emergency department
Intervention: Pharmacist prescribing
Comparison: Physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Prescribing errors assessed with: Number of events	There were significantly fewer prescribing errors reported in the pharmacist prescribing group compared with the physician prescribing group.	73 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.10 Surgery patients

3.5.2.10.1 Prescribing errors

One RCT reported on prescribing errors (medications charted at incorrect frequency, medications charted at incorrect dose, and doses missed during inpatient stay) in a pharmacist prescribing and medication review group compared with a pharmacist medication review only group or a physician prescribing group [83]. Figure 106 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

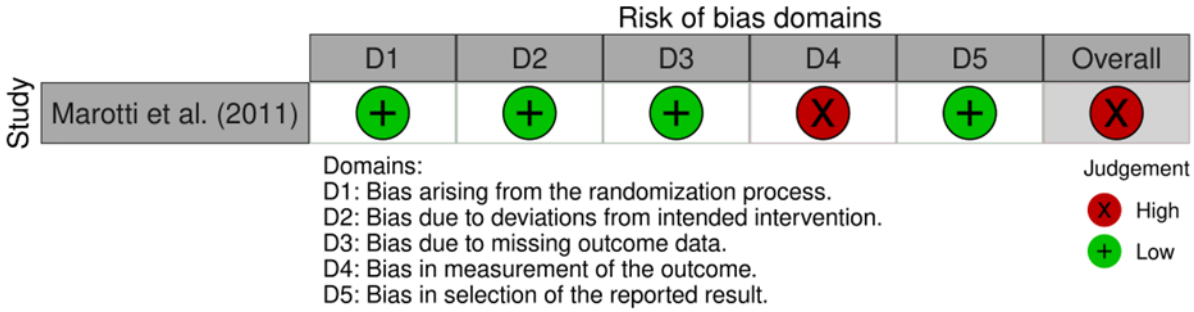

Figure 106: Prescribing errors in surgery patients (risk of bias assessment using RoB 2)

The RCT reported very low-certainty evidence indicating fewer prescribing errors in the pharmacist prescribing and medication review group compared with the pharmacist medication review only group and the physician prescribing group [83]. An overview of the evidence is provided in Table 113.

Table 113: Prescribing errors in surgery patients

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [83]	Supplementary prescribing	Pharmacist prescribing and medication review versus pharmacist medication review	Inpatient	High	Very low	Medications charted at incorrect frequency Mean (95% CI) 0.015 (0.00–0.06) versus 0.07 (0.02–0.12); p<0.01	Pharmacist prescribing
RCT [83]	Supplementary prescribing	Pharmacist prescribing and medication review versus physician prescribing	Inpatient	High	Very low	Medications charted at incorrect frequency Mean (95% CI) 0.015 (0.00–0.07) versus 0.29 (0.19–0.39); p<0.01	Pharmacist prescribing
RCT [83]	Supplementary prescribing	Pharmacist prescribing and medication review versus pharmacist medication review	Inpatient	High	Very low	Medications charted at incorrect dose Mean (95% CI) 0.02 (0.00–0.04) versus	Pharmacist prescribing

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
						0.12 (0.05–0.18) *p*<0.01	
RCT [83]	Supplementary prescribing	Pharmacist prescribing and medication review versus physician prescribing	Inpatient	High	Very low	Medications charted at incorrect dose Mean (95% CI) 0.02 (0.00–0.05) versus 0.48 (0.35–0.18); *p*<0.01	Pharmacist prescribing
RCT [83]	Supplementary prescribing	Pharmacist prescribing and medication review versus pharmacist medication review	Inpatient	High	Very low	Doses missed during inpatient stay Mean (95% CI) 1.07 (0.9–1.25) versus 3.30 (2.98–3.63); *p*<0.001	Pharmacist prescribing
RCT [83]	Supplementary prescribing	Pharmacist prescribing and medication review versus physician prescribing	Inpatient	High	Very low	Doses missed during inpatient stay Mean (95% CI) 1.07 (0.9–1.26) versus 3.21 (2.89–3.5); *p*<0.001	Pharmacist prescribing

3.5.2.10.2 Summary of findings

One study assessed safety outcomes with respect to prescribing errors in pharmacist prescribing for surgery patients [83]. There were significantly fewer prescribing errors in the pharmacist prescribing and medication review group compared with the pharmacist medication review only group and the physician prescribing group across all outcomes (Table 114).

Table 114: Summary of safety findings for surgery patients

Pharmacist prescribing and medication review compared with pharmacist medication review or physician prescribing for surgery patients

Patient or population group: Surgery patients
Prescribing authority: Supplementary
Setting: Hospital
Intervention: Pharmacist prescribing and medication review
Comparison: Pharmacist medication review; physician prescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Medications charted at incorrect frequency assessed with: Mean	There were significantly fewer medications charted at incorrect frequencies reported in the pharmacist prescribing and medication review group compared with the pharmacist medication review only group.	221 (1 RCT)	⊕◯◯◯ Very low
Medications charted at incorrect frequency assessed with: Mean	There were significantly fewer medications charted at incorrect frequencies reported in the pharmacist prescribing and medication review group compared with the physician prescribing group.	221 (1 RCT)	⊕◯◯◯ Very low
Medications charted at incorrect dose assessed with: Mean	There were significantly fewer medications charted at incorrect doses reported in the pharmacist prescribing and medication review group compared with the pharmacist medication review only group.	221 (1 RCT)	⊕◯◯◯ Very low
Medications charted at incorrect dose assessed with: Mean	There were significantly fewer medications charted at incorrect doses reported in the pharmacist prescribing and medication review group compared with the physician prescribing group.	221 (1 RCT)	⊕◯◯◯ Very low
Doses missed during inpatient stay assessed with: Mean	There were significantly fewer missed doses reported in the pharmacist prescribing and medication review group compared with the pharmacist medication review only group.	221 (1 RCT)	⊕◯◯◯ Very low
Doses missed during inpatient stay assessed with: Mean	There were significantly fewer missed doses reported in the pharmacist prescribing and medication review group compared with the physician prescribing group.	221 (1 RCT)	⊕◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.2.11 People at risk of drug-related problems

One RCT assessed the safety pharmacist prescribing for people at risk of drug-related problems [76]. The safety outcome assessed was mortality.

3.5.2.11.1 Mortality

One RCT reported on mortality among people at risk of drug-related problems in a pharmacist prescribing group compared with a physician prescribing group [76]. Figure 107 presents the risk of bias assessment; the study was judged to have an overall high risk of bias score for this outcome.

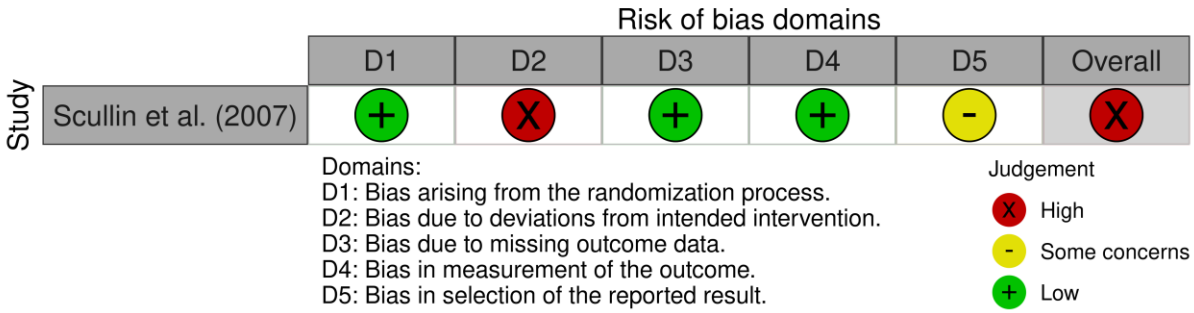

Figure 107: Mortality in people at risk of drug-related problems (risk of bias assessment using RoB 2)

This study reported very low-certainty evidence indicating no significant difference in mortality between the pharmacist prescribing and physician prescribing groups. An overview of the evidence is provided in Table 115.

Table 115: Mortality in people at risk of drug-related problems

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
RCT [76]	Protocol prescribing: discharge prescriptions	Pharmacist prescribing versus physician prescribing	Inpatient	High	Very low	Number of events (%) 67/371 (18.1%) versus 76/391 (19.4%); *p*=0.578	No significant difference

3.5.2.11.2 Summary of findings

One study assessed the safety of pharmacist prescribing for people at risk of drug-related problems [76]. No significant difference in mortality was reported between the pharmacist prescribing and physician prescribing groups (Table 116).

Table 116: Summary of safety findings for people at risk of drug-related problems

Pharmacist prescribing compared with physician prescribing for people at risk of drug-related problems			
Patient or population group: People at risk of drug-related problems **Prescribing authority:** Protocol **Setting:** Inpatient **Intervention:** Pharmacist prescribing **Comparison:** Physician prescribing			
Outcomes	**Findings**	**Number of participants (number of studies)**	**Certainty of the evidence**
Mortality assessed with: Yes/No	No significant difference was reported between the pharmacist prescribing and physician prescribing groups.	762 (1 RCT)	⨁◯◯◯ Very low
GRADE Working Group grades of evidence **High certainty:** we are very confident that the true effect lies close to that of the estimate of the effect. **Moderate certainty:** we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different. **Low certainty:** our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect. **Very low certainty:** we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.			

3.5.2.12 Mixed health conditions

One retrospective cohort study assessed safety outcomes in pharmacist prescribing for mixed health conditions [79]. The safety outcome assessed was hospitalisations/emergency department visits due to adverse events.

3.5.2.12.1 Hospitalisations/emergency department visits due to adverse events

One retrospective cohort study assessed hospitalisations/emergency department visits due to adverse events in older people with mixed health conditions in pharmacist deprescribing compared with physician deprescribing groups. Figure 108 presents the risk of bias assessment for the retrospective cohort study; the study was judged to have an overall critical risk of bias score for this outcome.

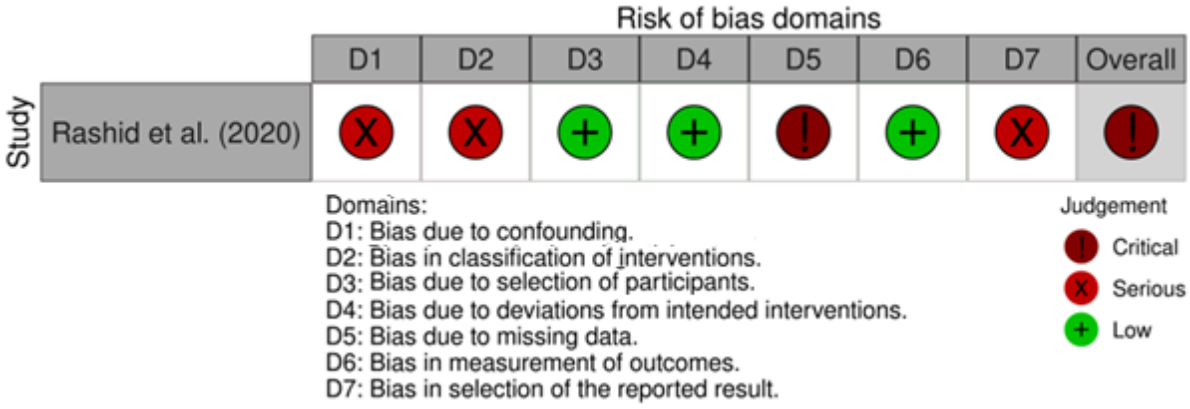

Figure 108: Adverse events in mixed health populations (risk of bias assessment using ROBINS-I)

This retrospective cohort study reported very low-certainty evidence. No significant difference was reported in acute kidney injury events or gastrointestinal bleeding events between the pharmacist deprescribing and physician deprescribing groups. Significantly fewer hospitalisations and emergency department visits due to adverse pain events were reported in the pharmacist deprescribing group compared with the physician deprescribing group [79]. An overview of the evidence is provided in Table 117.

Table 117: Hospitalisations/emergency department visits in mixed health populations

Study design	Prescriptive authority	Intervention versus comparator	Setting	Risk of bias	Certainty of evidence	Effect estimates	Direction of effect favours
Retrospective cohort study [79]	Collaborative practice agreement: deprescribe	Pharmacist deprescribing versus physician deprescribing	Outpatient	Critical	Very low	Adjusted odds ratio (95% CI) for acute kidney injury events (hospitalisations and emergency department visits) (%) 0.53 (0.24–1.16); *p*=0.11	No significant difference
Retrospective cohort study [79]	Collaborative practice agreement: deprescribe	Pharmacist deprescribing versus physician deprescribing	Outpatient	Critical	Very low	Adjusted odds ratio (95% CI) for gastrointestinal bleeding events (hospitalisations and emergency department visits) 0.65 (0.36–1.16); *p*=0.15	No significant difference
Retrospective cohort study [79]	Collaborative practice agreement: deprescribe	Pharmacist deprescribing versus physician deprescribing	Outpatient	Critical	Very low	Adjusted odds ratio (95% CI) for pain (hospitalisations and emergency department visits) 0.50 (0.33–0.77); *p*<0.01	Pharmacist deprescribing

3.5.2.12.2 Summary of findings

One retrospective cohort study assessed hospitalisations/emergency department visits due to adverse events in older people with mixed health conditions in pharmacist deprescribing compared with physician deprescribing groups.

No significant difference was reported in acute kidney injury events or gastrointestinal bleeding events between the pharmacist deprescribing and physician deprescribing groups. Significantly fewer

hospitalisations and emergency department visits due to adverse pain events were reported in the pharmacist deprescribing group compared with the physician deprescribing group (Table 118).

Table 118: Summary of safety findings for mixed health populations

Pharmacist prescribing compared with primary care provider, medical internist, or physician prescribing for older people in long-term care

Patient or population group: Mixed health conditions
Prescribing authority: Collaborative practice agreement
Setting: Outpatient
Intervention: Pharmacist deprescribing
Comparison: Physician deprescribing

Outcomes	Findings	Number of participants (number of studies)	Certainty of the evidence
Acute kidney injury events (hospitalisations and emergency department visits) assessed with: Number of events	No significant difference was reported between the pharmacist deprescribing group and the physician deprescribing group.	2,155 (1 retrospective cohort study)	⨁◯◯◯ Very low
Gastrointestinal bleeding events (hospitalisations and emergency department visits) assessed with: Number of events	No significant difference was reported between the pharmacist deprescribing group and the physician deprescribing group.	2,155 (1 retrospective cohort study)	⨁◯◯◯ Very low
Pain (hospitalisations and emergency department visits) assessed with: Number of events	Significantly fewer hospitalisations and emergency department visits were reported in the pharmacist deprescribing group compared with the physician deprescribing group.	1,805 (1 retrospective cohort study)	⨁◯◯◯ Very low

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

3.5.3 Cost-effectiveness results

We included 13 studies that reported on cost-effectiveness outcomes [84–96]. Outcomes were reported for eight healthcare population categories: diabetes [85–87], hypertension [88–90], chronic kidney disease [96], urinary tract infection [84], common conditions [93], acute pharyngitis [94], female contraceptive users [91,92], and chronic pain conditions [95].

3.5.3.1 Diabetes

Three studies assessed the cost-effectiveness of pharmacist prescribing for diabetes [85–87]. A condensed summary of the quality assessment is provided in Table 119; the full assessment is available in Appendix K.

Table 119: Diabetes (critical appraisal summary using Philips checklist)

Quality dimension	Quality dimension met		
	Hirsch *et al.* (2017) [86]	Brown *et al.* (2016) [85]	Yu *et al.* (2013) [87]
Structure			
S1 Statement of decision problem/objective	Yes	Yes	Yes
S2 Statement of scope/perspective	Yes	Yes	Yes
S3 Rationale for structure	Partial	Yes	Yes
S4 Structural assumptions	Yes	Yes	Yes
S5 Strategies/comparators	Yes	Partially	Yes
S6 Model type	Yes	Yes	Yes
S7 Time horizon	Yes	Yes	No
S8 Disease states/pathways	No	Yes	Yes
S9 Cycle length	Not applicable (N/A)	No	Yes
Data			
D1 Data identification	Partially	Partially	Partially
D2 Data modelling	Yes	Yes	Yes
D2a Baseline data	Yes	Partially	Partially
D2b Treatment effects	Partially	Partially	Partially
D2c Costs	Yes	Yes	Yes
D2d Quality of life weights (utilities)	Partially	Partially	Partially
D3 Data incorporation	Partially	Partially	Yes
D4 Assessment of uncertainty	No	No	No
D4a Methodological	Yes	No	Yes
D4b Structural	Yes	Yes	Yes
D4c Heterogeneity	No	No	No
D4d Parameter	Yes	No	Yes
Consistency			
C1 Internal consistency	Yes	Yes	No
C2 External consistency	No	Partially	Partially

The first study conducted a cost-utility analysis in order to evaluate the cost-effectiveness of a pharmacist–endocrinologist outpatient clinic for people with diabetes from a United States of America (USA) payer perspective [86]. The pharmacist–endocrinologist model was found to be the dominant strategy, with lower projected treatment costs for the full cohort of 60 patients (3,879,964 United States dollars (USD) versus USD 4,114,363) and higher projected quality-adjusted life years (QALYs) (385 years 375) compared with primary care provider care.

The second study evaluated the cost-effectiveness of pharmacist-initiated insulin therapy for patients with type 2 diabetes mellitus from a Canadian healthcare system perspective [85]. The study compared early pharmacist-led insulin initiation with delayed physician-led insulin initiation. Pharmacists initiating insulin therapy 1 or 2 years earlier than physicians led to per-patient cost savings of 624 Canadian dollars (CAD) or CAD 805, respectively, as well as gains in QALYs (0.048 or 0.075, respectively). Treatment costs

increased if insulin initiation was delayed by 3 or 5 years, but still remained cost-effective. This resulted in an incremental cost-effectiveness ratio (ICER) of CAD 7,613 per QALY, well below the cost-effectiveness threshold of CAD 50,000 per QALY in Canada.

The third study evaluated the cost-effectiveness of a pharmacist-led diabetes management intervention in a primary care setting from a USA third-party payer perspective [87]. The pharmacist prescribing model was the dominant strategy. Lower per-patient treatment cost (USD 35,740 versus USD 44,528), additional life years (8.9 versus 8.1 years), and more QALYs (5.51 versus 5.02) were projected in the pharmacist prescribing model compared with the primary care provider prescribing model. An overview of the findings is provided in Table 120.

Table 120: Cost-effectiveness of pharmacist prescribing for diabetes

Study design (model type)	Prescriptive authority	Intervention versus comparator	Setting	Perspective	Time horizon	Price year (currency); discount rate	Key findings
Cost-utility analysis (Archimedes) [86]	Collaborative practice agreement	Pharmacist–endocrinologist versus primary care provider	Outpatient clinic	USA payer	10 years	2014 (USD); 3%	Lower treatment costs and higher QALYs projected in the pharmacist–endocrinologist model.
Cost-utility analysis (Markov) [85]	Independent	Pharmacist prescribing versus physician prescribing	Community pharmacy	Canadian healthcare system	50 years	2014 (CAD); 5%	Pharmacists initiating insulin therapy 1 or 2 years earlier led to per-patient cost savings and gains in QALYs. Treatment delays of up to 5 years remained cost-effective.
Cost-utility analysis (Markov) [87]	Collaborative practice agreement	Pharmacist prescribing versus physician prescribing	Outpatient primary care clinic	USA third-party payer	10 years	2011 (USD); 3%	Lower treatment costs, additional life years, and higher QALYs projected in the pharmacist-led diabetes management model.

3.5.3.2 Hypertension

Three studies assessed the cost-effectiveness of pharmacist prescribing for hypertension [88–90]. A condensed summary of the quality assessment is provided in Table 121; the full assessment is available in Appendix K.

Table 121: Hypertension (critical appraisal summary using Philips checklist)

Quality dimension	Quality dimension met		
	Jay *et al.* (2021) [88]	Dixon *et al.* (2023) [89]	Marra *et al.* (2017) [90]
Structure			
S1 Statement of decision problem/objective	Yes	Yes	Yes
S2 Statement of scope/perspective	Yes	Yes	Yes
S3 Rationale for structure	Yes	Yes	Yes
S4 Structural assumptions	Yes	Yes	Yes
S5 Strategies/comparators	Yes	Partially	Partially
S6 Model type	Yes	Yes	Yes
S7 Time horizon	Partially	Yes	Yes
S8 Disease states/pathways	No	No	Yes
S9 Cycle length	NA	No	No
Data			
D1 Data identification	Partially	Partially	Partially
D2 Data modelling	Yes	Yes	Yes
D2a Baseline data	Yes	Partially	Partially
D2b Treatment effects	Partially	Partially	Partially
D2c Costs	Partially	Yes	Yes
D2d Quality of life weights (utilities)	N/A	Partially	Partially
D3 Data incorporation	Yes	Yes	Yes
D4 Assessment of uncertainty	No	No	No
D4a Methodological	No	Yes	Yes
D4b Structural	Yes	Yes	Yes
D4c Heterogeneity	No	No	No
D4d Parameter	No	Partially	Partially
Consistency			
C1 Internal consistency	No	No	No
C2 External consistency	No	No	No

The first study conducted a cost-benefit analysis in order to evaluate the cost-effectiveness of a pharmacist–physician collaborative care model in a primary care setting for hypertension from a USA payer perspective [88]. The pharmacist–physician collaborative care model was found to be the dominant strategy, with lower projected treatment costs (USD 702.00 versus USD 810.00) and lower downstream healthcare expenditure (USD 1,535.82 versus USD 1,698.64) compared with the primary care model.

The second study conducted a cost-utility analysis in order to evaluate the cost-effectiveness of pharmacist-led medication management in a primary care setting for hypertension from a USA third-party payer perspective [89]. Pharmacist-led medication management was the dominant strategy. Lower treatment costs (USD 179,485 versus USD 189,648), additional life years (15.0 versus 14.6), and higher QALYs (12.4 versus 11.8) were projected in the pharmacist-led medication management group compared with a hypothetical cohort assuming usual care.

The final study conducted a cost-utility analysis to evaluate the cost-effectiveness of pharmacist-led medication management for hypertension in a community pharmacy from a Canadian public payer perspective [90]. The pharmacist-led programme was the dominant strategy. Lower per-patient treatment costs (CAD 134,277 versus CAD 140,641), additional life years (12.7 versus 12.4), and higher QALYs (10.8 versus 10.4) were projected in the pharmacist-led model compared with usual care. An overview of the findings is provided in Table 122.

Table 122: Cost-effectiveness of pharmacist prescribing for hypertension

Study design (model type)	Prescriptive authority	Intervention versus comparator	Setting	Perspective	Time horizon	Price year (currency); discount rate	Key findings
Cost-benefit analysis (decision tree) [88]	Collaborative practice agreement: medication management	Pharmacist–physician model versus primary care model	Primary care	USA payer	3 years	2020 (USD); N/A	The pharmacist–physician collaborative care model had lower treatment costs and lower downstream healthcare expenditure (i.e. higher benefits).
Cost-utility analysis (Markov) [89]	Independent prescribing: medication management	Pharmacist led versus hypothetical cohort	Primary care	USA third-party payer	30 years	2021 (USD); 3%	Lower treatment costs, additional life years, and higher QALYs projected in the pharmacist-led medication management model.
Cost-utility analysis (Markov) [90]	Independent prescribing: initiation and medication management	Pharmacist led versus usual care	Community pharmacy	Canadian public payer	30 years	2015 (CAD); 5%	Lower treatment costs, additional life years, and higher QALYs projected in the pharmacist-led medication management model.

3.5.3.3 Chronic kidney disease

One study assessed the cost-effectiveness of pharmacist prescribing for chronic kidney disease [96]. A condensed summary of the quality assessment for this study is provided in Table 123; the full assessment is available in Appendix K.

Table 123: Chronic kidney disease (critical appraisal summary using Philips checklist)

Quality dimension	Quality dimension met Aspinall *et al.* (2013) [96]
Structure	

Quality dimension	Quality dimension met Aspinall *et al.* (2013) [96]
S1 Statement of decision problem/objective	Yes
S2 Statement of scope/perspective	Yes
S3 Rationale for structure	Yes
S4 Structural assumptions	Yes
S5 Strategies/comparators	Yes
S6 Model type	Yes
S7 Time horizon	Partially
S8 Disease states/pathways	Yes
S9 Cycle length	Yes
Data	
D1 Data identification	Partially
D2 Data modelling	Yes
D2a Baseline data	Partially
D2b Treatment effects	Partially
D2c Costs	Yes
D2d Quality of life weights (utilities)	Partially
D3 Data incorporation	Yes
D4 Assessment of uncertainty	Yes
D4a Methodological	Yes
D4b Structural	Yes
D4c Heterogeneity	Yes
D4d Parameter	Yes
Consistency	
C1 Internal consistency	No
C2 External consistency	No

This study used a cost-utility analysis to evaluate the economic impact of a pharmacist-managed erythropoiesis-stimulating agent primary care clinic for people with chronic kidney disease from a USA payer perspective. The pharmacist–physician collaborative care model was the dominant strategy. Lower treatment costs (USD 13,412 versus USD 16,173) and higher QALYs gained (2.096 versus 2.093) were projected in the pharmacist–physician model compared with a physician prescribing model. An overview of the findings is provided in Table 124.

Table 124: Cost-effectiveness of pharmacist prescribing for chronic kidney disease

Study design (model type)	Prescriptive authority	Intervention versus comparator	Setting	Perspective	Time horizon	Price year (currency); discount rate	Key findings
Cost-utility analysis (Markov) [96]	Collaborative practice agreement: initiation and management	Pharmacist prescribing versus physician prescribing	Primary care	USA payer	5 years	2012 (USD); 3%	Lower treatment costs and higher QALYs projected in the pharmacist-managed erythropoiesis-stimulating agent clinic.

3.5.3.4 Urinary tract infection

One study assessed the cost-effectiveness of pharmacist prescribing for urinary tract infection [84]. A condensed summary of the quality assessment for this study is provided in Table 125; the full assessment is available in Appendix K.

Table 125: Urinary tract infection (critical appraisal summary using Philips checklist)

Quality dimension	Quality dimension met Sanyal *et al.* (2019) [84]
Structure	
S1 Statement of decision problem/objective	Yes
S2 Statement of scope/perspective	Yes
S3 Rationale for structure	Yes
S4 Structural assumptions	Yes
S5 Strategies/comparators	Yes
S6 Model type	Yes
S7 Time horizon	No
S8 Disease states/pathways	Yes
S9 Cycle length	N/A
Data	
D1 Data identification	Yes
D2 Data modelling	Yes
D2a Baseline data	Yes
D2b Treatment effects	Partially
D2c Costs	Yes
D2d Quality of life weights (utilities)	Yes
D3 Data incorporation	Yes
D4 Assessment of uncertainty	No
D4a Methodological	Yes
D4b Structural	No
D4c Heterogeneity	No
D4d Parameter	Partially
Consistency	
C1 Internal consistency	No
C2 External consistency	No

This study conducted a cost-utility analysis to evaluate cost-effectiveness outcomes of pharmacist prescribing in a community pharmacy setting for urinary tract infection from a Canadian healthcare system perspective. The pharmacist prescribing model was found to be cost saving over primary care provider prescribing and emergency care provider prescribing, with lower projected treatment costs (CAD 72.47 versus CAD 141.53 versus CAD 368.16) and comparable quality-adjusted life months (QALMs) (0.75 vs 0.75 vs 0.75). An overview of the findings is provided in Table 126.

Table 126: Cost-effectiveness of pharmacist prescribing for urinary tract infection

Study design (model type)	Prescriptive authority	Intervention versus comparator	Setting	Perspective	Time horizon	Price year (currency); discount rate	Key findings
Cost-utility (decision tree) [84]	Independent prescribing: initiation	Pharmacist prescribing versus primary care provider prescribing versus emergency care provider prescribing	Community pharmacy	Canadian public healthcare system	1 month	2018 (CAD); 3%	Lower treatment costs and comparable QALMs projected in the pharmacist prescribing model.

3.5.3.5 Common conditions

One study assessed the cost-effectiveness of pharmacist prescribing for common conditions [93]. A condensed summary of the quality assessment for this study is provided in Table 127; the full assessment is available in Appendix K.

Table 127: Common conditions (critical appraisal summary using Philips checklist)

Quality dimension	Quality dimension met Kim *et al.* (2021) [93]
Structure	
S1 Statement of decision problem/objective	Yes
S2 Statement of scope/perspective	Yes
S3 Rationale for structure	Yes
S4 Structural assumptions	Yes
S5 Strategies/comparators	Yes
S6 Model type	Yes
S7 Time horizon	N/A
S8 Disease states/pathways	N/A
S9 Cycle length	N/A
Data	
D1 Data identification	Partially
D2 Data modelling	Yes
D2a Baseline data	Yes
D2b Treatment effects	N/A
D2c Costs	Yes
D2d Quality of life weights (utilities)	N/A
D3 Data incorporation	Yes
D4 Assessment of uncertainty	No
D4a Methodological	No
D4b Structural	Yes
D4c Heterogeneity	No
D4d Parameter	Partially
Consistency	
C1 Internal consistency	No

Quality dimension	Quality dimension met Kim *et al.* (2021) [93]
C2 External consistency	No

This study conducted a cost-minimisation analysis to evaluate the economic impact of a pharmacist prescribing programme in a community pharmacy setting for common conditions from a Canadian public payer perspective. This study assessed costs across two scenarios: (1) a prescription-detached scenario (in which the pharmacist is assumed to be compensated through a consultation fee whether a prescription is issued or not), and (2) a prescription-attached scenario (in which the pharmacist is assumed to be compensated only if a prescription is issued).

At a 38% pharmacist prescribing service uptake rate in the prescription-detached scenario, the pharmacist prescribing service was projected to save CAD 7.51, CAD 4.08, and CAD 5.15 per patient for upper respiratory tract infections, contact dermatitis, and conjunctivitis, respectively, compared with physician prescribing.

At a 38% pharmacist prescribing service uptake rate in the prescription-attached scenario, the pharmacist prescribing service was projected to save CAD 12.26, CAD 4.89, and CAD 9.27 per patient for upper respiratory tract infections, contact dermatitis, and conjunctivitis, respectively, compared with physician prescribing. An overview of the findings is provided in Table 128.

Table 128: Cost-effectiveness of pharmacist prescribing for common conditions

Study design (model type)	Prescriptive authority	Intervention versus comparator	Setting	Perspective	Time horizon	Price year (currency); discount rate	Key findings
Cost-minimisation analysis (decision tree) [93]	Independent prescribing: upper respiratory tract infections, contact dermatitis, and conjunctivitis	Pharmacist prescribing versus physician prescribing	Community pharmacy	Canadian public payer	N/A	2016 (CAD); N/A	At a 38% pharmacist prescribing service uptake rate, pharmacist prescribing was projected to be cost saving compared with physician prescribing in usual care.

3.5.3.6 Acute pharyngitis

One study assessed the cost-effectiveness of pharmacist prescribing for acute pharyngitis [94]. A condensed summary of the quality assessment for this study is provided in Table 129; the full assessment is available in Appendix K.

Table 129: Acute pharyngitis (critical appraisal summary using Philips checklist)

Quality dimension	Quality dimension met Klepser *et al.* (2012) [94]
Structure	
S1 Statement of decision problem/objective	Yes
S2 Statement of scope/perspective	Yes
S3 Rationale for structure	Yes

Quality dimension	Quality dimension met Klepser *et al.* (2012) [94]
S4 Structural assumptions	Yes
S5 Strategies/comparators	Yes
S6 Model type	Yes
S7 Time horizon	N/A
S8 Disease states/pathways	N/A
S9 Cycle length	N/A
Data	
D1 Data identification	Partially
D2 Data modelling	Yes
D2a Baseline data	Yes
D2b Treatment effects	N/A
D2c Costs	Yes
D2d Quality of life weights (utilities)	Yes
D3 Data incorporation	Yes
D4 Assessment of uncertainty	No
D4a Methodological	No
D4b Structural	Yes
D4c Heterogeneity	No
D4d Parameter	Partially
Consistency	
C1 Internal consistency	No
C2 External consistency	No

This study conducted a cost-minimisation analysis to evaluate the economic impact of a pharmacist prescribing programme in a community pharmacy setting for acute pharyngitis from a USA payer perspective. The cost of the pharmacist treatment was USD 53.56, with a loss of 0.27 quality-adjusted life days (QALDs).

This study included six hypothetical comparator arms: (1) a walk-in clinic with a rapid antigen detection test (cost USD 79.12; QALDs lost 0.27); (2) physician observation (cost USD 80.42; QALDs lost 0.28); (3) physician culture (cost USD 83.77; QALDs lost 0.27); (4) physician empiric (i.e. based on physician judgement) (cost USD 84.92; QALDs lost 0.41); (5) a physician rapid antigen detection test (cost USD 88.97; QALDs lost 0.27); and (6) a physician rapid antigen detection test (cost USD 98.38; QALDs lost 0.27).

Of the seven strategies studied, pharmacist-provided care was the most cost-saving strategy for the diagnosis and treatment of acute pharyngitis in adult. An overview of the findings is provided in Table 130.

Table 130: Cost-effectiveness of pharmacist prescribing for acute pharyngitis

Study design (model type)	Prescriptive authority	Intervention versus comparator	Setting	Perspective	Time horizon	Price year (currency); discount rate	Key findings
Cost-minimisation analysis (decision tree) [94]	Independent prescribing: testing and prescribing	Pharmacist prescribing versus six comparator arms*	Community pharmacy	USA payer	2 weeks	2010 (USD); N/A	Pharmacist prescribing was projected to be the most cost-saving strategy.

* The comparator arms included: (1) a walk-in clinic with a rapid antigen detection test; (2) physician observation; (3) physician culture; (4) physician empiric (i.e. based on physician judgement); (5) a physician rapid antigen detection test; and (6) a nurse rapid antigen detection test.

3.5.3.7 Female contraceptive users

Two studies assessed the cost-effectiveness of pharmacist prescribing for female contraceptive users [91,92]. A condensed summary of the quality assessment is provided in Table 131; the full assessment is available in Appendix K.

Table 131: Female contraceptive users (critical appraisal summary using Philips checklist)

Quality dimension	Quality dimension met	
	Gumbie *et al.* (2019) [91]	Rodriguez *et al.* (2019) [92]
Structure		
S1 Statement of decision problem/objective	Yes	Yes
S2 Statement of scope/perspective	Yes	Yes
S3 Rationale for structure	Yes	Yes
S4 Structural assumptions	Yes	Yes
S5 Strategies/comparators	Yes	Partially
S6 Model type	Yes	Yes
S7 Time horizon	Yes	No
S8 Disease states/pathways	Yes	No
S9 Cycle length	No	N/A
D1 Data identification	Partially	Partially
D2 Data modelling	Yes	Yes
D2a Baseline data	Partially	Yes
D2b Treatment effects	Partially	Partially
D2c Costs	Yes	Yes
D2d Quality of life weights (utilities)	Partially	Partially
D3 Data incorporation	Yes	Yes
D4 Assessment of uncertainty	No	Yes
D4a Methodological	Yes	Yes
D4b Structural	Yes	Yes
D4c Heterogeneity	No	No
D4d Parameter	Yes	Yes
C1 Internal consistency	Yes	No
C2 External consistency	Yes	No

The first study conducted a cost-utility analysis in to evaluate the cost-effectiveness of independent pharmacist prescribing in a community pharmacy setting from an Australian healthcare system

perspective [91]. Modelled on the entire population of Australia women (N=5,644,701), pharmacist prescribing was found to be the dominant strategy with lower projected treatment costs (Australian dollars (AUD) 46.91 billion versus AUD 50.27 billion) and more QALYs (85.70 million versus 85.68 million) compared with physician prescribing.

The second study conducted a cost-utility analysis in order to evaluate the cost-effectiveness of independent pharmacist prescribing in a community pharmacy from a USA Medicaid payer perspective [92]. Pharmacist prescribing had lower projected treatment costs (USD 191.72 million versus USD 193.32 million) and higher QALYs (5,252,419 versus 5,248,470) compared with physician prescribing. An overview of the findings is provided in Table 132.

Table 132: Cost-effectiveness of pharmacist prescribing for female contraceptive users

Study design (model type)	Prescriptive authority	Intervention versus comparator	Setting	Perspective	Time horizon	Price year (currency); discount rate	Key findings
Cost-utility analysis (Markov) [91]	Independent prescribing	Pharmacist prescribing versus physician prescribing	Community pharmacy	Australian healthcare system	35 years	2016 (AUD); 5%	Lower treatment costs and higher QALYs projected in the pharmacist prescribing.
Cost-utility analysis (decision tree) [92]	Independent prescribing	Pharmacist prescribing versus physician prescribing	Community pharmacy	USA Medicaid payer	1 year	2018 (USD); N/A	Lower treatment costs and higher QALYs projected in pharmacist prescribing.

