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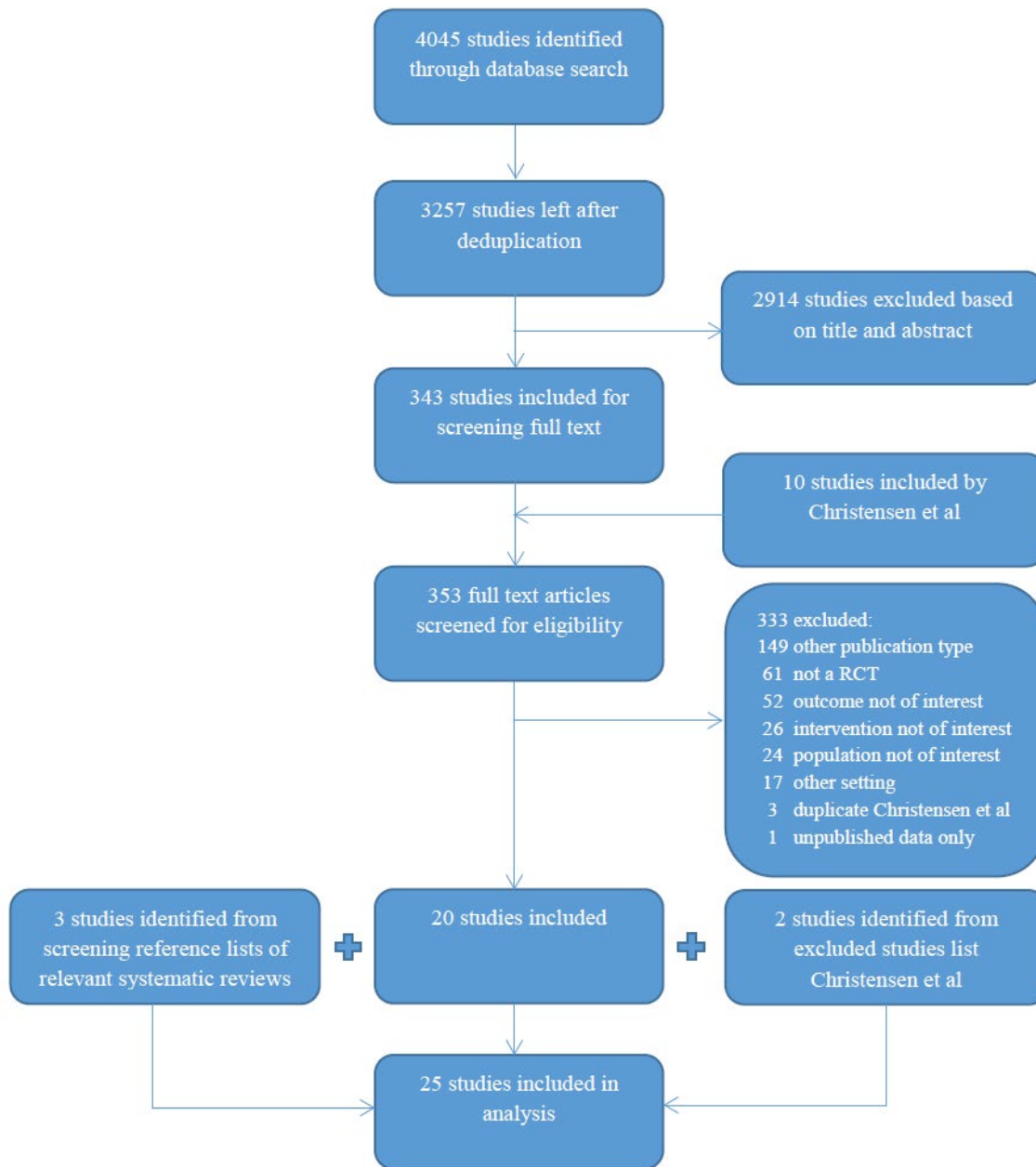
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Supplementary Table S1. Medication review interventions categorized into 9 components

| Intervention component | Definitions | | | |
|--|--|--|--|---|
| Medication review (mdrev) | Medication review is a structured evaluation of a patient's medicines with the aim of optimizing medicine use and improving health outcomes. This entails detecting medication-related problems and recommending interventions. | | | |
| | Performed by: - Pharmacist alone - Pharmacist and physician team - Physician alone - Nurse - Pharmacy technician - Other | Context: - Solely a medication review - Medication review as part of a Comprehensive Geriatric Assessment | How many times performed? - Once - Daily - Weekly - Certain number of times | Delivery of recommendations: - Written report - Oral report/deliberation - Directly executed. |
| Medication reconciliation (mdrec) | The process of identifying the most accurate list of a patient's current medicines including the name, dosage, frequency and route – and comparing them to the current list in use, recognizing and documenting any discrepancies, thus resulting in a complete list of medications. | | | |
| Shared decision making (sdm) | The process of information exchange, deliberation and making a decision between patient and physician. | | | |
| Patient education/ medication counselling (pedu) | Interventions designed to provide patient support, typically via tailored education to inform the patient about their condition(s), medication indications and its correct use, supporting medication adherence or using motivational interviewing. There is a focus on medications which had been commenced or discontinued too. | | | |
| Health professional education (hpedu) | Education of health professionals on how to perform a medication review or raising awareness about the importance of medication reviews. | | | |
| Use of validated methods (vm) | The use of validated criteria for determining inappropriate medication use, like Beers' criteria ¹ or START/STOPP criteria ² . | | | |
| Use of Computerized Decision Support (cds) | Computerized decision-making support (CDS) for medication management involves a programme on the health professional's computer to guide the prescriber to the selection of appropriate treatment(s) by means of electronic alerts. | | | |
| Compliance aid (ca) | The use of tools to improve compliance with the medication regimen, e.g. dosette or Webster pack. | | | |
| Transitional care (tc) | The development of an individualized discharge plan for a patient prior to them leaving hospital for home. Discharge planning may also extend across healthcare settings and include postdischarge support. Regarding medication use: the preparation of a medicines record sheet, outlining all medications and dosage instructions. The distribution of this information to the patient's general practitioner and community pharmacist. (Telephone) follow-up by the clinical pharmacist or physician. | | | |



Supplementary Figure S1. Flow diagram of study selection

Supplementary Table S2. Individual study characteristics of the 25 randomized controlled studies included in the analysis