3.5.3.8 Chronic pain conditions

One study assessed the cost-effectiveness of pharmacist prescribing for chronic pain conditions as part of a trial-based full economic evaluation [95]. The quality assessment for this study is provided in Table 133; the full assessment is available in Appendix L.

Table 133: Chronic pain conditions (critical appraisal summary using the Consensus Health Economic Criteria list (CHEC list))

Quality dimension	Quality dimension met Neilson *et al.* (2015) [95]
1. Is the study population clearly described?	Yes
2. Are competing alternatives clearly described?	Yes
3. Is a well-defined research question posed in answerable form?	Yes
4. Is the economic study design appropriate to the stated objective?	Yes
5. Is the chosen time horizon appropriate to include relevant costs and consequences?	No
6. Is the actual perspective chosen appropriate?	Yes
7. Are all important and relevant costs for each alternative identified?	Yes
8. Are all costs measured appropriately in physical units?	Yes
9. Are costs valued appropriately?	Yes
10. Are all important and relevant outcomes for each alternative identified?	Yes

Quality dimension	Quality dimension met Neilson *et al.* (2015) [95]
11. Are all outcomes measured appropriately?	Yes
12. Are outcomes valued appropriately?	Yes
13. Is an incremental analysis of costs and outcomes of alternatives performed?	No
14. Are all future costs and outcomes discounted appropriately?	N/A
15. Are all important variables, whose values are uncertain, appropriately subjected to sensitivity analysis?	No
16. Do the conclusions follow from the data reported?	Yes
17. Does the study discuss the generalisability of the results to other settings and patient/client groups?	No
18. Does the article indicate that there is no potential conflict of interest of study researcher(s) and funder(s)?	Yes
19. Are ethical and distributional issues discussed appropriately?	Yes

This study conducted a cost-utility analysis to evaluate the cost-effectiveness of independent pharmacist prescribing compared with either GP prescribing with pharmacist medication review, or GP prescribing only from a United Kingdom (UK) health system perspective [95]. Both the pharmacist prescribing group and the pharmacist medication review group had higher projected treatment costs per patient compared with usual care by GPs (77.50 Great British pounds (GBP) more than usual care and GBP 54.40 more than usual care, respectively). Comparable QALYs were reported across all three groups. Therefore, usual care was the most cost-saving in this non-randomised trial. An overview of the findings is provided in Table 134.

Table 134: Cost-effectiveness of pharmacist prescribing for chronic pain conditions

Study design (model type)	Prescriptive authority	Intervention versus comparator	Setting	Perspective	Time horizon	Price year (currency); discount rate	Key findings
Cost-utility analysis (trial-based regression model) [95]	Independent prescribing	Pharmacist-led management versus usual care by general practice team	General practice	UK health system	6 months	N/A	Lower treatment costs and comparable QALYs projected in usual care.

3.5.3.9 Summary of findings

The majority of studies projected pharmacist prescribing models to be dominant (i.e. lower treatment cost, more effective) [85–87,89–92,96], or cost saving (i.e. lower treatment cost, equally effective) [84,93,94], or had a better cost-benefit ratio [88] when compared with alternative scenarios. Only one study (on chronic pain) reported that usual care was cost saving over a pharmacist prescribing model [95]. Table 135 provides a summary of the cost-effectiveness findings.

Table 135: Summary of cost-effectiveness findings

Study design	Health condition	Intervention versus comparator	Setting	Perspective	Time horizon	Key findings
Cost-utility analysis [86]	Diabetes	Pharmacist–endocrinologist versus primary care provider	Outpatient clinic	USA payer	10 years	The pharmacist–endocrinologist model was the dominant strategy.
Cost-utility analysis [85]	Diabetes	Pharmacist prescribing versus physician prescribing	Community pharmacy	Canadian healthcare system	50 years	Pharmacists initiating insulin therapy 1 or 2 years earlier was the dominant strategy.
Cost-utility analysis [87]	Diabetes	Pharmacist prescribing versus physician prescribing	Outpatient primary care clinic	USA third-party payer	10 years	Pharmacist prescribing was the dominant strategy.
Cost-benefit analysis [88]	Hypertension	Pharmacist–physician model versus primary care model	Primary care	USA payer	3 years	The pharmacist–physician collaborative care model had a better cost-benefit ratio.
Cost-utility analysis [89]	Hypertension	Pharmacist led versus hypothetical cohort	Primary care	USA third-party payer	30 years	The pharmacist-led medication management model was the dominant strategy.
Cost-utility analysis [90]	Hypertension	Pharmacist led versus usual care	Community pharmacy	Canadian public payer	30 years	The pharmacist-led medication management model was the dominant strategy.
Cost-utility analysis [96]	Chronic kidney disease	Pharmacist prescribing versus physician prescribing	Primary care	USA payer	5 years	The pharmacist prescribing clinic was the dominant strategy.
Cost-utility analysis [84]	Urinary tract infection	Pharmacist prescribing versus primary care provider prescribing versus emergency care provider prescribing	Community pharmacy	Canadian public healthcare system	1 month	The pharmacist prescribing model was projected to be cost saving.
Cost-minimisation analysis [93]	Common conditions	Pharmacist prescribing versus physician prescribing	Community pharmacy	Canadian public payer	N/A	Pharmacist prescribing was projected to be cost saving.

Study design	Health condition	Intervention versus comparator	Setting	Perspective	Time horizon	Key findings
Cost-minimisation analysis [94]	Acute pharyngitis	Pharmacist prescribing versus six comparator arms	Community pharmacy	USA payer	2 weeks	Pharmacist prescribing was projected to be the most cost-effective strategy.
Cost-utility analysis [91]	Female contraceptive users	Pharmacist prescribing versus physician prescribing	Community pharmacy	Australian healthcare system	35 years	Pharmacist prescribing was the dominant strategy.
Cost-utility analysis [92]	Female contraceptive users	Pharmacist prescribing versus physician prescribing	Community pharmacy	USA Medicaid payer	1 year	Pharmacist prescribing was the dominant strategy.
Cost-utility analysis [95]	Chronic pain conditions	Pharmacist prescribing versus pharmacist medication review versus GP usual care.	General practice	UK health system	6 months	Usual care was the projected to be cost-saving.

Based on the critical appraisal using the Philips checklist of 12 modelling studies, the models appear to be well conducted, with clear definitions of the decision problem, scope, structural assumptions, and model type in most cases. Data modelling was generally strong, especially in terms of incorporating costs and treatment effects. However, there were some limitations. Gaps in data identification and incorporation reduce transparency, and key methodological aspects (such as time horizon and disease pathways) were inconsistently reported. Uncertainty assessments were incomplete in several models, with six models not addressing heterogeneity and four models only partially addressing parameter variability. Internal consistency was not assessed in seven models, and six models had not been externally validated. Overall, we judge the models to be generally well conducted. However, uncertainty assumptions could affect the accuracy and reliability of future projections.

One study was a pilot trial-based economic evaluation and critical appraisal summary using the CHEC list. This study appeared to be well conducted, including clear descriptions of the study population, competing alternatives, and the research question. Similar to the modelling studies, uncertainty assessments and time horizon limit the accuracy and reliability of the reported findings. Additionally, this study was based on a pilot trial, and the original trial reports a small sample size as a limitation, raising concerns over the precision of the data incorporated into this economic evaluation.

4 Discussion

4.1 Summary of findings

4.1.1 Is pharmacist prescribing effective?

Of the 52 included studies, 32 studies reported on effectiveness outcomes [45–76]. Seventeen were retrospective cohort studies, 2 were prospective cohort studies, 4 were non-randomised trials, 8 were parallel RCTs, and 2 were cluster RCTs. In relation to healthcare setting, 3 were based in community pharmacies, 12 were based in outpatient clinics, 10 were based in primary care, 3 were based in long-term care, and 4 were based in impatient settings. The prescriptive authority varied: 18 studies assessed collaborative practice agreements, 7 assessed protocol prescribing, 1 assessed formulary prescribing, and 6 assessed independent prescribing. In relation to geographical location, 22 studies were based in the USA, 4 in Canada, 4 in the UK, and 2 in Singapore.

Effectiveness outcomes were reported for 13 healthcare population categories, which were: diabetes [46–53]; heart failure [54–56]; stroke [57]; dyslipidaemia [58]; hypertension [59,60]; coagulation disorders [61–66]; chronic kidney disease [67]; urinary tract infection [68]; older people in long-term care [69–71]; female contraceptive users [72,73]; anaemia in pregnancy [74]; chronic pain conditions [75]; and mixed health conditions [45,76]. All outcomes were graded as very low certainty.

4.1.1.1 Diabetes

Eight studies assessed the effectiveness of pharmacist prescribing for people with diabetes. The effectiveness outcomes assessed were blood glucose, blood pressure, lipids, and health-related quality of life. There was a significant improvement [50] or no significant difference [46–48,51,53] in blood glucose outcomes in pharmacist prescribing groups compared with primary care provider prescribing groups and physician prescribing groups. There was no significant difference in blood pressure, lipids [49,50], or health-related quality of life [52] between groups.

4.1.1.2 Heart failure

Three studies assessed the effectiveness of pharmacist prescribing for people with heart failure. This study reported very low-certainty evidence comparing 30-day all-cause readmission events, 30-day heart failure readmission rates, and emergency department visits in the pharmacist prescribing group with the two comparator groups (pharmacist medication review only and endocrinologist prescribing) [54]. Significant improvement in 30-day all-cause readmission events was reported in the pharmacist prescribing group and the endocrinologist prescribing group. There was no significant difference in 30-day heart failure readmission events between the pharmacist prescribing group and the endocrinologist prescribing group. No inferential statistics were reported for the outcomes related to healthcare utilisation [54].

The proportion of patients achieving ARNI target dose was higher and the number of visits required to reach this target was lower in the pharmacist prescribing group compared with the clinician prescribing group [55]. There was no significant difference in the average number of days to achieve the target ARNI dose between groups [55]. In relation to the aspirin deprescribing outcome, there were significant improvements in the pharmacist prescribing group compared with the primary care provider prescribing group [56].

4.1.1.3 Stroke

One RCT assessed the effectiveness of pharmacist prescribing compared with physician prescribing for people with a recent minor ischaemic stroke or transient ischaemic attack [57]. The effectiveness

outcomes assessed were blood pressure and lipid level goals achieved, systolic blood pressure levels, lipids, adherence, self-rated health, and health-related quality of life. No inferential statistics were reported for these outcomes.

4.1.1.4 Dyslipidaemia

One cluster RCT assessed the effectiveness of pharmacist prescribing for people with dyslipidaemia [58]. The effectiveness outcomes assessed were lipid levels, blood pressure, fasting blood glucose levels, healthcare utilisation, and adherence. One cluster RCT assessed the effectiveness of pharmacist prescribing for people with dyslipidaemia (55). There was significantly higher likelihood of achieving lipid target in the pharmacist prescribing group compared with the physician prescribing group. There was no significant difference in outcomes related to LDL cholesterol, HDL cholesterol, triglyceride levels, blood pressure, fasting blood glucose, or healthcare utilisation in the pharmacist prescribing group compared with the physician prescribing group. No inferential statistics were reported for the adherence outcome.

4.1.1.5 Hypertension

Two studies assessed the effectiveness of pharmacist prescribing for people with hypertension. The effectiveness outcomes assessed were blood pressure, adherence, and health-related quality of life. There was either an improvement [60] or no significant difference [59,60] in the pharmacist prescribing groups compared with the physician prescribing groups across all blood pressure outcomes. There was no significant difference in the adherence or health-related quality of life outcomes between groups [60].

4.1.1.6 Coagulation disorders

Six studies assessed the effectiveness of pharmacist prescribing for people with coagulation disorders [61–66]. The effectiveness outcomes assessed were related to blood clotting. There was either an improvement [63,64] or no significant difference [66] in the proportion of patients achieving international normalised ratio (INR) control in pharmacist prescribing groups compared with physician prescribing groups or nurse prescribing groups. One study reported very low-certainty evidence indicating INR was in a therapeutic range for significantly higher percentage of time in the pharmacist prescribing group compared with the physician prescribing group [62].

No inferential statistics were reported in relation to average time to achieve therapeutic INR between the pharmacist prescribing group and the physician prescribing group [62]. No significant difference was reported in relation to average time to achieve therapeutic proconvertin and prothrombin levels [65], partial thromboplastin time [65], and prothrombin time ratio [61] in the pharmacist prescribing groups compared with the physician prescribing groups.

4.1.1.7 Chronic kidney disease

One study assessed the effectiveness of pharmacist prescribing for people with chronic kidney disease [67]. The effectiveness outcome assessed was haemoglobin goal achieved. There was a significantly higher proportion of patients achieving their haemoglobin goals in the pharmacist prescribing group compared with both the clinic physician prescribing and the usual care groups.

4.1.1.8 Urinary tract infection

One study assessed the effectiveness of pharmacist prescribing for women with urinary tract infections [68]. The effectiveness outcomes assessed were clinical cure at 2 weeks, time to access care, and adherence. No statistically significant difference in clinical cure at 2 weeks was reported in the pharmacist prescribing group compared with the physician prescribing group. Significant improvements in both time to access care and adherence were reported in the pharmacist prescribing group compared with the physician prescribing group.

4.1.1.9 Older people in long-term care

Three studies assessed the effectiveness of pharmacist prescribing for older people in long-term care [69–71]. The effectiveness outcomes assessed were falls, drug burden, health-related quality of life, depression, anxiety, systolic blood pressure levels, and healthcare utilisation. There was either a significant improvement or no significant difference in pharmacist prescribing groups compared with primary care provider, physician, or medical internist prescribing groups for most outcomes.

There was a significant improvement in the drug burden outcome reported in the pharmacist prescribing groups compared with the primary care provider prescribing [69] or medical internist prescribing [71] groups. In relation to falls, either no significant difference was reported [69] or no inferential statistics were reported [70] between the pharmacist prescribing and primary care provider prescribing or physician prescribing groups. For health-related quality of life, there was either a significant improvement in a pharmacist prescribing group compared with a primary care provider prescribing group [69] or no significant difference between a pharmacist prescribing group and a physician prescribing group [70]. There was no significant difference in depression, anxiety, or healthcare utilisation outcomes between pharmacist prescribing groups and primary care provider prescribing, physician prescribing, or medical internist prescribing groups [69–71].

4.1.1.10 Female contraceptive users

Two studies assessed the effectiveness of pharmacist prescribing for women seeking contraception. The effectiveness outcomes assessed were continuation and adherence [72,73]. The studies found both a significant improvement [72,73] and no significant difference [72,73] in the pharmacist prescribing groups compared with the physician prescribing groups for both outcomes.

4.1.1.11 Anaemia in pregnancy

One study assessed the effectiveness of pharmacist prescribing for women with anaemia in pregnancy. The effectiveness outcome assessed was related to achieving haemoglobin goals and mean haemoglobin levels [74]. Significantly more patients achieved their target haemoglobin levels, and there was a significant improvement in mean haemoglobin levels, in the pharmacist prescribing group compared with the OB/GYN prescribing group.

4.1.1.12 Chronic pain conditions

One study assessed the effectiveness of pharmacist prescribing for people with chronic pain conditions [75]. The effectiveness outcomes assessed were chronic pain, health-related quality of life, and mental health. No inferential statistics were reported for these outcomes.

4.1.1.13 Mixed health conditions

Two studies assessed the effectiveness of pharmacist prescribing for people with mixed health conditions [45,76]. The effectiveness outcomes assessed were healthcare utilisation, blood pressure goal achieved, low-density lipoprotein (LDL) cholesterol goal achieved, and haemoglobin A1c (HbA1c) goal achieved.

There were significantly more ambulatory care visits in the pharmacist prescribing group compared with the physician prescribing group, but fewer hospitalisations in the pharmacist prescribing groups compared with the primary care provider prescribing [45] or physician prescribing [45,76] groups. Length of hospital stay was significantly shorter in a pharmacist prescribing group compared with a physician prescribing group. Significantly fewer emergency department visits were reported in the pharmacist prescribing group compared with the primary care provider prescribing group, but no significant difference was reported between the pharmacist prescribing group and the physician prescribing group [45].

Significantly higher numbers of participants achieved their blood pressure goals in the pharmacist prescribing group compared with the primary care provider prescribing group, but no significant difference was reported between the pharmacist prescribing group and the physician prescribing group [45]. There was no significant difference in the achievement of LDL cholesterol goals or HbA1c goals between the pharmacist prescribing group and the physician prescribing or primary care provider prescribing groups.

4.1.2 Is pharmacist prescribing safe?

Of the 52 included studies, 20 studies reported on safety outcomes [55,57,58,61,62,64,66–71,76–83]. Eight were retrospective cohort studies, five were parallel RCTs, four were non-randomised trials, two were cluster RCTs, and one was a prospective cohort study. In relation to healthcare setting, seven studies were based in outpatient clinics, four were based in community pharmacies, three were based in long-term care, two were based in primary care, three were based in inpatient settings, and one was based in the emergency department. The prescriptive authority varied: nine studies assessed collaborative practice agreements, five assessed independent prescribing, four assessed protocol prescribing, one assessed formulary prescribing, and one assessed supplementary prescribing. In relation to geographical location, 11 studies were based in the USA, 5 in Canada, 2 in the UK, and 2 in Australia.

Safety outcomes were reported for 12 healthcare population categories: heart failure [55]; stroke [57]; dyslipidaemia [58]; coagulation disorders [61,62,64,66]; chronic kidney disease [67,77]; urinary tract infection [68,78]; older people in long-term care [69–71]; female contraceptive users [80,81]; emergency department patients [82]; surgery patients [83]; people at risk of drug-related problems [76]; and mixed health conditions [79]. All outcomes were graded as very low certainty.

4.1.2.1 Heart failure

One study assessed safety outcomes in people with heart failure [55]. The safety outcomes assessed were heart failure hospitalisations and all-cause death. No significant difference in hospitalisations due to heart failure was reported between the pharmacist prescribing group and the clinician prescribing group. Significantly fewer all-cause deaths were reported in the pharmacist prescribing group compared with the clinician prescribing group.

4.1.2.2 Stroke

One study assessed the safety of pharmacist prescribing for people with a recent minor ischaemic stroke or transient ischaemic attack [57]. The safety outcomes assessed were mortality and adverse vascular events. No inferential statistics were reported for these outcomes.

4.1.2.3 Dyslipidaemia

One study assessed the safety of pharmacist prescribing for people with dyslipidaemia [58]. The safety outcome assessed was adverse events, but no inferential statistics were reported.

4.1.2.4 Coagulation disorders

Four studies assessed the safety of pharmacist prescribing for people with coagulation disorders [61,62,64,66]. The safety outcomes assessed were adverse events, and hospitalisations/emergency department visits due to adverse events. No significant difference in the number of bleeding or thromboembolic adverse events was reported between the pharmacist prescribing group and the physician prescribing group in one study [61]. Significantly fewer anticoagulation-related adverse events were reported in the pharmacist prescribing group compared with the physician prescribing group in one study [64]. No inferential statistics were reported for a combined bleeding/adverse drug events outcome [62]. Significantly fewer anticoagulation-related hospital admissions [64,66] and emergency department

visits [64] were reported in pharmacist prescribing groups compared with physician prescribing groups in two studies. One study reported significantly fewer warfarin-related hospitalisations/emergency department visits were reported in a pharmacist prescribing group compared with a nurse prescribing group.

4.1.2.5 Chronic kidney disease

Two studies assessed the safety of pharmacist prescribing compared with usual care and physician prescribing for people with chronic kidney disease [67,77]. The safety outcomes assessed were adverse events and prescribing errors. No inferential statistics were reported for these outcomes.

4.1.2.6 Urinary tract infection

Two studies assessed the safety of pharmacist prescribing for people with urinary tract infections [68,78]. The safety outcomes assessed were adverse events, physician or emergency department visits, and antimicrobial therapy guideline concordance. There was no significant difference in adverse events or physician/emergency department visits in the pharmacist prescribing groups compared with the physician prescribing groups [68]. There was significantly improved antimicrobial therapy guideline concordance in the pharmacist prescribing group compared with the physician prescribing group [78].

4.1.2.7 Older people in long-term care

Three studies assessed the safety of pharmacist prescribing for older people in long-term care[69–71,79]. The safety outcomes assessed were mortality and adverse events. There were significantly fewer deaths in the pharmacist prescribing group compared with the medical internist prescribing group [71], and no significant difference in the number of deaths in the pharmacist prescribing group compared with the primary care provider prescribing group [69].

The third study reported was no significant difference between a pharmacist prescribing group compared with a physician prescribing group for the following adverse events: syncope, hypokalaemia, hyperkalaemia, hyponatraemia, orthostatic presyncope, and change in estimated glomerular filtration rate (eGFR). There were significantly more hypotension adverse events reported in the pharmacist prescribing group compared with the physician prescribing group[70]. The certainty of the evidence was very low for all outcomes.

4.1.2.8 Female contraceptive users

Two studies assessed the safety of pharmacist prescribing compared with physician prescribing for women prescribed contraception [80,81]. One study reported no significant difference in medical contraindications between the pharmacist prescribing group and the physician prescribing group [80], whereas the other study did not report inferential statistics [81].

4.1.2.9 Emergency department patients

One study assessed the safety of pharmacist prescribing compared with physician prescribing for people in the emergency department [82]. A significantly lower prescribing error rate was reported in the pharmacist prescribing group compared with the physician prescribing group.

4.1.2.10 Surgery patients

One study assessed the safety of pharmacist prescribing for surgery patients [83]. There were significantly fewer prescribing errors in the pharmacist prescribing and medication review group compared with the pharmacist medication review only group and the physician prescribing group.

4.1.2.11 People at risk of drug-related problems

One study assessed the safety of pharmacist prescribing compared with physician prescribing for people at risk of drug-related problems [76]. There was no significant difference in mortality reported between the pharmacist prescribing and physician prescribing groups.

4.1.3 Is pharmacist prescribing cost-effective?

Of the 52 included studies, 13 studies reported on cost-effectiveness outcomes [84–96]. Ten were cost-utility studies, two were cost-minimisation analyses, and one was a cost-benefit analysis. In relation to healthcare setting, six were based in community pharmacies, four were based in primary care, and three were based in outpatient clinics. The prescriptive authority varied: seven studies assessed collaborative practice agreements and six assessed independent prescribing by pharmacists. Seven studies were from a USA perspective, four were from a Canadian perspective, one was from a UK perspective, and one was from an Australian perspective.

Cost-effectiveness outcomes were reported for eight healthcare population categories: diabetes [85–87], hypertension [88–90], chronic kidney disease [96], urinary tract infection [84], common conditions [93], acute pharyngitis [94], female contraceptive users [91,92], and chronic pain conditions [95].

4.1.3.1 Diabetes

Three studies assessed the cost-effectiveness of pharmacist prescribing for diabetes [85–87]. All three studies projected pharmacist prescribing as the dominant strategy.

The first cost-utility analysis (from a USA payer perspective) projected a pharmacist–endocrinologist outpatient clinic to be the dominant strategy, with lower projected treatment costs (USD 3.88 million versus USD 4.11 million) and higher QALYs (385 versus 375) compared with primary care provider care.

The second cost-utility analysis (from a Canadian healthcare system perspective) of pharmacist-initiated insulin therapy demonstrated cost savings (CAD 624–805 per patient) and QALY gains (0.048–0.075 years) compared with delayed physician-led insulin initiation. An ICER of CAD 7,613 per QALY, which was below the CAD 50,000 per QALY cost-effectiveness threshold.

The third cost-utility analysis (from a USA third-party payer perspective) projected a pharmacist-led primary care intervention to be dominant compared with primary care physician prescribing, with reduced costs (USD 35,740 versus USD 44,528 per patient), additional life years (8.9 versus 8.1), and higher QALYs gained (5.51 versus 5.02).

4.1.3.2 Hypertension

Three studies assessed the cost-effectiveness of pharmacist prescribing for hypertension [88–90] [85–87]. All three studies projected pharmacist prescribing as the dominant strategy.

The cost-benefit analysis (from a USA payer perspective) found pharmacist–physician collaborative care to be the dominant strategy, reducing treatment costs (USD 702.00 versus USD 810.00) and downstream healthcare expenditure (USD 1,535.82 versus USD 1,698.64).

The first cost-utility analysis (from a USA third-party payer perspective) showed pharmacist-led medication management to be the dominant strategy, with lower treatment costs (USD 179,485 versus USD 189,648), additional life years (15.0 versus 14.6), and higher QALYs (12.4 versus 11.8).

The second cost-utility analysis (from a Canadian public payer perspective) found a pharmacist-led medication management programme in a community pharmacy setting to be the dominant strategy. This study reported per-patient treatment costs were reduced (CAD 134,277 versus CAD 140,641), additional life years (12.7 versus 12.4), and higher QALYs (10.8 versus 10.4).

4.1.3.3 Chronic kidney disease

One study assessed the cost-effectiveness of pharmacist prescribing for chronic kidney disease [96]. The cost-utility analysis (from a USA payer perspective) found a pharmacist-managed erythropoiesis-stimulating agent clinic to be the dominant strategy compared with physician prescribing. This study reported reduced costs (USD 13,412 versus USD 16,173) and slightly higher QALYs (2.096 versus 2.093).

4.1.3.4 Urinary tract infection

One study assessed the cost-effectiveness of pharmacist prescribing for urinary tract infection [84]. The cost-utility analysis (from a Canadian public healthcare system perspective) found pharmacist prescribing in a community pharmacy setting to be cost-saving compared with primary care provider or emergency care provider prescribing. This study projected lower costs (CAD 72.47 versus CAD 141.53 versus CAD 368.16) and comparable QALMs gained (0.75 for all groups).

4.1.3.5 Common conditions

One study assessed the cost-effectiveness of pharmacist prescribing for common conditions [93]. The study used a cost-minimisation analysis to evaluate the economic impact of a pharmacist prescribing programme in a community pharmacy setting for common conditions from a Canadian public payer perspective.

This study projected savings under two compensation models. In the prescription-detached model (pharmacist is compensated per consultation), savings ranged from CAD 4.08 to CAD 7.51 per patient compared with physician prescribing. In the prescription-attached model (pharmacist is compensated per prescription), savings ranged from CAD 4.89 to CAD 12.26 per patient compared with physician prescribing.

4.1.3.6 Acute pharyngitis

One study assessed cost-effectiveness outcomes of pharmacist prescribing for acute pharyngitis [93]. The cost-minimisation analysis (from a USA payer perspective) found pharmacist prescribing to be the most cost-saving strategy. This study projected treatment costs of CAD 53.56 and comparable QALD losses (0.27 QALDs lost), outperforming six physician-led alternatives.

4.1.3.7 Female contraceptive users

Two studies assessed the cost-effectiveness of pharmacist prescribing for female contraceptive users [91,92]. Both cost-utility analyses found pharmacist prescribing in community pharmacies to be dominant compared with physician prescribing. One study (from an Australian healthcare system perspective) projected lower treatment costs (AUD 46.91 billion versus AUD 50.27 billion) and slightly higher QALYs (85.70 million versus 85.68 million). The second study (from a USA Medicaid payer perspective) also projected lower costs (USD 191.72 million versus USD 193.32 million) and slightly higher QALYs (5,252,419 versus 5,248,470).

4.1.3.8 Chronic pain conditions

One study assessed the cost-effectiveness of pharmacist prescribing for chronic pain conditions as part of a trial-based full economic evaluation. The cost-utility analysis (from a UK national health system perspective) projected a higher cost per patient (GBP 77.50) and comparable QALYs, in pharmacist prescribing compared with usual care. Usual care the most cost-saving strategy in this pilot trial.

4.1.3.9 Mixed health conditions

One study assessed the safety of pharmacist prescribing for a population with mixed health conditions [79]. There was no significant difference was reported in acute kidney injury events or gastrointestinal bleeding events between the pharmacist deprescribing group and the physician deprescribing group. Significantly fewer hospitalisations and emergency department visits due to adverse pain events were reported in the pharmacist deprescribing group compared with the physician deprescribing group. The certainty of evidence was very low for all outcomes.

4.2 Comparison with other research

As highlighted in Section 1.1, we identified two systematic reviews that focused specifically on pharmacist prescribing: one in hospital settings [1] and the other in minor ailment management schemes [18]. The findings of both reviews broadly align with our findings. Firstly, the review on hospital settings reported that pharmacists achieve prescribing standards comparable to doctors while reducing errors and omissions [1]. Secondly, the review on minor ailment management schemes reported that significant cost savings were associated with pharmacist prescribing compared with GP prescribing for common conditions [18].

Poh *et al.* (2018) identified 15 studies assessing the safety and effectiveness of pharmacist prescribing in hospitals [1]. The effectiveness and safety outcomes assessed included blood pressure, cholesterol, blood sugar, haemoglobin, blood clotting, and adverse events. In line with our findings from hospital-based studies, Poh *et al.* (2018) reported that pharmacist prescribing appears to be as safe and effective as physician prescribing.

Paudyal *et al.* (2013) identified 31 evaluations of minor ailment management schemes indicating that common conditions could be dealt with appropriately by pharmacist prescribers [18]. This broadly aligns with our findings on pharmacist prescribing for urinary tract infections. Assessment of basic costing studies found that pharmacist consultations were less expensive than consultations with GPs [18]. Our evidence review findings from economic evaluation studies support the cost-effectiveness of pharmacist prescribing for urinary tract infections, acute pharyngitis, and common conditions.

Three additional systematic reviews reported on the effectiveness, safety, and cost-effectiveness of non-medical prescribing aggregated across all healthcare professionals (e.g. pharmacists, podiatrists, physiotherapists, and nurses) [2,5,16]. Largely consistent with our findings, all three reviews reported comparable or favourable effectiveness and safety outcomes in pharmacist prescribing compared with usual care prescribing [2,5,16]. Babashahi *et al.* (2023) reported pharmacist prescribing was cost-effective based on four studies on cardiovascular disease and venous thrombosis [5]. However, GP prescribing was projected to be more cost-effective for chronic pain management [5], in line with our evidence review's reporting of the same study [95].

4.3 Gaps in research

The remit of this evidence review was intentionally broad, providing evidence on pharmacist prescribing across a wide range of healthcare settings in inpatient, outpatient, primary care, and community pharmacy settings. As highlighted in our findings in Section 3.3, pharmacists prescribe across multiple healthcare conditions, each requiring varying competencies. This has resulted in an extensive evidence base, which includes research designs ranging from low to high levels of evidence on the hierarchy of evidence for effectiveness [100].

To focus on the most reliable evidence, we limited our study design criteria for effectiveness and safety outcomes to RCTs, non-randomised trials, and cohort studies, which generally provide stronger and more

reliable evidence than other designs. This means that some observational studies were excluded, including those that may offer useful context. For example, an survey-based evaluation of a statewide pilot of an expanded role for 800 community pharmacists in Victoria, Australia was published in May 2025 [101].

No studies on pharmacist prescribing in paediatric populations met our inclusion criteria and we were unable to identify an existing systematic review on pharmacist prescribing in paediatric populations. The most relevant review was conducted in 2018 on pharmacist services more generally [102]. The authors reported that pharmacists played a beneficial role in identifying and managing physician prescribing errors, with high acceptance of pharmacist recommendations by physician prescribers.

In countries with established independent prescribing models, large research projects have investigated enhanced models. The comparator groups of these studies included usual care pharmacist prescribers, and therefore did not meet our inclusion criteria. These studies investigated how increased engagement of independent pharmacist prescribers could lower cardiovascular risk [103], optimise hypertension treatments [104], improve lipid levels [105], and reduce the likelihood of drug overdose [106,107].

While pharmacist prescribers are increasingly involved in treating hepatitis C or prescribing opioid substitution therapy to treat opioid dependency, we found no studies on these health populations that met our inclusion criteria. The SuperDOT-C cluster RCT compared a community pharmacist-led care pathway with a nurse-led care pathway in Scotland [108]. This study was excluded because the pharmacist-led care pathway involved both pharmacist and physician prescribing compared with nurse and physician prescribing, and it was not possible to attribute the observed effects solely to the pharmacist component, as required by our inclusion criteria. The authors reported improvements in clinical effectiveness, service uptake, and treatment completion in the pharmacist-led pathway compared with the nurse-led care pathway. However, an accompanying cost-utility analysis estimated that treatment costs were higher in the pharmacist-led care pathway compared with the nurse-led care pathway [109]. Within the current National Health Service (NHS) framework, the nurse prescribing pathway was projected to be more cost-effective.

Only one study in our review assessed access to care, and it reported a significant reduction in time to access care with pharmacist prescribing compared with the physician prescribing group [68]. A systematic review conducted in 2024 identified 47 articles assessing the impact of pharmacist prescribing on access to medicine. This review reported increased accessibility and improved medication access for pharmacist prescribing [110]. However, most studies in that review were qualitative or cross-sectional surveys and did not meet our inclusion criteria.

4.4 Future research

Considering the policy context of this evidence review, future research on pharmacist prescribing within the Irish context would be valuable. Exploring the barriers and facilitators affecting patients, healthcare professionals, and policy-makers could support efforts to effectively integrate pharmacist prescribing within the existing healthcare system. International experiences may also offer useful perspectives on key factors influencing successful implementation across different healthcare settings.

The cost-effectiveness studies identified in our review were conducted from a USA, Canadian, Australian, or UK perspective, using region-specific cost, utility, and health metrics. Due to variations in health systems, cost-effectiveness studies specific to the Irish setting would provide more accurate projections of potential cost savings and healthcare impacts. Additional research on public preferences for revenue generation for various pharmacist prescribing models – whether through general taxation, co-payment, or out-of-pocket payment – would inform resource allocation policy decisions. Discrete choice experiments

or contingent valuation studies would provide valuable information on citizens' willingness to pay for pharmacist prescribing through general taxation over alternative prescribing models in Ireland.

No studies assessing pharmacist prescribing in children or adolescents were identified. Including younger age groups in future primary research would help address this gap. Additionally, limited research exists on specific clinical areas, such as mental health, respiratory conditions, and infectious diseases. Conducting primary research in these populations would contribute to a broader understanding of pharmacist prescribing for different healthcare needs.

As outline in Section 3.4, sources of bias in included studies differed according to study design. Among RCTs, the domains most frequently judged to be at some concerns or high risk of bias were randomisation procedures and missing outcome data. In non-randomised studies of interventions, not controlling for confounding variables was a common source of bias. Biases due to confounding, intervention classification, outcomes measurement, and justification of the selected result were all sources of bias. Future research could minimise risk of bias by addressing these methodological limitations and by providing transparent and comprehensive reporting in published articles.

Most studies identified in our review were graded as having a very low certainty of evidence, partly due to challenges in participant blinding in pharmacist prescribing research, which is a limitation that future RCTs may also encounter. An alternative approach could involve establishing large-scale national surveillance studies to monitor the safety of pharmacist prescribing as new policies and legislation are introduced in Ireland. Integrating and naming pharmacist prescribers within the existing clinical incident reporting systems (e.g. the National Incident Management System (NIMS)) would facilitate standardised data collection, enabling comparisons of clinical incidents and prescribing errors. Such data would enable more comprehensive assessment of prescribing safety across hospital settings rather than relying on clinical disease markers.

4.5 Strengths and limitations

Internationally, this is the most comprehensive evidence review on pharmacist prescribing that has been published to date. This review covers a range of healthcare settings, populations, and prescriptive authorities. The inclusion of effectiveness, safety, and cost-effectiveness outcomes provides valuable insights for policy-makers, as well as outlining where additional research is needed.

The methodologies employed for the searches for all three research questions were carefully considered. The principal strengths of these searches are that they were comprehensive; they were conducted across a range of relevant, reputable databases and sources; and they employed best-practice methods. These factors strengthen the validity of the search results.

A minor limitation in the search methodology was the lack of a Medical Subject Headings (MeSH) term for 'pharmacist prescribing'. To mitigate this limitation, we used a broader MeSH term ('non-medical prescribing') and we searched for key words and phrases, both in the title and abstract, in order to capture relevant evidence. Robust citation chasing of systematic reviews and included papers also ensured the thorough retrieval of relevant evidence. This resulted in the retrieval of many articles that required screening to determine inclusion in or exclusion from this review. Data extraction; risk of bias assessments; and Grading of Recommendations Assessment, Development, and Evaluation (GRADE) assessments were conducted by one reviewer and validated by a second.

Although we have provided our exploratory meta-analyses in Appendix O, the data did not meet our pre-specified requirements for meta-analysis outlined in Section 2.6.2, and we have not included the results of the exploratory meta-analyses in the final report. Therefore, we can only narratively state the findings

and general trends across the studies. However, most of the evidence had consistent findings indicating that pharmacist prescribing is safe, effective, and cost-effective.

We only included studies with a clear statement of prescriptive authority in this evidence review. This approach was necessary to ensure consistency in the studies selected. By focusing on studies with this clear statement, we aimed to capture evidence relevant to the specific context of prescribing practices. It is possible that studies excluded on this basis may have met our inclusion criteria in other respects and could still offer valuable insights if prescriptive authority had been explicitly stated.

Prescribing is not the sole activity carried out by pharmacists or doctors, and their roles differ. Before prescribing, pharmacists focus on medication history-taking, reconciliation, and review, while doctors may prioritise medical examinations and clinical diagnosis. Pharmacists are also more likely to provide medication counselling when prescribing. These activities may influence prescribing outcomes that were not accounted for in this review. Some studies in this review also included variations in interventions, such as different follow-up durations or additional lifestyle modification advice. Finally, pharmacists' training and qualifications were rarely described in the included studies. These factors may have contributed to variations in outcomes across studies.

As this review focused on the effectiveness, safety, and cost-effectiveness of pharmacist prescribing; it did not examine patient or public perspectives, as this was beyond the scope of the review. This represents a limitation of the current review, as user views are an important consideration for implementation and policy development. An umbrella review is currently being conducted by a separate group exploring stakeholder perspectives of pharmacist prescribing [14].

4.6 Conclusion

This evidence review included 52 studies, of which 32 reported on effectiveness, 20 reported on safety, and 13 reported on cost-effectiveness outcomes.

In relation to effectiveness and safety outcomes, all outcomes were graded as low to very low certainty, meaning our confidence in the findings is limited (Appendix Q). Out of the 167 outcomes related to safety and effectiveness, 51 outcomes were significantly improved with pharmacist prescribing. For 75 outcomes, no significant difference was reported indicating equivalence of care and outcomes between pharmacist prescribing and other prescribing groups including medical doctors. Inferential statistics were reported for 39 outcomes, meaning we cannot comment on the statistical significance of these outcomes.

Only two outcomes reported in favour of the non-pharmacist prescriber group. One study reported increased healthcare utilisation in relation to outpatient clinic visits, but fewer hospitalisations, in the pharmacist prescribing group compared with the usual care group. This potentially reflects a substitution effect, with greater use of outpatient clinics helping to reduce hospitalisations. Another study reported significantly more hypotension adverse events in pharmacist prescribing compared with physician prescribing.

In relation to cost-effectiveness outcomes, most studies projected pharmacist prescribing models to be dominant (i.e. lower treatment cost, more effective), or cost-saving (i.e. lower treatment cost, equally effective), or had a better cost-benefit ratio when compared with alternative scenarios. Only one study on chronic pain reported that the general practice team was cost saving compared with the pharmacist prescribing model.

Although most outcomes were graded as very low certainty, there is still clear rationale for progressing Irish policy and legislation in this area considering the projected cost-effectiveness, alongside the effectiveness and safety findings. As highlighted in Section 3.4.5, strong or conditional policy

recommendations may be made despite lower certainty evidence, provided the potential benefits outweigh the risks and are supported by considered judgement. The findings of this review align with the second paradigmatic situation (lower certainty evidence suggests potential equivalence, but one option is clearly less costly). However, additional input from clinical expert groups would be required to make these judgements

Based on the findings of this review, expanding the role of pharmacists in prescribing could be cost-effective while maintaining patient safety and treatment outcomes. Continued research and policy development will contribute to determining the benefits of pharmacist prescribing and facilitating its effective integration into the Irish healthcare system. Future research in the Irish context – based on implementation, public and patient preferences, and cost-effectiveness – would provide valuable information for policy-makers.

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6 Appendices

Appendix A High-level summary

Pharmacist prescribing models in three regions

A high-level summary

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Melissa Sharp

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Jean Long

19 August 2025

Abbreviations

Abbreviation	Explanation
eHealth	Electronic Health Systems
ePharmacy	Electronic Pharmacy System
GP	general practitioner
GPhC	General Pharmaceutical Council
HEPMA	Hospital Electronic Prescribing and Medicines Administration System
NHS	National Health Service
NZePS	New Zealand ePrescription Service
PIN	Pharmaceutical Information Network

A1 Background

Pharmacist prescribing has emerged as a key strategy to improve healthcare access, optimise medication management, and enhance patient outcomes. Internationally, pharmacist prescribing models have been implemented to varying degrees, enabling pharmacists to prescribe medications independently or in collaboration with other healthcare providers. These models aim to address healthcare system challenges, including physician shortages, increasing demands for chronic disease management, and the need for timely access to medications [4–6].

In July 2023, the Minister for Health established the Expert Taskforce to Support the Expansion of the Role of Pharmacy in Ireland. The Taskforce's remit was to identify and support the delivery of specific objectives, which will serve to align the services and practices that can be delivered by pharmacists (and pharmacies) with the needs of the health service and patients [15]. To gain further insight into pharmacist prescribing models implemented internationally, the Department of Health requested a high-level summary of pharmacist prescribing models in operation in three regions.

This appendix provides an overview of the scopes of practice, timelines of policy development, educational/certification requirements, information and communication technology systems, and financing models for pharmacist prescribing in Alberta, Canada; New Zealand; and Scotland. An evidence review of the safety, effectiveness, and cost-effectiveness of pharmacist prescribing is reported in the main document [111].

A2 Alberta, Canada

A2.1 Current model

Alberta implements a pharmacist prescribing model that allows qualified pharmacists to play a key role in patient care by independently prescribing certain medications. This is one of the most progressive models of pharmacist prescribing internationally. Pharmacists have varying levels of prescriptive authority, categorised into three main types [112]:

1. Adaptation of prescriptions: Pharmacists are authorised to make therapeutic substitutions, alter doses, or modify a patient's medication to suit their individual needs. This includes adjusting medications to ensure optimal therapeutic outcomes.
2. Emergency prescribing: In cases where a patient requires immediate medication and is unable to see a physician, pharmacists can prescribe medications in emergency situations. This is typically limited to acute conditions or the continuation of chronic medications when a patient is out of supply.
3. Additional prescribing authority: Pharmacists are authorised to independently initiate, modify, and monitor drug therapy for chronic diseases and other health conditions. This allows them to prescribe within their scope of practice without a prior consultation with a physician.

A2.1.1 Timeline of policy developments

The introduction of pharmacist prescribing in Alberta followed a gradual policy development timeline, beginning in the early 2000s and evolving through various regulatory changes and pilot programmes [112–114]. The following provides an overview of key milestones:

- 2000: The Health Professions Act was enacted to restructure the regulatory framework for health professionals in Alberta, allowing pharmacists to take on expanded roles, including the potential for prescribing.

- 2006: The Collaborative Practice Agreement Framework was introduced to allow pharmacists to work in collaboration with other healthcare providers, laying the groundwork for prescriptive authority.
- 2007: The Pharmacists Profession Regulation formally established pharmacists' prescribing authority under the Health Professions Act. This included giving pharmacists the authority to adapt prescriptions and prescribe medication in emergency situations.
- 2009: Additional prescribing authority was introduced for pharmacists, enabling them to independently initiate, modify, and manage drug therapy.
- 2012: Pharmacists with additional prescribing authority were further empowered to manage chronic conditions like hypertension, diabetes, and asthma, strengthening their role in primary care.
- 2014: The Alberta College of Pharmacy refined the application process and experience requirements for additional prescribing authority, ensuring pharmacists demonstrate clinical competency.
- 2019: Pharmacists with additional training were permitted to prescribe medications for opioid dependency treatment to help address the opioid crisis in Alberta.

These developments collectively expanded pharmacists' role, enabling them to prescribe independently and contribute more effectively to patient care in Alberta.

A2.2 Educational/certification requirements

As highlighted in Section A2.1, pharmacists in Alberta have varying levels of prescriptive authority. Each level of prescriptive authority requires specific educational qualifications and training to ensure that pharmacists are equipped with the knowledge and clinical skills necessary to prescribe safely and effectively. Table A1 provides a summary of the educational requirements for pharmacists by prescriptive authority type.

Table A1: Educational requirements for pharmacist prescribers in Alberta, Canada

Prescribing authority	Educational requirements	Licensure/accreditation	Additional training/experience
Adaptation of prescriptions	Bachelor of Science in Pharmacy or Doctor of Pharmacy	Standard licensure with the Alberta College of Pharmacy [115]	No additional experience required
Emergency prescribing	Bachelor of Science in Pharmacy or Doctor of Pharmacy	Standard licensure with the Alberta College of Pharmacy [115]	Clinical experience in direct patient care recommended
Additional prescribing authority	Bachelor of Science in Pharmacy or Doctor of Pharmacy	Standard licensure with the Alberta College of Pharmacy Additional prescribing authorisation accreditation required [116]	Minimum 1 year of clinical experience in direct patient care Submission of case studies to demonstrate prescribing competency

A2.3 Information and communication technology systems

Pharmacist prescribing in Alberta relies on a range of information and communication systems to ensure the secure and effective management of patient care. These systems facilitate the accessing, sharing, and

documenting of patient information while also ensuring compliance with privacy regulations. The range of eHealth initiatives for pharmacists in Alberta is outlined in Figure A1.

Figure A1: eHealth initiatives for pharmacist prescribers in Alberta, Canada

Source: Alberta Netcare, 2025 [117]

The four key eHealth initiatives relevant to pharmacist prescribing include Real Time Integration, Alberta Netcare, the Pharmaceutical Information Network (PIN), and PrescribeIT.

A2.4 Electronic health record

Alberta Netcare is the provincial electronic health record system. The Alberta Netcare Portal is a viewer for patients' electronic health records [118]. The portal facilitates authorised healthcare professionals, including pharmacists, to access up-to-date information about their patients.

Alberta Netcare provides pharmacists with real-time access to key patient health information such as demographic details, event history, laboratory results, immunisations, transcribed reports, community reports, and medication history. Pharmacists use Alberta Netcare to verify prescriptions, update medication histories, assess potential drug interactions, and monitor health outcomes [118].

A2.5 Medication history management

The Pharmaceutical Information Network (PIN) is a core part of Alberta Netcare that provides access to a patient's current and previous medications. PIN aims to facilitate improved care quality by providing authorised healthcare providers with the information and tools they need in order to make optimal drug therapy decisions [119].

PIN also includes allergy and intolerance information, pharmacy care plans, access to drug monographs, drug decision support, dispensing information, and the ability to create prescriptions and manage warnings. PIN is the central repository of the patient's medication profile (Figure A2).

Figure A2: Tools available through the Pharmaceutical Information Network (PIN)

Source: Alberta Netcare, 2025 [119]

A2.6 ePrescribing systems

PrescribeIT is a national ePrescribing service in Canada that provides safer and more efficient medication management by connecting community-based prescribers to community pharmacies, enabling the digital transmission of prescriptions [120]. PrescribeIT serves patients, pharmacies, and prescribers, and it:

- ensures patients' choice of pharmacy
- safeguards patients' health data from commercial use
- maintains an influence-free prescribing and dispensing environment
- continues to be accountable to Canadians through their federal and provincial/territorial governments.

PrescribeIT enables prescribers and pharmacists to electronically create, receive, renew, and cancel prescriptions [120]. Other features of the service provide:

- secure clinician messaging
- prescription status notifications
- integration with public drug formularies
- standardised terminology through the Canadian Clinical Drug Data Set
- enhanced user identity proofing with multifactor authentication
- reduced potential for fraud and abuse, especially for narcotics and other controlled substances.

A2.7 Financing model

Pharmacist prescribing is publicly funded in Alberta and is primarily supported by government funding and social insurance programmes. The Alberta Government generates these funds through tax revenues, and funding is integrated into the provincial healthcare budget [121]. The following pharmacist services are publicly funded in Alberta [122]:

- medication review/assessment (basic/standard)
- medication review/assessment (specific for diabetes)

- medication review/assessment (advanced/comprehensive)
- prescription renewal
- prescription adaptation
- therapeutic substitution
- minor ailment assessment/prescribing
- smoking cessation prescribing
- Immunisation.

Payment for pharmacist services is structured through agreements with the Alberta Blue Cross Pharmaceutical Services programme (an independent, not-for-profit insurance provider) and the Ministerial Order for the Compensation of Pharmacy Services [123,124].

These agreements outline how pharmacists are reimbursed for their services, and patients can access these services without paying directly out of pocket. Pharmacists are compensated through a fee-for-service model, meaning they receive a set fee for each service they provide, including patient assessments, prescribing services, and follow-up services [125].

A3 New Zealand

A3.1 Current model

The pharmacy profession in New Zealand has three scopes of practice [126]:

1. intern pharmacist
2. pharmacist
3. pharmacist prescriber.

Under the 'intern pharmacist' and 'pharmacist' scopes of practice, pharmacists do not have prescriptive authority. Only pharmacists under the 'pharmacist prescriber' scope of practice have prescriptive authority in New Zealand. However, this prescriptive authority does not include independent prescribing rights, as pharmacist prescribers are required to work in a collaborative team with other healthcare professionals and are not primary diagnosticians [126].

As part of a collaborative health team, pharmacist prescribers can write a prescription for a patient in their care to initiate or modify therapy (including discontinuation or maintenance of therapy originally initiated by another prescriber). They can also provide a wide range of assessment and treatment interventions, which include, but are not limited to:

- ordering and interpreting investigations (including laboratory and related tests)
- assessing and monitoring a patient's response to therapy
- providing education and advice to a patient on their medicine therapy.

Pharmacist prescribers must prescribe within the limits of their professional expertise, competence, and ethical codes of practice [126].

In 2023, there were 4,421 pharmacists registered with the Pharmacy Council of New Zealand. Of these pharmacists, 51 had additional registration under the pharmacist prescriber scope of practice. This represents approximately 1.15% of all pharmacists in New Zealand [127].

A3.1.1 Timeline of policy developments

The introduction of pharmacist prescribing in New Zealand followed a gradual policy development timeline, beginning in the early 2000s and evolving through various regulatory changes and pilot programmes. The following provides an overview of key milestones:

- 2003: The Medicines Amendment Act 2003 introduced the possibility of extending prescribing rights to certain healthcare professions, including pharmacists, in New Zealand [128].
- 2011: The Pharmacy Council of New Zealand's application for pharmacist prescribing was approved in principle by Health Workforce New Zealand [129].
- 2013: The Pharmacy Council of New Zealand established formal registration pathways for prescriber pharmacists. Pharmacists with the necessary postgraduate qualifications and training could apply for registration as prescribers [130].
- 2023: A community pharmacy-based Minor Health Conditions Service was piloted in 10 priority districts from 12 June 2023 to 30 September 2023 [131].

A3.2 Educational/certification requirements

In order to register under the pharmacist prescriber scope of practice with the Pharmacy Council of New Zealand, registered pharmacists must meet the following requirements [126]:

- Pharmacists must undertake postgraduate study through one of the two approved courses delivered by the University of Otago and the University of Auckland (run as a conjoined course).
- In addition to undertaking this postgraduate course, pharmacists must have relevant clinical experience and postgraduate clinical qualifications.
- Pharmacists must work within a collaborative environment.

The Pharmacy Council of New Zealand provides guidance to assist pharmacists who want to complete additional study, register, and work as a pharmacist prescriber under this scope of practice. While the Pharmacy Council has defined the scope of practice, it has not specifically suggested a job description. Each practitioner will have variations depending on the specifics of their role. Pharmacist prescribers in New Zealand work in both primary care and hospital settings [132].

Pharmacists who have an equivalent qualification from overseas may apply to the Pharmacy Council of New Zealand for registration under this scope of practice. The pharmacist's clinical qualifications, experience, and proposed work environment are considered by the Pharmacy Council, and the pharmacist is assigned a mentor for support and advice in adapting to the New Zealand health system [126].

A3.3 Information and communication technology systems

A3.3.1 ePrescribing systems

The New Zealand ePrescription Service (NZePS) is the primary national platform that allows healthcare providers, including pharmacist prescribers, to securely send and manage electronic prescriptions [133]. It enables a prescription to be generated by the prescriber, transmitted to the NZePS health information exchange broker, and downloaded electronically at a community pharmacy (Figure A3).

The prescriber can note the reason for prescribing and make other comments at the time of prescribing. This will be sent as part of the prescription information that is passed electronically to the pharmacy. Prescribers can request a notification when a patient's medication has not been dispensed, and

pharmacists can send dispensing comments back to the prescriber [133]. Uptake of the NZePS has increased significantly since 2020, indicating more widespread use of the ePrescribing system throughout New Zealand [134].

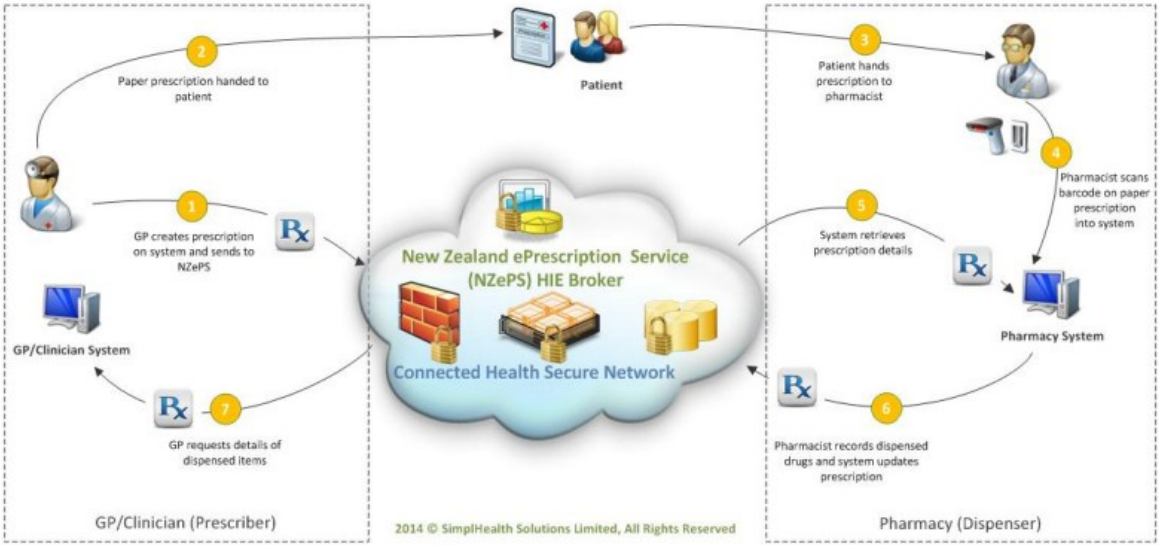


Figure A3: New Zealand ePrescription Service (NZePS)

Source: Toniq, 2024 [135]

A3.3.2 Practice management system

A practice management system in New Zealand is software designed to streamline administrative and clinical operations in healthcare practices, including managing patient records, appointments, billing, insurance claims, and other essential tasks. The NZePS is integrated with the Medtech, MyPractice, Indici, Profile for Windows, Medimap, Elixir, and Expect Maternity practice management systems, as well as the Waikato District's Clinical Workstation Outpatient Prescribing service. Pharmacist prescribers working as part of these healthcare teams require access to these software applications [133].

A3.4 Financing model

Pharmacist prescribing in New Zealand is integrated into the public healthcare system, which is largely funded through general taxation. The Combined Pharmaceutical Budget is a dedicated portion of the Government's health budget managed by Pharmac, New Zealand's Pharmaceutical Management Agency [136]. The Combined Pharmaceutical Budget covers the costs of medicines, medical devices, vaccines, and related products dispensed in community pharmacies. However, service fees associated with prescribing, patient consultation, and dispensing are not financed through the Combined Pharmaceutical Budget. These professional service fees are financed separately by Health New Zealand [137,138].

As highlighted in Section A3.1.1, a community pharmacy-based Minor Health Conditions Service was piloted in 10 priority districts from June to September 2023. During this period, pharmacists conducted approximately 60,000 consultations for conditions like conjunctivitis, eczema, and scabies. In this pilot, Health New Zealand implemented a fee-for-service model (25 New Zealand dollars (NZD) per consultation), as well as covering costs for the medicines and treatment aids provided [131].

A4 Scotland, United Kingdom

A4.1 Current model

Pharmacist prescribing in Scotland allows qualified pharmacists to prescribe medications either independently or in collaboration with other healthcare professionals. This approach aims to improve access to treatment and support healthcare services. Pharmacist prescribing is divided into two main categories:

1. Supplementary prescribing: Pharmacists can prescribe medicines under a Clinical Management Plan that is agreed upon with a doctor or other independent prescriber. This allows pharmacists to adjust, continue, or stop medications for conditions such as asthma, diabetes, and hypertension within an established treatment plan [139].
2. Independent prescribing: Pharmacist independent prescribers can assess, diagnose, and prescribe medications within their area of competence without the need for a doctor's approval. Their prescribing role includes managing long-term conditions (such as hypertension, diabetes, and respiratory diseases), prescribing most controlled drugs, and providing treatment for acute conditions, including infections, minor injuries, and skin conditions [140].

A4.1.1 Timeline of policy developments

The introduction of pharmacist prescribing in Scotland has been shaped by various policy changes over time:

- 1999: *The Crown Report: a new prescribing framework* recommended expanding prescribing rights to pharmacists and other healthcare professionals [141].
- 2003: Supplementary prescribing was introduced, enabling pharmacists to prescribe within a defined treatment plan [139].
- 2006: Independent prescribing was introduced, permitting pharmacists to prescribe any licensed medicine within their competence [142].
- 2012: Pharmacist independent prescribers gained the authority to prescribe most controlled drugs, except for addiction treatment drugs [143].
- 2018: National Health Service (NHS) Scotland's primary care reform expanded pharmacist prescribing roles in general practitioner (GP) surgeries and hospitals [144].
- 2020: NHS Pharmacy First was introduced, enabling pharmacists to treat common conditions without a GP referral [145].
- 2022: NHS Pharmacy First Plus expanded pharmacist prescribing responsibilities, enabling them to manage a wider range of conditions [146,147].

These policy developments have supported the integration of pharmacist prescribers across different healthcare settings in Scotland.

A4.2 Educational/certification requirements

To become a pharmacist in Scotland, candidates must complete a structured educational and training pathway regulated by the General Pharmaceutical Council (GPhC) (Table A2) [148].

Table A2: Educational and training requirements for pharmacists in Scotland

Step	Description
Obtain an accredited Master of Pharmacy (MPharm) degree	Aspiring pharmacists must complete an MPharm degree from a university that is accredited by the GPhC. The MPharm degree typically takes 4 years to complete and

Step	Description
	provides students with foundational knowledge in pharmacology, pharmaceutical science, and clinical practice.
Complete a foundation training year	After obtaining the MPharm degree, graduates must undertake a 1-year paid foundation training placement under the supervision of a registered pharmacist. During this period, trainees gain hands-on experience in a clinical setting and must demonstrate competency in pharmacy practice.
Pass the General Pharmaceutical Council registration assessment	At the end of the foundation training year, candidates must pass the General Pharmaceutical Council registration assessment, which evaluates their ability to apply their pharmaceutical knowledge in practical scenarios. This is a critical step in ensuring that pharmacists are prepared for independent practice.
Register with the General Pharmaceutical Council	Upon successful completion of the registration assessment, candidates can apply to become a registered pharmacist with the General Pharmaceutical Council. Registration is a legal requirement to practise as a pharmacist in Scotland.

From 2026, pharmacists joining the General Pharmaceutical Council register will be automatically annotated as independent prescribers if they: (1) have been fully trained to the 2021 *Standards for the initial education and training of pharmacists*; (2) have passed the General Pharmaceutical Council registration assessment; and (3) meet General Pharmaceutical Council criteria for registration [149].

However, pharmacists who are already registered, as well as those due to join the General Pharmaceutical Council register before 2026, will not automatically receive this annotation. These pharmacists need to achieve a practice certificate in independent prescribing before they can apply for annotation as an independent prescriber. To be awarded the practice certificate, they must successfully complete a General Pharmaceutical Council accredited pharmacist independent prescribing course (Table A3) [149–151].

Table A3: Educational and training requirements for independent prescribing pharmacists in Scotland

Step	Description
Gain experience as a qualified pharmacist	The entry requirements for training as a pharmacist independent prescriber state the following: • Applicants must have relevant experience in a pharmacy setting and be able to recognise, understand, and articulate the skills and attributes required by a prescriber. This experience and awareness will act as the basis of their prescribing practice while training. • For the purpose of developing their independent prescribing practice, applicants must identify an area of clinical or therapeutic practice on which to base their learning.
Complete an accredited independent prescribing course	Pharmacists must undertake a General Pharmaceutical Council accredited prescribing course at a recognised university. The course usually lasts 6 months (part time) and includes: • theoretical training in prescribing and clinical decision-making • a minimum of 90 hours of supervised practice under the guidance of a designated prescribing practitioner (typically a doctor or experienced pharmacist prescriber).
Apply for General Pharmaceutical Council annotation as an independent prescriber	After completing the course, pharmacists must apply to the General Pharmaceutical Council for annotation as an independent prescriber. This official recognition enables them to legally prescribe medications within their scope of practice.

A4.3 Information and communication technology systems

Pharmacist prescribing in Scotland is supported by various information and communication technology systems that enable pharmacists to manage patient care effectively and securely. In 2017, NHS Scotland published *Achieving Excellence in Pharmaceutical Care: A Strategy for Scotland* [152]. Commitment 8 of the Strategy focused on optimising the use of digital information, data, and technologies for improved service delivery, as well as the range of digital information and technology systems that are outlined in Figure A4.

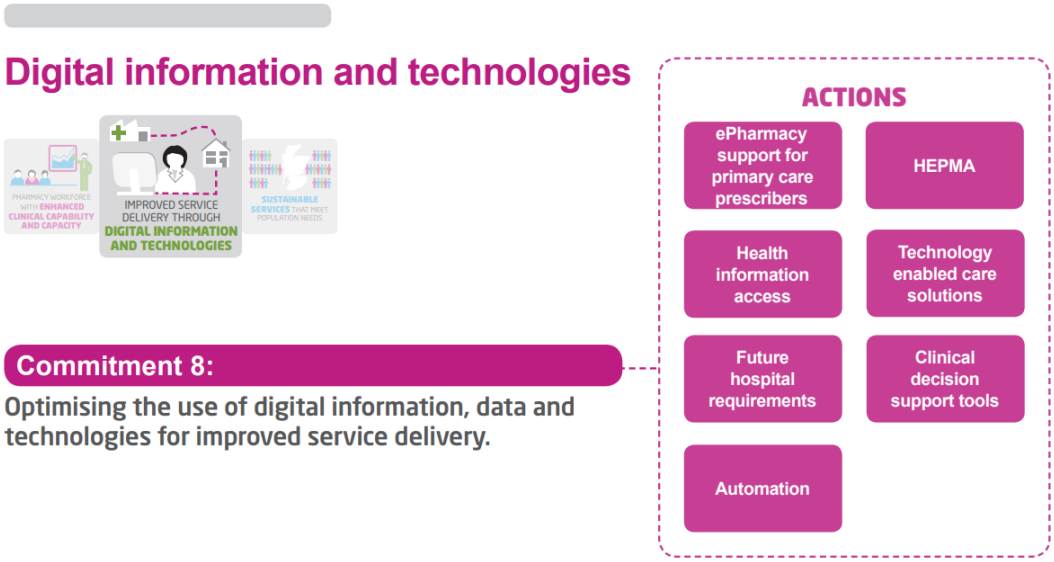


Figure A4: Optimising the use of digital information, data, and technologies for improved service delivery

Source: NHS Scotland, 2017 [152]

The core digital and information technologies relevant to pharmacist prescribing include ePharmacy support for primary care prescribers; the Hospital Electronic Prescribing and Medicines Administration (HEPMA) system, an integrated digital safer medicines programme; technology-enabled care solutions; clinical decision support tools; and digital integration for medicines management.

A4.3.1 ePharmacy system

The ePharmacy system is part of NHS Scotland's broader eHealth strategy to streamline prescribing processes. The system allows healthcare professionals to issue, manage, and dispense prescriptions electronically, reducing reliance on paper-based methods [152,153]. Key components include the following:

- Electronic transfer of prescriptions: The system enables the secure electronic transmission of prescriptions from prescribers to pharmacies, ensuring accuracy and reducing the risk of errors.
- Pharmacy care record: This is a digital record that allows pharmacists to document patient interactions, medication reviews, and interventions, improving continuity of care.
- Chronic medication service: This service supports patients with long-term conditions by enabling electronic serial prescriptions, which allow for regular medication dispensing over an extended period.
- Acute medication service: This service facilitates the electronic processing of acute prescriptions, enabling pharmacists to dispense medications more efficiently.

- Minor ailment service: This is a digital system that enables eligible patients to receive treatment for minor ailments directly from community pharmacies without the need for a GP appointment.

A4.3.2 Hospital Electronic Prescribing and Medicines Administration System (HEPMA)

The HEPMA system is a digital solution implemented across NHS Scotland to enhance the prescribing, dispensing, and administration of medicines in hospital settings. By replacing traditional paper-based prescribing with an electronic system, HEPMA aims to improve communication between healthcare professionals, increase accuracy, and enhance patient care [152,154]. Key components of HEPMA include the following:

- Electronic prescribing: Allows clinicians to create, review, and modify prescriptions digitally, reducing errors and improving efficiency.
- Medication administration recording: Provides real-time tracking of medication administration, ensuring accurate dosage and timing.
- Clinical decision support: Integrates safety checks, including allergy alerts and drug interactions, to support clinicians in making informed prescribing decisions.
- Interoperability: Enables integration with electronic patient records and other NHS Scotland eHealth systems to enhance coordination of care.
- Audit and reporting tools: Generates detailed reports on medication usage, administration patterns, and compliance, aiding in clinical governance and resource planning.

A4.4 Financing model

Pharmacist prescribing in Scotland is reimbursed through NHS payment systems. Community-based pharmacists prescribing under NHS services are reimbursed as part of the NHS Scotland's Community Pharmacy Services. Reimbursement is based on a fee-per-service model, where pharmacists are paid for specific services they provide, including prescribing as part of Pharmacy First [155,156].

The NHS Pharmacy First Scotland service remunerates contractors for making the service available to their communities (via a monthly base payment of 1,000 Great British pounds (GBP)) and for the episodes of care provided in line with the service (fee-for-service). These fees are set by NHS Scotland and are based on the level of service provided, such as the number of consultations or the complexity of the prescribing task [155,156].

Active reimbursement for pharmacists involved in prescribing via the ePharmacy system is handled through NHS Scotland's electronic systems. Pharmacists prescribing within these frameworks (such as for ongoing medication reviews or chronic conditions) are paid for their professional input (such as reviewing medication, issuing prescriptions, and any related services) [155,156].

Pharmacists who work in hospitals and prescribe medicines under HEPMA are part of NHS Scotland's general hospital budget [157]. In this setting, pharmacists receive a salary and are reimbursed as part of their employment package.

A5 Summary of findings

A5.1 Alberta, Canada

Alberta implements a progressive pharmacist prescribing model, enabling qualified pharmacists to independently prescribe certain medications. Prescriptive authority is categorised into three levels: adaptation of prescriptions, emergency prescribing, and additional prescribing authority. Each level requires specific educational qualifications and training to ensure pharmacists can prescribe safely and effectively. Pharmacists must complete accredited pharmacy education and practical training, and for additional prescribing authority, they must demonstrate clinical competency through experience and assessment.

Pharmacist prescribing in Alberta has evolved through several key milestones. The 2000 Health Professions Act set the foundation for expanded pharmacist roles. In 2007, pharmacists were granted the authority to adapt prescriptions and prescribe medication in emergencies. By 2009, additional prescribing authority allowed them to independently initiate, modify, and manage drug therapy. Subsequent refinements in 2014 strengthened competency requirements, and in 2019, their prescribing authority expanded to include opioid dependency treatment.

Pharmacist prescribing in Alberta is supported by a range of information and communication systems, including Alberta Netcare, the Pharmaceutical Information Network, and PrescribeIT. These systems facilitate secure access to patient health records, medication histories, and electronic prescribing, ensuring efficient and safe medication management.

Pharmacist prescribing in Alberta is publicly funded through government funding and social insurance programmes, with compensation structured under agreements with Alberta Blue Cross and the Ministerial Order for the Compensation of Pharmacy Services. Pharmacists are reimbursed on a fee-for-service basis for various patient care services.

A5.2 New Zealand

New Zealand's pharmacy profession has three scopes of practice: intern pharmacist, pharmacist, and pharmacist prescriber. Only pharmacist prescribers have prescriptive authority, and they must operate within a collaborative healthcare team rather than prescribing independently. They can initiate, modify, or discontinue therapy; order and interpret tests; monitor treatment effectiveness; and provide medication education. As of 2023, only 51 pharmacists (1.15% of all pharmacists in New Zealand) were registered as pharmacist prescribers.

Pharmacist prescribing in New Zealand has evolved through a number of key policy milestones. The Medicines Amendment Act 2003 laid the groundwork for extending prescribing rights to certain healthcare professions, including pharmacists. In 2011, pharmacist prescribing was approved in principle, and by 2013, formal pathways for registration were established. A 2023 pilot programme tested a Minor Health Conditions Service in community pharmacies.

To become a pharmacist prescriber, a pharmacist must complete postgraduate study through approved programmes at the University of Otago or the University of Auckland, gain relevant clinical experience, and work in a collaborative healthcare setting. Overseas-qualified pharmacists may apply for registration, and the Pharmacy Council of New Zealand will consider their clinical experience and proposed work environment.

Pharmacist prescribing in New Zealand is supported by digital health systems, primarily the New Zealand ePrescription Service, which facilitates secure electronic prescribing and communication between prescribers and pharmacists. Pharmacist prescribers also require access to integrated practice management systems for patient records and medication management.

Pharmacist prescribing in New Zealand is publicly funded through general taxation. The Combined Pharmaceutical Budget covers medicine costs, while service fees for prescribing and consultations are funded separately by Health New Zealand. A 2023 pilot programme used a fee-for-service model (NZD 25 per consultation) to fund pharmacist-led consultations for minor health conditions.

A5.3 Scotland, United Kingdom

Pharmacist prescribing in Scotland enables qualified pharmacists to prescribe medications either independently or in collaboration with other healthcare professionals, improving access to treatment. There are two main types of prescribing authority: (1) supplementary prescribing, where pharmacists prescribe under a Clinical Management Plan that is agreed with a doctor, enabling pharmacists to adjust or continue treatment plans; and (2) independent prescribing, where pharmacists can assess, diagnose, and prescribe medications within their area of competence; manage long-term conditions; and prescribe controlled substances.

Key policy developments in pharmacist prescribing in Scotland include the introduction of supplementary prescribing in 2003 and independent prescribing in 2006, and the expansion of pharmacist roles through Pharmacy First in 2020 and Pharmacy First Plus in 2022.

Starting in 2026, pharmacists will be automatically annotated as independent prescribers upon GPhC registration, provided they meet the required training and assessment criteria. Current pharmacists must complete an accredited independent prescribing course to gain this annotation.

Pharmacist prescribing in Scotland is supported by digital systems such as ePharmacy and HEPMA, which facilitate electronic prescribing, improve communication, and ensure medication safety.

Reimbursement for pharmacist prescribing services in Scotland is based on NHS Scotland's fee-for-service model, where community pharmacists are paid per consultation or service provided under Pharmacy First. Hospital pharmacists are salaried and reimbursed as part of NHS Scotland's general budget.

A5.4 Summary table

Table A5 summarises key information relevant to pharmacist prescribing in each of the three jurisdictions.