| First author, year | Study design | Comparison(s) ^a | Outcome(s) ^b | Duration of follow-up (weeks) |
|-----------------------|--------------|---|-------------------------|-------------------------------|
| Bladh, 2011 | Parallel | Mdrev+pedu+cds+tc; uc | 1,3 | 26 |
| Bonetti, 2018 | Parallel | Mdrev+pedu+tc; uc | 1,2 | 4 |
| Brühwiler, 2019 | Parallel | Mdrev+mdrec; uc | 1,2 | 4 |
| Chiu, 2018 | Quasi | Mdrev+mdrec+pedu; uc | 1,2 | 12 |
| Cossette, 2017 | Parallel | Mdrev+cds; uc | 1,2 | 4 |
| Edey, 2019 | Cluster | Mdrev+tc; uc | 1,2 | 4 |
| Elliott, 2017 | Parallel | Mdrev+cds; mdrev | 1,2 | 8 |
| Gillespie, 2009 | Parallel | Mdrev+mdrec+pedu+tc; uc | 1,4 | 52 |
| Gustafsson, 2017 | Parallel | Mdrev+mdrec+tc; uc | 1,2,3,5 | 26 |
| Haag, 2016 | Parallel | Mdrev+tc; uc | 1,2 | 4 |
| Hohl, 2017 | Quasi | Mdrev+mdrec; uc | 1,2 | 4 |
| Holland, 2005 | Parallel | Mdrev+pedu+hpedu+ca+tc; uc | 1,3,6 | 26 |
| Legrain, 2011 | Parallel | Mdrev+mdrec+pedu+tc; uc | 1,3 | 26 |
| Lenssen, 2018 | Parallel | Mdrev+mdrec+tc; uc | 5 | 52 |
| Lisby, 2018 | Parallel | Mdrev+mdrec; uc | 1 | 12 |
| Lisby, 2010 | Parallel | Mdrev+mdrec; uc | 1 | 12 |
| Mannheimer, 2006 | Parallel | Mdrev+cds; uc | 1,3 | 26 |
| Naunton, 2003 | Parallel | Mdrev+pedu+ca+tc; uc | 1,5 | 12 |
| Nielsen, 2017 | Parallel | Mdrev+mdrec; uc | 1,4 | 52 |
| Ravn-Nielsen, 2018 | Parallel | Mdrev+mdrec+pedu+hpedu+tc; mdrev+hpedu; uc | 1,2,3,5 | 26 |
| Scullin, 2007 | Parallel | Mdrev+mdrec+pedu+hpedu+tc; uc | 1,4 | 52 |
| Spinewine, 2007 | Quasi | Mdrev+mdrec+pedu+tc; uc | 1,4 | 52 |
| Tuttle, 2018 | Parallel | Mdrev+mdrec+pedu+hpedu; uc | 1 | 12 |
| van der Heijden, 2019 | Cluster | Mdrev+mdrec+pedu+hpedu+vm+tc; uc | 1,3 | 26 |
| Van der Linden, 2017 | Quasi | Mdrev+mdrec+hpedu+vm; uc | 1,2 | 4 |

^a Abbreviations: mdrev, medication review; mdrec, medication reconciliation; pedu, patient education/medication counselling; hpedu, health professional education; vm, use of validated methods; cds, use of Computerized Decision Support; ca, compliance aid; tc, transitional care; uc, usual care.

^b Outcomes abbreviations:

Outcome 1 = all-cause hospital readmissions at any time

Outcome 2 = all-cause hospital readmissions within 30 days after discharge from the index admission

Outcome 3 = all-cause hospital readmissions within 180 days after discharge from the index admission

Outcome 4 = all-cause hospital readmissions within 1 year after discharge from the index admission

Outcome 5 = Persons experiencing medication-related readmissions

Outcome 6 = Hospital readmission rate (number of all-cause hospital readmissions per certain number of people and time units)

Supplementary Table S3. Individual participant characteristics of the 25 randomized controlled studies included in the analysis

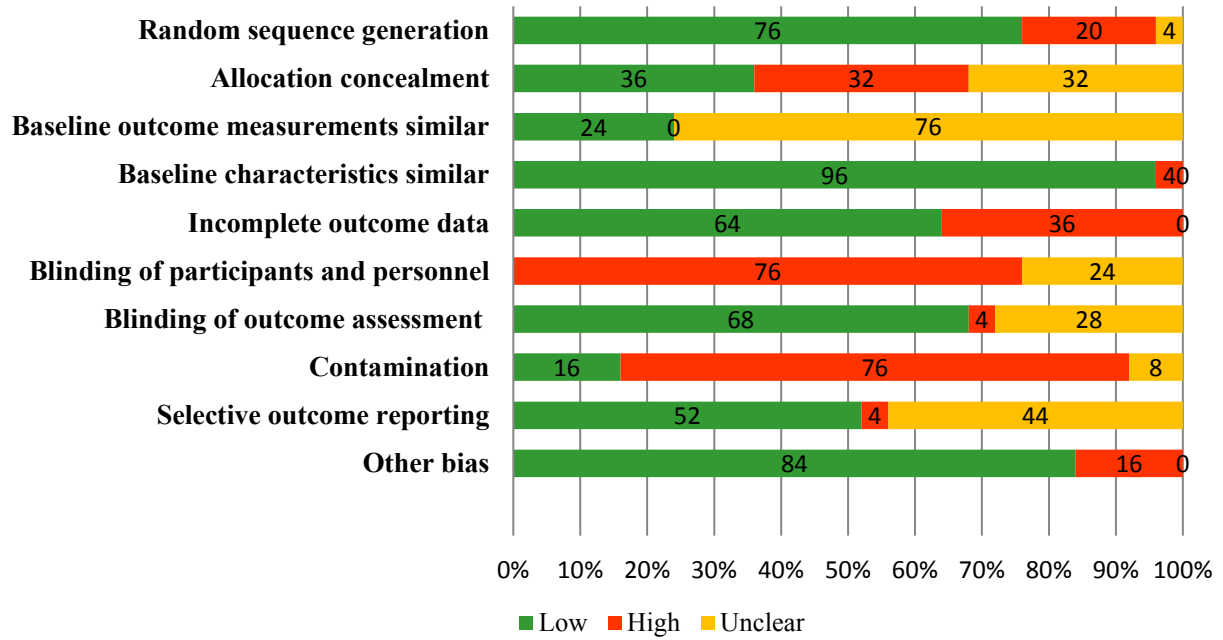
| First author, year | Country | Setting | Sample size | Mean/ median age (years) | Female (%) | Regular used medication, mean/median number |
|-----------------------|-----------------|--------------------|-------------|--------------------------|------------|---|
| Bladh, 2011 | Sweden | Hospital | 345 | 81;82* | 60.9 | NR |
| Bonetti, 2018 | Brazil | Hospital | 104 | 65 | 31.3;35.8* | 7;8* |
| Brühwiler, 2019 | Switzerland | Hospital | 152 | 72;71* | 36.8;43.4* | 6 |
| Chiu, 2018 | China | Hospital | 207 | 83.3 | 50;53.8* | 9.4 |
| Cossette, 2017 | Canada | Hospital | 254 | 81.5;80.5* | 61.9;58.6* | NR |
| Edey, 2019 | Canada | Hospital | 358 | 69 | 48.4 | 7.5 |
| Elliott, 2017 | United States | Hospital | 110 | 75.6 | 61.8 | NR |
| Gillespie, 2009 | Sweden | Hospital | 368 | 86.6 | 58.7 | 8.7;7.3* |
| Gustafsson, 2017 | Sweden | Hospital | 429 | 83.1 | 63;64* | 8.4;8.3* |
| Haag, 2016 | United States | Hospital | 22 | 81;86* | 31;17* | 17;15.5* |
| Hohl, 2017 | Canada | Hospital | 4049 | 71;69* | 56.4;55.1* | 8.1;7.7* |
| Holland, 2005 | United Kingdom | Community | 855 | 85.4;85.5* | 61.1;63.8* | 6.0;5.8* |
| Legrain, 2011 | France | Hospital | 665 | 85.8;86.4* | 69.7;62.6* | 6.9;6.6* |
| Lenssen, 2018 | Germany | Hospital | 60 | 77.6 | 60 | 16.8 |
| Lisby, 2018 | Denmark | Hospital | 98 | 80.4;80.5* | 72;71* | 7.0;6.4* |
| Lisby, 2010 | Denmark | Hospital | 99 | 80.2;78.2* | 60;61* | 10.2;10.1* |
| Mannheimer, 2006 | Sweden | Hospital | 300 | 71;74* | 51;48* | 7.4;6.9* |
| Naunton, 2003 | Australia | Community | 121 | 74;77* | 56;69* | 7;6.5* |
| Nielsen, 2017 | Denmark | Hospital | 310 | 74.1;72.1* | 54;46* | 8 |
| Ravn-Nielsen, 2018 | Denmark | Hospital | 1467 | 72 | 53.7 | 10;10;9* |
| Scullin, 2007 | United Kingdom | Hospital | 762 | 70.3;69.9* | NR | NR |
| Spinewine, 2007 | Belgium | Hospital | 172 | 82.4;81.9* | 71.9;66.7* | 7.9;7.3* |
| Tuttle, 2018 | United States | Community | 141 | 69 | 48 | 13 |
| van der Heijden, 2019 | The Netherlands | Community pharmacy | 123 | 75.5;73.9* | 48.1;56.4* | 8.9;8.4* |
| Van der Linden, 2017 | Belgium | Hospital | 166 | 84.5 | 48;56* | 9;10* |

* Data reported per study arm. NR; not reported

Supplementary Table S4. Individual Cochrane EPOC risk of bias assessment of the included studies

| First author, year | Random sequence generation | Allocation concealment | Similar baseline outcome measures | Similar baseline characteristics | Incomplete outcome data | Blinding of participants and personnel | Blinding of outcome assessment | Contamination | Selective outcome reporting | Other bias |
|-----------------------|----------------------------|------------------------|-----------------------------------|----------------------------------|-------------------------|--|--------------------------------|---------------|-----------------------------|------------|
| Bladh, 2011 | Low | Low | Unclear | Low | High | Unclear | Low | High | Low | Low |
| Bonetti, 2018 | Low | Unclear | Unclear | Low | High | High | Low | Unclear | Unclear | Low |
| Brühwiler, 2019 | Low | High | Unclear | Low | Low | High | Low | high | Unclear | Low |
| Chiu, 2018 | High | High | Unclear | Low | High | High | Unclear | High | Unclear | Low |
| Cossette, 2017 | Low | Unclear | Low | Low | High | High | Unclear | high | Low | High |
| Edey, 2019 | High | High | Unclear | Low | Low | High | Low | Low | Low | High |
| Elliott, 2017 | Low | Unclear | Unclear | Low | Low | High | Unclear | High | Low | Low |
| Gillespie, 2009 | Low | Unclear | Unclear | Low | Low | High | Low | High | Low | Low |
| Gustafsson, 2017 | Low | Low | Unclear | High | Low | High | Low | High | Low | Low |
| Haag, 2016 | Low | Low | Unclear | Low | Low | High | Low | High | Unclear | Low |
| Hohl, 2017 | High | High | Unclear | Low | Low | High | Low | Unclear | Unclear | Low |
| Holland, 2005 | Low | Low | Unclear | Low | Low | High | Low | High | Unclear | Low |
| Legrain, 2011 | Low | High | Low | Low | Low | High | Low | High | Unclear | Low |
| Lenssen, 2018 | Low | High | Unclear | Low | Low | Unclear | Low | High | Low | Low |
| Lisby, 2018 | Low | Low | Unclear | Low | Low | High | Low | High | Low | Low |
| Lisby, 2010 | Low | Unclear | Unclear | Low | Low | High | Unclear | High | Unclear | Low |
| Mannheimer, 2006 | Low | Low | Unclear | Low | Low | High | Unclear | High | Unclear | Low |
| Naunton, 2003 | Low | Unclear | Low | Low | Low | High | Low | High | Unclear | High |
| Nielsen, 2017 | Low | Low | Unclear | Low | High | High | Low | High | Low | Low |
| Ravn-Nielsen, 2018 | Low | Low | Low | Low | Low | High | Low | High | Low | Low |
| Scullin, 2007 | Low | Unclear | Low | Low | High | Unclear | Low | Low | Unclear | High |
| Spinewine, 2007 | High | High | Low | Low | High | Unclear | Low | high | Low | Low |
| Tuttle, 2018 | Low | Low | Unclear | Low | Low | High | Unclear | High | Low | Low |
| van der Heijden, 2019 | Unclear | Unclear | Unclear | Low | High | Unclear | High | Low | High | High |

| | | | | | | | | | | |
|----------------------|------|------|---------|-----|------|---------|---------|-----|-----|-----|
| Van der Linden, 2017 | High | High | Unclear | Low | High | Unclear | Unclear | Low | Low | Low |
|----------------------|------|------|---------|-----|------|---------|---------|-----|-----|-----|



Supplementary Figure S2. Aggregate risk of bias assessment per domain

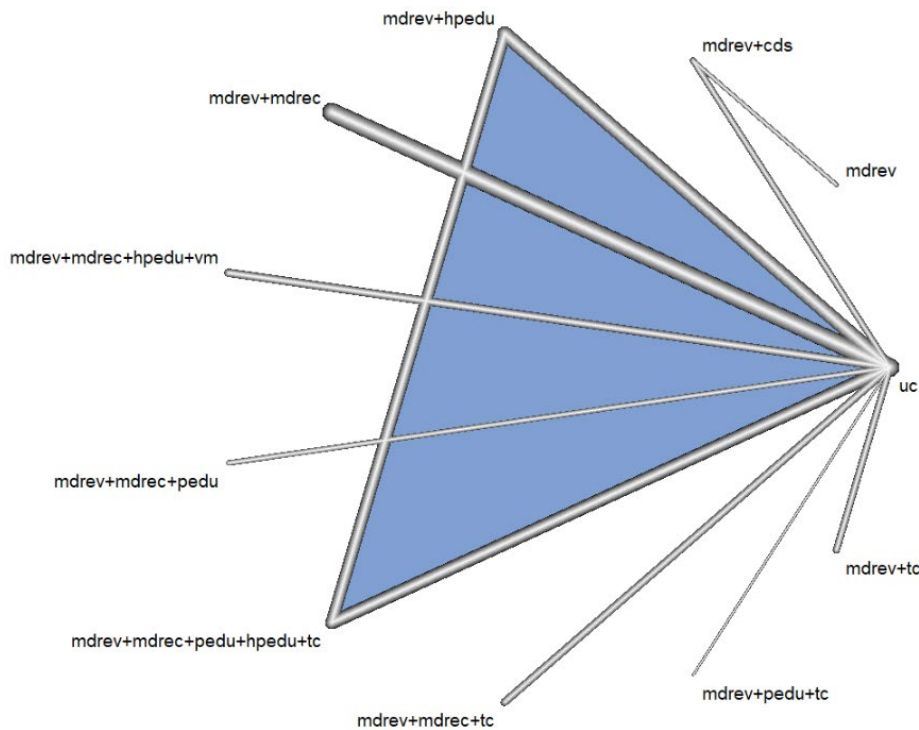
Characteristics of the medication review

A summary of medication review methodology is presented in Supplementary Table S5. All medication review interventions were performed in combination with at least one co-intervention. In 20 studies (80%) the medication review was performed by a pharmacist or clinical pharmacologist alone. Medication review was performed by a geriatrician in one study only.³ The number of times the medication review was performed varied from once (n=10, 40%) to several times (n=3, 12%) and daily (n=6, 24%). Recommendations following medication review were directly implemented in one study.⁴ While advice for the physician was given verbally (n=5, 20%), written (n=7, 28%) or both (n=4, 16%) in the remaining studies. The number of recommendations that followed from the medication review was described in only 3 studies, but the acceptance rate was reported in 10 studies, ranging from 18 to 82%. The studies barely reported on medication appropriateness or potentially inappropriate medication.

Supplementary Table S5. Description of how the medication review was conducted

| Aspects of the medication review | Number of studies (%) |
|---|-----------------------|
| Type of intervention | |
| Single component | 0 |
| Multiple components | 25 (100%) |
| Who performed the medication review | |
| Pharmacist or clinical pharmacologist | 20 (80%) |
| Pharmacist and clinical pharmacologist | 2 (8%) |
| Pharmacist and pharmacy technician | 1 (4%) |
| Pharmacist and trial nurse | 1 (4%) |
| Geriatrician | 1 (4%) |
| Number of times the medication review was conducted | |
| Once | 10 (40%) |
| Multiple times | 3 (12%) |
| Daily | 6 (24%) |
| Not reported | 6 (24%) |
| The way the recommendations were delivered | |
| Directly executed | 1 (4%) |
| Written report | 7 (28%) |
| Oral report/deliberation | 5 (20%) |
| Both written and oral | 4 (16%) |
| Not reported | 8 (32%) |

Results from (component) NMA for all-cause hospital readmissions within 30 days



A network plot provides an overview of the intervention data resulting from all included randomized controlled trials and visualizes the studied interventions and the direct comparisons between these interventions.