Table A5: Summary of key findings

	Alberta, Canada	New Zealand	Scotland, United Kingdom
Scope of practice	Independent prescribing	As part of a collaborative team	Independent prescribing
Timeline for policy development	• 2000: The Health Professions Act was enacted, enabling pharmacists to take on expanded roles. • 2006: The Collaborative Practice Agreement Framework allowed pharmacists to collaborate with other healthcare providers. • 2007: The Pharmacists Profession Regulation formally established	• 2003: The Medicines Amendment Act 2003 was introduced, enabling the possibility of extending prescribing rights to certain healthcare professions. • 2011: The Pharmacy Council of New Zealand's application for pharmacist prescribing was approved in principle.	• 1999: *The Crown Report: a new prescribing framework* recommended expanding prescribing rights to pharmacists. • 2003: Supplementary prescribing was introduced. • 2006: Independent prescribing was introduced, permitting pharmacists to prescribe any licensed

	Alberta, Canada	New Zealand	Scotland, United Kingdom
	pharmacists' prescribing authority. • 2009: Additional prescribing authority was introduced. • 2012: Pharmacists with additional prescribing authority were further empowered to manage chronic conditions. • 2014: The Alberta College of Pharmacy refined the application process and experience requirements for additional prescribing authority. • 2019: Pharmacists with additional training were permitted to prescribe medications for opioid dependency treatment.	• 2013: The Pharmacy Council of New Zealand established formal registration pathways for prescriber pharmacists. • 2023: A community pharmacy-based Minor Health Conditions Service was piloted in 10 priority districts.	medicine within their competence. • 2012: Pharmacist independent prescribers gained the authority to prescribe most controlled drugs. • 2018: The NHS Scotland's primary care reform expanded pharmacist prescribing roles in GP surgeries and hospitals. • 2020: NHS Pharmacy First was introduced, enabling pharmacists to treat common conditions without a GP referral. • 2022:NHS Pharmacy First Plus expanded pharmacist prescribing responsibilities.
Educational/certification requirements	• Standard licensure with the Alberta College of Pharmacy • Additional prescribing authorisation accreditation	• Undertake postgraduate study through one of two approved courses • Gain relevant clinical experience and postgraduate clinical qualifications • Work within a collaborative environment	• Gain experience as a qualified pharmacist • Complete an accredited independent prescribing course • Apply for GPhC annotation as an independent prescriber
Information and communication technology systems	• Electronic health record • Medication history management (PIN) • ePrescribing systems (PrescribeIT*)*	• ePrescribing systems (NZePS) • Practice management system	• ePharmacy system • HEPMA
Financing models	• Fee for service	• Combined Pharmaceutical Budget • Fee for service	• Monthly base payment of GBP 1,000 • Fee for service

A6 Limitations

The information provided in this appendix is not intended to be fully comprehensive, but serves as a high-level overview of pharmacist prescribing models in three regions. It has not undergone peer review, nor has it been reviewed by country-specific experts. While it aims to provide an accurate summary based on available sources, the details may not fully reflect the changes in national or provincial-level policies or practices since mid-2024, or any regional/local variations.

Appendix B Preferred Reporting Items for Systematic reviews and Meta-Analyses

Section and topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	p34
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	p21
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	p32
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	p33
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	p34-38
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Appendix C Appendix D
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix C Appendix D
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	p39-40
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	p41
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	p41
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	p41
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if	p41-43

Section and topic	Item #	Checklist item	Location where item is reported
		applicable, details of automation tools used in the process.	
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Section 3.5
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	p43-44
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	p43-44
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	p43-44
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	p43-44
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Not applicable
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Not applicable
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	p41-43
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	p43-44
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	p44-46
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Appendix R
Study characteristics	17	Cite each included study and present its characteristics.	Appendix M
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Appendix H, Appendix I, Appendix J
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Section 3.5

Section and topic	Item #	Checklist item	Location where item is reported
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Section 3.5
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Not applicable
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Not applicable
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Not applicable
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Section 3.5
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Appendix Q
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	p191
	23b	Discuss any limitations of the evidence included in the review.	p192
	23c	Discuss any limitations of the review processes used.	p193-194
	23d	Discuss implications of the results for practice, policy, and future research.	p192-193
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	p34
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	p34
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	p44
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	p2
Competing interests	26	Declare any competing interests of review authors.	p2
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	All available upon request, please e-mail hrb@hrb.ie

Appendix C Literature search details

Search tables

Table A1: Search results for effectiveness and safety questions

Resource	Search date	Search results	Duplicates	Ti/Ab screened
Dimensions AI	12 July 2024	111	17	94
Embase (Ovid)	19 July 2024	1,913	48	1,865
MEDLINE (EBSCO)	11 July 2024	2,316	39	2,277
SCiELO	10 July 2024	41	8	33
Subtotal		4,381	112	4,269
Cochrane library	22 July 2024	49	12	37
Epistemonikos	22 July 2024	158	43	115
Subtotal		207	55	152
Citation chasing		1,733	408	1,325
Total		**6,321**	**167**	**5,746**

Table A2: Search results for cost-effectiveness question

Resource	Search date	Search results	Duplicates	Ti/Ab screened
Dimensions AI	14 Aug 2024	183	6	177
EconLit	23 Aug 2024	13	0	13
Econpapers	22 Aug 2024	46	0	46
Embase (Ovid)	14 Aug 2024	1,618	40	1,578
Medline (EBSCO)	14 Aug 2024	663	130	533
Cochrane library	27 Aug 2024	9	0	9
Total		**2,542**	**176**	**2,356**

EBSCO MEDLINE search strategy

Research question: Q1 and Q2 (effectiveness and safety)

Search date: 11 July 2024

#	Query	Limiters/Expanders	Last Run Via	Results
S34	S16 AND S32	Limiters - Peer Reviewed Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	2,316
S33	S16 AND S32	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search	2,336

			Screen - Advanced Search Database - MEDLINE	
S32	S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	2,911,761
S31	PT clinical trial	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	540,156
S30	TI ("Prospective Stud*") OR AB ("Prospective Stud*")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	217,819
S29	TI ("Retrospective Stud*") OR AB ("Retrospective Stud*")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	244,874
S28	TI (("non-randomi#ed controlled" or "nonrandomi#ed controlled" or (nonrandom* N2 control*)) OR AB (("non-randomi#ed controlled" or "nonrandomi#ed controlled" or (nonrandom* N2 control*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	5,352

S27	TI (("randomi#ed controlled" or (random* N2 control*)) OR AB (("randomi#ed controlled" or random* N2 control*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	411,573
S26	(MH "Prospective Studies")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	691,899
S25	(MH "Retrospective Studies")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	1,215,173
S24	(MH "Non-Randomized Controlled Trials as Topic")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	1,104
S23	MH "Randomized Controlled Trials as Topic+")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	175,610
S22	(MH "Controlled Clinical Trials as Topic+")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced	181,415

			Search Database - MEDLINE	
S21	TI (time* series AND (((pre OR before OR prior) N/5 (post OR after OR follow*)) OR quasi-experiment* OR quasiexperiment* OR natural experiment* OR ARIMA OR autoregress* OR auto-regress* OR segmented OR segments OR piecewise OR piece-wise OR interrupt* OR implement* OR guideline*) OR AB (time* series AND (((pre OR before OR prior) N/5 (post OR after OR follow*)) OR quasi-experiment* OR quasiexperiment* OR natural experiment* OR ARIMA OR autoregress* OR auto-regress* OR segmented OR segments OR piecewise OR piece-wise OR interrupt* OR implement* OR guideline*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	14,463
S20	TX ((piecewise OR piece-wise))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	7,259
S19	TX (integrat* moving average OR slope change)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	2,733
S18	TI (segment and regression) OR AB (segment and regression)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	11,737
S17	TI "(interrupt* time* series)" OR AB "(interrupt* time* series)"	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	6,546

S16	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	10,952
S15	TX (prescrib* N3 pharmacist*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	1,960
S14	TI ((collaborative n5 pharmacist) or (pharmacist-physician)) OR AB ((collaborative n5 pharmacist) or (pharmacist-physician))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	1,001
S13	SU "pharmacist-physician"	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	30
S12	(MH “Evidence-Based Pharmacy Practice”) OR (MH “Scope of Practice”)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	265
S11	((prescrib* N3 pharmacist*) AND ((MH “Scope of Practice”) or (MH “Evidence-Based Pharmacy Practice”)) or (SU "pharmacist-physician" or TI (collaborative n5 pharmacist) or TI (pharmacist-physician))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced	301

			Search Database - MEDLINE	
S10	TI ((("non-medical prescribing" or "non-medical prescribing" or prescribing or pharmacist-led) N7 pharmacist*))) OR AB ((("non-medical prescribing" or "non-medical prescribing" or prescribing or pharmacist-led) N7 pharmacist*)))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	3,334
S9	TX (pharmacist N2 prescri*) AND SU (Medication Therapy Management*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	55
S8	TX ("pharmacist-prescriber*") OR "pharmacist prescriber*" or “independent prescrib*” or "prescribing clinical pharmacist*" or "pharmacist-led" or (prescribing N3 NMP))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	2,288
S7	TI (("pharmacist-prescriber*" OR "pharmacist prescriber*" or “independent prescrib*” or ("prescribing clinical pharmacist*") or "pharmacist-led" or (prescribing N3 NMP) or "pharmacist-independent prescriber" or "pharmacist independent prescriber" or (pharmacist N2 PIP))) OR AB (("pharmacist-prescriber*" OR "pharmacist prescriber*" or “independent prescrib*” or ("prescribing clinical pharmacist*") or "pharmacist-led" or (prescribing N3 NMP) or "pharmacist-independent prescriber" or "pharmacist independent prescriber" or (pharmacist N2 PIP))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	2,249
S6	TI ((pharmacist* and prescribing) N5 (authority or "additional authori*" or “additional prescribing authori#ation” or right# or train* OR "prescribing training")) OR AB ((pharmacist* and prescribing) N5 (authority or "additional authori*" or “additional prescribing authori#ation” or right# or train* OR "prescribing training"))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	494

S5	TI (((pharmacist* and prescrib*) and (formular* or (pharmacist N2 protocol) or "supplementary prescribing" or "prescribing practice" or "non-medical prescri*" or "non medical prescri*"))) OR AB (((pharmacist* and prescrib*) and (formular* or (pharmacist N2 protocol) or "supplementary prescribing" or "prescribing practice" or "non-medical prescri*" or "non medical prescri*")))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	411
S4	TI (((pharmacist* N5 deprescrib*) OR deprescrip*)) OR AB (((pharmacist* N5 deprescrib*) OR deprescrip*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	330
S3	(MM "Deprescriptions")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	991
S2	(MH "Non-Medical Prescribing")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	1
S1	(MH "Pharmacists") and ((TI (prescrb*) OR AB (prescri*)) or (TX prescri*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	5,682

Embase search strategy

Research question: Q1 and Q2 (effectiveness and safety)

Search date: 18 July 2024

Search line	Search string	Results
1	exp Pharmacist/	103,942
2	exp Prescription/	269,654
3	1 and 2	21,695
4	deprescribing.mp.	2,957
5	"non-medical prescrib*".mp.	481
6	(pharmacist* and (prescrib* adj3 protocol)).ti. or (pharmacist* and (prescrib* adj3 protocol)).ab.	71
7	(pharmacist* and prescrib* and formular*).ti. or (pharmacist* and prescrib* and formular*).ab.	539
8	(pharmacist* and prescrib* and ("supplementary prescribing" or "prescribing practice" or "non-medical prescri*" or "non medical prescri*")).ti. or (pharmacist* and prescrib* and ("supplementary prescribing" or "prescribing practice" or "non-medical prescri*" or "non medical prescri*")).ab.	417
9	(pharmacist* and prescribing and (authori* or right* or train* or "prescribing training")).ti. or (pharmacist* and prescribing and (authori* or right* or train* or "prescribing training")).ab.	2,329
10	pharmacist-prescriber.mp.	119
11	pharmacist prescriber.mp.	119
12	"independent prescriber*".mp.	332
13	"prescribing clinical pharmacist*".mp.	6
14	"non-medical prescriber".mp.	61
15	"non medical prescriber".mp.	61
16	"clinical pharmacist".mp.	8,405
17	"pharmacist-independent prescriber".mp.	46
18	"pharmacist independent prescriber".mp.	46
19	((prescribing adj3 NMP).ti. or prescribing.mp.) adj3 NMP.ab. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	69
20	(prescribing adj3 PIP).ti. or (prescribing adj3 PIP).ab.	285
21	(pharmacist* adj2 prescri*).mp. and ("pharmacy (shop)"/ or hospital pharmacy/) [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	333
22	("non-medical prescribing" or "non-medical prescribing").ti. or ("non-medical prescribing" or "non-medical prescribing").ab.	295
23	(("pharmacist-led" or "pharmacist led") and ("non-medical prescribing" or "non-medical prescribing")).ti. or (("pharmacist-led" or "pharmacist led") and ("non-medical prescribing" or "non-medical prescribing")).ab.	9
24	3 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 19 or 21 or 22 or 23	23,694
25	exp time series analysis/	42,052
26	time series.mp. or time series analysis/	72,555
27	exp controlled study/ or exp major clinical study/	13,061,958
28	exp quasi experimental study/ or exp controlled study/	10,703,317
29	quasiexperimental.mp.	1,202
30	ARIMA.mp.	2,386
31	autoregress.mp.	2
32	piecewise.mp.	6,302
33	interrupted time series.mp.	8,209
34	segment.mp.	378,331

Search line	Search string	Results
35	(segment and regression).ti. or (segment and regression).ab.	13,304
36	(integrat* moving average or slope change).tw.	2,653
37	(piecewise or piece-wise).tw.	6,741
38	"controlled clinical trial (topic)"/	13,518
39	exp "randomized controlled trial (topic)"/	277,695
40	exp retrospective study/	1,649,086
41	exp prospective study/	927,157
42	pragmatic trial/	2,825
43	("randomi*ed controlled" or (random* adj2 control*)).ti. or ("randomi*ed controlled" or (random* adj2 control*)).ab.	525,102
44	((time* series and (pre or before or prior)) adj5 (post or after or follow*)).ti. or ((time* series and (pre or before or prior)) adj5 (post or after or follow*)).ab.	6,432
45	((time* series and (pre or before or prior)) adj5 (quasi-experiment* or quasiexperiment* or natural experiment* or ARIMA or autoregress* or auto-regress* or segmented or segments or piecewise or piece-wise or interrupt* or implement* or guideline*)).ti. or ((time* series and (pre or before or prior)) adj5 (quasi-experiment* or quasiexperiment* or natural experiment* or ARIMA or autoregress* or auto-regress* or segmented or segments or piecewise or piece-wise or interrupt* or implement* or guideline*)).ab.	5,940
46	25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45	14,424,402
47	24 and 46	7,481
48	limit 47 to (article-in-press status or embase status or in-process status)	4,198
49	limit 48 to "remove medline records"	1,913

Dimensions.ai search strategy

Research question: Q1 and Q2 (effectiveness and safety)

Search date: 12 July 2024

#	Query	Results
#1	(((((mesh_terms:(Non-Medical Prescribing)) AND (mesh_terms:Pharmacists))	
#2	OR (mesh_terms:Deprescriptions)) AND (mesh_terms:Pharmacists))	
#3	OR (title:((pharmacist* and (supplemental or formulary or formularies or "independent prescribing" or "non-medical prescribing" or "non medical prescribing")))))	
#4	OR (abstract:((pharmacist* and (supplemental or formulary or formularies or "independent prescribing" or "non-medical prescribing" or "non medical prescribing"))))	
Total		94

Cochrane library search strategy

Research question: Q1 and Q2 (effectiveness and safety)

Search date: 22 July 2024

#	Search string	Results
#1	MeSH descriptor: [Pharmacists] explode all trees	1120
#2	prescribe* or prescription* or prescribed or prescriber	48162
#3	#1 and #2	324

#4	MeSH descriptor: [Non-Medical Prescribing] explode all trees	0
#5	pharmacist* N5 (deprescrib* or deprescrip*)	1
#6	(formular* or "supplementary prescribing" or "prescribing practice" or "non-medical prescri*" or "non medical prescri*") N2 pharmacist*	17
#7	(authority or" additional authori*" or "additional prescribing authori*ation" or right* or train* OR "prescribing training") N10 pharmacist*	0
#8	("pharmacist-prescriber*" OR "pharmacist prescriber*" or "independent prescrib*" or "prescribing clinical pharmacist*" or pharmacist-led or "pharmacist-independent prescriber" or "pharmacist independent prescriber")	750
#9	"Medication Therapy Management" N2 pharmacist*	13
#10	#3 or #4 or #5 or #6 or #7 or #8 in Cochrane Reviews, Cochrane Protocols, Trials	991

Medline search strategy

Research question: Q3 (cost-effectiveness)

Search date: 14 August 2024

#	Query	Limiters/Expanders	Last Run Via	Results
S24	S16 AND S23	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	663
S23	S17 OR S18 OR S19 OR S20 OR S21 OR S22	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	481,490
S22	TI (((cost N5 (benefit* or effectiv* or comparat* or analy*)))) OR AB (((cost N5 (benefit* or effectiv* or comparat* or analy*))))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	257,286
S21	TX (("cost benefit" or "cost-benefit" or "cost analysis" or "cost-analysis" or "cost compar*" or "cost implication*" or "cost-effectiv*" or "health-care reference costs" or "cost minimi#ation analysis"))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	326,128
S20	(MM "Hospital Costs")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	5,207
S19	(MH "Cost Control+")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	34,332

#	Query	Limiters/Expanders	Last Run Via	Results
S18	(MH "Costs and Cost Analysis+")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	272,185
S17	(MM "Cost-Benefit Analysis")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	10,854
S16	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	7,721
S15	TX (prescrib* N3 pharmacist*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	1,976
S14	TI ((collaborative N5 pharmacist) or (pharmacist-physician)) OR AB ((collaborative N5 pharmacist) or (pharmacist-physician))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	1,007
S13	SU "pharmacist-physician"	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	30
S12	(MH “Evidence-Based Pharmacy Practice”) OR (MH “Scope of Practice”)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	267
S11	((prescrib* N3 pharmacist*) AND ((MH “Scope of Practice”) or (MH “Evidence-Based Pharmacy Practice”)) or (SU "pharmacist-physician" or TI (collaborative n5 pharmacist) or TI (pharmacist-physician))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	301
S10	TI ((("non-medical prescribing" or "non-medical prescribing" or prescribing or pharmacist-led) N7 pharmacist*))) OR AB ((("non-medical prescribing" or "non-medical prescribing" or	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	3,367

#	Query	Limiters/Expanders	Last Run Via	Results
	prescribing or pharmacist-led) N7 pharmacist*)))			
S9	TX (pharmacist N2 prescrib*) AND SU (Medication Therapy Management*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	44
S8	TX ("pharmacist-prescriber*") OR (minor ailment schemes (MAS)) OR "pharmacist prescriber*" or "independent prescrib*" or "prescribing clinical pharmacist*" or "pharmacist-led" or (prescribing N3 NMP))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	2,315
S7	TI (("pharmacist-prescriber*" OR "pharmacist prescriber*" or "independent prescrib*" or ("prescribing clinical pharmacist*") or "pharmacist-led" or (prescribing N3 NMP) or "pharmacist-independent prescriber" or "pharmacist independent prescriber" or (pharmacist N2 PIP))) OR AB (("pharmacist-prescriber*" OR "pharmacist prescriber*" or "independent prescrib*" or ("prescribing clinical pharmacist*") or "pharmacist-led" or (prescribing N3 NMP) or "pharmacist-independent prescriber" or "pharmacist independent prescriber" or (pharmacist N2 PIP)))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	2,271
S6	TI ((pharmacist* and prescribing) N5 (authority or "additional authori*" or “additional prescribing authori#ation” or right# or train* OR "prescribing training")) OR AB ((pharmacist* and prescribing) N5	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	496

#	Query	Limiters/Expanders	Last Run Via	Results
	(authority or "additional authori*" or “additional prescribing authori#ation” or right# or train* OR "prescribing training"))			
S5	TI (((pharmacist* and prescrib*) and (formular* or (pharmacist N2 protocol) or "supplementary prescribing" or "prescribing practice" or "non-medical prescrib*" or "non medical prescrib*"))) OR AB (((pharmacist* and prescrib*) and (formular* or (pharmacist N2 protocol) or "supplementary prescribing" or "prescribing practice" or "non-medical prescrib*" or "non medical prescrib*")))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	412
S4	TI ((pharmacist* N5 deprescrib*)) OR AB ((pharmacist* N5 deprescrib*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	153
S3	(MH "Deprescriptions") AND ((TI pharmacist*) OR (AB pharmacist*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	203
S2	(MH "Non-Medical Prescribing")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	2
S1	(MH "Pharmacists") and ((TI (prescrib*) OR AB (prescrib*)))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - MEDLINE	3,039

Embase search strategy

Research question: Q3 (cost-effectiveness)

Search date: 14 August 2024

#	Search string	#
1	exp Pharmacist/	104698
2	exp Prescription/	271513
3	1 and 2	21798
4	((deprescribing or deprescription) and pharmacist*).ti,ab,kw.	738
5	(pharmacist* and (prescrib* adj3 protocol)).ti,ab.	74
6	((pharmacist* and prescrib*) adj3 formular*).ti,ab.	247
7	((prescribing adj3 NMP) or (prescribing adj3 PIP)).ti,ab.	358
8	(pharmacist* and prescrib* and ("supplementary prescribing" or "prescribing practice" or "non-medical prescrib*" or "non medical prescrib*")).ti,ab,kw.	467
9	(pharmacist* and prescribing and (authori* or right* or train* or "prescribing training")).ti,ab,kw.	2473
10	("pharmacist-led" or "pharmacist led").ti,ab,kw.	3722
11	(pharmacist-prescriber or "pharmacist prescriber" or "independent prescriber" or "prescribing clinical pharmacist" or "clinical pharmacist" or "non-medical prescriber" or "non medical prescriber" or "pharmacist-independent prescriber" or "pharmacist independent prescriber").ti,ab,kw.	6644
12	("non-medical prescribing" or "non-medical prescribing" or "collaborative prescribing").ti,ab.	327
13	(pharmacist* adj2 prescri*).ti,ab,kw. and ("pharmacy (shop)"/ or hospital pharmacy/)	370
14	(pharma* and "minor ailments").ti,ab,kw.	332
15	3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	32172
16	Cost of illness/	21957
17	Cost control/	78907
18	((cost adj2 estimate$) or (cost adj2 estimate$) or (cost adj2 variable$) or "cost benefit analysis" or "cost effectiveness analysis" or "comparative effectiveness" or "controlled stud*" or "cost control" or "economic stud*" or "economic evaluation*" or "cost minimi#ation analysis" or "outcome assessment*" or "utili#ation review*").ti,ab,kw.	219278
19	(Pharmacist prescribing and care improves cardiovascular risk, but is it cost-effective?).m_titl.	1
20	Cost-effectiveness analysis of doctor-pharmacist collaborative prescribing for venous thromboembolism.m_titl.	1
21	Cost-effectiveness analysis of doctor-pharmacist collaborative prescribing for venous thromboembolism.m_titl.	1
22	Cost analysis of a community pharmacy 'minor ailment scheme' across three primary care trusts.m_titl.	1
23	16 or 17 or 18 or 19 or 20 or 21 or 22	307648
24	15 and 23	1618

EconLit search strategy

Research question: Q3 (cost-effectiveness)

Search date: 24 August 2024

#	Search String	Limits	Results
S4	S1 OR S2 OR S3	Expanders - Apply equivalent subjects Search modes - Proximity Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - EconLit	13
S3	TX (((pharmacists or pharmacist or pharmacies or pharmacy or pharmacy service) N3 (prescribe or prescribing or prescriber)))		11
S2	TI (independent prescriber or non medical prescriber or pharmacist-led) OR AB (independent prescriber or non medical prescriber or pharmacist-led)		2
S1	TI ((pharmacists or pharmacist or pharmacies or pharmacy or pharmacy service) AND (prescribe or prescribing or prescriber)) AND AB ((pharmacists or pharmacist or pharmacies or pharmacy or pharmacy service) AND (prescribe or prescribing or prescriber))		1

Dimensions.ai search strategy

Research question: Q3 (cost-effectiveness)

Database/resource: Dimensions.ai

Search date: 19 August 2024

#	Search string	Result
#1	(pharmacist or "non-medical prescriber" or "pharmacist-independent" or "independent prescriber") and (cost or costs or evaluation)	
#2		185

Econpapers search strategy

Research question: Q3 (cost-effectiveness)

Search date: 19 August 2024

#	Search string	Result
#1	((pharmacists or pharmacist) and (prescribe or prescribing or deprescribe or deprescription)	
	and ("cost benefit" or "cost control" or "cost-benefit" or "cost-control" or "economic evaluation" or “cost-benefit analysis”))	
Limit	“journal articles”	
		47

Cochrane Library search strategy

Research question: Q3 (cost-effectiveness)

Search date: 11 September 2024

ID	Search	Hits
#1	MeSH descriptor: [Pharmacists] explode all trees	1127
#2	prescribe* or prescription* or prescribed or prescriber	48663
#3	#1 and #2	325
#4	MeSH descriptor: [Non-Medical Prescribing] explode all trees	0
#5	pharmacist* N5 (deprescrib* or deprescrip*)	1
#6	(formular# or "supplementary prescribing" or "prescribing practice" or "non-medical prescri#" or "non medical prescri#") N2 pharmacist#	11
#7	("pharmacist-prescriber#" OR "pharmacist prescriber#" or "independent prescrib#" or "prescribing clinical pharmacist#" or pharmacist-led or "pharmacist-independent prescriber" or "pharmacist independent prescriber")	762
#8	#3 and (#4 or #5 or #6 or #7)	89
#9	"cost-benefit analysis" or ("cost benefit analysis")	14066
#10	"economic analysis" or "economic evaluation"	8014
#11	("cost benefit" or "cost-benefit" or "cost analysis" or "cost-analysis" or "cost compar#" or "cost implication#" or "cost-effectiv#" or "health-care reference costs" or "cost minimi$ation analysis")	17454
#12	#9 or #10 or #11	22201
#13	#8 and #9	9

Appendix D Supplementary searches

Search engines

	Date	Search engine	Search strings	Results screened by IS
Q2 and Q3	09 Sept 2024	DuckDuckGo	Deprescription or deprescribe Pharmacist prescribing Pharmacists' prescribing Pharmacist intervention	200
	09 Sept 2024	Google	Deprescription or deprescribe Pharmacist prescribing Pharmacists' prescribing Pharmacist intervention	200
Q4	09 Sept 2024	DuckDuckGo	pharmacist prescribing and costs cost benefit cost analysis / independent prescribing and costs cost benefit cost analysis / formulary prescribing and pharmacists and costs cost benefit cost analysis / deprescribing and pharmacists and costs cost benefit cost analysis /	200
	09 Sept 2024	Google	Economic analysis and pharmacist deprescribing Economic analysis and pharmacist prescribing	200

Systematic review citation chasing: Q1, Q2, Q3 (effectiveness, safety, cost-effectiveness)

Systematic reviews identified from Cochrane Library and Epistemonikos (n=15)
de Barra M, Scott CL, Scott NW, et al. Pharmacist services for non-hospitalised patients. Cochrane Database of Systematic Reviews Published Online First: 2018. doi:10.1002/14651858.CD013102
de Barra M, Scott CL, Scott NW, et al. Pharmacist services for non-hospitalised patients. Cochrane Database of Systematic Reviews Published Online First: 2018. doi:10.1002/14651858.CD013102
Eckhaus LM, Ti AJ, Curtis KM, et al. Patient and pharmacist perspectives on pharmacist-prescribed contraception: A systematic review. Contraception 2021;103:66–74. doi:10.1016/j.contraception.2020.10.012
Eng Whui Poh, McArthur Alexa, Stephenson Matthew, et al. Effects of pharmacist prescribing on patient outcomes in the hospital setting: a systematic review. JBI Database of Systematic Reviews & Implementation Reports 2018;16:1823–73. doi:10.11124/JBISRIR-2017-003697
Gillaizeau F, Chan E, Trinquart L, et al. Computerized advice on drug dosage to improve prescribing practice. Cochrane Database of Systematic Reviews Published Online First: 2013. doi:10.1002/14651858.CD002894.pub3
Greer N, Bolduc J, Geurkink E, et al. Pharmacist-Led Chronic Disease Management: A Systematic Review of Effectiveness and Harms Compared to Usual Care. 2015.
Kamitani E, Mizuno Y, DeLuca JB, et al. Systematic review of alternative HIV pre-exposure prophylaxis (PrEP) care delivery models to improve PrEP services. AIDS (London, England) Published Online First: 2023. doi:10.1097/QAD.0000000000003601

Kc B, Alrasheedy AA, Leggat PA, et al. Types and outcomes of pharmacist-managed travel health services: A systematic review. Travel medicine and infectious disease 2022;51:102494. doi:10.1016/j.tmaid.2022.102494

Mills T, Patel N, Ryan K. Pharmacist non-medical prescribing in primary care. A systematic review of views, opinions and attitudes. International journal of clinical practice 2020;:e13827. doi:10.1111/ijcp.13827

Oñatibia-Astibia A, Malet-Larrea A, Gastelurrutia MÁ, et al. Community pharmacist interventions to improve adherence to lipid lowering medication and their influence on clinical outcomes: A systematic review and meta-analysis. Journal of evaluation in clinical practice Published Online First: 2020. doi:10.1111/jep.13451

Ramos DC, Ferreira L, Santos Júnior GAD, et al. Pharmacist prescribing: a review of perceptions and attitudes of patients, pharmacists and other interested professionals. Ciencia & saude coletiva 2022;27:3531–46. doi:10.1590/1413-81232022279.19972021

Ruiz-Ramos J, Hernández MH, Juanes-Borrego AM, et al. The Impact of Pharmaceutical Care in Multidisciplinary Teams on Health Outcomes: Systematic Review and Meta-Analysis. Journal of the American Medical Directors Association 2021;22:2518–26. doi:10.1016/j.jamda.2021.05.038

Thakur T, Frey M, Chewning B. Pharmacist roles, training, and perceived barriers in naloxone dispensing: A systematic review. Journal of the American Pharmacists Association : JAPhA 2019;60:178–94. doi:10.1016/j.japh.2019.06.016

Walpola RL, Issakhany D, Gisev N, et al. The accessibility of pharmacist prescribing and impacts on medicines access: A systematic review. Research in social & administrative pharmacy : RSAP Published Online First: 2024. doi:10.1016/j.sapharm.2024.01.006

Wright DJ, Maskrey V, Blyth A, et al. Systematic review and narrative synthesis of pharmacist provided medicines optimisation services in care homes for older people to inform the development of a generic training or accreditation process. The International journal of pharmacy practice 2020;28:207–19. doi:10.1111/ijpp.12591

Wu JH, Khalid F, Langford BJ, et al. Community pharmacist prescribing of antimicrobials: A systematic review from an antimicrobial stewardship perspective. Canadian pharmacists journal : CPJ = Revue des pharmaciens du Canada : RPC 2021;154:179–92. doi:10.1177/1715163521999417

Records identified for backward citations chasing	1,031
Records identified for forward citation chasing	434
Total	1,465

Systematic reviews identified through Medline, Embase, Dimensions.ai, EconLit, Econpapers database searches (n=22)

Ahumada-Canale Antonio, Quirland Camila, Martinez-Mardones Francisco J, et al. Economic evaluations of pharmacist-led medication review in outpatients with hypertension, type 2 diabetes mellitus, and dyslipidaemia: a systematic review. The European journal of health economics : HEPAC : health economics in prevention and care 2019;20:1103–16. doi:10.1007/s10198-019-01080-z

Al Raiisi Fatma, Stewart Derek, Fernandez-Llimos Fernando, et al. Clinical pharmacy practice in the care of Chronic Kidney Disease patients: a systematic review. International journal of clinical pharmacy 2019;41:630–66. doi:10.1007/s11096-019-00816-4

Alabkal Rahma M, Medlinskiene Kristina, Silcock Jonathan, et al. Impact of Pharmacist-Led Interventions to Improve Clinical Outcomes for Adults With Type 2 Diabetes at Risk of Developing Cardiovascular Disease: A Systematic Review and Meta-analysis. Journal of pharmacy practice 2023;36:888–99. doi:10.1177/08971900211064459

Baumgartner Andrew D, Clark Collin M, LaValley Susan A, et al. Interventions to deprescribe potentially inappropriate medications in the elderly: Lost in translation? Journal of Clinical Pharmacy and Therapeutics 2019;45:453–61. doi:10.1111/jcpt.13103

Bužančić Iva, Kummer Ingrid, Držaić Margita, et al. Community-based pharmacists' role in deprescribing: A systematic review. British Journal of Clinical Pharmacology 2021;88:452–63. doi:10.1111/bcp.14947

Cao V F. S, Cowley E, Koshman S L, et al. Pharmacist-led optimization of heart failure medications: A systematic review. JACCP Journal of the American College of Clinical Pharmacy 2021;4:862–70. doi:10.1002/jac5.1450

Croke A, Cardwell K, Clyne B, et al. The effectiveness and cost of integrating pharmacists within general practice to optimize prescribing and health outcomes in primary care patients with polypharmacy: A systematic review. medRxiv Published Online First: 2022. doi:10.1101/2022.12.15.22283519

Croke Aisling, Cardwell Karen, Clyne Barbara, et al. The effectiveness and cost of integrating pharmacists within general practice to optimize prescribing and health outcomes in primary care patients with polypharmacy: a systematic review. BMC primary care 2023;24:41. doi:10.1186/s12875-022-01952-z

De Oliveira Gildasio S, Jr, Castro-Alves Lucas J, et al. Effectiveness of Pharmacist Intervention to Reduce Medication Errors and Health-Care Resources Utilization After Transitions of Care: A Meta-analysis of Randomized Controlled Trials. Journal of patient safety 2021;17:375–80. doi:10.1097/PTS.0000000000000283

Elnour A A, Raja N S, Abdi F, et al. Protocol for systematic review and meta-analysis of randomized controlled trials, cost-benefit analysis and interrupted time-series interventions on pharmacist's prescribing. Pharmacy Practice 2022;20:2713. doi:10.18549/PharmPract.2022.3.2713

Entezari-Maleki Taher, Dousti Samaneh, Hamishehkar Hadi, et al. A systematic review on comparing 2 common models for management of warfarin therapy; pharmacist-led service versus usual medical care. Journal of clinical pharmacology 2016;56:24–38. doi:10.1002/jcph.576

Guillaume L, Cooper R, Avery A, et al. Supplementary prescribing by community and primary care pharmacists: an analysis of PACT data, 2004-2006. Journal of clinical pharmacy and therapeutics 2008;33:11–6. doi:10.1111/j.1365-2710.2008.00869.x

Guillot J, Schott A, Roy H, et al. Evolution of pharmacy practice models in infectiology: A 30-year review. Pharmacien Hospitalier et Clinicien 2013;48:239–48. doi:10.1016/j.phclin.2013.03.003

Hou Kelu, Yang Hui, Ye Zhikang, et al. Effectiveness of Pharmacist-led Anticoagulation Management on Clinical Outcomes: A Systematic Review and Meta-Analysis. Journal of pharmacy & pharmaceutical sciences : a publication of the Canadian Society for Pharmaceutical Sciences, Societe canadienne des sciences pharmaceutiques 2017;20:378–96. doi:10.18433/J3SQ0B

Jeong Sohyun, Lee Minhee, Ji Eunhee. Effect of pharmaceutical care interventions on glycemic control in patients with diabetes: a systematic review and meta-analysis. Therapeutics and clinical risk management 2018;14:1813–29. doi:10.2147/TCRM.S169748

Nicoll Ruairidh, Robertson Lynn, Gemmell Elliot, et al. Models of care for chronic kidney disease: A systematic review. Nephrology (Carlton, Vic) 2018;23:389–96. doi:10.1111/nep.13198

Noblet Timothy, Marriott John, Graham-Clarke Emma, et al. Clinical and cost-effectiveness of non-medical prescribing: A systematic review of randomised controlled trials. PloS one 2018;13:e0193286. doi:10.1371/journal.pone.0193286

Ragab M H, Al-Hindi M Y, Alrayees M M. Neonatal parenteral nutrition: Review of the pharmacist role as a prescriber. Saudi Pharmaceutical Journal 2016;24:429–40. doi:10.1016/j.jsps.2014.06.009	
Stone R H, Rafie S, Ernest D, et al. Emergency contraception access and counseling in urban pharmacies: A comparison between states with and without pharmacist prescribing. Pharmacy 2020;8:1–10. doi:10.3390/pharmacy8020105	
Vaismoradi Mojtaba, Jordan Sue, Logan Patricia A, et al. A Systematic Review of the Legal Considerations Surrounding Medicines Management. Medicina (Kaunas, Lithuania) 2021;57. doi:10.3390/medicina57010065	
Varas-Doval R, Saéz-Benito L, Gastelurrutia M A, et al. Systematic review of pragmatic randomised control trials assessing the effectiveness of professional pharmacy services in community pharmacies. BMC health services research 2021;21:156. doi:10.1186/s12913-021-06150-8	
Weeks Greg, George Johnson, Maclure Katie, et al. Non-medical prescribing versus medical prescribing for acute and chronic disease management in primary and secondary care. The Cochrane database of systematic reviews 2016;11:CD011227. doi:10.1002/14651858.CD011227.pub2	
Records identified for backward citations chasing	1,115
Records identified for forward citation chasing	478
Total identified	1593