Nodes represent interventions consisting of one or more components and their size is proportional to the number of participants randomized to this intervention. Edges represent direct evidence obtained from randomized controlled trials directly comparing the interventions linked by this edge. Thickness of edges is proportional to the number of participants randomized to this comparison. The blue shadow connecting multiple interventions indicates a multi-arm trial.

Abbreviations: mdrev, medication review; mdrec, medication reconciliation; pedu, patient education/medication counselling; hpedu, health professional education; vm, use of validated methods; cds, use of Computerized Decision Support; ca, compliance aid; tc, transitional care; uc, usual care.

Supplementary Figure S3. Network plot for the outcome all-cause hospital readmissions within 30 days

Supplementary Table S6. Risk ratios (RR) with 95% confidence intervals (95% CI) resulting from network meta-analysis (left) and component network meta-analysis (right) for every intervention versus usual care for the outcome all-cause hospital readmissions within 30 days

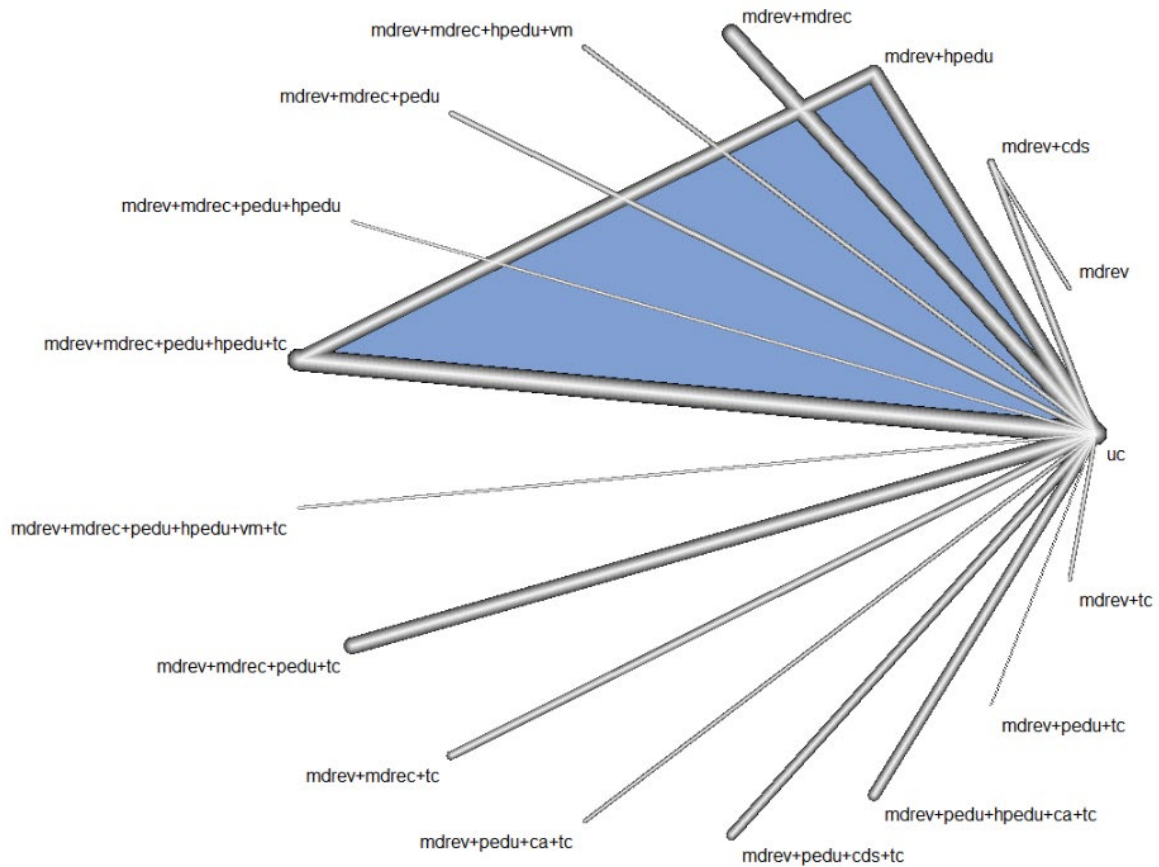
| Interventions | FULL NMA | | | CNMA | | |
|---------------------------|----------|---------|---------|------|---------|---------|
| | RR | 95% CIL | 95% CIH | RR | 95% CIL | 95% CIH |
| mdrev | 1.06 | 0.45 | 2.51 | 0.83 | 0.60 | 1.13 |
| mdrev+cds | 0.73 | 0.43 | 1.22 | 0.66 | 0.43 | 1.02 |
| mdrev+mdrec | 0.88 | 0.72 | 1.07 | 0.85 | 0.71 | 1.03 |
| mdrev+mdrec+pedu | 0.45 | 0.26 | 0.80 | 0.54 | 0.35 | 0.85 |
| mdrev+mdrec+pedu+hpedu+tc | 0.64 | 0.49 | 0.84 | 0.63 | 0.48 | 0.82 |
| mdrev+mdrec+tc | 0.79 | 0.52 | 1.22 | 0.89 | 0.66 | 1.22 |
| mdrev+mdrec+hpedu+vm | 0.88 | 0.59 | 1.31 | 0.88 | 0.59 | 1.31 |
| mdrev+pedu+tc | 0.59 | 0.18 | 1.91 | 0.55 | 0.30 | 1.01 |
| mdrev+tc | 0.89 | 0.55 | 1.42 | 0.87 | 0.59 | 1.27 |
| mdrev+hpedu | 0.89 | 0.70 | 1.14 | 0.91 | 0.71 | 1.15 |
| uc | - | - | - | 1.00 | 1.00 | 1.00 |

Abbreviations: mdrev, medication review; mdrec, medication reconciliation; pedu, patient education/medication counselling; hpedu, health professional education; vm, use of validated methods; cds, use of Computerized Decision Support; ca, compliance aid; tc, transitional care; uc, usual care.

Supplementary Table S7. Risk ratios with 95% confidence intervals (95% CI) resulting from the component network meta-analysis for every intervention component versus usual care for the outcome all-cause hospital readmissions within 30 days

| Component | Risk ratio | 95% CI |
|--|------------|-----------|
| Use of Computerized Decision Support | 0.80 | 0.51-1.27 |
| Medication reconciliation | 1.03 | 0.73-1.46 |
| Medication review | 0.83 | 0.60-1.13 |
| Patient education/medication counselling | 0.64 | 0.41-0.99 |
| Transitional care | 1.05 | 0.78-1.42 |
| Health professional education | 1.10 | 0.76-1.58 |
| Use of validated methods | 0.94 | 0.54-1.64 |

Results from (component) NMA for all-cause hospital readmissions at any time



A network plot provides an overview of the intervention data resulting from all included randomized controlled trials and visualizes the studied interventions and the direct comparisons between these interventions.

Nodes represent interventions consisting of one or more components and their size is proportional to the number of participants randomized to this intervention. Edges represent direct evidence obtained from randomized controlled trials directly comparing the interventions linked by this edge. Thickness of edges is proportional to the number of participants randomized to this comparison. The blue shadow connecting multiple interventions indicates a multi-arm trial.

Abbreviations: mdrev, medication review; mdrec, medication reconciliation; pedu, patient education/medication counselling; hpedu, health professional education; vm, use of validated methods; cds, use of Computerized Decision Support; ca, compliance aid; tc, transitional care; uc, usual care.

Supplementary Figure S4. Network plot for the outcome all-cause hospital readmissions at any time

Supplementary Table S8. Risk ratios (RR) with 95% confidence intervals (95% CI) resulting from network meta-analysis (left) and component network meta-analysis (right) for every intervention versus usual care for the outcome all-cause hospital readmissions at any time

| Interventions | FULL NMA | | | CNMA | | |
|------------------------------|----------|---------|---------|------|---------|---------|
| | RR | 95% CIL | 95% CIU | RR | 95% CIL | 95% CIU |
| mdrev | 1.50 | 0.84 | 2.69 | 1.00 | 0.79 | 1.26 |
| mdrev+cds | 1.02 | 0.79 | 1.31 | 0.95 | 0.76 | 1.20 |
| mdrev+mdrec | 0.92 | 0.82 | 1.05 | 0.88 | 0.75 | 1.03 |
| mdrev+mdrec+pedu | 0.76 | 0.55 | 1.04 | 0.84 | 0.64 | 1.10 |
| mdrev+mdrec+pedu+tc | 0.91 | 0.79 | 1.04 | 0.87 | 0.75 | 1.02 |
| mdrev+mdrec+pedu+hpedu | 1.01 | 0.58 | 1.76 | 0.86 | 0.66 | 1.13 |
| mdrev+mdrec+pedu+hpedu+tc | 0.82 | 0.74 | 0.91 | 0.89 | 0.74 | 1.08 |
| mdrev+mdrec+pedu+hpedu+vm+tc | 2.22 | 1.29 | 3.83 | 1.25 | 0.85 | 1.84 |
| mdrev+mdrec+tc | 0.94 | 0.74 | 1.19 | 0.91 | 0.71 | 1.16 |
| mdrev+mdrec+hpedu+vm | 0.88 | 0.59 | 1.31 | 1.25 | 0.86 | 1.82 |
| mdrev+pedu+cds+tc | 1.02 | 0.82 | 1.26 | 0.95 | 0.74 | 1.21 |
| mdrev+pedu+ca+tc | 0.62 | 0.38 | 1.02 | 1.02 | 0.74 | 1.40 |
| mdrev+pedu+tc | 0.59 | 0.18 | 1.91 | 1.00 | 0.72 | 1.38 |
| mdrev+pedu+hpedu+ca+tc | 1.22 | 1.01 | 1.46 | 1.04 | 0.79 | 1.37 |
| mdrev+tc | 0.89 | 0.55 | 1.42 | 1.03 | 0.77 | 1.40 |
| mdrev+hpedu | 0.97 | 0.86 | 1.10 | 1.02 | 0.80 | 1.29 |
| uc | - | - | - | 1.00 | 1.00 | 1.00 |

Abbreviations: mdrev, medication review; mdrec, medication reconciliation; pedu, patient education/medication counselling; hpedu, health professional education; vm, use of validated methods; cds, use of Computerized Decision Support; ca, compliance aid; tc, transitional care; uc, usual care.

Supplementary Table S9. Risk ratios with 95% confidence intervals (95% CI) resulting from the component network meta-analysis for every intervention component versus usual care for the outcome all-cause hospital readmissions at any time

| Component | Risk ratio | 95% CI |
|--|------------|-----------|
| Use of Computerized Decision Support | 0.95 | 0.70-1.30 |
| Medication reconciliation | 0.88 | 0.68-1.14 |
| Medication review | 1.00 | 0.79-1.26 |
| Compliance aid | 1.02 | 0.69-1.51 |
| Patient education/medication counselling | 0.96 | 0.74-1.25 |
| Transitional care | 1.04 | 0.82-1.31 |
| Health professional education | 1.02 | 0.82-1.27 |
| Use of validated methods | 1.40 | 0.92-2.14 |

Additional information about methods

1.1 Additional information regarding study population, interventions, comparators and outcomes

Supplementary Table S10. Study population, interventions, comparators and outcomes

| | |
|---------------------|---|
| Population | Adults aged ≥ 65 years Included: - Hospitalized patients or recently* discharged to the community, nursing home or rehabilitation center after hospital admission Excluded: studies that included, in particular: <ul style="list-style-type: none">- Persons with solely end of life care- Persons with psychiatric diseases, such as schizophrenia or depression- Persons with specific diseases, receiving disease-specific medication (e.g. COPD or heart failure)- Persons recruited from intensive care units- Outpatients and persons seen at the emergency department but not admitted to a hospital |
| Intervention | Medication review as an isolated intervention or with co-interventions performed during hospital admission, at discharge or shortly after*. Interventions of included studies were classified into the 9 intervention components presented in Supplementary Table S1. Excluded: - Medication reviews targeting specific medication types instead of the whole medication list |
| Comparator | Usual care, a sham intervention or another medication review intervention |
| Outcomes | 1. Persons experiencing at least one all-cause hospital readmission <ul style="list-style-type: none">- within 30 days after discharge from the index admission- within 180 days after discharge from the index admission- within 1 year after discharge from the index admission- at any time 2. Persons experiencing at least one medication-related readmissions at any time 3. Hospital readmission rate (number of all-cause hospital readmissions per certain number of people and time units) |

* the medication review was performed within 2 weeks of discharge

1.2 Additional information regarding NMA:

We compared the relative intervention efficacy using frequentist NMA.^{5,6} When the number of included studies was sufficient, we performed random-effects NMA for each of the aforementioned outcomes, using the graph-theoretical method. Network plots were used to examine the network geometry, and forest plots and league tables (that rank the interventions from most effective to least effective) to present the results. We computed the restricted maximum likelihood estimate of the heterogeneity variance, the I^2 index that shows the

proportion of variance that is due to heterogeneity rather than sampling variance and we evaluated the confidence in the treatment effect estimates using the CINeMA approach that compares 95% confidence intervals to 95% predictive intervals in terms of their agreement in statistically significant and clinically important effects.⁷ This approach also compares heterogeneity variance estimates to those estimated from empirical distributions and evaluates how large the estimates are.⁸

After we had categorized the interventions of included studies into the nine components (Supplementary Table S1), many studies turned out to consist of interventions with more than one component (e.g. medrev + medrec + pedu). We analyzed the effect of the (combination of) components in three steps:

1. Each existing combination of components was considered to be a distinct intervention. The effect of these combinations was compared with usual care (e.g. medrev + medrec + pedu as a distinct intervention versus usual care).

2. The effect of a single component was determined by disentanglement of combinations of components that included this particular single component. This means that the effect of a single component results from every combination this component was part of. For example, to determine the effect of medrev versus usual care, data is used from comparisons such as 'medrev + medrec + pedu versus usual care' and 'medrev+pedu+pl versus usual care.'

3. Next, we rebuilt interventions by adding up the separate effects of single components. For example, to determine the effect of medrev+medrec+pedu versus usual care, we add up the effect of the single components (determined in step 2) medrev, medrec, and pedu via an algorithm. The data for the effect of this compound intervention came from many more studies than just those that have investigated precisely this combination of components.

Step one was our primary analysis, for step 2 and 3 we applied the additive model of component network meta-analysis (CNMA).

1.3 Additional information regarding the CINeMA approach:

For each treatment comparison we summarized within study biases and indirectness by the average risk of bias and indirectness assessments in the respective studies. We considered risk ratios less than 0.8 or larger than 1.25 to be clinically relevant and we evaluated imprecision by comparing statistical significance to clinical relevance. For more information about the CINeMA assessments we refer to Nikolakopoulou et al.⁷

For each treatment comparison we rated the corresponding treatment effect at each of the six domains (within-study bias, across-study bias, indirectness, imprecision, heterogeneity, and incoherence) as either ‘no concerns’, ‘minor concerns’ and ‘major concerns’. If there was at most one domain with minor concerns and the other domains with no concerns, we rated the overall confidence as high. If there were at most two domains with minor concerns or at most one domain with major concerns and the other domains with no concerns, we rated the overall confidence as moderate. If there were three or more domains with minor concerns or two or more domains with major concerns, we rated the overall confidence as low.