Table A3: Summary of systematic review citation chasing

Question and # of relevant systematic reviews	References retrieved	Citations retrieved	Total retrieved	Removed through deduplication	Screened on title & abstract	Included in final paper
Q1, Q2, Q3 systematic Reviews (n=15) from systematic review search in Cochrane Library and Epistemonikos	1,115	478	1,593	1,733	1,325	8
Q1, Q2, Q3 systematic Reviews (n=22) from database search	1,031	434	1,465			
Total	2,319	1,048	3,367	1,788	1,570	8

Grey literature searches

Searches completed between (August and September 2024)

Source	Organisation	Website
Australia	Advanced Pharmacy Australia (formerly The Society of Hospital Pharmacists of Australia (SHPA) as of the 28 August, 2024)	https://www.adpha.au/
	Australian Pharmacy Council	https://www.pharmacycouncil.org.au/

Source	Organisation	Website
	Pharmacist Society of Australia	https://www.psa.org.au/psa-release-pharmacist-prescribing-position-statement/
Canada	The Canadian Pharmacists Association (CPhA)	https://www.pharmacists.ca/
	College of Pharmacists of BC	https://www.bcpharmacists.org/contact-us
	Deprescribing.org	https://deprescribing.org/about/
	New Brunswick's Pharmacists' Association	https://nbpharma.ca/
	The National Association of Pharmacy Regulatory Authorities (NAPRA)	https://www.napra.ca/resources/pharmacy-regulatory-authorities/
UK	The Pharmacists' Defence Association (PDA)	https://www.the-pda.org/
New Zealand	Health, Quality and Safety Commission	https://www.hqsc.govt.nz/
	Pharmaceutical Society of New Zealand	https://www.psnz.org.nz/
	Pharmacy Council	https://pharmacycouncil.org.nz/
Databases/ International	CADTH	https://www.cadth.ca/
	HIQA	https://www.hiqa.ie/
	Health Evidence	https://www.healthevidence.org/
	INAHTA	https://database.inahta.org/
	The International Pharmaceutical Federation (FIP)	https://www.fip.org/
	World Health Organization (WHO)	https://www.who.int/data/gho/gho-search
	London School of Economics	https://eprints.lse.ac.uk/
	National Centre for Pharmacoeconomics, Ireland	https://www.ncpe.ie/about/
	Econpapers	https://econpapers.repec.org/
	CEA Registry	https://cear.tuftsmedicalcenter.org/
	Health Evidence	https://www.healthevidence.org/
	Centre for Reviews and Dissemination	https://www.crd.york.ac.uk/CRDWeb/

Appendix E EPPI-Reviewer Web

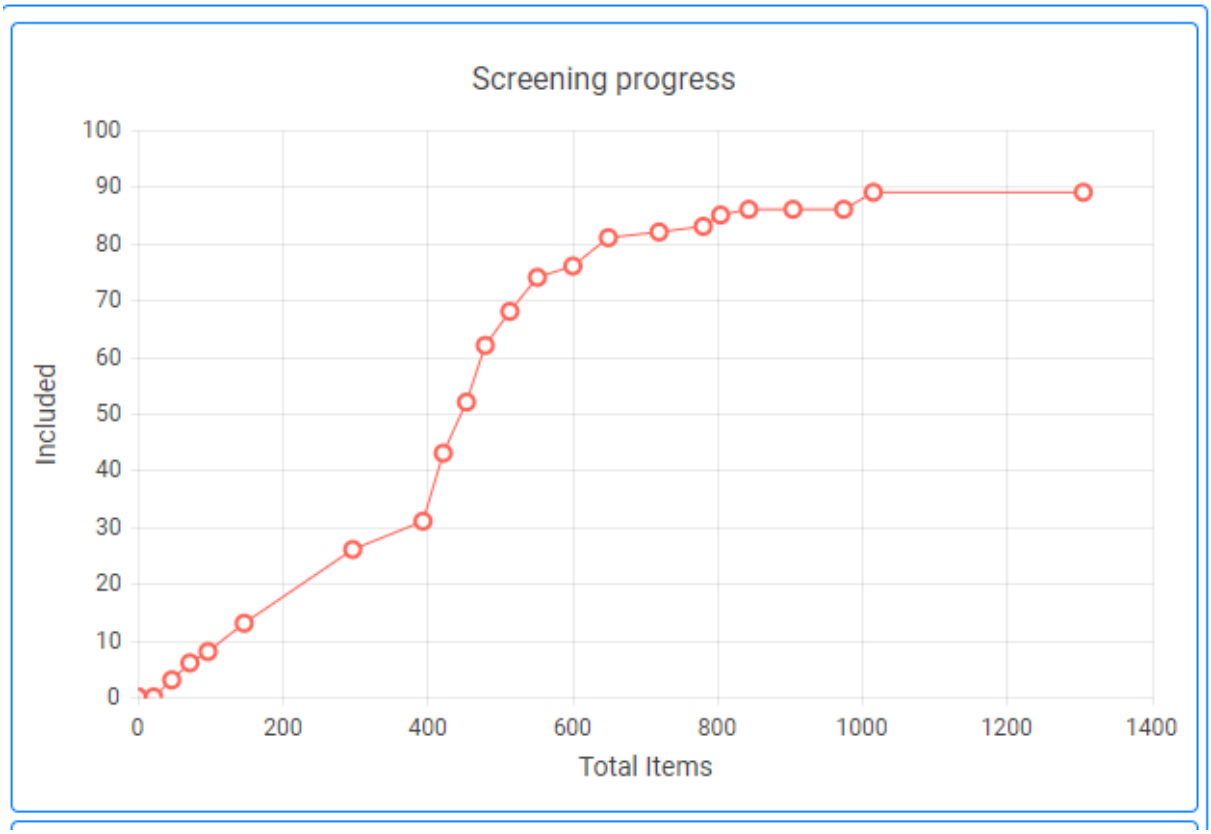


Figure: Priority screening graph of Q4 citation chasing records (n=1,325) from Eppi-reviewer

Appendix F National Heart, Lung, and Blood Institute controlled studies assessment

	1. Was the study described as randomised, a randomised trial, a randomised clinical trial, or an RCT?	2. Was the method of randomisation adequate?	3. Was the treatment allocation concealed?	4. Were study participants and providers blinded to treatment group assignment?	5. Were the people assessing the outcomes blinded to the participants' group assignments?	6. Were the groups similar at baseline on important characteristics that could affect outcomes?	7. Was the overall drop-out rate at endpoint 20% or lower of the number allocated to treatment?	8. Was the differential drop-out rate at endpoint 15 percentage points or lower?	9. Was there high adherence to the intervention protocols for each treatment group?	10. Were other interventions avoided or similar in the groups?	11. Were outcomes assessed using valid and reliable measures, implemented consistently across all study participants?	12. Was the sample size was sufficiently large to to detect a difference in the main outcome between groups with at least 80% power?	13. Were outcomes reported or subgroups analysed pre-specified?	14. Were all randomised participants analysed in the group to which they were originally assigned?
Boddy (2001)	No	No	No	No	No	Yes	Yes	Yes	Yes	CD	Yes	No	Yes	CD
Bruhn et al. (2013)	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes
Damaske et al. (2005)	No	No	No	No	No	NR	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Holland et al. (2023)	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jameson et al. (2010)	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lau et al. (2022)	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Marotti et al. (2011)	Yes	Yes	Yes	No	CD	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
McAllister et al. (2014)	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Ogilve et al. (2022)	Yes	Yes	Yes	No	No	CD	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Thompson et al. (1984)	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Villeneueve et al. (2010)	Yes	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Vivian (2002)	Yes	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Xu et al. (2021)	Yes	Yes	Yes	No	No	CD	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

Appendix G National Heart, Lung, and Blood Institute cohort and observational studies assessment

Study	1. Was the research question or objective in this paper clearly stated?	2. Was the study population clearly specified and defined?	3. Was the participation rate of eligible persons at least 50%?	4. Were all the subjects selected or recruited from similar populations? Were inclusion/ exclusion criteria prespecified and applied uniformly?	5. Was a sample size justification, power description, or variance and effect estimates provided?	6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome?	9. Were the exposure measures clearly defined, valid, reliable, and implemented consistently across all study participants?	10. Was the exposure(s) assessed more than once over time?	11. Were the outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants?	12. Were the outcome assessors blinded to the exposure status of participants?	13. Was loss to follow-up after baseline 20% or less?	14. Were key potential confounding variables measured and adjusted statistically for the relationship between exposure(s) and outcome(s)?
Aspinall et al. (2012)	Yes	Yes	CD	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	NR
Beahm et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	No	Yes	No
Beahm et al. (2021)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	No
Cohen et al. (1985)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	NA	No
Cowart et al. (2020)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	No
Cowart et al. (2022)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes

Study	1. Was the research question or objective in this paper clearly stated?	2. Was the study population clearly specified and defined?	3. Was the participation rate of eligible persons at least 50%?	4. Were all the subjects selected or recruited from similar populations? Were inclusion/ exclusion criteria prespecified and applied uniformly?	5. Was a sample size justification, power description, or variance and effect estimates provided?	6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome?	9. Were the exposure measures clearly defined, valid, reliable, and implemented consistently across all study participants?	10. Was the exposure(s) assessed more than once over time?	11. Were the outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants?	12. Were the outcome assessors blinded to the exposure status of participants?	13. Was loss to follow-up after baseline 20% or less?	14. Were key potential confounding variables measured and adjusted statistically for the relationship between exposure(s) and outcome(s)?
Hall et al. (2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes
Hanh et al. (2019)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	No
Hernández-Muñoz et al. (2021)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	CD	Yes
Lum et al. (2023)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes
Maeng et al (2018)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes
Manzoor et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	NA	Yes	No	Yes	Yes

Study	1. Was the research question or objective in this paper clearly stated?	2. Was the study population clearly specified and defined?	3. Was the participation rate of eligible persons at least 50%?	4. Were all the subjects selected or recruited from similar populations? Were inclusion/ exclusion criteria prespecified and applied uniformly?	5. Was a sample size justification, power description, or variance and effect estimates provided?	6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome?	9. Were the exposure measures clearly defined, valid, reliable, and implemented consistently across all study participants?	10. Was the exposure(s) assessed more than once over time?	11. Were the outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants?	12. Were the outcome assessors blinded to the exposure status of participants?	13. Was loss to follow-up after baseline 20% or less?	14. Were key potential confounding variables measured and adjusted statistically for the relationship between exposure(s) and outcome(s)?
McFarland et al. (2009)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	No
Morello et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes
O'Neill et al. (2014)	Yes	Yes	Yes	CD	Yes	Yes	Yes	No	Yes	NA	Yes	No	No	Yes
Rana et al. (2023)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	No
Rashid et al. (2020)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes
Rodriguez et al. (2020)	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes

Study	1. Was the research question or objective in this paper clearly stated?	2. Was the study population clearly specified and defined?	3. Was the participation rate of eligible persons at least 50%?	4. Were all the subjects selected or recruited from similar populations? Were inclusion/ exclusion criteria prespecified and applied uniformly?	5. Was a sample size justification, power description, or variance and effect estimates provided?	6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome?	9. Were the exposure measures clearly defined, valid, reliable, and implemented consistently across all study participants?	10. Was the exposure(s) assessed more than once over time?	11. Were the outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants?	12. Were the outcome assessors blinded to the exposure status of participants?	13. Was loss to follow-up after baseline 20% or less?	14. Were key potential confounding variables measured and adjusted statistically for the relationship between exposure(s) and outcome(s)?
Rodriguez et al. (2021)	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes
Rodriguez et al. (2021b)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	No
Rodriguez et al. (2022)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	Yes
Romanelli et al. (2015)	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	NA	Yes	No	Yes	Yes
Varghese et al. (2024)	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	NA	Yes	No	Yes	No
Weaver et al. (2023)	Yes	Yes	CD	Yes	No	Yes	CD	No	Yes	NA	Yes	No	Yes	Yes

Appendix H Cochrane Risk of Bias 2 tool (for parallel randomised controlled trials) assessment

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Chenella et al. (1983)	Effectiveness	No. days to achieve therapeutic proconvertin and prothrombin	Not reported	Pharmacist prescribing	Physician prescribing	Some concerns	Low	High	Low	Some concerns	High
Chenella et al. (1983)	Effectiveness	Partial thromboplastin time (PTT)	Not reported	Pharmacist prescribing	Physician prescribing	Some concerns	Low	High	Low	Some concerns	High
Bruhn et al. (2013)	Effectiveness	Health-related quality of life	Primary	Pharmacist prescribing	1. Medication review 2. Usual care	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs medication review)	Effectiveness	Quality of life (physical component score)	Primary	Pharmacist prescribing	Medication review	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs medication review)	Effectiveness	Quality of life (mental component score)	Primary	Pharmacist prescribing	Medication review	Low	Low	High	Low	Low	High

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Bruhn et al. (2013) (intervention vs medication review)	Effectiveness	Chronic pain intensity	Secondary	Pharmacist prescribing	Medication review	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs medication review)	Effectiveness	Chronic pain disability	Secondary	Pharmacist prescribing	Medication review	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs usual care)	Effectiveness	Quality of life (physical component score)	Primary	Pharmacist prescribing	Usual care	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs usual care)	Effectiveness	Quality of life (mental component score)	Primary	Pharmacist prescribing	Usual care	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs usual care)	Effectiveness	Chronic pain intensity	Secondary	Pharmacist prescribing	Usual care	Low	Low	High	Low	Low	High

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Bruhn et al. (2013) (intervention vs usual care)	Effectiveness	Chronic pain disability	Secondary	Pharmacist prescribing	Usual care	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs. medication review)	Effectiveness	Depression	Secondary	Pharmacist prescribing	Medication review	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs. medication review)	Effectiveness	Anxiety	Secondary	Pharmacist prescribing	Medication review	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs. usual care)	Effectiveness	Depression	Secondary	Pharmacist prescribing	Usual care	Low	Low	High	Low	Low	High
Bruhn et al. (2013) (intervention vs. usual care)	Effectiveness	Anxiety	Secondary	Pharmacist prescribing	Usual care	Low	Low	High	Low	Low	High

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Jameson et al. (2010)	Effectiveness	Change in HbA1C	Primary	Pharmacist management of diabetes	Physician prescribing with nurse case management	Some concerns	Low	Low	Low	Some concerns	Some concerns
Jameson et al. (2010)	Effectiveness	Patients who achieved at least a 1.0% decrease in HbA1C	Secondary	Pharmacist management of diabetes	Physician prescribing with nurse case management	Some concerns	Low	Low	Low	Some concerns	Some concerns
Lau et al. (2022)	Effectiveness	Fall requiring medical attention	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	Some concerns

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Lau et al. (2022)	Effectiveness	Health related quality of life	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	Some concerns
Lau et al. (2022)	Effectiveness	Hospitalisations	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	Some concerns
Lau et al. (2022)	Effectiveness	Proportion achieving systolic BP targets on 24-h ambulatory BP monitoring	Primary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	Some concerns
Lau et al. (2022)	Effectiveness	Depression	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	Some concerns
Lau et al. (2022)	Effectiveness	Anxiety	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	Some concerns

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Lau et al. (2022)	Effectiveness	ED admissions	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	Some concerns
McAllister et al. (2014)	Effectiveness	Attained optimal systolic blood pressure and lipid level by 6 months	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	High	Low	High	Some concerns
McAllister et al. (2014)	Effectiveness	Systolic BP	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	Low	Low	High	Some concerns
McAllister et al. (2014)	Effectiveness	Mean LDL	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	High	Low	High	Some concerns
McAllister et al. (2014)	Effectiveness	Change in HDL cholesterol	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	High	Low	High	Some concerns
McAllister et al. (2014)	Effectiveness	Self-reported adherence of 75% or higher for blood pressure or lipid-lowering medications	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	High	High	High	Some concerns
McAllister et al. (2014)	Effectiveness	Self-rated health	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	High	High	High	Some concerns
McAllister et al. (2014)	Effectiveness	Quality of life	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	High	High	High	Some concerns

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Scullin et al. (2007)	Effectiveness	Length of hospital stay	Primary	Pharmacist prescribing (integrated medicines management)	Usual care, physician prescribing	Low	High	Low	Low	Some concerns	High
Scullin et al. (2007)	Effectiveness	Hospital readmission	Secondary	Pharmacist prescribing (integrated medicines management)	Usual care, physician prescribing	Low	High	Low	Low	Some concerns	High
Vivian (2002)	Effectiveness	Systolic blood pressure	Not reported	Pharmacist prescribing	Physician prescribing	High	Some concerns	Low	Low	Low	High
Vivian (2002)	Effectiveness	Diastolic blood pressure	Not reported	Pharmacist prescribing	Physician prescribing	High	Some concerns	Low	Low	Low	High
Vivian (2002)	Effectiveness	Blood pressure goal reached	Not reported	Pharmacist prescribing	Physician prescribing	High	Some concerns	Low	Low	Low	High

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Vivian (2002)	Effectiveness	Adherence	Not reported	Pharmacist prescribing	Physician prescribing	High	Some concerns	Low	Some concerns	Low	High
Vivian (2002)	Effectiveness	Quality of life	Not reported	Pharmacist prescribing	Physician prescribing	High	Some concerns	Low	Low	Low	High
Xu et al. (2021)	Effectiveness	Change in HbA1C	Primary	Team-based pharmaceuti cal care	Usual care, physician prescribing	Low	Low	Some concerns	Low	High	High
Xu et al. (2021)	Effectiveness	Diabetes-specific quality of life	Secondary	Team-based pharmaceuti cal care	Usual care, physician prescribing	Low	Low	Some concerns	Some concerns	High	High
Lau et al. (2022)	Safety	Syncope	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	High

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Lau et al. (2022)	Safety	Hypotension	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	High
Lau et al. (2022)	Safety	Hypokalemia	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	High
Lau et al. (2022)	Safety	Hyperkalemia	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	High
Lau et al. (2022)	Safety	Hyponatremia	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	High
Lau et al. (2022)	Safety	Orthostatic presyncope	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	High
Lau et al. (2022)	Safety	Change in eGFR	Secondary	Pharmacist-led case management	Enhanced usual care	Some concerns	Low	Some concerns	Low	Low	High
Marotti et al. (2011) (intervention vs usual care)	Safety	Doses missed during inpatient stay	Primary	Pharmacist medication review and prescribing	Usual care	Low	Low	Low	High	Some concerns	High

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Marotti et al. (2011) (intervention vs usual care)	Safety	Medication charted at incorrect dose	Secondary	Pharmacist medication review and prescribing	Usual care	Low	Low	Low	High	Some concerns	High
Marotti et al. (2011) (intervention vs usual care)	Safety	Medications charted at incorrect frequency	Secondary	Pharmacist medication review and prescribing	Usual care	Low	Low	Low	High	Some concerns	High
Marotti et al. (2011) (intervention vs. medication review)	Safety	Doses missed during inpatient stay	Primary	Pharmacist medication review and prescribing	Medication review	Low	Low	Low	High	Some concerns	High
Marotti et al. (2011) (intervention vs. medication review)	Safety	Medication charted at incorrect dose	Secondary	Pharmacist medication review and prescribing	Medication review	Low	Low	Low	High	Some concerns	High
Marotti et al. (2011) (intervention vs. medication review)	Safety	Medications charted at incorrect frequency	Secondary	Pharmacist medication review and prescribing	Medication review	Low	Low	Low	High	Some concerns	High

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1. Randomisation	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
McAllister et al. (2014)	Safety	Mortality	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	High	Low	High	High
McAllister et al. (2014)	Safety	Vascular event	Secondary	Pharmacist-led case management	Nurse-led case management	Low	Low	High	Low	High	High
Ogilvie et al. (2022)	Safety	Prescribing errors	Not reported	Pharmacist prescribing with nurse case management	Medical practitioner prescribing	Low	Low	High	Low	Some concerns	High
Scullin et al. (2007)	Safety	12-month mortality	Secondary	Pharmacist prescribing (Integrated medicines management)	Usual care, physician prescribing	Low	High	Low	Low	Some concerns	High

Appendix I Cochrane Risk of Bias 2 tool (for cluster randomised controlled trials) assessment

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1a. Randomisation	1b. Timing of identification or recruitment	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Holland et al. (2023)	Effectiveness	Fall rate/person at six months	Primary	Pharmacist prescribing	Usual care, GP prescribing	Some concerns	Some concerns	High	High	Low	Low	High
Holland et al. (2023)	Effectiveness	Quality of life (EQ-5D by proxy)	Secondary	Pharmacist prescribing	Usual care, GP prescribing	Some concerns	Some concerns	High	High	High	Low	High
Holland et al. (2023)	Effectiveness	Drug Burden Index	Secondary	Pharmacist prescribing	Usual care, GP prescribing	Some concerns	Some concerns	High	High	Low	Low	High
Holland et al. (2023)	Effectiveness	Hospital admissions	Secondary	Pharmacist prescribing	Usual care, GP prescribing	Some concerns	Some concerns	High	High	Low	Low	High
Villeneueve et al. (2010)	Effectiveness	Mean LDL	Primary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Low	Some concerns
Villeneueve et al. (2010)	Effectiveness	Proportion achieving target lipid levels	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Low	Some concerns
Villeneueve et al. (2010)	Effectiveness	HDL cholesterol	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Low	Some concerns
Villeneueve et al. (2010)	Effectiveness	Triglycerides	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Low	Some concerns
Villeneueve et al. (2010)	Effectiveness	Systolic blood pressure	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Low	Some concerns

Author (year)	Category	Outcome	Primary or secondary outcome	Intervention	Comparator	1a. Randomisation	1b. Timing of identification or recruitment	2. Deviations from intended interventions	3. Missing data	4. Measurement of outcome	5. Selection of the reported result	Overall
Villeneueve et al. (2010)	Effectiveness	Diastolic blood pressure	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Low	Some concerns
Villeneueve et al. (2010)	Effectiveness	Fasting blood glucose	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Low	Some concerns
Villeneueve et al. (2010)	Effectiveness	Healthcare utilisation (number of physician visits)	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Some concerns	Some concerns
Villeneueve et al. (2010)	Effectiveness	Adherence	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Low	Some concerns
Holland et al. (2023)	Safety	Mortality	Secondary	Pharmacist prescribing	Usual care, GP prescribing	Some concerns	Some concerns	High	High	Low	Low	High
Villeneueve et al. (2010)	Safety	Adverse events	Secondary	Pharmacist prescribing	Usual care (physician prescribing)	Some concerns	Some concerns	Low	Low	Low	Some concerns	Some concerns

Appendix J Risk Of Bias In Non-Randomised Studies – of Interventions assessment

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Aspinall et al. (2012) (intervention vs. clinic physician)	Effectiveness	Proportion of haemoglobin values within the target range of 10-12 g/dl	Primary	Y	NA	N	Proceed	Serious	Serious	Serious	Serious	Serious	Serious	Serious	Critical
Aspinall et al. (2012) (intervention vs. usual care)	Effectiveness	Proportion of haemoglobin values within the target range of 10-12 g/dl	Primary	Y	NA	N	Proceed	Moderate	Serious	Serious	Moderate	Moderate	Serious	Serious	Critical
Beahm et al. (2018)	Effectiveness	Clinical cure	Primary	N	Y	PN	Critical								Critical
Beahm et al. (2018)	Effectiveness	Waiting time	Secondary	N	Y	PN	Critical								Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Beahm et al. (2018)	Effectiveness	Adherence	Secondary	N	Y	PN	Critical								Critical
Boddy (2001)	Effectiveness	INR goal achieved	Not reported	N	Y	N	Critical								Critical
Boddy (2001)	Effectiveness	INR <2.0	Not reported	N	Y	N	Critical								Critical
Boddy (2001)	Effectiveness	INR >6.0	Not reported	N	Y	N	Critical								Critical
Cohen et al. (1985)	Effectiveness	Prothrombin time ratio	Not reported	N	Y	N	Critical								Critical
Cowart et al. (2020)	Effectiveness	HbA1C	Not reported	N	Y	N	Critical								Critical
Cowart et al. (2020)	Effectiveness	HbA1C	Not reported	N	Y	N	Critical								Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Cowart et al. (2022)	Effectiveness	Time to treatment intensification	Not reported	Y	NA	PN	Proceed	Serious	Critical	Critical	Serious	Moderate	Serious	Serious	Critical
Cowart et al. (2022)	Effectiveness	HbA1C	Not reported	Y	NA	N	Proceed	Serious	Critical	Critical	Serious	Moderate	Serious	Serious	Critical
Damaske et al. (2005)	Effectiveness	Average time to therapeutic INR	Not reported	N	Y	Y	Critical								Critical
Hahn et al. (2019) (intervention vs. medication therapy management with no CPA)	Effectiveness	Hospitalisations (all-cause)	Primary	N	Y	N	Critical								Critical
Hahn et al. (2019) (intervention vs. medication therapy managemen	Effectiveness	Hospitalisations (all-cause)	Primary	N	Y	N	Critical								Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
t with no CPA)															
Hahn et al. (2019) (intervention vs. medication therapy management with no CPA)	Effectiveness	Emergency department visits	Secondary	N	Y	N	Critical								Critical
Hahn et al. (2019) (intervention vs. usual care)	Effectiveness	Hospitalisations (heart failure cause)	Secondary	N	Y	N	Critical								Critical
Hahn et al. (2019) (intervention vs. usual care)	Effectiveness	Hospitalisations (heart failure cause)	Secondary	N	Y	N	Critical								Critical
Hahn et al. (2019) (intervention vs. usual care)	Effectiveness	Emergency department visits	Secondary	N	Y	N	Critical								Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Hall et al. (2011)	Effectiveness	INR goal achieved	Not reported	Y	NA	N	Proceed	Serious	Low	Critical	Serious	Serious	Serious	Serious	Critical
Hall et al. (2011)	Effectiveness	Time therapeutic goal maintained	Not reported	Y	NA	N	Proceed	Serious	Low	Critical	Serious	Serious	Serious	Serious	Critical
Hernández-Muñoz et al. (2021)	Effectiveness	HbA1C	Primary	Y	NA	N	Proceed	Serious	Low	Moderate	Serious	Critical	Low	Serious	Critical
Lum et al. (2023)	Effectiveness	HbA1C	Primary	Y	NA	N	Proceed	Serious	Serious	Serious	Low	Low	Low	Serious	Critical
Maeng et al. (2018)	Effectiveness	HbA1C	Not reported	Y	NA	N	Proceed	Serious	Serious	Serious	Low	Low	Low	Serious	Critical
Maeng et al. (2018)	Effectiveness	HbA1C	Not reported	Y	NA	N	Proceed	Serious	Serious	Serious	Low	Low	Low	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Maeng et al. (2018)	Effectiveness	LDL cholesterol	Not reported	Y	NA	N	Proceed	Serious	Serious	Serious	Low	Low	Low	Serious	Critical
Maeng et al. (2018)	Effectiveness	LDL cholesterol	Not reported	Y	NA	N	Proceed	Serious	Serious	Serious	Low	Low	Low	Serious	Critical
Maeng et al. (2018)	Effectiveness	Systolic blood pressure	Not reported	Y	NA	N	Proceed	Serious	Serious	Serious	Low	Low	Low	Serious	Critical
Maeng et al. (2018)	Effectiveness	Diastolic blood pressure	Not reported	Y	NA	N	Proceed	Serious	Serious	Serious	Low	Low	Low	Serious	Critical
Maeng et al. (2018)	Effectiveness	Blood pressure goal reached	Not reported	Y	NA	N	Proceed	Serious	Serious	Serious	Low	Low	Low	Serious	Critical
Manzoor et al. (2018)	Effectiveness	INR	Primary	Y	NA	N	Proceed	Serious	Serious	Moderate	Low	Low	Low	Serious	Serious
Morello et al. (2016)	Effectiveness	HbA1C	Primary	Y	NA	N	Proceed	Serious	Serious	Critical	Low	Low	Serious	Serious	Critical
Morello et al. (2016)	Effectiveness	Fasting blood glucose	Secondary	Y	NA	N	Proceed	Serious	Serious	Critical	Low	Low	Serious	Serious	Critical
Morello et al. (2016)	Effectiveness	LDL cholesterol	Secondary	Y	NA	N	Proceed	Serious	Serious	Critical	Low	Serious	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Morello et al. (2016)	Effectiveness	HDL cholesterol	Secondary	Y	NA	N	Proceed	Serious	Serious	Critical	Low	Serious	Serious	Serious	Critical
Morello et al. (2016)	Effectiveness	Triglycerides	Secondary	Y	NA	N	Proceed	Serious	Serious	Critical	Low	Serious	Serious	Serious	Critical
Morello et al. (2016)	Effectiveness	Systolic blood pressure	Secondary	Y	NA	N	Proceed	Serious	Serious	Critical	Low	Low	Serious	Serious	Critical
Morello et al. (2016)	Effectiveness	Diastolic blood pressure	Secondary	Y	NA	N	Proceed	Serious	Serious	Critical	Low	Low	Serious	Serious	Critical
O'Neill et al. (2014)	Effectiveness	Blood pressure goal achieved	Primary	Y	NA	N	Proceed	Serious	Low	Critical	Low	Serious	Serious	Serious	Critical
O'Neill et al. (2014)	Effectiveness	Systolic blood pressure	Primary	Y	NA	N	Proceed	Serious	Low	Critical	Low	Serious	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
O'Neill et al. (2014)	Effectiveness	Diastolic blood pressure	Primary	Y	NA	N	Proceed	Serious	Low	Critical	Low	Serious	Serious	Serious	Critical
Rana et al. (2023)	Effectiveness	Target dose achieved (proportion)	Primary	N	Y	N	Critical								Critical
Rana et al. (2023)	Effectiveness	Target dose achieved (median)	Secondary	N	Y	N	Critical								Critical
Rana et al. (2023)	Effectiveness	Target dose achieved (number of days)	Secondary	N	Y	N	Critical								Critical
Rodriguez et al. (2021a)	Effectiveness	Continuation	Primary	Y	NA	N	Proceed	Moderate	Low	Low	Low	Low	Low	Serious	Serious
Rodriguez et al. (2021a)	Effectiveness	Adherence	Secondary	Y	NA	N	Proceed	Moderate	Low	Low	Low	Low	Low	Serious	Serious
Rodriguez et al. (2022)	Effectiveness	Continuation	Primary	Y	NA	N	Proceed	Moderate	Low	Low	Low	Low	Low	Serious	Serious
Rodriguez et al. (2022)	Effectiveness	Adherence	Secondary	Y	NA	N	Proceed	Moderate	Low	Low	Low	Low	Low	Serious	Serious
Romanelli et al. (2015) (intervention	Effectiveness	Clinic visits	Primary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Low	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
medication management programme vs. patient centred medical home)															
Romanelli et al. (2015) (intervention medication management programme vs. patient centred medical home)	Effectiveness	Emergency department visits	Primary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Low	Serious	Serious	Critical
Romanelli et al. (2015) (intervention medication management programme vs. patient centred medical home)	Effectiveness	Hospitalisations	Primary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Low	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Romanelli et al. (2015) (intervention medication management programme vs. patient centred medical home)	Effectiveness	Systolic/diastolic blood pressure (% at goal)	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Serious	Serious	Serious	Critical
Romanelli et al. (2015) (intervention medication management programme vs. patient centred medical home)	Effectiveness	LDL cholesterol	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Serious	Serious	Serious	Critical
Romanelli et al. (2015) (intervention medication management programme vs. patient centred medical home)	Effectiveness	HbA1C	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Serious	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Romanelli et al. (2015) (intervention vs. usual care)	Effectiveness	Clinic visits	Primary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Low	Serious	Serious	Critical
Romanelli et al. (2015) (intervention vs. usual care)	Effectiveness	Emergency department visits	Primary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Low	Serious	Serious	Critical
Romanelli et al. (2015) (intervention vs. usual care)	Effectiveness	Hospitalisations	Primary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Low	Serious	Serious	Critical
Romanelli et al. (2015) (intervention vs. usual care)	Effectiveness	Systolic/diastolic blood pressure (% at goal)	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Serious	Serious	Serious	Critical
Romanelli et al. (2015) (intervention vs. usual care)	Effectiveness	LDL cholesterol	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Serious	Serious	Serious	Critical
Romanelli et al. (2015) (intervention vs. usual care)	Effectiveness	HbA1C	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Low	Serious	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Thompson et al. (1984)	Effectiveness	Average number of drugs per patient		N	Y	N	Critical								Critical
Thompson et al. (1984)	Effectiveness	Hospitalisations	Not reported	N	Y	N									Critical
Varghese et al. (2024)	Effectiveness	Deprescribing	Primary	N	Y	N									Critical
Weaver et al. 2023	Effectiveness	Haemoglobin (proportion)	Primary	Y	N	N	Proceed	Serious	Low	Critical	Serious	Critical	Serious	Serious	Critical
Weaver et al. 2023	Effectiveness	Haemoglobin (mean levels)	Secondary	Y	N	N	Proceed	Serious	Low	Critical	Serious	Critical	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Aspinall et al. (2012) (intervention vs. clinic physician)	Safety	Thromboembolica adverse event	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Moderate	Moderate	Serious	Serious	Critical
Aspinall et al. (2012) (intervention vs. clinic physician)	Safety	Heart failure adverse event	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Moderate	Moderate	Serious	Serious	Critical
Aspinall et al. (2012) (intervention vs. clinic physician)	Safety	Uncontrolled hypertension adverse event	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Moderate	Moderate	Serious	Serious	Critical
Aspinall et al. (2012) (intervention vs. usual care)	Safety	Thromboembolica adverse event	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Moderate	Moderate	Serious	Serious	Critical
Aspinall et al. (2012) (intervention vs. usual care)	Safety	Heart failure adverse event	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Moderate	Moderate	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Aspinall et al. (2012) (intervention vs. usual care)	Safety	Uncontrolled hypertension adverse event	Secondary	Y	NA	N	Proceed	Moderate	Serious	Serious	Moderate	Moderate	Serious	Serious	Critical
Beahm et al. (2018)	Safety	All adverse events	Secondary	N	Y	PN	Critical								Critical
Beahm et al. (2018)	Safety	Gastrointestinal adverse events	Secondary	N	Y	PN	Critical								Critical
Beahm et al. (2018)	Safety	Vaginal candidiasis adverse events	Secondary	N	Y	PN	Critical								Critical
Beahm et al. (2018)	Safety	Headache adverse events	Secondary	N	Y	PN	Critical								Critical
Beahm et al. (2018)	Safety	Other adverse events	Secondary	N	Y	PN	Critical								Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Beahm et al. (2018)	Safety	Physician or emergency department events	Secondary	N	Y	PN	Critical								Critical
Beahm et al. (2021)	Safety	Antibacterial therapy guideline concordance	Primary	N	Y	N	Critical								Critical
Cohen et al. (1985)	Safety	Warfarin-related complications (bleeding)	Not reported	N	Y	N	Critical								Critical
Cohen et al. (1985)	Safety	Warfarin-related complications (thromboembolic events)	Not reported	N	Y	N	Critical								Critical
Damaske et al. (2005)	Safety	Bleeds/adverse drug events	Not reported	N	Y	Y	Critical								Critical
Hall et al. (2011)	Safety	Anticoagulation-related adverse events	Not reported	Y	NA	N	Proceed	Serious	Low	Critical	Serious	Serious	Serious	Serious	Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Hall et al. (2011)	Safety	Anticoagulation-related emergency department visits	Not reported	Y	NA	N	Proceed	Serious	Low	Critical	Serious	Serious	Serious	Serious	Critical
Hall et al. (2011)	Safety	Anticoagulation-related hospital admissions	Not reported	Y	NA	N	Proceed	Serious	Low	Critical	Serious	Serious	Serious	Serious	Critical
Manzoor et al. (2018)	Safety	Warfarin related hospitalisations/ED visits	Secondary	Y	NA	N	Proceed	Serious	Serious	Moderate	Low	Low	Low	Serious	Serious
McFarland et al. (2009)	Safety	Rates of inappropriate initial dosing	Secondary	N	Y	N	Critical								Serious
Rana et al. (2023)	Safety	HF hospitalizations	Secondary	N	Y	N	Critical								Critical
Rana et al. (2023)	Safety	All-cause death	Secondary	N	Y	N	Critical								Critical

Author (year)	Category	Outcome	Primary or secondary outcome	B1 Did the authors make any attempt to control for confounding ?	*B2 Is there sufficient potential for confounding that an unadjusted result should not be considered further?*	B3 Was the method of measuring the outcome inappropriate?	Proceed or appraised	1. CONFOUNDING (variant A)	2. CLASSIFICATION OF INTERVENTIONS	3. SELECTION OF PARTICIPANTS	4. DEVIATIONS FROM INTENDED INTERVENTIONS (variant A)	5. MISSING DATA	6. MEASUREMENT OF OUTCOME	7. SELECTION OF THE REPORTED RESULT	Overall
Rashid et al. (2020)	Safety	Gastrointestinal (GI) bleeding events (hospitalisations and ER visits)	Not reported	Y	NA	N	Proceed	Serious	Serious	Low	Low	Critical	Low	Serious	Critical
Rashid et al. (2020)	Safety	Acute kidney injury (AKI) events (hospitalisations and ER visits)	Not reported	Y	NA	N	Proceed	Serious	Serious	Low	Low	Critical	Low	Serious	Critical
Rashid et al. (2020)	Safety	Pain (hospitalisations and ER visits)	Not reported	Y	NA	N	Proceed	Serious	Serious	Low	Low	Critical	Low	Serious	Critical
Rodriguez et al. (2020)	Safety	Medical contraindications	Secondary	Y	NA	N	Proceed	Moderate	Low	Low	Low	Low	Low	Serious	Serious
Rodriguez et al. (2021b)	Safety	Medical contraindications	Primary	N	Y	N	Critical								Critical
Thompson et al. (1984)	Safety	Death	Not reported	N	Y	N	Critical								Critical

Appendix K Philips checklist assessment

Domain	Item	Aspinall et al. (2013)	Brown et al. (2016)	Dixon et al. (2023)	Gumbie et al. (2019)	Hirsch et al. (2017)	Jay et al. (2021)	Kim et al. (2021)	Klepser et al. (2012)	Marra et al. (2017)	Rodriguez et al. (2019)	Sanyal et al. (2019)	Yu et al. (2013)
S1 Statement of decision problem/ objective	Is there a clear statement of the decision problem?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Is the objective of the evaluation and model specified and consistent with the stated decision problem?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Is the primary decision-maker specified	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Is the perspective of the model stated clearly?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
	Are the model inputs consistent with the stated perspective?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S2 Statement of scope/ perspective	Has the scope of the model been stated and justified?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Are the outcomes of the model consistent with the perspective, scope and overall objective of the model?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S3 Rationale for structure	Is the structure of the model consistent with a coherent theory of the health condition under evaluation?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Domain	Item	Aspinall et al. (2013)	Brown et al. (2016)	Dixon et al. (2023)	Gumbie et al. (2019)	Hirsch et al. (2017)	Jay et al. (2021)	Kim et al. (2021)	Klepser et al. (2012)	Marra et al. (2017)	Rodriguez et al. (2019)	Sanyal et al. (2019)	Yu et al. (2013)
	Are the sources of data used to develop the structure of the model specified?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Are the causal relationships described by the model structure justified appropriately?	Yes	Yes	Yes	Yes	CD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Are the structural assumptions transparent and justified?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S4 Structural assumptions	Are the structural assumptions reasonable given the overall objective, perspective and scope of the model?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Is there a clear definition of the options under evaluation?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S5 Strategies/ comparators	Have all feasible and practical options been evaluated?	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
	Is there justification for the exclusion of feasible options?	Yes	No	Yes	NA	NA	NA	NA	NA	Yes	Yes	NA	NA
S6 Model type	Is the chosen model type appropriate given the decision problem and specified	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Domain	Item	Aspinall et al. (2013)	Brown et al. (2016)	Dixon et al. (2023)	Gumbie et al. (2019)	Hirsch et al. (2017)	Jay et al. (2021)	Kim et al. (2021)	Klepser et al. (2012)	Marra et al. (2017)	Rodriguez et al. (2019)	Sanyal et al. (2019)	Yu et al. (2013)
	causal relationships within the model												
	Is the time horizon of the model sufficient to reflect all important differences between options?	Yes	Yes	Yes	Yes	Yes	No	NA	NA	Yes	No	No	No
S7 Time horizon	Are the time horizon of the model, the duration of treatment and the duration of treatment effect described and justified?	No	Yes	Yes	Yes	Yes	Yes	NA	NA	Yes	No	No	No
S8 Disease states/ pathways	Do the disease states (state transition model) or the pathways (decision tree model) reflect the underlying biological process of the disease in question and the impact of interventions?	Yes	Yes	Yes	Yes	CD	No	NA	NA	Yes	Yes	Yes	Yes
S9 Cycle length	Is the cycle length defined and justified in terms of the natural history of disease?	Yes	CD	No	No	NA	NA	NA	NA	No	NA	NA	Yes
D1 Data identification	Are the data identification methods transparent and appropriate given the objectives of the model?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Domain	Item	Aspinall et al. (2013)	Brown et al. (2016)	Dixon et al. (2023)	Gumbie et al. (2019)	Hirsch et al. (2017)	Jay et al. (2021)	Kim et al. (2021)	Klepser et al. (2012)	Marra et al. (2017)	Rodriguez et al. (2019)	Sanyal et al. (2019)	Yu et al. (2013)
	Where choices have been made between data sources, are these justified appropriately?	CD	CD	NA	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	NA
	Has particular attention been paid to identifying data for the important parameters in the model?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Has the quality of the data been assessed appropriately?	No	No	CD	CD	CD	CD	CD	CD	CD	CD	Yes	CD
	Where expert opinion has been used, are the methods described and justified?	NA	NA	NA	No	NA	NA	No	NA	No	NA	Yes	No
D2 Data modelling	Is the data modelling methodology based on justifiable statistical and epidemiological techniques?	Yes	CD	Yes	Yes	Yes	CD	Yes	Yes	Yes	Yes	Yes	Yes
	Is the choice of baseline data described and justified?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
D2a Baseline data	Are transition probabilities calculated appropriately?	Yes	CD	Yes	Yes	Yes	NA	NA	NA	Yes	Yes	Yes	Yes
	Has a half-cycle correction been	No	No	CD	No	NA	NA	NA	NA	CD	NA	NA	CD

Domain	Item	Aspinall et al. (2013)	Brown et al. (2016)	Dixon et al. (2023)	Gumbie et al. (2019)	Hirsch et al. (2017)	Jay et al. (2021)	Kim et al. (2021)	Klepser et al. (2012)	Marra et al. (2017)	Rodriguez et al. (2019)	Sanyal et al. (2019)	Yu et al. (2013)
	applied to both cost and outcome? If not, has this omission been justified?												
	If relative treatment effects have been derived from trial data, have they been synthesised using appropriate techniques?	NA	NA	CD	CD	NA	CD	NA	NA	CD	CD	CD	CD
D2b Treatment effects	Have the methods and assumptions used to extrapolate short-term results to final outcomes been documented and justified?	Yes	Yes	CD	CD	Yes	Yes	NA	NA	CD	Yes	Yes	Yes
	Have assumptions regarding the continuing effect of treatment once treatment is complete been documented and justified?	No	No	NA	Yes	No	Yes	NA	NA	NA	No	No	No
	Have alternative assumptions been explored through sensitivity analysis?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes
D2c Costs	Are the costs incorporated into the model justified?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Has the source for all costs been described?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Domain	Item	Aspinall et al. (2013)	Brown et al. (2016)	Dixon et al. (2023)	Gumbie et al. (2019)	Hirsch et al. (2017)	Jay et al. (2021)	Kim et al. (2021)	Klepser et al. (2012)	Marra et al. (2017)	Rodriguez et al. (2019)	Sanyal et al. (2019)	Yu et al. (2013)
D2d Quality of life weights (utilities)	Have discount rates been described and justified given the target decision-maker?	Yes	Yes	Yes	Yes	Yes	No	NA	NA	Yes	NA	NA	Yes
	Are the utilities incorporated into the model appropriate?	Yes	Yes	Yes	Yes	Yes	NA	NA	Yes	Yes	Yes	Yes	Yes
	Is the source for the utility weights referenced?	Yes	Yes	Yes	Yes	Yes	NA	NA	Yes	Yes	Yes	Yes	Yes
	Are the methods of derivation for the utility weights justified?	CD	CD	Yes	CD	CD	NA	NA	Yes	CD	CD	Yes	No
D3 Data incorporation	Have all data incorporated into the model been described and referenced in sufficient detail?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Has the use of mutually inconsistent data been justified (i.e. are assumptions and choices appropriate)?	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Is the process of data incorporation transparent?	Yes	No	Yes	Yes	CD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	If data have been incorporated as distributions, has the choice of distribution for each parameter	NA	CD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Domain	Item	Aspinall et al. (2013)	Brown et al. (2016)	Dixon et al. (2023)	Gumbie et al. (2019)	Hirsch et al. (2017)	Jay et al. (2021)	Kim et al. (2021)	Klepser et al. (2012)	Marra et al. (2017)	Rodriguez et al. (2019)	Sanyal et al. (2019)	Yu et al. (2013)
	been described and justified?												
	If data have been incorporated as distributions, is it clear that second order uncertainty is reflected?	NA	CD	NA	Yes	NA	NA	NA	NA	NA	NA	NA	NA
D4 Assessment of uncertainty	Have the four principal types of uncertainty been addressed? If not, has the omission of particular forms of uncertainty been justified?	Yes	No	No	No	No	No	No	No	No	Yes	No	No
D4a Methodological	Have methodological uncertainties been addressed by running alternative versions of the model with different methodological assumptions?	Yes	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
D4b Structural	Is there evidence that structural uncertainties have been addressed via sensitivity analysis?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
D4c Heterogeneity	Has heterogeneity been dealt with by running the model separately for different subgroups?	NA	No	No	No	No	No	No	No	No	No	No	No

Domain	Item	Aspinall et al. (2013)	Brown et al. (2016)	Dixon et al. (2023)	Gumbie et al. (2019)	Hirsch et al. (2017)	Jay et al. (2021)	Kim et al. (2021)	Klepser et al. (2012)	Marra et al. (2017)	Rodriguez et al. (2019)	Sanyal et al. (2019)	Yu et al. (2013)
D4d Parameter	Are the methods of assessment of parameter uncertainty appropriate?	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
	If data are incorporated as point estimates, are the ranges used for sensitivity analysis stated clearly and justified?	Yes	CD	CD	Yes	Yes	No	No	No	CD	Yes	No	No
C1 Internal consistency	Is there evidence that the mathematical logic of the model has been tested thoroughly before use?	CD	Yes	No	Yes	Yes	No	No	No	No	No	No	No
	Are any counterintuitive results from the model explained and justified?	Yes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C2 External consistency	If the model has been calibrated against independent data, have any differences been explained and justified?	NA	Yes	No	Yes	No	No	No	No	No	No	No	No
	Have the results of the model been compared with those of previous models and any differences in results explained?	No	No	Yes	Yes	No	Yes	Yes	No	Yes	No	No	Yes

Appendix L Consensus Health Economic Criteria list assessment

Items	Neilson et al. 2015
1. Is the study population clearly described?	Yes
2. Are competing alternatives clearly described?	Yes
3. Is a well-defined research question posed in answerable form?	Yes
4. Is the economic study design appropriate to the stated objective?	Yes
5. Is the chosen time horizon appropriate to include relevant costs and consequences?	No
6. Is the actual perspective chosen appropriate?	Yes
7. Are all important and relevant costs for each alternative identified?	Yes
8. Are all costs measured appropriately in physical units?	Yes
9. Are costs valued appropriately?	Yes
10. Are all important and relevant outcomes for each alternative identified?	Yes
11. Are all outcomes measured appropriately?	Yes
12. Are outcomes valued appropriately?	Yes
13. Is an incremental analysis of costs and outcomes of alternatives performed?	No
14. Are all future costs and outcomes discounted appropriately?	NA
15. Are all important variables, whose values are uncertain, appropriately subjected to sensitivity analysis?	No
16. Do the conclusions follow from the data reported?	Yes
17. Does the study discuss the generalizability of the results to other settings and patient/ client groups?	No
18. Does the article indicate that there is no potential conflict of interest of study researcher(s) and funder(s)?	Yes
19. Are ethical and distributional issues discussed appropriately?	Yes

Appendix M Table of characteristics

Table of characteristics for effectiveness and safety studies

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
Aspinall et al. (2012)	USA	To compare the quality of erythropoietin stimulating agents prescribing and monitoring for patients with non–dialysis-dependent chronic kidney disease in Veterans Affairs Medical Centers with and without pharmacist-managed erythropoietin stimulating agents clinics.	Retrospective cohort (n=572)	Veterans receiving long-term erythropoietin stimulating agents treatment	Intervention: 1.9% Comparator 1: 3.3% Comparator 2: 3.0%	Intervention: 73.9 ± 10.9 Comparator 1: 76.2 ± 12.0 Comparator 2: 78.4 ± 8.8	Outpatient	Collaborative practice agreement	Pharmacists' scope of practice allowed them to dose and monitor erythropoietin stimulating agents therapy. Patients at most sites were referred to the pharmacist-managed erythropoietin stimulating agents clinic by a medical provider.	1. Physician managed erythropoiesis-stimulating agent clinic 2. Usual care	Six months
Beahm et al. (2018)	New Brunswick, Canada	To evaluate effectiveness, safety and patient satisfaction with pharmacist prescribing and care in patients with uncomplicated urinary tract infection.	Non-randomised trial (n= 750)	Patients aged 19 years and over with symptoms suggestive of urinary tract infection	Intervention: 100% Comparator: 100%	Intervention: 40.4 ± 15.9 Comparator: 43.7 ± 16.1	Community pharmacy	Independent prescribing	Pharmacists performed patient assessments for symptoms of urinary tract infection and prescribed antibacterial therapy, modified antibacterial therapy, provided education only or referred to physician, as appropriate.	Physician prescribing	Two weeks
Beahm et al. (2021)	New Brunswick, Canada	To further evaluate the appropriateness of antibacterial prescribing in the RxOUTMAP study.	Non-randomised trial (n= 750)	Patients aged 19 years and over with symptoms suggestive of	Intervention: 100%	Intervention: 40.4 ± 15.9	Community pharmacy	Independent prescribing	Pharmacists performed patient assessments for symptoms of UTI and prescribed	Physician prescribing	Two weeks

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
				urinary tract infection	Comparator: 100%	Comparator: 43.7 ± 16.1			antibacterial therapy to patients presenting without a prescription.		
Boddy (2001)	England, UK	To evaluate the anticoagulation control on the medical wards, to implement warfarin guidelines, and to investigate the benefits of the guidelines for the doctors compared to pharmacists.	Non-randomised trial (n= 138)	Patients in acute care medical wards	Intervention: 51.4% Comparator: 46.9%	Intervention: 54 (range 22 - 74) Comparator: 57 (range 23 - 74)	Inpatient	Protocol	Warfarin dosing was conducted by haematology pharmacists.	Physician-prescribing	Unclear
Bruhn et al. (2013)	England and Scotland, UK	To compare the effectiveness of pharmacist medication review, with or without pharmacist prescribing, with standard care, for patients with chronic pain.	RCT (n=196)	Patients aged 18 years and over, receiving regular prescribed medication for pain	Intervention: 54.4% Comparator 1: 74.2% Comparator 2: 58.7%	Intervention: 66.1 ± 12.1 Comparator 1: 65.7 ± 14.2 Comparator 2: 64.9 ± 11.6	Primary care	Independent prescribing	Pharmacists conducted a medication review, agreed a pharmaceutical care plan with the patient, and issued any required prescriptions.	1. GP prescribing with medication review 2. GP prescribing	12 weeks
Chenella et al. (1983)	California, USA	To determine the ability of the pharmacist to independently adjust heparin and warfarin dosages. In this paper, the results of that study are reported.	RCT (n=81)	Hospitalised patients who were referred to the anticoagulant service by a primary care provider	Intervention (mean): 54.8% Comparator mean): 59.0%	Intervention: 46.0 ± 16.0 Comparator: 52 ± 16.0	Inpatient	Independent prescribing	Patients in the pharmacist–prescriber group had a pharmacist write daily heparin and warfarin dosage adjustments.	Physician prescribing	Unclear
Cohen et al. (1985)	Michigan, USA	To compare the management of patients on warfarin therapy by the anticoagulation surveillance clinic and by other Veterans Administration Medical	Retrospective cohort (n=95)	Male outpatients who, over a 2.5-year period, had been monitored for warfarin	Intervention: 0% Comparator: 0%	Intervention: 55.8 ± 10.5 Comparator: 57.8 ± 9.4	Outpatient	Protocol	Patients were managed by clinic pharmacists according to a VAMC-approved protocol including education, drug-	Physician prescribing	Unclear

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
		Centre clinics at the same institution.		therapy for a minimum of 3 months					drug interaction screening and have warfarin dosage adjustments.		
Cowart et al. (2020)	Florida, USA	To analyse the time to achieve an HbA1c of less than 7% for a pharmacist–physician managed cohort, as compared with a usual medical care cohort of patients with type 2 diabetes.	Retrospective cohort (n=257)	Patients aged 18 years and over with type 2 diabetes for at least 12 months	Not reported	Intervention: 59.8 ±11.6 Comparator: 57.9 ± 12.6	Primary care	Collaborative practice agreement	Advanced practice pharmacists had authority to initiate, titrate, or discontinue antidiabetic medications; order drug therapy–related laboratory tests; and provide diabetes self-management education.	Primary care provider prescribing	Until goal achieved or last clinic visit
Cowart et al. (2022)	Florida, USA	To evaluate time to treatment intensification in a pharmacist–physician management as compared with usual medical care and to explore characteristics (method and type) of antidiabetic treatment intensification in the pharmacist–physician management and usual medical care cohorts.	Retrospective cohort (n=56)	Patients aged 18 years and over with type 2 diabetes for at least 12 months	Not reported	Intervention: 60.9 ± 11.2 Comparator: 60.6 ± 11.8	Primary care	Collaborative practice agreement	Advanced practice pharmacists to initiated, titrated, or discontinued antidiabetic medications, order antidiabetic therapy–related laboratory tests, and provide diabetes-related counselling.	Physician prescribing	Eight visits
Damaske et al. (2005)	Texas, USA	To compare results from the protocol with results from usual, physician-directed warfarin therapy.	Non-randomised trial (n=51)	All patients in the identified service lines with an indication for warfarin	Not reported	Not reported	Inpatient	Protocol	Pharmacists followed a warfarin dosing protocol for 6 days. Dosage changes continued on day 7 of warfarin therapy until discharge by adjusting the dose	Physician prescribing	6 days or until therapeutic range was reached

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
									10% to 20% if the patient was still not within the target therapeutic range.		
Hall et al. (2011)	Pennsylvania, USA	To evaluate the differences in health care expenditures while accounting for operational costs, therapeutic outcomes, and patient compliance with laboratory tests and warfarin refills in patients receiving warfarin therapy management by a pharmacist managed anticoagulation service compared with those receiving usual medical care.	Retrospective cohort (n=350)	Patients aged 18 years and over with an index heart failure exacerbation admission	Intervention: 77% Comparator: 77%	Intervention: 63.7 Comparator: 65.1	Outpatient	Collaborative practice agreement	The pharmacists manage patients' anticoagulation through a collaborative care agreement and protocol under the referring physician's authority.	Physician prescribing	Not reported
Hanh et al. (2019)	Texas, USA	To evaluate post-discharge care provided by either a clinical pharmacy specialist with collaborative practice agreement, medication therapy management MTM pharmacist without collaborative practice agreement, or no pharmacist and their impact on all-cause and heart failre readmission rates.	Retrospective cohort (n=98)	Patients receiving anticoagulant therapy	Intervention: 62.9% Comparator 1: 46.4% Comparator 2: 34.3%	Intervention: 60.0 ± 13.0 Comparator 1: 63.0 ± 14.0 Comparator 2: 59.0 ± 14.0	Outpatient	Collaborative practice agreement	Interventions provided by the clinical pharmacist specialist included medication therapy management, ordering referrals, nutrition, smoking cessation, medication access specialist, and anticoagulation management), making therapeutic medication changes including medication discontinuations and initiations, ordering medication	1. Medication therapy management pharmacist 2. Endocrinologist prescribing	Discharge, within 10 days after discharge, follow-up care during 21 days post-discharge

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
									refills and labs, and triaging acute issues by admitting patients directly to the emergency department.		
Hernández-Muñoz et al. (2021)	Texas, USA	To analyse a year's worth of endocrinologists' referral data to describe the impact of the pharmacist-led diabetes care collaborative model programme on the absolute change in HbA1c from baseline as compared to the group of diabetic patients not referred to the pharmacists by the endocrinologists.	Retrospective cohort (n=121)	Patients aged 18 years and over with type 2 diabetes mellitus	Not reported by subgroup	Not reported by subgroup	Outpatient	Collaborative practice agreement	A pharmacist, via written protocol with the endocrinologists of the clinic, could independently adjust, substitute, or discontinue the patient's diabetic pharmacotherapy regimen as needed.	1. Endocrinologist prescribing	Endocrinologist determined the number of days between the initial endocrinologist visit and the first scheduled pharmacist visit. Pharmacist determined any subsequent visits. The mean number of days between pre and post index dates was 108.
Holland et al. (2023)	UK	To estimate the effectiveness, cost effectiveness (to be reported elsewhere), and safety of pharmacy independent prescribers in care homes.	Cluster RCT (n=882)	People aged 65 years and over residing in a care home	Intervention: 72.0% Comparator: 67.0%	Intervention: 85.1 ± 7.7 Comparator: 85.4 ± 7.6	Long-term care	Independent prescribing	The pharmacist independent prescriber visited care homes to do medication reviews and optimise therapy for all	GP prescribing	Six months

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
									participating residents.		
Jameson et al. (2010)	Michigan, USA	To investigate the effect of pharmacist management of poorly controlled diabetes mellitus in a community-based primary care group.	RCT (n=104)	Patients aged 18 years and over with diabetics and an A1C levels of 9.0% or higher	Intervention: 51.1% Comparator: 51.0%	Intervention: 49.3 ± 10.8 Comparator: 49.7 ± 10.9	Primary care	Collaborative practice agreement	Clinical pharmacists worked in the clinic on a part-time basis and were responsible for managing drug therapy including starting or altering drug regimens, and ordering and assessing laboratory tests to monitor patient outcomes.	Primary care provider prescribing	12 months
Lau et al. (2022)	Alberta, Canada	To compare the efficacy and safety of combining home-based blood pressure telemonitoring and protocolised case management, and enhanced usual care with home-based blood pressure monitoring only, in older, community-dwelling adults.	RCT (n=120)	Patients aged 65 years and older residing in community-based supportive living	Intervention: 69% Comparator: 85%	Intervention: 79.8 ± 7.7 Comparator: 79.2 ± 7.4	Long-term care	Protocol	Pharmacists administered behavioural counselling, education, reviewed telemonitored blood pressure summaries, remind participants and adjusted medications according to protocol.	Physician prescribing	12 months
Lum et al. (2023)	Singapore	To evaluate the changes in mean HbA1c level over 12 months and to identify care activities that were associated with this change.	Retrospective cohort (n=420)	Adults aged 21 years and over with type 2 diabetes	Intervention: 30.5% Comparator: 35.7%	Intervention: 65.8 ± 11.2 Comparator: 65.4 ± 11.1	Outpatient	Collaborative practice agreement	Pharmacists provided medication review, identified drug–drug problems, and furnished prescriptions on behalf of the cardiologists with	Cardiologist prescribing	3-12 months

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
									appropriate dose adjustments.		
Maeng et al. (2018)	Pennsylvania and New Jersey, USA	To assess the impact of a medication therapy diabetes programme on the achievement of guideline-based disease targets, health care utilisation, and cost.	Retrospective cohort (n=5500)	Adults with a primary diagnosis of diabetes	Intervention: 50.0% Comparator: 48.0%	Intervention: 59.0 ± 13 Comparator: 59.0 ± 13	Primary care	Collaborative practice agreement	The pharmacist is authorised to manage prescriptions for all the diabetes mellitus related conditions.	Primary care provider prescribing	Minimum 12 months
Manzoor et al. (2018)	Illinois, USA	To compare the quality of anticoagulation-related outcomes via two models of care, pharmacist-managed anticoagulation clinic and a nurse managed anticoagulation clinic.	Retrospective cohort (n=200)	Patients aged 18 years and over, being treated with warfarin	Intervention: 65.0% Comparator: 52.0%	Intervention: 58.7 ± 15.5 Comparator: 64.2 ± 13.2	Outpatient	Collaborative practice agreement	Pharmacists dose and manage warfarin under institutional collaborative practice agreements.	Nurse prescribing	15 months
Marotti et al. (2011)	Australia	To measure the effect of pharmacist involvement in medication history taking and supplementary prescribing in the perioperative setting.	RCT (n=332)	Elective surgical patients taking regular medications with a postoperative hospital stay of one night or more	Intervention: 49.0% Comparator 1: 55.0% Comparator 2: 51.0%	Intervention: 64 median (IQR 47-75) Comparator 1: 62 median (IQR 52-71) Comparator 2: 65 median (IQR 54-75)	Inpatient	Supplementary	Pharmacist prescribing was guided by protocols. Where patients did not fit the protocol, prescribing was guided by discussion with the patient's medical team.	1. Medication review with physician prescribing 2. Physician prescribing	Six months
McAlister et al. (2014)	Alberta, Canada	A controlled comparison of two modes of case management: active prescribing (pharmacist-led case management) versus screening and delegating to primary care physicians	RCT (n=279)	Patients aged 18 years and over who had a ischemic stroke or transient ischemic attack	Intervention: 39.2% Comparator: 44.8%	Intervention: 66.8 ± 11.1 Comparator: 66.3 ± 11.3	Primary care	Collaborative practice agreement	Pharmacists initiated or titrated antihypertensive and/or lipid-lowering therapy as appropriate	Physician prescribing with nurse case management	Six months

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
		(nurse-led case management).									
McFarland et al. (2009)	Tennessee, USA	To evaluate the prevalence of potentially inappropriate dosing in patients for whom sitagliptin was initiated by a pharmacist versus patients in whom sitagliptin was initiated by a non-pharmacist prescriber.	Retrospective cohort (n=290)	Patients initiated on sitagliptin by a provider in the department of internal medicine	Not reported	Not reported	Outpatient	Collaborative practice agreement	A pharmacist had the authority to order laboratory tests, initiate medications, make referrals, and schedule follow-up when deemed necessary.	Physician prescribing	Not reported
Morello et al. (2016)	California, USA	to assess mean change in A1C at 6 months after the baseline visit in the diabetes intense medical management clinic and compare this group with a similar comparator group of type 2 diabetes mellitus patients who were not referred to the diabetes intense medical management clinic.	Retrospective cohort (n=155)	Adults with type 2 diabetes with an A1C ≥8%	Intervention: 2.0% Comparator: 3.6%	Intervention: 62.2 ± 8.1 Comparator: 62.4 ± 10.0	Outpatient	Collaborative practice agreement	The pharmacist had full laboratory ordering and prescribing authority to initiate, adjust, monitor, or discontinue medication therapy for diabetes and all related conditions	Primary care provider prescribing	Six months
Ogilvie et al. (2022)	Australia	An evaluation of a collaborative pharmacist prescribing model compared to the usual medical prescribing model in the emergency department.	RCT (n=94)	Adults, referred for medical admission from emergency into the hospital	Intervention: 47.4% Comparator: 40.0%	Intervention: 69.8 (range 44-89) Comparator: 70.9 (range 40-89)	Emergency department	Collaborative practice agreement	The pharmacist's scope of prescribing involved withholding or continuation of regular medications, and prescribing any new therapy based on the agreed pharmaceutical plan between admitting medical practitioner and pharmacist prescriber.	Physician prescribing	At admission

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
O'Neill et al. (2014)	Michigan, USA	To compare blood pressure between clinical pharmacy specialists-directed and physician-directed registered nurse case management.	Retrospective cohort (n=126)	Veterans with uncontrolled hypertension	Intervention: 3.2% Comparator: 1.6%	Intervention: 63.4 ± 9.8 Comparator: 63.8 ± 10.0	Outpatient	Collaborative practice agreement	Nurse assesses each patient present uncontrolled hypertension the case either to a physician or a CPS to collaboratively design a plan of care including education changing medication therapy, consulting referral services, laboratory test ordering and/or arranging follow-up.	Physician prescribing with nurse case management	Unclear, at least 2 visits
Rana et al. (2023)	USA	To determine if a pharmacist-led outpatient angiotensin receptor/neprilysin inhibitor replacement and titration programme led to more patients achieving target doses of sacubitril–valsartan compared to usual care.	Retrospective cohort (n=791)	Aged 18 years and over, diagnosed with heart failure with reduced ejection fraction, with an active sacubitril-valsartan prescription	Intervention: 32.8% Comparator: 34.4%	Intervention: 57.1 ± 12.6 Comparator: 64.5 ± 12.6	Outpatient	Collaborative practice agreement	Pharmacists initiate, titrate, monitor, clinical review, follow-up, counselling, insurance authorisation/appeals for patient prescribed angiotensin receptor/neprilysin inhibitor.	Physician prescribing	Until target dose achieved
Rashid et al. (2020)	California, USA	To evaluate effectiveness, safety, and economic outcomes of a pharmacist-managed deprescribing of non-steroidal anti-inflammatory drugs within an integrated health care system.	Retrospective cohort (n=2155)	Adults at least 65 years of age receiving non-steroidal anti-inflammatory drugs	Intervention: 53.8% Comparator: 55.1%	Intervention: 76.1 ± 6.7 Comparator: 75.8 ± 7.1	Outpatient	Collaborative practice agreement	Clinical pharmacists obtain protocol authorisation to review and deprescribe medications	Physician deprescribing	6 months
Rodriguez et al. (2020)	California, Colorado, Hawaii,	To test whether there are differences in the amount of contraceptive supply	Prospective cohort study (n=448)	Women aged 18-50 years presenting at a	Intervention: 100%	Intervention 18-24 years: 56.94%	Community pharmacy	Independent prescribing	Pharmacist initiates a new prescription for a contraceptive	Physician prescribing	12 months

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
	and Oregon, USA	dispensed by pharmacists compared with clinicians.		pharmacy to fill or initiate a new prescription for contraception for prevent pregnancy	Comparator: 100%	25-39 years: 18.06% 30-34 years: 15.28% ≥35 years: 9.72% Comparator 18-24 years: 43.23% 25-39 years: 23.31% 30-34 years: 15.79% ≥35 years: 17.67%			(pill, patch, ring, or injectable)		
Rodriguez et al. (2021a)	California, Colorado, Hawaii, and Oregon, USA	To determine whether 12-month rates of continuation of an effective form of contraception or perfect use of contraception differ by prescribing provider (pharmacist or clinician).	Prospective cohort (n=388)	Women aged 18-50 years presenting at a pharmacy to fill or initiate a new prescription for contraception for prevent pregnancy	Intervention: 100% Comparator: 100%	Mean: Not reported; Range: 18-50 Intervention: 45.2% 18-24 Comparator: 56.1% 18-24	Community pharmacy	Independent prescribing	Pharmacist initiates a new prescription for a contraceptive (pill, patch, ring, or injectable)	Physician prescribing	12 months
Rodriguez et al. (2021b)	Oregon, USA	To determine whether pharmacist prescription of contraception is associated with inappropriate prescription to women with medical contraindications	Retrospective cohort (n=439,240)	Women aged 18-50 years presenting at a pharmacy to fill or initiate a new prescription for contraception for prevent pregnancy	Intervention: 100% Comparator: 100%	12-17 years: 11.4% 18-24 years: 31.3% 25-29 years: 21.8% 30-34 years: 16.8% ≥35 years: 17.6%	Community pharmacy	Independent prescribing	Pharmacist initiates a new prescription for a contraceptive (pill, patch, ring, or injectable)	Physician prescribing	After prescription

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
Rodriguez et al. (2022)	Oregon, USA	To assess whether pharmacist prescription of combined hormonal contraception is associated with 12-month contraceptive continuation rates or breaks in contraceptive coverage	Retrospective cohort (n=172,325)	Females aged 12-51 years, who new users of short-acting reversible contraception	Intervention: 100% Comparator: 100%	Intervention: 50.5% 25-34 Comparator: 42.2% <25	Community pharmacy	Independent prescribing	Pharmacist initiates a new prescription for a contraceptive (pill, patch, ring, or injectable)	Physician prescribing	12 months
Romanelli et al. (2015)	California, USA	To test the hypothesis that the addition of a clinical pharmacist to a patient-centered medical home team can augment patient care within a patient-centered medical home setting, resulting in reduced healthcare resource use and improved disease management as measured by intermediate clinical outcomes.	Retrospective cohort (n=1,108)	Adults seeking ambulatory care	Intervention: 66.79 ± 16.40 Comparator 1: 65.03 ± 16.26 Comparator 2: 64.86 ± 17.84	Intervention: 70.1% Comparator 1: 68.7% Comparator 2: 70.6%	patient centred medical home	Collaborative practice agreement	Pharmacist's intervention included coordination of care, disease management, and medication therapy management (refill orders; adjustment of medication therapy including discontinuation, modification, and addition of alternative medications)	1. Physician prescribing 2. Primary care provider prescribing	13.5 months
Scullin et al. (2007)	Northern Ireland, UK	To determine whether an increased input by clinical pharmacists at each stage of the patient's hospital journey, from admission through discharge, resulted in an enhanced level of patient care as measured by a number of clinical and economic outcomes.	RCT (n=762)	Patients who met one of the following criteria: 1. taking at least 4 regular medications; 2. taking a high-risk drug(s); 3. taking antidepressants and were 65 years of age or older; and 4. had a previous	Intervention: 55.0% Comparator: 51.0%	Intervention: 70.3 ± 13.8 Comparator: 69.9 ± 14.8	Inpatient	Protocol	Patients received an intensive clinical pharmacy service throughout their hospital stay including generating and authorising a discharge prescription according to protocols.	Physician prescribing	Until discharge

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
				hospital admission within the last 6 months							
Thompson et al. (1984)	California, USA	To determine whether direct intervention, through drug therapy prescribing and patient care management, could improve the quality of patient care	Non-randomised trial (n=152)	Adults residing in a nursing home	Intervention: 82.0% Comparator: 85.0%	Intervention: 85.1 ± 10.5 Comparator: 86.3 ± 8.1	Long-term care	Formulary	Clinical pharmacists made dose adjustments, or discontinued.	Physician prescribing	12 months
Varghese et al. (2024)	Wisconsin, USA	To implement and evaluate the benefit of a pharmacist driven aspirin deprescribing protocol compared with primary care provider education only in a primary care setting	Prospective cohort (n=122)	Veterans with an active prescription of aspirin for atherosclerotic cardiovascular disease who were at least 70 years of age	Intervention: 0% Comparator: 0%	Intervention and comparator: 75 (Range 70-81)	Primary care	Protocol	Using a standardised template, and the aspirin prescription was discontinued by the pharmacist, if appropriate.	Physician deprescribing	Unclear
Villeneuve et al. (2010)	Québec, Canada	To compare a collaborative model involving physicians and pharmacists with usual care for patients with dyslipidaemia.	Cluster RCT (n=225)	Patients aged 18 and over with dyslipidaemia	Intervention: 36.0% Comparator: 40.0%	Intervention: 59.3 ± 9.6 Comparator: 62.2 ± 12.0	Primary care	Collaborative practice agreement	The pharmacist provided counselling and used a patient decision aid to draw up a treatment plan, which included lifestyle changes and pharmacotherapy. The pharmacist then scheduled titration visits which included evaluate lifestyle changes, assessing tolerance of and adherence with the pharmacotherapy,	Physician prescribing	12 months

Author	Country	Research question	Study design (sample size)	Study population(s)	Female (%)	Age	Setting	Prescriptive authority	Intervention description	Comparator/s	Duration
									and then adjusting the statin dosage if appropriate.		
Vivian (2002)	Pennsylvania, USA	To determine whether a pharmacist-managed hypertension clinic improves treatment outcomes in patients with hypertension.	RCT (n=56)	Patients aged 18 years and over with confirmed diagnosis of hypertension	Intervention: 0% Comparator: 0%	Intervention: 64 ± 10.9 Comparator: 65.5 ± 7.8	Primary care	Protocol	The pharmacist made drug therapy changes (in both drug selection and dosage) for blood pressure control following a protocol.	Physician prescribing	6 months
Weaver et al. (2023)	California, USA	To evaluate the impact of a pharmacist-led anaemia management service in pregnant patients with iron deficiency anaemia.	Retrospective cohort (n=100)	Pregnant women aged 16 years of age or older with iron deficiency anaemia	Intervention: 100% Comparator: 100%	Intervention: 35.0 ± 4 Comparator: 35.0 ± 4	Outpatient	Collaborative practice agreement	In a telephone-based ambulatory care pharmacy clinic performed pharmacists were authorised to initiate and adjust iron therapies, order baseline and follow-up laboratory tests, counsel patients, and assess the efficacy, safety, and tolerability of the iron regimens selected.	Obstetrician gynaecologist prescribing	At delivery
Xu et al. (2021)	Singapore	To examine the impact of pharmaceutical care on glycemia and self-care in patients with long-standing diabetes.	RCT (n=248)	Patients aged 21 years and over with uncontrolled type 2 diabetes (defined as A1C >7%);	Intervention: 69.0% Comparato: 61.0%	Intervention: 59.7 ± 7.3 Comparator: 59.9 ± 6.8	Primary care	Collaborative practice agreement	Pharmacists conducted medication review, dose adjustments, and insulin initiation and titration, switching drugs, and furnishing prescriptions.	Physician prescribing	6 months