1.4 Electronic search strategy

Supplementary Table S11. Electronic search strategy MEDLINE

| Search Line | Search Terms |
|-------------|---|
| 1 | Pharmacy service, hospital/ [ML] |
| 2 | ((PHARMACEUTICAL CARE or PHARMACY or PHARMACIES or PHARMACIST? or PRESCRIBING) and (inpatient? or hospital\$ or WARD? or UNIT or UNITS)).ti. |
| 3 | ((PHARMACEUTICAL CARE or PHARMACY or PHARMACIES or PHARMACIST? or PRESCRIBING) adj2 (inpatient? or hospital\$ or WARD? or UNIT or UNITS)).ab. |
| 4 | Medication Systems, Hospital/ [ML] |
| 5 | ((medication? or prescribing or prescription? or dispensing) adj2 system?).ti,ab. and (hospital\$ or WARD or WARDS or (CARE adj2 UNIT?) or INPATIENT?).ti,hw. |
| 6 | (stopp or beer's criteria).ti,ab. [Term added Aug 2011] |
| 7 | or/1-6 [Hosp Pharm/Med Systems] |
| 8 | exp Hospitals/ or exp Hospital Units/ [ML] |
| 9 | (hospital\$ or WARD or WARDS).ti. |
| 10 | Hospitalization/ [ML] |
| 11 | hospital\$.ab. |
| 12 | "length of stay"/ or Patient admission/ or Patient discharge/ or Patient readmission/ or Patient transfer/ [ML] |
| 13 | ((patient? or hospital\$.ti,hw. and (discharg\$ or admission? or admitting or readmission? or readmit\$ or transfer?).ti.) or "length of stay".ti. |

| | |
|----|---|
| 14 | ((patient? or hospital?) adj2 (discharg\$ or admission? or admitting or readmission? or transfer?)) or "length of stay").ab. |
| 15 | Inpatients/ [ML] |
| 16 | (inpatient? or in-patient?).ti. |
| 17 | exp HOSPITAL DEPARTMENTS/ or HOSPITAL SHARED SERVICES/ [ML] |
| 18 | MEDICAL STAFF, HOSPITAL/ or HOSPITALISTS/ [ML] |
| 19 | or/8-18 [Hospitals/Hospitalization/Inpatients] |
| 20 | (pharmacy or pharmacies or pharmacist? or prescription? or prescribing).ti. |
| 21 | (pharmacist-led or pharma\$ initiated or ((driven or lead or led) adj2 pharmacist?)).ab. |
| 22 | (PRESCRIBING adj2 PATTERN?).ab. |
| 23 | ("physician-pharmacist?" or "doctor-pharmacist?").ti,ab. |
| 24 | ((IMPROV\$ or OPTIMI?ING or OPTIMI?E? or OPTIMAL\$) and (DOSING or DOSAGE or PHARMAC\$ or PRESCRIB\$ or PRESCRIPT\$)).ti. or ((IMPROV\$ or OPTIMI?ING or OPTIMI?E? or OPTIMAL\$) adj2 (PHARMACEUTICAL CARE or PHARMACY or PRESCRIB\$ or PRESCRIPT\$)).ab. |
| 25 | ((pharmaceutical adj (care or consult\$)) or (pharmacist? adj2 (care or consult\$ or intervention? or managed))).ab. |
| 26 | ((prescription? or prescribing or medication?) adj4 review\$) or (pharmacist? adj2 review\$)).ti,ab. |
| 27 | ((drug therapy or drug regime? or medication? or medicine\$ or pharmacy or pharmacist? or pharmaceutical or PRESCRIB\$ or prescription?) adj2 (audit\$ or monitor\$ or RECONCIL\$ or review?)).ti,ab. |
| 28 | ((medication? or prescrib\$ or pharmac\$) adj2 (manage? or management or service? or system?)).ti,ab. |
| 29 | ("drug therapy" or dosage? or dose? or medication? or PRESCRIPTION? or PRESCRIB\$ or PHARMACIST? or PHARMACEUTICAL CARE) adj2 (managing or management or monitor\$)).ti,ab. |
| 30 | (drug? review? or drug? assess\$ or drug? audit? or drug? reconcil\$).ti,ab. |
| 31 | ("drug utili?ation" adj2 (review? or reconcil\$ or audit?)).ab. or ("drug utili?ation" and (review? or reconcil\$ or audit?)).ti. |
| 32 | Medication adherence/ [ML] |
| 33 | Pharmacists/ or Pharmacists' Aides/ [ML] |
| 34 | Pharmaceutical Services/ or Drug Information Services/ [ML] |
| 35 | Clinical Pharmacy Information Systems/ [ML] |
| 36 | Prescriptions/ or Drug Prescriptions/ or Pharmaceutical Preparations/ or Drug Therapy/ or Drug Dosage Calculations/ or Electronic Prescribing/ or Medication Systems/ [ML] |
| 37 | Drug Monitoring/ or Medication Therapy Management/ [ML] |
| 38 | Drug Therapy/ or Drug Therapy, Computer-Assisted/ [ML] |
| 39 | POLYPHARMACY/ or POLYPHARM\$.ti. [ML] |
| 40 | MEDICATION ERRORS/ [ML] |
| 41 | Drug utilization review/ [ML] |
| 42 | Drug Utilization/ [ML] |
| 43 | inappropriate prescribing/ [Term added Aug 2011] |
| 44 | ((Medication? or prescrib\$ or prescription? or drug therap\$) adj2 assessment?).ti,ab. [Term added Aug 2011] |
| 45 | (inappropriate\$ adj2 (medicine? or medication? or prescrib\$ or drug?)).ti,ab. [Term added Aug 2011] |
| 46 | or/20-45 [PHARMA/DRUG CONCEPTS --combine with hospital concepts] |

| | |
|----|--|
| 47 | (randomized controlled trial or controlled clinical trial).pt. or randomized.ab. or placebo.ab. or clinical trials as topic.sh. or randomly.ab. or trial.ti. |
| 48 | exp animals/ not humans.sh. |
| 49 | 47 not 48 [Cochrane RCT Filter 6.4.d Sens/Precision Maximizing] |
| 50 | 7 and 49 [Hosp Pharma & RCT] |
| 51 | 19 and 46 and 49 [Hospitals & Pharma/Drug sets & RCT] |
| 52 | 50 or 51 |
| 53 | limit 52 to yr="1980 -Current" |
| 54 | (2012\$ or 2013\$ or 2014\$).ed,ep,dp. [Entry date, E-pub date, Pub Date] |
| 55 | (198\$ or 199\$ or 2\$).ep. [Electronic publication date 1980 to present] |
| 56 | (201108\$ or 201109\$ or 20111\$).ed,dp. [August 2011-Dec2011] |
| 57 | 52 and 54 |
| 58 | (52 and 55) not 57 |
| 59 | (52 and 56) not (or/57-58) |
| 60 | 52 and 2011\$.dp,ep,yr,ed. [2011 all date search] |
| 61 | 60 not (or/57-59) |
| 62 | 57 or 58 or 59 or 61 [Results to export Jan 7 2013 update search] |
| 63 | remove duplicates from 62 |
| 64 | limit 63 to yr="2014 -Current" |

Search run at 13-09-2019 using Ovid MEDLINE(R)

Supplementary Table S12. Electronic search strategy Embase

| Search Line | Search Terms |
|-------------|---|
| 1 | 1 *hospital pharmacy/ not outpatient?.ti. [EM] |
| 2 | hospital? pharmacy.ti. |
| 3 | ((pharmaceutical care or pharmacist? or prescribing) adj4 (inpatient? or hospital\$ or ward? or ICU or intensive care or (emergency adj2 (room? or department? or unit or units))))).ti. |
| 4 | ((pharmaceutical care or pharmacist? or prescribing) adj3 (inpatient? or hospital\$ or ward? or ICU or intensive care or (emergency adj2 (room? or department? or unit or units))))).ab. |
| 5 | ((medication? or prescribing or prescription? or dispensing) adj2 system?).ti,ab. and (hospital\$ or ward or wards or (care adj2 unit?) or inpatient?).ti,hw. |
| 6 | (medication? adj4 (review\$ or audit\$)).ti. and (hospital\$ or ward or wards or (care adj2 unit?) or inpatient?).ti,hw. |
| 7 | (stopp or beer's criteria).ti,ab. [Term added Aug 2011] |
| 8 | or/1-7 [Hosp Medication Rev or Hosp Pharm--combine with Filters] |
| 9 | ((medication? or medicine?) adj4 (review or audit)).ti. |
| 10 | ((medication? or medicine?) adj2 (review or audit)).ab. |
| 11 | ((prescription? or prescribing) adj4 review\$) or (pharmacist? adj2 review\$)).ti,ab. |
| 12 | ((drug formulary or drug therapy or drug regime? or medication? or medicines or pharmacy or pharmacist? or pharmaceutical or prescrib\$ or prescription?) adj3 (audit\$ or monitor\$ or reconcil\$)).ti,ab. |
| 13 | (drug? review? or drug? assess\$ or drug? audit? or drug? reconcil\$).ti,ab. |
| 14 | ("drug utili?ation" adj2 (reconcil\$ or audit?)).ab. or ("drug utili?ation" adj4 (reconcil\$ or audit?)).ti. [line moved] |
| 15 | inappropriate prescribing/ [Term added Aug 2011] |

| | |
|----|---|
| 16 | ((Medication? or prescrib\$ or prescription? or drug therap\$) adj2 assessment?).ti,ab. [Term added Aug 2011] |
| 17 | (inappropriate\$ adj2 (medicine? or medication? or prescrib\$ or drug?)).ti,ab. [Term added Aug 2011] |
| 18 | or/9-17 [Medication Review/Audit] |
| 19 | exp *Hospital/ [EM] |
| 20 | exp *Ward/ [EM] |
| 21 | (hospital\$ or WARD or WARDS).ti. |
| 22 | *Hospitalization/ [EM] |
| 23 | *Hospital care/ or *Intensive care/ [EM] |
| 24 | *"length of stay"/ or *hospital admission/ or *Hospital discharge/ or *Hospital readmission/ or *Patient transport/ [EM] |
| 25 | ((patient? or hospital\$) and (discharg\$ or admission? or admitting or readmission? or readmit\$ or transfer?)) or "length of stay").ti. |
| 26 | ((patient? or hospital?) adj2 (discharg\$ or admission? or admitting or readmission? or transfer?)) or "length of stay").ab. |
| 27 | *hospital patient/ [EM] |
| 28 | (inpatient? or in-patient?).ti. |
| 29 | *Hospital service/ [EM] |
| 30 | *Hospital personnel/ or *Hospital physician/ or *Medical staff/ or *Resident/ [EM] |
| 31 | or/19-30 [Hospitals/Hospitalization/Inpatients] |
| 32 | (pharmacy or pharmacies or pharmacist? or prescription? or prescribing).ti. |
| 33 | (pharmacist-led or pharma\$ initiated or ((driven or lead or led) adj2 pharmacist?)).ab. |
| 34 | (prescribing adj2 pattern?).ab. |
| 35 | ("physician-pharmacist?" or "doctor-pharmacist?").ti,ab. |
| 36 | ((improv\$ or optimi?ing or optimi?e? or optimal\$) and (dosing or dosage or pharmac\$ or prescrib\$ or prescript\$)).ti. or ((improv\$ or optimi?ing or optimi?e? or optimal\$) adj2 (pharmaceutical care or pharmacy or prescrib\$ or prescript\$)).ab. |
| 37 | ((pharmaceutical adj (care or consult\$)) or (pharmacist? adj2 (care or consult\$ or intervention? or managed))).ab. |
| 38 | ((medication? or prescrib\$ or pharmac\$) adj2 (manage? or management or service? or system?)).ti,ab. |
| 39 | (("drug therapy" or dosage? or dose? or medication? or PRESCRIPTION? or PRESCRIB\$ or PHARMACIST? or PHARMACEUTICAL CARE) adj2 (managing or management or monitor\$)).ti,ab. |
| 40 | *Patient compliance/ and (medication? or pharmac\$ or drug? or prescrib\$ or prescription?).ti. |
| 41 | *Pharmacist/ or *Pharmacy technician/ [EM] |
| 42 | *Pharmaceutical care/ [EM] |
| 43 | *medical information system/ and (medication? or pharmac\$ or drug? or prescrib\$ or prescription?).ti,hw. [EM] |
| 44 | *Prescription/ [EM] |
| 45 | *Medication therapy management/ or *Recommended drug dose/ or *Optimal drug dose/ [EM] |
| 46 | *Polypharmacy/ or POLYPHARM\$.ti. [EM] |
| 47 | *Medication error/ [EM] |
| 48 | *"drug use"/ [EM] |
| 49 | *Drug utilization/ [EM] |
| 50 | *DRUG FORMULARY/ |

| | |
|----|--|
| 51 | or/32-50 [Pharmacy/Prescribing/Med Use] |
| 52 | medical audit/ |
| 53 | *medical audit/ or *monitoring/ [EM] |
| 54 | monitoring/ |
| 55 | (audit? or monitoring or reconcil\$.ti. |
| 56 | or/52,54-55 [Monitoring/Audit broad] |
| 57 | randomized controlled trial/ or controlled study/ or controlled clinical trial/ [EM] |
| 58 | pretest posttest control group design/ |
| 59 | clinical study/ or major clinical study/ or clinical trial/ |
| 60 | multicenter study/ |
| 61 | random\$.ti. or (randomi?ed or randomly).ab. or controlled.ti. |
| 62 | (clinical study/ or major clinical study/ or clinical trial/) and random\$.ti. |
| 63 | crossover-procedure/ or double-blind procedure/ or single-blind procedure/ [EM] |
| 64 | or/57-63 [Trials Filter EM] |
| 65 | (animal model? or animal experiment? or animal study? or animal trial? or canine or feline or bovine or cow or cows or mice or dog? or cat or cats or rabbit? or rat or rats or veterinar\$.ti. or (animal or veterinary).hw. [EM] |
| 66 | (editorial or letter or note or "review" or trade or survey).pt. [EM] |
| 67 | systematic review/ or meta-analysis/ or (systematic adj3 review).ti. or (meta-analy\$ or metaanaly\$.ti. or (literature adj2 review).ti. |
| 68 | 64 not (or/65-67) [EPOC RCT Filter EM] |
| 69 | 18 and 31 [Drug Review/Audit & Hosp] |
| 70 | 31 and 51 and 56 [Hosp & Pharma & Monitoring--Broad search] |
| 71 | (or/69-70) and 68 [RCT Results 2] |
| 72 | 8 and 68 [Med Rev Hosp & RCT Results 1] |
| 73 | 72 or 71 [RCT Results] |
| 74 | (2011\$ or 20114\$ or 20115\$ or 2012\$ or 2013\$ or 2014\$).em. [Entry week Aug 2011 to Nov 2014] |
| 75 | ("2011" or "2012" or "2013" or "2014").yr. |
| 76 | 73 and (74 or 75) [Results Nov 18, 2014] |
| 77 | remove duplicates from 76 |
| 78 | limit 77 to yr="2014 -Current" |