Table of characteristics for cost-effectiveness studies

Author	Health condition	Setting	Perspective	Study design	Intervention	Comparator	Time horizon	Discounting	Model
Aspinall *et al.* (2013)	Chronic kidney disease	Primary care	USA payer	Cost-utility	Pharmacist-managed erythropoiesis-stimulating agent clinics	Usual care provided by physicians	5 years	3%	Markov
Brown *et al.* (2016)	Type 2 diabetes	Community pharmacy	Canadian healthcare system	Cost utility	Pharmacist-led initiation of insulin glargine in patients with uncontrolled type 2 diabetes mellitus	Usual clinical practice (insulin initiation delayed by 1 to 5 years by physicians)	50 years	5%	Markov
Dixon *et al.* (2023)	Hypertension	Outpatient	USA third party payer	Cost utility	Pharmacist-prescribing intervention to reduce blood pressure by optimising medication management, counselling, and follow-up care.	Hypothetical control group assuming blood pressure would remain at baseline levels.	30 years	3%	Markov
Gumbie *et al.* (2019)	Female contraceptive users	Community pharmacy	Australian healthcare system	Cost-utility	Reclassifying oral contraceptive pills from prescription-only to pharmacist-only.	Current prescription-only oral contraceptive pill access in Australia.	35 years	5%	Markov
Hirsch *et al.* (2017)	Type 2 diabetes	Outpatient	USA payer	Cost utility	Endocrinologist-pharmacist diabetes intense medical management clinic combining medication therapy management and diabetes education.	Usual primary care physician care without pharmacist-led services.	10 years	3%	Archimedes
Jay *et al.* (2021)	Hypertension	Primary care	USA payer	Cost-benefit	Pharmacist physician collaborative care model	Usual care for hypertension management by primary care provider.	3 years	Not specified	Decision tree
Kim *et al.* (2021)	Common conditions	Community pharmacy	Canadian public payer	Cost minimisation	Pharmacist prescribing for common conditions model enabling pharmacists to assess and prescribe for conditions like urinary tract infection, contact dermatitis, and conjunctivitis.	Usual care model with all care provided by physicians (family physician, walk-in clinics, or emergency department).	Not specified but assume acute management	Not applicable	Decision tree
Klepser *et al.* (2012)	Acute pharyngitis	Community pharmacy	USA payer perspective	Cost minimisation	Community pharmacist-provided diagnosis and treatment for Group A Streptococcus pharyngitis using rapid antigen detection tests.	Usual care provided by physicians or nurse practitioners using rapid antigen detection tests, culture, or empirical therapy.	Acute	Not applicable	Decision tree
Marra *et al.* (2017)	Hypertension	Community pharmacy	Canadian public payer	Cost utility	Comprehensive pharmacist-led hypertension management, including prescribing, education, and follow-up visits.	Usual care without additional pharmacist interventions.	30 years	5%	Markov
Neilson *et al.* (2015)	Chronic pain	Primary care	UK healthcare system	Cost utility	Pharmacist-led management including medication review and prescribing or review with feedback to the general practitioner.	Usual care provided by general practitioners.	6 months	NA	Regression model
Rodriguez *et al.* (2019)	Female contraceptive users	Community pharmacy	USA payer perspective	Cost utility	Pharmacist-led prescribing of hormonal contraception (pill, patch, or ring) compared with standard care via clinic-based prescription.	Standard care requiring clinic visits for contraceptive prescription.	1 year	NA	Decision tree
Sanyal *et al.* (2019)	Urinary tract infection	Community pharmacy	Canadian healthcare system	Cost utility	Pharmacist-initiated management of uncomplicated urinary tract infection.	Family or emergency physician-initiated management.	1 month	NA	Decision tree

Author	Health condition	Setting	Perspective	Study design	Intervention	Comparator	Time horizon	Discounting	Model
Yu *et al.* (2013)	Type 2 diabetes	Outpatient	US third party payer	Cost utility	Pharmacist enhanced care including prescribing, adjusting, lab ordering, immunisation administration, and self-management education	Usual care provided by primary care physicians.	10 years	3%	Markov

Appendix N Feasibility assessment for meta-analysis

Feasibility assessment for effectiveness outcomes

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Chronic kidney disease	Haemoglobin	Proportion of haemoglobin values within the target range of 10-12 g/dl	Aspinall *et al.* (2012) (intervention vs. clinic physician)	Outpatient clinic	Collaborative practice agreement	Clinic physician	Retrospective cohort	Too few studies
Chronic kidney disease		Proportion of haemoglobin values within the target range of 10-12 g/dl	Aspinall *et al.* (2012) (intervention vs. usual care)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Urinary tract infection	Clinical cure	Clinical cure at two weeks	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	NRCT	Too few studies
Urinary tract infection	Waiting time	Time to access care	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	NRCT	Too few studies
Urinary tract infection	Adherence	Adherence (taken as prescribed)	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	NRCT	Too few studies
Anticoagulation	INR goal achieved	INR control achieved	Boddy (2001)	Inpatient	Protocol	Physician prescribing	NRCT	Too few studies
Anticoagulation	INR goal achieved	INR within therapeutic range	Hall *et al.* (2011)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	
Anticoagulation	Time to achieve therapeutic range	No. days to achieve therapeutic proconvertin and prothrombin	Chenella *et al.* (1983)	Inpatient	Independent	Physician prescribing	RCT	Too few studies
Anticoagulation	Time to achieve therapeutic range	Average time to therapeutic INR	Damaske *et al.* (2005)	Inpatient	Protocol	Physician prescribing	NRCT	Too few studies
Anticoagulation		Time that INR was within therapeutic range	Hall *et al.* (2011)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Anticoagulation	Partial thromboplastin time (PTT)	Partial thromboplastin time (PTT)	Chenella *et al.* (1983)	Inpatient	Independent	Physician prescribing	RCT	Too few studies
Anticoagulation	Prothrombin time ratio	Prothrombin time ratio	Cohen *et al.* (1985)	Outpatient clinic	Protocol	Physician prescribing	Retrospective cohort	Too few studies
Anticoagulation	INR	Proportion INR in therapeutic range	Manzoor *et al.* 2018	Outpatient clinic	Collaborative practice agreement	Nurse presrcibing	Retrospective cohort	Too few studies

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Chronic pain	Health-related quality of life	Health-related quality of life	Bruhn *et al.* (2013)	Primary care	Independent		RCT	Too few studies
Chronic pain	Health-related quality of life	Health-quality of life (physical component score)	Bruhn *et al.* (2013) (intervention vs medication review)	Primary care	Independent	Medication review	RCT	Too few studies
Chronic pain	Health-related quality of life	Health-related quality of life (physical component score)	Bruhn *et al.* (2013) (intervention vs usual care)	Primary care	Independent	Usual care	RCT	Too few studies
Chronic pain	Health-related quality of life	Health-related quality of life (mental component score)	Bruhn *et al.* (2013) (intervention vs medication review)	Primary care	Independent	Medication review	RCT	Too few studies
Chronic pain	Health-related quality of life	Health-related quality of life (mental component score)	Bruhn *et al.* (2013) (intervention vs usual care)	Primary care	Independent	Usual care	RCT	Too few studies
Chronic pain	Chronic pain	Chronic pain intensity	Bruhn *et al.* (2013) (intervention vs medication review)	Primary care	Independent	Medication review	RCT	Too few studies
Chronic pain	Chronic pain	Chronic pain intensity	Bruhn *et al.* (2013) (intervention vs usual care)	Primary care	Independent	Usual care	RCT	Too few studies
Chronic pain	Chronic pain	Chronic pain disability	Bruhn *et al.* (2013) (intervention vs medication review)	Primary care	Independent	Medication review	RCT	Too few studies
Chronic pain	Chronic pain	Chronic pain disability	Bruhn *et al.* (2013) (intervention vs usual care)	Primary care	Independent	Usual care	RCT	Too few studies
Chronic pain	Mental health	Depression	Bruhn *et al.* (2013) (intervention vs. medication review)	Primary care	Independent	Medication review	RCT	Too few studies
Chronic pain	Mental health	Depression	Bruhn *et al.* (2013) (intervention vs. usual care)	Primary care	Independent	Usual care	RCT	Too few studies

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Chronic pain	Mental health	Anxiety	Bruhn *et al.* (2013) (intervention vs. medication review)	Primary care	Independent	Medication review	RCT	Too few studies
Chronic pain	Mental health	Anxiety	Bruhn *et al.* (2013) (intervention vs. usual care)	Primary care	Independent	Usual care	RCT	Too few studies
Type 2 diabetes	HbA1C	Goal achieved (yes/no)	Cowart *et al.* (2020)	Primary care	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	HbA1C		Cowart *et al.* (2022)	Primary care	Collaborative practice agreement	Physician prescribing	Retrospective cohort	
Type 2 diabetes	HbA1C		Maeng *et al.* (2018)	Primary care	Collaborative practice agreement	Usual care (primary care provider clinic)	Retrospective cohort	
Type 2 diabetes	HbA1C	Time to achieve HbA1c goal	Cowart *et al.* (2020)	Primary care	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	HbA1C	Change in HbA1C (pre and post index date)	Hernández-Muñoz *et al.* (2021)	Outpatient clinic	Collaborative practice agreement	Usual care (endocrinologist)	Retrospective cohort	Too few studies
Type 2 diabetes	HbA1C	Change in HbA1C	Jameson *et al.* (2010)	Primary care	Collaborative practice agreement	Usual care (primary care providers)	RCT	Comparator different, study designs too different
Type 2 diabetes	HbA1C		Lum *et al.* (2023)	Outpatient clinic	Collaborative practice agreement	Cardiologist managed clinic	Retrospective cohort	
Type 2 diabetes	HbA1C		Xu *et al.* (2021)	Primary care	Collaborative practice agreement	Physician prescribing	RCT	
Type 2 diabetes	HbA1C	Patients who achieved at least a 1.0% decrease in HbA1C	Jameson *et al.* (2010)	Primary care	Collaborative practice agreement	Usual care (primary care providers)	RCT	Too few studies
Type 2 diabetes	HbA1C	Mean HbA1c levels	Morello *et al.* (2016)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	HbA1C		Maeng *et al.* (2018)	Primary care	Collaborative practice agreement	Usual care (primary care provider clinic)	Retrospective cohort	

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Type 2 diabetes	HbA1C	Relative risk for achieving an A1C of 7% or below	Irons *et al.* (2002)	Prison primary care	Collaborative practice agreement	Usual care (primary care providers)	Retrospective cohort	Too few studies
Type 2 diabetes	HbA1C	Fasting blood glucose	Morello *et al.* (2016)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	LDL cholesterol	Mean LDL	Morello *et al.* (2016)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	LDL cholesterol		Maeng *et al.* (2018)	Primary care	Collaborative practice agreement	Usual care (primary care provider clinic)	Retrospective cohort	
Type 2 diabetes	LDL cholesterol	Goal achieved (yes/no)	Maeng *et al.* (2018)	Primary care	Collaborative practice agreement	Usual care (primary care provider clinic)	Retrospective cohort	Too few studies
Type 2 diabetes	HDL cholesterol	HDL cholesterol	Morello *et al.* (2016)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	Triglycerides	Triglycerides	Morello *et al.* (2016)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	Systolic blood pressure	Systolic blood pressure levels	Morello *et al.* (2016)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	Systolic blood pressure		Maeng *et al.* (2018)	Primary care	Collaborative practice agreement	Usual care (primary care provider clinic)	Retrospective cohort	
Type 2 diabetes	Diastolic blood pressure	Diastolic blood pressure levels	Morello *et al.* (2016)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Type 2 diabetes	Diastolic blood pressure		Maeng *et al.* (2018)	Primary care	Collaborative practice agreement	Usual care (primary care provider clinic)	Retrospective cohort	
Type 2 diabetes	Blood pressure goal reached	Blood pressure goal reached	Maeng *et al.* (2018)	Primary care	Collaborative practice agreement	Usual care (primary care provider clinic)	Retrospective cohort	Too few studies
Type 2 diabetes	Time to treatment intensification	Time to treatment intensification	Cowart *et al.* (2022)	Primary care	Collaborative practice agreement	Physician prescribing	Retrospective cohort	Too few studies

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Type 2 diabetes	Healthcare utilisation	Scheduled diabetes-related clinic visits	Irons *et al.* (2002)	Prison primary care	Collaborative practice agreement	Usual care (primary care providers)	Retrospective cohort	Too few studies
Type 2 diabetes	Healthcare utilisation	Unscheduled diabetes-related clinic visits	Irons *et al.* (2002)	Prison primary care	Collaborative practice agreement	Usual care (primary care providers)	Retrospective cohort	Too few studies
Type 2 diabetes	Health-related quality of life	Diabetes-specific quality of life	Xu *et al.* (2021)	Primary care	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Heart failure	Hospitalisations (healthcare utilisation)	30-day all-cause readmission rate	Hahn *et al.* (2019) (intervention vs. medication therapy management with no CPA)	Outpatient clinic	Collaborative practice agreement	Pharmacist medication management	Retrospective cohort	Too few studies
Heart failure	Hospitalisations (healthcare utilisation)	30-day all-cause readmission rate	Hahn *et al.* (2019) (intervention vs. usual care)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Heart failure	Hospitalisations (healthcare utilisation)	30-day HF readmissions	Hahn *et al.* (2019) (intervention vs. medication therapy management with no CPA)	Outpatient clinic	Collaborative practice agreement	Pharmacist medication management	Retrospective cohort	Too few studies
Heart failure	Hospitalisations (healthcare utilisation)	30-day HF readmissions	Hahn *et al.* (2019) (intervention vs. usual care)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Heart failure	Emergency department visits (healthcare utilisation)	Emergency department visits	Hahn *et al.* (2019) (intervention vs. medication therapy management with no CPA)	Outpatient clinic	Collaborative practice agreement	MTM (no CPA)	Retrospective cohort	Different populations
Heart failure	Emergency department visits (healthcare utilisation)	Emergency department visits	Hahn *et al.* (2019) (intervention vs. usual care)	Outpatient clinic	Collaborative practice agreement	Usual care	Retrospective cohort	Different populations

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Heart failure	Target dose achieved	Percentage of patients achieving target ARNI dose	Rana *et al.* (2023)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	Retrospective cohort	Too few studies
Heart failure	Target dose achieved	Number of visits required to achieve target dose	Rana *et al.* (2023)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	Retrospective cohort	Too few studies
Heart failure	Target dose achieved	Days required to achieve target/maximally tolerated ARNI dose	Rana *et al.* (2023)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	Retrospective cohort	Too few studies
Heart failure	Deprescribing	Proportion of aspirin deprescribing	Varghese *et al.* (2024)	Primary care	Protocol	Physician deprescribing	Prospective cohort study	Too few studies
Older person care	Falls	Fall rate/person at six months	Holland *et al.* (2023)	Long term care	Independent	Usual care (GP)	RCT	Too few studies
Older person care	Health-related quality of life	Health-related quality of life (EQ-5D by proxy)	Holland *et al.* (2023)	Long term care	Independent	Usual care (GP)	RCT	Too few studies
Older person care	Drug burden	Drug Burden Index	Holland *et al.* (2023)	Long term care	Independent	Usual care (GP)	RCT	Too few studies
Older person care	Hospitalisations (healthcare utilisation)	Hospitalisations	Holland *et al.* (2023)	Long term care	Independent	Usual care (GP)	RCT	Different interventions
Older person care	Hospitalisations (healthcare utilisation)		Lau *et al.* (2022)	Long term care	Protocol	Enhanced usual care	RCT	
Older person care	Hospitalisations (healthcare utilisation)		Thompson *et al.* (1984)	Long term care	Formulary	Physician prescribing	NRCT	
Older person care	Falls	Fall requiring medical attention	Lau *et al.* (2022)	Long term care	Protocol	Enhanced usual care	RCT	Too few studies
Older person care	Health-related quality of life	Health related quality of life	Lau *et al.* (2022)	Long term care	Protocol	Enhanced usual care	RCT	Too few studies
Older person care	Systolic blood pressure	Goal achieved (yes/no)	Lau *et al.* (2022)	Long term care	Protocol	Enhanced usual care	RCT	Too few studies
Older person care	Mental health	Depression	Lau *et al.* (2022)	Long term care	Protocol	Enhanced usual care	RCT	Too few studies
Older person care	Mental health	Anxiety	Lau *et al.* (2022)	Long term care	Protocol	Enhanced usual care	RCT	Too few studies

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Older person care	Emergency department visits (healthcare utilisation)	Emergency department admissions	Lau *et al.* (2022)	Long term care	Protocol	Enhanced usual care	RCT	Different populations
Older person care	Drug burden	Average number of drugs per patient	Thompson *et al.* (1984)	Long term care	Formulary	Physician prescribing	NRCT	Too few studies
Stroke	Systolic blood pressure	Attained optimal systolic blood pressure and lipid level by 6 months	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Nurse case management	RCT	Too few studies
Stroke	Systolic blood pressure	Systolic BP	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Nurse case management	RCT	Too few studies
Stroke	LDL cholesterol	Mean LDL	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Nurse case management	RCT	Too few studies
Stroke	HDL cholesterol	Change in HDL cholesterol	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Nurse case management	RCT	Different populations
Stroke	Adherence	Self-reported adherence of 75% or higher for blood pressure or lipid-lowering medications	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Nurse case management	RCT	Too few studies
Stroke	General health	Self-rated health	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Nurse case management	RCT	Too few studies
Stroke	Health-related quality of life	Health-related quality of life	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Nurse case management	RCT	Too few studies
Hypertension	Blood pressure goal achieved	Goal achieved (yes/no)	O'Neill *et al.* (2014)	Outpatient clinic	Collaborative practice agreement	Physician prescribing with nurse case management	Retrospective cohort	Too few studies
Hypertension	Systolic blood pressure	Systolic blood pressure change	O'Neill *et al.* (2014)	Outpatient clinic	Collaborative practice agreement	Physician prescribing with nurse case management	Retrospective cohort	Too few studies
Hypertension	Diastolic blood pressure	Diastolic blood pressure change	O'Neill *et al.* (2014)	Outpatient clinic	Collaborative practice agreement	Physician prescribing with	Retrospective cohort	Too few studies

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
						nurse case management		
Hypertension	Systolic blood pressure	Systolic blood pressure	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Diastolic blood pressure	Diastolic blood pressure	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Adherence	Adherence	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Adherence	Adherence	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Health-related quality of life	Health-related quality of life	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Health-related quality of life	Physical functioning	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Health-related quality of life	Physical functioning	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Health-related quality of life	Role limitations, physical	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Health-related quality of life	Role limitations, emotional	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Health-related quality of life	Social functioning	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Health-related quality of life	Energy, fatigue	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Hypertension	Health-related quality of life	Bodily pain	Vivian (2002)	Outpatient clinic	Protocol	Physician prescribing	NRCT	Too few studies
Contraception	Continuation	12-month contraceptive continuation rate	Rodriguez *et al.* (2021)	Community pharmacy	Independent	Clinician prescribing	Prospective cohort	Too few studies
Contraception	Continuation		Rodriguez *et al.* (2022)	Community pharmacy	Independent	Clinician prescribing	Retrospective cohort	
Contraception	Adherence	Perfect use across 12-months	Rodriguez *et al.* (2021)	Community pharmacy	Independent	Clinician prescribing	Prospective cohort	

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Contraception	Adherence		Rodriguez *et al.* (2022)	Community pharmacy	Independent	Clinician prescribing	Retrospective cohort	Too few studies, different study designs
Mixed health conditions	Clinic visits	Ambulatory care visits	Romanelli *et al.* (2015) (intervention medication management programme vs. patient centred medical home)	Primary care (medical home)	Collaborative practice agreement	Patient centred medical home	Retrospective cohort	Too few studies
Mixed health conditions	Clinic visits	Ambulatory care visits	Romanelli *et al.* (2015) (intervention vs. usual care)	Primary care (medical home)	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Mixed health conditions	Emergency department visits (healthcare utilisation)	Emergency department visits	Romanelli *et al.* (2015) (intervention medication management programme vs. patient centred medical home)	Primary care (medical home)	Collaborative practice agreement	Patient centred medical home	Retrospective cohort	Different populations
Mixed health conditions	Emergency department visits (healthcare utilisation)	Emergency department visits	Romanelli *et al.* (2015) (intervention vs. usual care)	Primary care (medical home)	Collaborative practice agreement	Usual care	Retrospective cohort	Different populations
Mixed health conditions	Hospitalisations (healthcare utilisation)	Hospitalisations	Romanelli *et al.* (2015) (intervention medication management programme vs. patient centred medical home)	Primary care (medical home)	Collaborative practice agreement	Patient centred medical home	Retrospective cohort	Too few studies
Mixed health conditions	Hospitalisations (healthcare utilisation)	Hospitalisations	Romanelli s*et al.* (2015) (intervention vs. usual care)	Primary care (medical home)	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Mixed health conditions	Systolic/diastolic blood pressure	Goal achieved (yes/no)	Romanelli *et al.* (2015) (intervention medication management programme	Primary care (medical home)	Collaborative practice agreement	Patient centred medical home	Retrospective cohort	Too few studies

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
			vs. patient centred medical home)					
Mixed health conditions	Systolic/diastolic blood pressure	Goal achieved (yes/no)	Romanelli *et al.* (2015) (intervention vs. usual care)	Primary care (medical home)	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Mixed health conditions	LDL cholesterol	Goal achieved (yes/no)	Romanelli *et al.* (2015) (intervention medication management programme vs. patient centred medical home)	Primary care (medical home)	Collaborative practice agreement	Patient centred medical home	Retrospective cohort	Too few studies
Mixed health conditions	LDL cholesterol	Goal achieved (yes/no)	Romanelli *et al.* (2015) (intervention vs. usual care)	Primary care (medical home)	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Mixed health conditions	HbA1C	Goal achieved (yes/no)	Romanelli *et al.* (2015) (intervention medication management programme vs. patient centred medical home)	Primary care (medical home)	Collaborative practice agreement	Patient centred medical home	Retrospective cohort	Too few studies
Mixed health conditions	HbA1C	Goal achieved (yes/no)	Romanelli *et al.* (2015) (intervention vs. usual care)	Primary care (medical home)	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Mixed health conditions	Healthcare utilisation	Length of hospital stay	Scullin *et al.* (2007)	Inpatient	Protocol	Physician prescribing	RCT	Too few studies
Mixed health conditions	Hospitalisations (healthcare utilisation)	Hospital readmission	Scullin *et al.* (2007)	Inpatient	Protocol	Physician prescribing	RCT	Too few studies
Dyslipidaemia	LDL cholesterol	Mean LDL	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Dyslipidaemia	Lipid levels achieved	Proportion achieving target lipid levels	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies

Population	Effectiveness outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Dyslipidaemia	HDL cholesterol	HDL cholesterol	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Dyslipidaemia	Triglycerides	Triglycerides	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Dyslipidaemia	Systolic blood pressure	Systolic blood pressure	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Dyslipidaemia	Diastolic blood pressure	Diastolic blood pressure	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Dyslipidaemia	HbA1C	Fasting blood glucose	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Dyslipidaemia	Healthcare utilisation	Healthcare utilisation (number of physician visits)	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Dyslipidaemia	Adherence	Adherence	Villeneueve *et al.* (2010)	Outpatient clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Pregnancy anaemia	Haemoglobin	Percentage achieving target haemoglobin	Weaver *et al.* 2023	Outpatient clinic	Protocol	Usual care (OB/GYN)	Retrospective cohort	Too few studies
Pregnancy anaemia	Haemoglobin	Haemoglobin level	Weaver *et al.* 2023	Outpatient clinic	Protocol	Usual care (OB/GYN)	Retrospective cohort	Too few studies

Feasibility assessment for safety outcomes

Population	Safety outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Chronic kidney disease	Serious adverse drug reaction	Thromboembolica (adverse event)	Aspinall *et al.* (2012) (intervention vs. clinic physician)	Outpatient	Collaborative practice agreement	Physician managed	Retrospective cohort	Too few studies
Chronic kidney disease	Serious adverse drug reaction	Thromboembolica (adverse event)	Aspinall *et al.* (2012) (intervention vs. usual care)	Outpatient	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Chronic kidney disease	Serious adverse drug reaction	Heart failure (adverse event)	Aspinall *et al.* (2012) (intervention vs. clinic physician)	Outpatient	Collaborative practice agreement	Physician managed	Retrospective cohort	Too few studies

Population	Safety outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Chronic kidney disease	Serious adverse drug reaction	Heart failure (adverse event)	Aspinall *et al.* (2012) (intervention vs. usual care)	Outpatient	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Chronic kidney disease	Serious adverse drug reaction	Uncontrolled hypertension (adverse event)	Aspinall *et al.* (2012) (intervention vs. clinic physician)	Outpatient	Collaborative practice agreement	Physician managed	Retrospective cohort	Too few studies
Chronic kidney disease	Serious adverse drug reaction	Uncontrolled hypertension (adverse event)	Aspinall *et al.* (2012) (intervention vs. usual care)	Outpatient	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Chronic kidney disease	Inappropriate prescribing	Rates of inappropriate initial dosing	McFarland *et al.* (2009)	Outpatient	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Urinary tract infection	Serious adverse drug reaction	All adverse events	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	Trial (prospective registry)	Too few studies
Urinary tract infection	Serious adverse drug reaction	Gastrointestinal adverse events	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	Trial (prospective registry)	Too few studies
Urinary tract infection	Serious adverse drug reaction	Vaginal candidiasis adverse events	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	Trial (prospective registry)	Too few studies
Urinary tract infection	Serious adverse drug reaction	Headache adverse events	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	Trial (prospective registry)	Too few studies
Urinary tract infection	Serious adverse drug reaction	Other adverse events	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	Trial (prospective registry)	Too few studies
Urinary tract infection	Drug related hospital admissions	Physician or emergency department events	Beahm *et al.* (2018)	Community pharmacy	Independent	Physician prescribing	Trial (prospective registry)	Too few studies
Urinary tract infection	Medication appropriateness	Antibacterial therapy guideline concordance	Beahm *et al.* (2021)	Community pharmacy	Independent	Physician prescribing	Trial (prospective registry)	Too few studies
Coagulation disorders	Serious adverse drug reaction	Warfarin-related complications (bleeding)	Cohen *et al.* (1985)	Outpatient	Protocol	Physician-managed Coagulation disorders clinic	Retrospective cohort	Different populations
Coagulation disorders	Serious adverse drug reaction	Thromboembolic events	Cohen *et al.* (1985)	Outpatient	Protocol	Physician-managed Coagulation disorders clinic	Retrospective cohort	Different populations

Population	Safety outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Coagulation disorders	Serious adverse drug reaction	Bleeds/adverse drug events	Damaske *et al.* (2005)	Inpatient	Protocol	Physician managed	Trial (pilot controlled)	Different populations
Coagulation disorders	Serious adverse drug reaction	Coagulation disorders-related adverse events	Hall *et al.* (2011)	Outpatient	Collaborative practice agreement	Usual care	Retrospective cohort	Different populations
Coagulation disorders	Drug related hospital admissions	Coagulation disorders-related emergency department visits	Hall *et al.* (2011)	Outpatient	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Coagulation disorders	Drug related hospital admissions	Coagulation disorders-related hospital admissions	Hall *et al.* (2011)	Outpatient	Collaborative practice agreement	Usual care	Retrospective cohort	Too few studies
Coagulation disorders	Drug related hospital admissions	Warfarin related hospitalisations/ emergency department	Manzoor *et al.* 2019	Outpatient	Collaborative practice agreement	Nurse-managed Coagulation disorders clinic	Retrospective cohort	Too few studies
Type 2 diabetes	Serious adverse drug reaction	Frequency of hypoglycaemic events	Irons *et al.* (2002)	Primary care	Collaborative practice agreement	Usual care (primary care providers)	Retrospective cohort	Too few studies
Heart failure	Drug related hospital admissions	Heart failure hospitalisations	Rana *et al.* (2023)	Outpatient	Collaborative practice agreement	Physician prescribing	Retrospective cohort	Too few studies
Heart failure	Mortality	All-cause death	Rana *et al.* (2023)	Outpatient	Collaborative practice agreement	Physician prescribing	Retrospective cohort	Too few studies
Older people in long-term care	Mortality	Mortality	Holland *et al.* (2023)	Long-term care	Independent	Usual care (GP)	RCT	Too few studies
Older people in long-term care	Serious adverse drug reaction	Syncope	Lau *et al.* (2022)	Long-term care	Protocol	Enhanced usual care	RCT	Too few studies
Older people in long-term care	Serious adverse drug reaction	Hypotension	Lau *et al.* (2022)	Long-term care	Protocol	Enhanced usual care	RCT	Too few studies
Older people in long-term care	Serious adverse drug reaction	Hypokalaemia	Lau *et al.* (2022)	Long-term care	Protocol	Enhanced usual care	RCT	Too few studies
Older people in long-term care	Serious adverse drug reaction	Hyperkalaemia	Lau *et al.* (2022)	Long-term care	Protocol	Enhanced usual care	RCT	Too few studies
Older people in long-term care	Serious adverse drug reaction	Hyponatremia	Lau *et al.* (2022)	Long-term care	Protocol	Enhanced usual care	RCT	Too few studies

Population	Safety outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Older people in long-term care	Serious adverse drug reaction	Orthostatic presyncope	Lau *et al.* (2022)	Long-term care	Protocol	Enhanced usual care	RCT	Too few studies
Older people in long-term care	Serious adverse drug reaction	Change in eGFR	Lau *et al.* (2022)	Long-term care	Protocol	Enhanced usual care	RCT	Too few studies
Mixed health conditions	Drug related hospital admissions	Gastrointestinal bleeding events (hospitalisations and emergency department visits)	Rashid *et al.* (2020)	Outpatient	Collaborative practice agreement	Physician deprescribing	Retrospective cohort	Too few studies
Mixed health conditions	Drug related hospital admissions	Acute kidney injury events (hospitalisations and ER visits)	Rashid *et al.* (2020)	Outpatient	Collaborative practice agreement	Physician deprescribing	Retrospective cohort	Too few studies
Mixed health conditions	Drug related hospital admissions	Pain (hospitalisations and emergency department visits)	Rashid *et al.* (2020)	Outpatient	Collaborative practice agreement	Physician deprescribing	Retrospective cohort	Too few studies
Older people in long-term care in long-term care	Mortality	Mortality	Thompson *et al.* (1984)	Long-term care	Formulary	Physician prescribing	NRCT	Too few studies
Stroke	Mortality	Mortality	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Usual care	RCT	Too few studies
Stroke	Serious adverse drug reaction	Vascular event	McAllister *et al.* (2014)	Primary care	Collaborative practice agreement	Usual care	RCT	Too few studies
Surgery	Underuse	Doses missed during inpatient stay	Marotti *et al.* (2011) (intervention vs. medication review)	Hospital	Supplementary	Medication review	RCT	Too few studies
Surgery	Underuse	Doses missed during inpatient stay	Marotti *et al.* (2011) (intervention vs usual care)	Hospital	Supplementary	Usual care	RCT	Too few studies
Surgery	Medication appropriateness	Medication charted at incorrect dose	Marotti *et al.* (2011) (intervention vs. medication review)	Hospital	Supplementary	Medication review	RCT	Too few studies
Surgery	Medication appropriateness	Medication charted at incorrect dose	Marotti *et al.* (2011) (intervention vs usual care)	Hospital	Supplementary	Usual care	RCT	Too few studies

Population	Safety outcome	Outcome description	Author	Setting	Intervention	Comparison	Study design	Meta-analysis feasibility decision
Surgery	Medication appropriateness	Medications charted at incorrect frequency	Marotti *et al.* (2011) (intervention vs. medication review)	Hospital	Supplementary	Medication review	RCT	Too few studies
Surgery	Medication appropriateness	Medications charted at incorrect frequency	Marotti *et al.* (2011) (intervention vs usual care)	Hospital	Supplementary	Usual care	RCT	Too few studies
Emergency department	Prescribing errors	Prescribing errors	Ogilve *et al.* (2022)	Emergency department	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
At risk of drug related problems	Mortality	12-month mortality	Scullin *et al.* (2007)	Inpatient	Protocol	Physician prescribing	RCT	Too few studies
Dyslipidemia	Serious adverse drug reaction	Adverse events	Villeneueve *et al.* (2010)	Family clinic	Collaborative practice agreement	Physician prescribing	RCT	Too few studies
Female contraceptive users	Clinically significant drug-drug interaction	Medical contraindications	Rodriguez *et al.* 2020	Community pharmacy	Independent	Clinician prescribing	Prospective cohort	Too few studies
Female contraceptive users	Clinically significant drug-drug interaction	Medical contraindications	Rodriguez *et al.* 2021b	Community pharmacy	Independent	Clinician prescribing	Retrospective cohort	Too few studies

Appendix O Exploratory meta-analyses

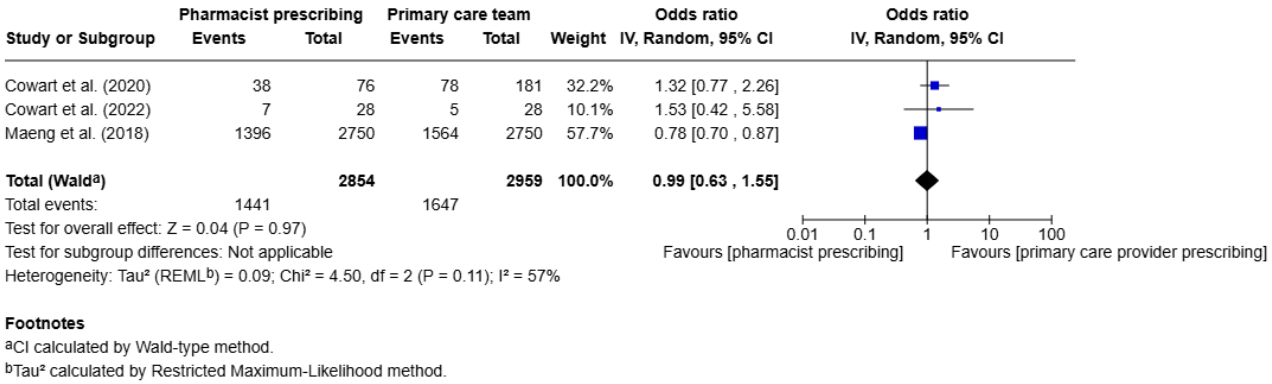


Figure: Pooled outcome for HbA1c goal achieved (yes/no) in diabetes

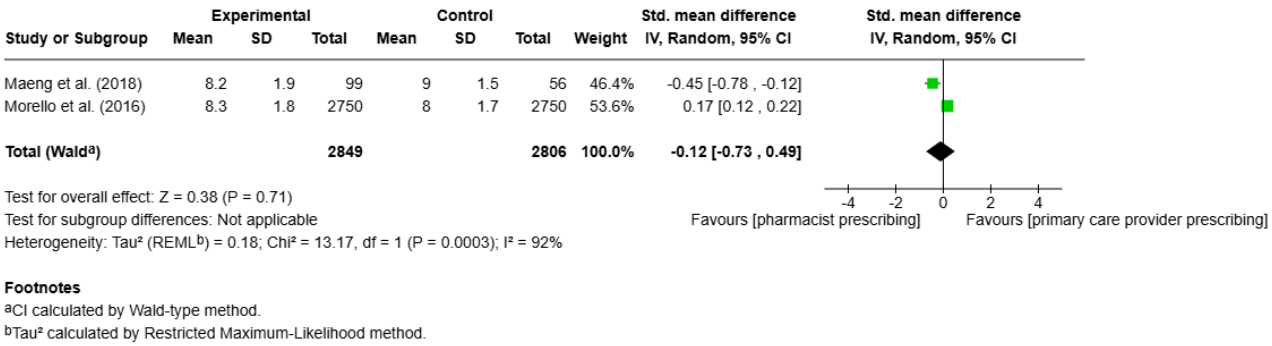


Figure: Pooled outcome for mean HbA1c levels (%) in diabetes

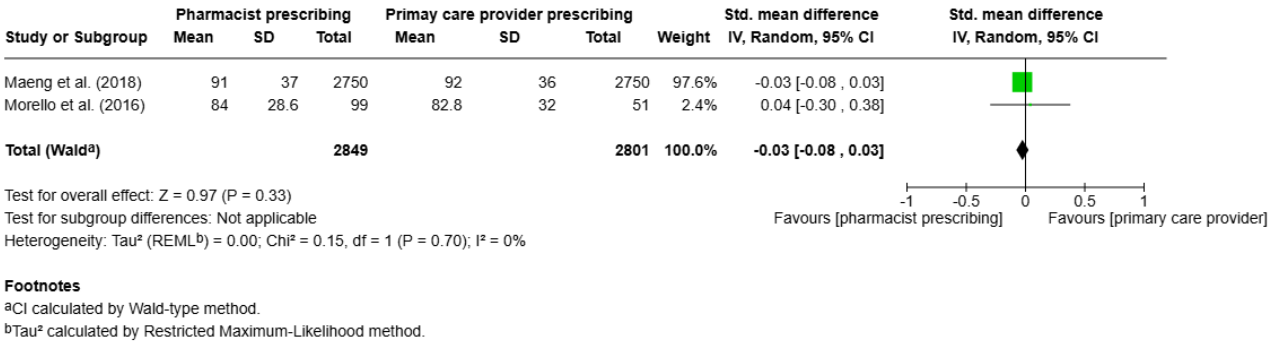
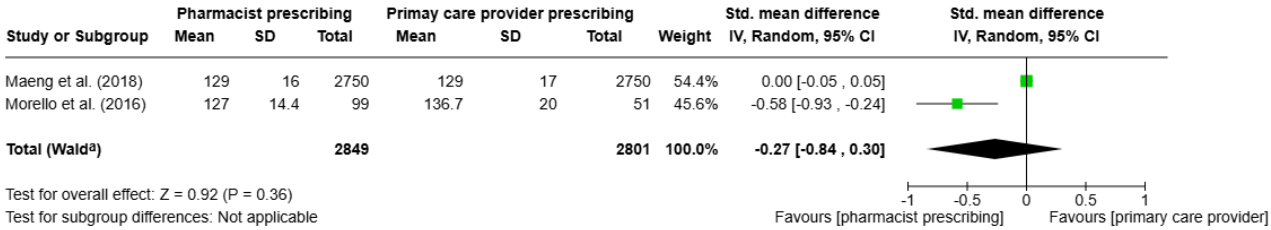


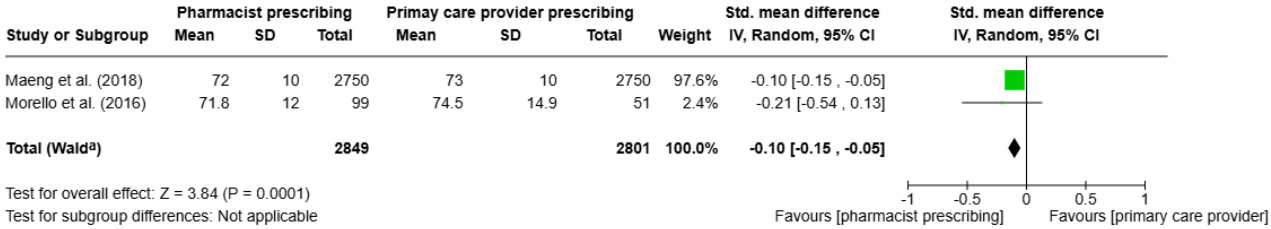
Figure: Pooled outcome for mean LDL levels in diabetes



Test for overall effect: Z = 0.92 (P = 0.36)
Test for subgroup differences: Not applicable
Heterogeneity: Tau² (REML[b]) = 0.16; Chi² = 10.82, df = 1 (P = 0.001); I² = 91%

Footnotes
[a]CI calculated by Wald-type method.
[b]Tau² calculated by Restricted Maximum-Likelihood method.

Figure: Pooled outcome for systolic blood pressure in diabetes



Test for overall effect: Z = 3.84 (P = 0.0001)
Test for subgroup differences: Not applicable
Heterogeneity: Tau² (REML[b]) = 0.00; Chi² = 0.37, df = 1 (P = 0.55); I² = 0%

Footnotes
[a]CI calculated by Wald-type method.
[b]Tau² calculated by Restricted Maximum-Likelihood method.

Figure: Pooled outcome for diastolic blood pressure in diabetes

Appendix P Synthesis Without Meta-analysis

SWiM reporting item	Item description	Page in manuscript where item is reported
Methods		
1 Grouping studies for synthesis	1a) Provide a description of, and rationale for, the groups used in the synthesis (e.g., groupings of populations, interventions, outcomes, study design)	p43
	1b) Detail and provide rationale for any changes made subsequent to the protocol in the groups used in the synthesis	Not applicable
2 Describe the standardised metric and transformation methods used	Describe the standardised metric for each outcome. Explain why the metric(s) was chosen, and describe any methods used to transform the intervention effects, as reported in the study, to the standardised metric, citing any methodological guidance consulted	Not applicable
3 Describe the synthesis methods	Describe and justify the methods used to synthesise the effects for each outcome when it was not possible to undertake a meta-analysis of effect estimates	p43
4 Criteria used to prioritise results for summary and synthesis	Where applicable, provide the criteria used, with supporting justification, to select the particular studies, or a particular study, for the main synthesis or to draw conclusions from the synthesis (e.g., based on study design, risk of bias assessments, directness in relation to the review question)	Not applicable
5 Investigation of heterogeneity in reported effects	State the method(s) used to examine heterogeneity in reported effects when it was not possible to undertake a meta-analysis of effect estimates and its extensions to investigate heterogeneity	Not applicable
6 Certainty of evidence	Describe the methods used to assess certainty of the synthesis findings	p44
7 Data presentation methods	Describe the graphical and tabular methods used to present the effects (e.g., tables, forest plots, harvest plots). Specify key study characteristics (e.g., study design, risk of bias) used to order the studies, in the text and any tables or graphs, clearly referencing the studies included	Appendix N Section 3.5
Results		
8 Reporting results	For each comparison and outcome, provide a description of the synthesised findings, and the certainty of the findings. Describe the result in language that is consistent with the question the synthesis addresses, and indicate which studies contribute to the synthesis	Section 3.5
Discussion		
9 Limitations of the synthesis	Report the limitations of the synthesis methods used and/or the groupings used in the synthesis, and how these affect the conclusions that can be drawn in relation to the original review question	p43

Appendix Q Grading of Recommendations Assessment, Development, and Evaluation

Diabetes effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
HbA1c goal achieved (assessed with: Yes/No)						
5813 (3 non-randomised studies)	very serious[a]	serious[b,c]	not serious	not serious[d,e]	none	⊕◯◯◯ Very low[a,b,c,d,e]
HbA1c levels (assessed with: Mean)						
1400 (2 non-randomised studies)	very serious[a]	serious[b,c]	not serious	not serious	none	⊕◯◯◯ Very low[a,b,c]
Change in HbA1c levels (assessed with: Mean change)						
541 (2 non-randomised studies)	very serious[a]	very serious[b,c]	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b,c]
Change in HbA1c levels (assessed with: Mean change)						
351 (2 RCTs)	serious[f]	very serious[b,c]	not serious	not serious[e]	none	⊕◯◯◯ Very low[b,c,e,f]
Time to achieve HbA1c goal (assessed with: Mean days)						
257 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[g,h]	none	⊕◯◯◯ Very low[a,g,h]
Time to antidiabetic treatment intensification (assessed with: Mean days)						
56 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[g,h]	none	⊕◯◯◯ Very low[a,g,h]
Achieving 1.0% decrease in HbA1c levels (assessed with: Yes/No)						
103 (1 RCT)	serious[f]	not serious	not serious	very serious[g,h]	none	⊕◯◯◯ Very low[f,g,h]
Fasting blood glucose levels (assessed with: Mean)						

Diabetes effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
215 (1 RCT)	serious[f]	not serious	not serious	very serious[g,h]	none	⊕◯◯◯ Very low[f,g,h]
Blood pressure goals achieved (assessed with: Yes/No)						
5500 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[g]	none	⊕◯◯◯ Very low[a,g]
5655 (2 non-randomised studies)	very serious[a]	very serious[b,c,i]	not serious	not serious	none	⊕◯◯◯ Very low[a,b,c,i]
Systolic blood pressure levels (assessed with: Mean)						
5655 (2 non-randomised studies)	very serious[a]	very serious[b,c,i]	not serious	not serious	none	⊕◯◯◯ Very low[a,b,c,i]
HDL cholesterol levels (assessed with: Mean)						
150 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[g,h]	none	⊕◯◯◯ Very low[a,g,h]
LDL cholesterol levels (assessed with: Mean)						
5655 (2 non-randomised studies)	very serious[a]	serious[b]	not serious	not serious	none	⊕◯◯◯ Very low[a,b]
LDL cholesterol goal achieved (assessed with: Yes/No)						
5500 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[g]	none	⊕◯◯◯ Very low[a,g]
248 (1 RCT)	very serious[a]	not serious	not serious	serious[g]	none	⊕◯◯◯ Very low[a,g]
Triglycerides levels (assessed with: Mean)						
142 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[g,h]	none	⊕◯◯◯ Very low[a,g,h]

Explanations
a. All studies were high risk of bias

b. Unpooled findings
c. Inconsistent effect across studies
d. Wide confidence intervals
e. Variations in effect ranges
f. Some studies had some concerns risk of bias
g. Single study
h. Small sample size
i. I-squared >75 in exploratory meta analyses

Heart failure effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
30-day all-cause readmission rate (assessed with: No. events)						
63 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
30-day all-cause readmission rate (assessed with: No. events)						
60 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
30-day heart failure readmission rate (assessed with: No. events)						
63 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
30-day heart failure readmission rate (assessed with: No. events)						
60 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Emergency department visits (assessed with: No. events)						
63 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Emergency department visits (assessed with: No. events)						
60 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]

Heart failure effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Angiotensin receptor neprilysin inhibitor (ARNI) target dose achieved (assessed with: Yes/No)						
791 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Number of visits required to achieve target dose (assessed with: Mean)						
791 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Time to achieve target/maximally tolerated angiotensin receptor neprilysin inhibitor (ARNI) dose (assessed with: Mean days)						
791 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Aspirin deprescribed (assessed with: Yes/No)						
122 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]

Explanations
a. All studies were high risk of bias
b. Single study
c. Small sample size

Stroke effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Systolic blood pressure levels (assessed with: Mean)						
279 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
LDL cholesterol levels (assessed with: Mean)						

Stroke effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
279 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Change in HDL cholesterol levels (assessed with: Mean change)						
279 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Adherence (assessed with: Yes/No, self-reported adherence of 75% of higher to blood pressure and lipid lower medications)						
279 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Health (assessed with: Self-reported)						
279 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Quality of life (assessed with: EQ-5D)						
279 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]

Explanations
a. Most studies are high risk of bias
b. Single study

Dyslipidaemia effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Target lipid levels achieved (assessed with: Yes/No)						
223 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]

Dyslipidaemia effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
LDL cholesterol levels (assessed with: Mean)						
211 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]
HDL cholesterol levels (assessed with: Mean)						
225 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]
Triglyceride levels (assessed with: Mean)						
225 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]
Systolic blood pressure levels (assessed with: Mean)						
225 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]
Diastolic blood pressure levels (assessed with: Mean)						
225 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]
Fasting blood glucose levels (assessed with: Mean)						
225 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]
Healthcare utilisation (No. physician visits) (assessed with: Mean)						
225 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]
Adherence (assessed with: Yes/No ?)						
215 (1 RCT)	serious[a]	not serious	not serious	serious[b,c]	none	⊕⊕◯◯ Low[a,b,c]

Explanations
a. Some studies were some concern risk of bias
b. Single study
c. Small sample size

Hypertension certainty outcomes						
Participants (studies) Follow-up	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Blood pressure goal achieved (assessed with: Yes/No)						
126 (1 RCT)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Blood pressure goal achieved (assessed with: Yes/No)						
126 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Systolic blood pressure levels (assessed with: Mean)						
53 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Change in systolic blood pressure levels (assessed with: Mean change)						
126 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Change in systolic blood pressure (assessed with: Mean change)						
126 (1 RCT)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Diastolic blood pressure levels (assessed with: Mean)						
53 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Change in diastolic blood pressure (assessed with: Mean change)						
126 (1 RCT)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]

Hypertension certainty outcomes						
Change in diastolic blood pressure (assessed with: Mean change)						
126 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Adherence (assessed with: No. refills)						
53 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Quality of life (assessed with: Mean)						
52 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]

Explanations
a. High risk of bias in all studies
b. Single study
c. Small sample size

Coagulation disorders certainty outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Time to achieve therapeutic INR (assessed with: Mean days)						
51 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
INR control achieved (assessed with: Yes/No)						
138 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
INR within therapeutic range (assessed with: Yes/No)						
350 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Difference between groups in those achieving INR within therapeutic range (assessed with: Mean change)						

Coagulation disorders certainty outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
200 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Time to achieve therapeutic proconvertin and prothrombin (assessed with: Mean days)						
81 (1 RCT)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Partial thromboplastic time (assessed with: Mean seconds)						
81 (1 RCT)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Prothrombin time ratio (assessed with: Time ratio)						
95 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]

Explanations

a. All studies were high risk of bias

b. Single study

c. Small sample size

Urinary tract infection certainty outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Clinical cure (assessed with: Yes/No)						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Waiting time (assessed with: Mean days to access care)						

Urinary tract infection certainty outcomes						
750 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Adherence (assessed with: Yes/No taken as prescribed)						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]

Explanations
a. Most studies were high risk of bias
b. Single study

Older people in long-term care effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Falls (assessed with: Mean)						
968 (2 RCTs)	very serious[a]	serious[b]	not serious	serious[c]	none	⊕◯◯◯ Very low[a,b,c]
Systolic blood pressure goal achieved (assessed with: Yes/No)						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[e,f]	none	⊕◯◯◯ Very low[d,e,f]
Drug burden (assessed with: Drug burden index)						
449 (1 RCT)	very serious[a]	not serious	not serious	serious[e]	none	⊕◯◯◯ Very low[a,e]
Drug burden (assessed with: Mean no. drugs per patient)						
139 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[e,f]	none	⊕◯◯◯ Very low[a,e,f]
Health-related quality of life (assessed with: Standardised scale?)						
968 (2 RCTs)	very serious[a]	serious[b]	not serious	serious[c]	none	⊕◯◯◯ Very low[a,b,c]
Depression (assessed with: HADS?)						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[e,f]	none	⊕◯◯◯ Very low[d,e,f]

Older people in long-term care effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Anxiety (assessed with: HADS?)						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[e,f]	none	⊕◯◯◯ Very low[d,e,f]
Hospitalisations (assessed with: Mean)						
968 (2 RCTs)	very serious[a]	not serious	not serious	not serious	none	⊕⊕◯◯ Low[a]
Hospitalisations (assessed with: Mean)						
139 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[e,f]	none	⊕◯◯◯ Very low[a,e,f]
Emergency department visits (assessed with: Mean)						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[e,f]	none	⊕◯◯◯ Very low[d,e,f]

Explanations

a. Most studies were high risk of bias
b. Inconsistent effect across studies
c. Variations in effect ranges
d. Some studies had some risk of concerns
e. Single study
f. Small sample size

Female contraceptive users effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Continuation (follow-up: 6 months; assessed with: Yes/No)						
172665 (2 non-randomised studies)	very serious[a]	serious[b]	not serious	serious[c]	none	⊕◯◯◯ Very low[a,b,c]

Female contraceptive users effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Adherence (follow-up: 6 months; assessed with: Yes/No)						
172665 (2 non-randomised studies)	very serious[a]	not serious	not serious	serious[c]	none	⊕◯◯◯ Very low[a,c]

Explanations

a. All studies were high risk of bias

b. Inconsistent effect across studies

c. Wide confidence intervals

Anaemia in pregnancy effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Haemoglobin goal achieved (assessed with: Yes/No)						
200 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Haemoglobin levels (assessed with: Mean)						
200 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]

Explanations

a. Most studies were high risk of bias

b. Single study

Chronic pain conditions effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Quality of life (physical) (assessed with: EQ-5D scale)						

Chronic pain conditions effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
84 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Quality of life (physical) (assessed with: EQ-5D)						
86 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Quality of life (psychological) (assessed with: EQ-5D)						
85 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Quality of life (psychological) (assessed with: EQ-5D)						
87 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Chronic pain intensity (assessed with: Chronic Pain Scale)						
89 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Chronic pain intensity (assessed with: Chronic pain scale)						
97 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Chronic pain disability (assessed with: Chronic Pain Scale)						
94 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Chronic pain disability (assessed with: Chronic Pain Scale)						
101 (1 RCT)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Depression (assessed with: HADS-D)						
86 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Depression (assessed with: HADS-D)						

Chronic pain conditions effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
93 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Anxiety (assessed with: HADS-A)						
87 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Anxiety (assessed with: HADS-A)						
92 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]

Explanations
a. Most studies are high risk of bias
b. Single study
c. Small sample size

Mixed health conditions effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
HbA1c goal achieved (assessed with: Yes/No)						
215 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
HbA1c goal achieved (assessed with: Yes/No)						
235 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Blood pressure goal achieved (assessed with: Yes/No)						
605 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]

Mixed health conditions effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Blood pressure goal achieved (assessed with: Yes/No)						
614 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
LDL cholesterol goal achieved (assessed with: Yes/No)						
314 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
LDL cholesterol goal achieved (assessed with: Yes/No)						
325 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
Clinic visits (assessed with: Relative risk)						
605 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
Clinic visits (assessed with: Relative risk)						
614 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
Hospitalisations (assessed with: Relative risk)						
605 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
Hospitalisations (assessed with: Relative risk)						
614 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
Hospitalisations (assessed with: No. events)						
753 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]

Mixed health conditions effectiveness outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Length of hospital stay (assessed with: Mean no. days)						
762 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
Emergency department visits (assessed with: Relative risk)						
605 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
Emergency department visits (assessed with: Relative risk)						
614 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]

Explanations

a. Most studies have high risk of bias

b. Single study

Heart failure safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Hospitalisations due to heart failure (assessed with: Yes/No)						
791 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]
Mortality (assessed with: No. events)						
791 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⨁◯◯◯ Very low[a,b]

Explanations

a. Most studies were high risk of bias

b. Single study

Stroke safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Mortality (assessed with: No. events)						
279 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Vascular adverse event (assessed with: No. events)						
279 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]

Explanations
a. Most studies were high risk of bias
b. Single study

Dyslipidaemia safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Adverse events						
211 (1 RCT)	serious[a]	not serious	not serious	serious[b]	none	⊕⊕◯◯ Low[a,b]

Explanations
a. Some studies were some concerns risk of bias
b. Single study

Coagulation disorder safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Warfarin-related complications (bleeding)						

Coagulation disorder safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
95 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Thromboembolic adverse events						
95 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Anticoagulation-related adverse events						
350 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b]	none	⊕◯◯◯ Very low[a,b]
Bleeds/adverse drug events						
51 (1 non-randomised study)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Anticoagulation-related hospital admissions						
350 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b]	none	⊕◯◯◯ Very low[a,b]
Anticoagulation-related emergency department visits						
350 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b]	none	⊕◯◯◯ Very low[a,b]
Warfarin related hospitalisations/ED visits						
200 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,d]	none	⊕◯◯◯ Very low[a,b,d]

Explanations
a. Most studies were high risk of bias
b. Single study
c. Small sample size
d. Wide confidence intervals

Urinary tract infection safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
All adverse events						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Gastrointestinal adverse events						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Vaginal candidiasis adverse events						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Headache adverse events						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Other adverse events						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Physician or emergency department events						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Antibacterial therapy guideline concordance						
686 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]

Explanations

a. Most studies were high risk of bias

b. Single study

Older people in long-term care safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Mortality (assessed with: No. events)						
876 (1 RCT)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Mortality (assessed with: No. events)						
139 (1 non-randomised study)	very serious[a]	not serious	not serious	very serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]
Syncope						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[b,c,d]
Hypotension						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[b,c,d]
Hypokalemia						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[b,c,d]
Hyperkalemia						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[b,c,d]
Hyponatremia						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[b,c,d]
Orthostatic presyncope						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[b,c,d]

Older people in long-term care safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Change in eGFR						
92 (1 RCT)	serious[d]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[b,c,d]

Explanations

a. Most studies were high risk of bias

b. Single study

c. Small sample size

d. Some studies were some concerns risk of bias

Female contraceptive users safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Medical contraindications (assessed with: Yes/No)						
439650 (2 non-randomised studies)	very serious[a]	not serious	not serious	not serious	none	⊕◯◯◯ Very low[a]

Explanations

a. Most studies were high risk of bias

Surgery patients safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Prescribing errors (assessed with: No. events)						

Surgery patients safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
73 (1 RCT)	very serious[a]	not serious	not serious	extremely serious[b,c]	none	⊕◯◯◯ Very low[a,b,c]

Explanations
a. Most studies were high risk of bias
b. Single study
c. Small sample size

People at risk of drug-related problems outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Mortality (assessed with: Yes/No)						
762 (1 RCT)	very serious[a]	not serious	not serious	very serious[b]	none	⊕◯◯◯ Very low[a,b]

Explanations
a. Most studies were high risk of bias
b. Single study

Mixed health conditions safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
Gastrointestinal (GI) bleeding events (hospitalisations and ER visits)						
2155 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Acute kidney injury (AKI) events (hospitalisations and ER visits)						

Mixed health conditions safety outcomes						
Participants (studies)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Overall certainty of evidence
2155 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]
Pain (hospitalisations and ER visits)						
1805 (1 non-randomised study)	very serious[a]	not serious	not serious	serious[b]	none	⊕◯◯◯ Very low[a,b]

Explanations

a. Most studies were high risk of bias

b. Single study

Appendix R Excluded studies

A list of studies excluded at full-text screening stage are provided in this appendix. Reasons for exclusion included not meeting eligibility criteria for population, intervention, comparator, outcome or study design outlined in Section 2.2.1, Section 2.2.2, or Section 2.2.3. One study was excluded as it was unavailable (i.e. the full article could not be accessed).

Excluded studies for Q1 and Q2 (effectiveness and safety)

Excluded on population (n=1)	
1.	Study on Impact of Clinical Pharmacist's Interventions in the Optimal Use of Oral Anticoagulants in Stroke Patients Lakshmi et al. Indian J Pharm Sci. 2013 Jan-Feb;75(1):53–59

Excluded on intervention (n=182)	
1.	Abah I O, Ojeh V B, Falang K D, et al. Pharmaceutical care outcomes in an outpatient human immunodeficiency virus treatment center in Jos, Nigeria. Journal of Basic and Clinical Pharmacy 2014;5:57–61. doi:10.4103/0976-0105.139727
2.	Abdulrhim Sara, Awaisu Ahmed, Ibrahim Mohamed Izham Mohamed, et al. Impact of pharmacist-involved collaborative care on diabetes management in a primary healthcare setting using real-world data. International journal of clinical pharmacy 2022;44:153–62. doi:10.1007/s11096-021-01327-x
3.	Adibe Maxwell Ogochukwu, Ukwe Chinwe V, Aguwa Cletus N. The Impact of Pharmaceutical Care Intervention on the Quality of Life of Nigerian Patients Receiving Treatment for Type 2 Diabetes. Value in health regional issues 2013;2:240–7. doi:10.1016/j.vhri.2013.06.007
4.	Adler David A, Bungay Kathleen M, Wilson Ira B, et al. The impact of a pharmacist intervention on 6-month outcomes in depressed primary care patients. General hospital psychiatry 2004;26:199–209. doi:10.1016/j.genhosppsych.2003.08.005
5.	Airee Anita, Guirguis Alexander B, Mohammad Rima A. Clinical outcomes and pharmacists' acceptance of a community hospital's anticoagulation management service utilizing decentralized clinical staff pharmacists. The Annals of pharmacotherapy 2009;43:621–8. doi:10.1345/aph.1L460
6.	Al Mazroui Nadia Rashid, Kamal Mostafa Mohamed, Ghabash Naserdeen Mehana, et al. Influence of pharmaceutical care on health outcomes in patients with Type 2 diabetes mellitus. British journal of clinical pharmacology 2009;67:547–57. doi:10.1111/j.1365-2125.2009.03391.x
7.	Al-Taie Anmar, Izzettin Fikret V, Sancar Mesut, et al. Impact of clinical pharmacy recommendations and patient counselling program among patients with diabetes and cancer in outpatient oncology setting. European journal of cancer care 2020;29:e13261. doi:10.1177/0145721708316625.;
8.	Albsoul-Younes Abla M, Hammad Eman A, Yasein Nada A, et al. Pharmacist-physician collaboration improves blood pressure control. Saudi medical journal 2011;32:288–92.
9.	Alex Sumana, Adenew Ayne B, Arundel Cherinne, et al. Medication Errors Despite Using Electronic Health Records: The Value of a Clinical Pharmacist Service in Reducing Discharge-Related Medication Errors. Quality management in health care 2016;25:32–7. doi:10.1097/QMH.0000000000000080
10.	Amariles Pedro, Sabater-Hernández Daniel, García-Jiménez Emilio, et al. Effectiveness of Dader Method for Pharmaceutical Care on Control of Blood Pressure and Total Cholesterol in Outpatients with Cardiovascular Disease or Cardiovascular Risk: EMDADER-CV Randomized

Excluded on intervention (n=182)	
	Controlled Trial. Journal of managed care pharmacy : JMCP 2012;18:311–23. doi:10.18553/jmcp.2012.18.4.311
11.	Ammerman Catherine A, Simpkins Brent A, Warman Nora, et al. Potentially Inappropriate Medications in Older Adults: Deprescribing with a Clinical Pharmacist. Journal of the American Geriatrics Society 2019;67:115–8. doi:10.1111/jgs.15623
12.	Anaya JP, Rivera JO, Lawson K, et al. Evaluation of pharmacist-managed diabetes mellitus under a collaborative drug therapy agreement. American Journal of Health-System Pharmacy 2008;65:1841–5. doi:10.2146/ajhp070568
13.	Anderegg Maxwell D, Gums Tyler H, Uribe Liz, et al. Physician-Pharmacist Collaborative Management: Narrowing the Socioeconomic Blood Pressure Gap. Hypertension (Dallas, Tex : 1979) 2016;68:1314–20. doi:10.1161/HYPERTENSIONAHA.116.08043
14.	Armour Carol L, Reddel Helen K, LeMay Kate S, et al. Feasibility and effectiveness of an evidence-based asthma service in Australian community pharmacies: a pragmatic cluster randomized trial. The Journal of asthma : official journal of the Association for the Care of Asthma 2012;50:302–9. doi:10.3109/02770903.2012.754463
15.	Ashjian Emily, Kurtz Brian, Renner Elizabeth, et al. Evaluation of a pharmacist-led outpatient direct oral anticoagulant service. American journal of health-system pharmacy : AJHP : official journal of the American Society of Health-System Pharmacists 2017;74:483–9. doi:10.2146/ajhp151026
16.	Aubert Carole E, Blum Manuel R, Gastens Viktoria, et al. Prescribing, deprescribing and potential adverse effects of proton pump inhibitors in older patients with multimorbidity: an observational study. CMAJ open 2023;11:E170–8. doi:10.9778/cmajo.20210240
17.	Bacci Jennifer L, Marcum Zachary A, Rodriguez Patricia, et al. Community pharmacist intervention to optimize statin adherence in diabetes care: The GuIDE-S study. Journal of the American Pharmacists Association : JAPhA 2023;63:946–51. doi:10.1016/j.japh.2023.03.002
18.	Baqir W, Hughes J, Jones T, et al. Impact of medication review, within a shared decision-making framework, on deprescribing in people living in care homes. European Journal of Hospital Pharmacy 2017;24:30–3. doi:10.1136/ejhpharm-2016-000900
19.	Batran Radwa Ahmed, Sabri Nagwa Ali, Ali Ihab, et al. Cost-Effectiveness of the Pharmacist-Managed Warfarin Therapy vs. Standard Care for Patients With Mechanical Mitral Valve Prostheses: An Egyptian Healthcare Perspective. Frontiers in cardiovascular medicine 2022;9:889197-NA. doi:10.3389/fcvm.2022.889197
20.	Bernsten Cecilia, Björkman Ingeborg, Caramona Margarida, et al. Improving the well-being of elderly patients via community pharmacy-based provision of pharmaceutical care: a multicentre study in seven European countries. Drugs & aging 2001;18:63–77. doi:10.2165/00002512-200118010-00005
21.	Biscup-Horn Paula J, Streiff Michael B, Ulbrich Timothy R, et al. Impact of an Inpatient Anticoagulation Management Service on Clinical Outcomes. The Annals of pharmacotherapy 2008;42:777–82. doi:10.1345/aph.1l027
22.	Bloom Caitlyn I, Ku Mary, Williams Mikesha. Clinical pharmacy specialists' impact in patient aligned care teams for type 2 diabetes management. Journal of the American Pharmacists Association : JAPhA 2019;59:717–21. doi:10.1016/j.japh.2019.05.002
23.	Blyler Ciantel A, Rader Florian. Sustainability of blood pressure reduction in black barbershops. Current opinion in cardiology 2019;34:693–9. doi:10.1097/HCO.0000000000000674

Excluded on intervention (n=182)	
24.	Bogden Paul E, Abbott Robert D, Williamson Pam, et al. Comparing Standard Care with a Physician and Pharmacist Team Approach for Uncontrolled Hypertension. Journal of general internal medicine 1998;13:740–5. doi:10.1046/j.1525-1497.1998.00225.x
25.	Bond C, Matheson C, Williams S, et al. Repeat prescribing: a role for community pharmacists in controlling and monitoring repeat prescriptions. The British journal of general practice : the journal of the Royal College of General Practitioners 2000;50:271–5.
26.	Bowers Brandi L, Drew Amy M, Verry Christian. Impact of Pharmacist-Physician Collaboration on Osteoporosis Treatment Rates. The Annals of pharmacotherapy 2018;52:876–83. doi:10.1177/1060028018770622
27.	Brook-Barclay L, Delaney C L, Scicchitano M, et al. Pharmacist influence on prescribing in peripheral arterial disease (PIPER). Vascular Medicine (United Kingdom) 2014;19:118–24. doi:10.1177/1358863X14523064
28.	Bucaloiu ID, Akers G, Bermudez MC, et al. Outpatient erythropoietin administered through a protocol-driven, pharmacist-managed program may produce significant patient and economic benefits. Manag Care Interface 2007;20:26–30.
29.	Bungard Tammy J, Ritchie Bruce, Garg Sipi, et al. Sustained impact of anticoagulant control achieved in an anticoagulation management service after transfer of management to the primary care physician. Pharmacotherapy 2012;32:112–9. doi:10.1002/PHAR.1011
30.	Burns Naomi. Evaluation of warfarin dosing by pharmacists for elderly medical in-patients. Pharmacy world & science : PWS 2004;26:232–7. doi:10.1023/b:phar.0000035885.00408.9e
31.	Carter Barry L, Coffey Christopher S, Ardery Gail, et al. Cluster-randomized trial of a physician/pharmacist collaborative model to improve blood pressure control. Circulation Cardiovascular quality and outcomes 2015;8:235–43. doi:10.1161/CIRCOUTCOMES.114.001283
32.	Carter Barry L, Doucette William R, Franciscus Carrie L, et al. Deterioration of blood pressure control after discontinuation of a physician-pharmacist collaborative intervention. Pharmacotherapy 2010;30:228–35. doi:10.1592/phco.30.3.228
33.	Chang Alex R, Evans Michael A, Yule Christina, et al. Using pharmacists to improve risk stratification and management of stage 3A chronic kidney disease: a feasibility study. BMC nephrology 2016;17:168–168. doi:10.1186/s12882-016-0383-7
34.	Chen Dayu, Wen Bo, Wu Xuanyu, et al. Pharmacist-Driven Dosing Services and Pharmaceutical Care Increase Probability of Teicoplanin Target Concentration Attainment and Improve Clinical and Economic Outcomes in Non-Critically Ill Patients. Infectious diseases and therapy 2023;12:1579–92. doi:10.1007/s40121-023-00812-2
35.	Chen Q, Wang Q, Zhang Y. Clinical Intervention Increases Rational Use of Proton Pump Inhibitors in the General Surgery Department. Frontiers in Pharmacology 2022;13:864081. doi:10.3389/fphar.2022.864081
36.	Chen Ziqian, Ernst Michael E, Ardery Gail, et al. Physician-pharmacist co-management and 24-hour blood pressure control. Journal of clinical hypertension (Greenwich, Conn) 2013;15:337–43. doi:10.1111/jch.12077
37.	Chiquette E, Amato M G, Bussey H I. Comparison of an anticoagulation clinic with usual medical care: anticoagulation control, patient outcomes, and health care costs. Archives of Internal Medicine 1998;158:1641–7. doi:10.1001/archinte.158.15.1641
38.	Choe Hae Mi, Mitrovich Sonya, Dubay Daniel, et al. Proactive case management of high-risk patients with type 2 diabetes mellitus by a clinical pharmacist: a randomized controlled trial. The American journal of managed care 2005;11:253–60.

Excluded on intervention (n=182)	
39.	Cranor C W, Christensen D B. The Asheville project: Short-term outcomes of a community pharmacy diabetes care program. Journal of the American Pharmacists Association 2012;52:838–40. doi:10.1331/JAPhA.2012.12542
40.	Damaske DL, and Baird RW. Development and Implementation of a Pharmacist-Managed Inpatient Warfarin Protocol. Baylor University Medical Center Proceedings 2005;18:397–400. doi:10.1080/08998280.2005.11928100
41.	Dashti-Khavidaki Simin, Sharif Zahra, Khalili Hossein, et al. The use of pharmaceutical care to improve health-related quality of life in hemodialysis patients in Iran. International journal of clinical pharmacy 2013;35:260–7. doi:10.1007/s11096-012-9748-6
42.	Dawson Nancy L, Porter Ivan E, Klipa Dusko, et al. Inpatient warfarin management: pharmacist management using a detailed dosing protocol. Journal of thrombosis and thrombolysis 2011;33:178–84. doi:10.1007/s11239-011-0655-9
43.	DeLucenay Alexander, Curran Kelly, Karnes Angela. Impact of a pharmacist and nurse led clinic on patient blood pressure control. Journal of Interprofessional Education & Practice 2017;8:57–9. doi:10.1016/j.xjep.2017.06.003
44.	Dineen-Griffin Sarah, Benrimoj Shalom I, Rogers Kris, et al. Cluster randomised controlled trial evaluating the clinical and humanistic impact of a pharmacist-led minor ailment service. BMJ quality & safety 2020;29:921–31. doi:10.1136/bmjqs-2019-010608
45.	Dixon Dave L, Baker William L, Buckley Leo F, et al. Effect of a Physician/Pharmacist Collaborative Care Model on Time in Target Range for Systolic Blood Pressure: Post Hoc Analysis of the CAPTION Trial. Hypertension (Dallas, Tex : 1979) 2021;78:966–72. doi:10.1161/HYPERTENSIONAHA.121.17873
46.	Edey Rachel, Edwards Nicholas, Von Sychowski Jonah, et al. Impact of deprescribing rounds on discharge prescriptions: an interventional trial. International journal of clinical pharmacy 2019;41:159–66. doi:10.1007/s11096-018-0753-2
47.	Ellis Samuel L, Carter Barry L, Malone Daniel C, et al. Clinical and Economic Impact of Ambulatory Care Clinical Pharmacists in Management of Dyslipidemia in Older Adults: The IMPROVE Study. Pharmacotherapy 2000;20:1508–16. doi:10.1592/phco.20.19.1508.34852
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Excluded on outcome (n=1)	
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2.	Dixon DL. Cost-effectiveness of pharmacist prescribing for managing hypertension in the United States. Health Policy 2023;6. doi:10.1001/jamanetworkopen.2023.41408
3.	Sanyal C, Turner JP, Martin P, et al. Cost-effectiveness of pharmacist-led deprescribing of NSAIDs in community-dwelling older adults. Journal of the American Geriatrics Society 2020;68:1090–7. doi:10.1111/jgs.16388

Excluded on study design (n=43)	
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