Search run at 13-09-2019 using Embase Classic+Embase

Supplementary Table S13. Electronic search strategy The Cochrane Library

| Search Line | Search Terms |
|-------------|---|
| 1 | ("PHARMACEUTICAL CARE" near/2 inpatient* or PHARMACY near/2 inpatient* or PHARMACIES near/2 inpatient* or PHARMACIST* near/2 inpatient* or PRESCRIBING near/2 inpatient*):ab or (stopp or (Beer N2 criteria)):ti,ab |
| 2 | ("PHARMACEUTICAL CARE" near/2 hospital* or PHARMACY near/2 hospital* or PHARMACIES near/2 hospital* or PHARMACIST* near/2 hospital* or PRESCRIBING near/2 hospital*):ab |
| 3 | ("PHARMACEUTICAL CARE" near/2 WARD* or PHARMACY near/2 WARD* or PHARMACIES near/2 WARD* or PHARMACIST* near/2 WARD* or PRESCRIBING near/2 WARD*):ab |
| 4 | ("PHARMACEUTICAL CARE" near/2 UNIT or PHARMACY near/2 UNIT or PHARMACIES near/2 UNIT or PHARMACIST* near/2 UNIT or PRESCRIBING near/2 UNIT):ab |
| 5 | ("PHARMACEUTICAL CARE" near/2 UNITS or PHARMACY near/2 UNITS or PHARMACIES near/2 UNITS or PHARMACIST* near/2 UNITS or PRESCRIBING near/2 UNITS):ab |
| 6 | (medication* near/2 system* or prescribing near/2 system* or prescription* near/2 system* or dispensing near/2 system*):ti,kw and (hospital* or WARD or WARDS or INPATIENT* or CARE near/2 UNIT*):ti,kw |
| 7 | MeSH descriptor: [Pharmacy Service, Hospital] this term only |
| 8 | MeSH descriptor: [Medication Systems, Hospital] this term only |
| 9 | (#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8) |
| 10 | MeSH descriptor: [Hospitalization] explode all trees |
| 11 | MeSH descriptor: [Inpatients] this term only |
| 12 | MeSH descriptor: [Hospital Departments] explode all trees |
| 13 | MeSH descriptor: [Hospital Shared Services] this term only |
| 14 | MeSH descriptor: [Hospital Units] explode all trees |
| 15 | MeSH descriptor: [Medical Staff, Hospital] explode all trees |
| 16 | (hospital* or WARD or WARDS):ti |
| 17 | hospital*:ab |
| 18 | (patient* or hospital*):ti,kw and (discharge* or admission* or admitting or readmission* or readmit* or transfer*):ti or "length of stay":ti |
| 19 | (Patient* near/2 discharg* or Patient* near/2 admission* or Patient* near/2 admitting or Patient* near/2 readmission* or Patient* near/2 transfer*) or "length of stay":ab |
| 20 | (hospital* near/2 discharg* or hospital* near/2 admission* or hospital near/2 admitting or hospital near/2 readmission* or hospital near/2 transfer*) or "length of stay":ab |
| 21 | (inpatient* or in-patient*):ti |
| 22 | (#10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 or #21) |
| 23 | (pharmacy or pharmacies or pharmacist* or prescription* or prescribing):ti |
| 24 | ("pharmacist-led" or "pharma* initiated" or pharmacist* near/2 driven or pharmacist* near/2 lead or pharmacist* near/2 led):ab |
| 25 | Prescribing near/2 Pattern*:ab |
| 26 | ("physician-pharmacist*" or "doctor-pharmacist*"):ti,ab |
| 27 | (IMPROV* or OPTIMI*ING or OPTIMI*E* or OPTIMAL*):ti and (DOSING or DOSAGE or PHARMAC* or PRESCRIB* or PRESCRIPT*):ti |

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|----|--|
| 28 | (IMPROV* near/2 "PHARMACEUTICAL CARE" or OPTIMI*ING near/2 "PHARMACEUTICAL CARE" or OPTIMI*E* near/2 "PHARMACEUTICAL CARE" or OPTIMAL* near/2 "PHARMACEUTICAL CARE"):ab |
| 29 | (IMPROV* near/2 PHARMACY or OPTIMI*ING near/2 PHARMACY or OPTIMI*E* near/2 PHARMACY or OPTIMAL* near/2 PHARMACY):ab |
| 30 | (IMPROV* near/2 PRESCRIB* or OPTIMI*ING near/2 PRESCRIB* or OPTIMI*E* near/2 PRESCRIB* or OPTIMAL* near/2 PRESCRIB*):ab |
| 31 | (IMPROV* near/2 PRESCRIPT* or OPTIMI*ING near/2 PRESCRIPT* or OPTIMI*E* near/2 PRESCRIPT* or OPTIMAL* near/2 PRESCRIPT*):ab |
| 32 | "pharmaceutical care" or "pharmaceutical consult*" or (pharmacist* near/2 care or pharmacist* near/2 consult* or pharmacist* near/2 intervention* or pharmacist* near/2 managed):ab |
| 33 | (prescription* near/4 review* or prescribing near/4 review* or medication* near/4 review* OR pharmacist* near/2 review*):ti,ab |
| 34 | ("drug therapy" near/2 audit* or "drug regime*" near/2 audit* or medication* near/2 audit* or medicine* near/2 audit* or pharmacy near/2 audit* or pharmacist* near/2 audit* or pharmaceutical near/2 audit* or PRESCRIB* near/2 audit* or prescription* near/2 audit*):ti,ab |
| 35 | ("drug therapy" near/2 monitor* or "drug regime*" near/2 monitor* or medication* near/2 monitor* or medicine* near/2 monitor* or pharmacy near/2 monitor* or pharmacist* near/2 monitor* or pharmaceutical near/2 monitor* or PRESCRIB* near/2 monitor* or prescription* near/2 monitor*):ti,ab |
| 36 | ("drug therapy" near/2 RECONCIL* or "drug regime*" near/2 RECONCIL* or medication* near/2 RECONCIL* or medicine* near/2 RECONCIL* or pharmacy near/2 RECONCIL* or pharmacist* near/2 RECONCIL* or pharmaceutical near/2 RECONCIL* or PRESCRIB* near/2 RECONCIL* or prescription* near/2 RECONCIL*):ti,ab |
| 37 | ("drug therapy" near/2 review* or "drug regime*" near/2 review* or medication* near/2 review* or medicine* near/2 review* or pharmacy near/2 review* or pharmacist* near/2 review* or pharmaceutical near/2 review* or PRESCRIB* near/2 review* or prescription* near/2 review*):ti,ab |
| 38 | (medication* near/2 manage* or prescrib* near/2 manage* or phamac* near/2 manage*):ti,ab |
| 39 | (medication* near/2 management or prescrib* near/2 management or phamac* near/2 management):ti,ab |
| 40 | (medication* near/2 service* or prescrib* near/2 service* or phamac* near/2 service*):ti,ab |
| 41 | (medication* near/2 system* or prescrib* near/2 system* or phamac* near/2 system*):ti,ab |
| 42 | ("drug therapy" near/2 managing or dosage* near/2 managing or dose* near/2 managing or medication* near/2 managing or PRESCRIPTION* near/2 managing or PRESCRIB* near/2 managing or PHARMACIST* near/2 managing or "PHARMACEUTICAL CARE" near/2 managing):ti,ab |
| 43 | ("drug therapy" near/2 management or dosage* near/2 management or dose* near/2 management or medication* near/2 management or PRESCRIPTION* near/2 management or PRESCRIB* near/2 management or PHARMACIST* near/2 management or "PHARMACEUTICAL CARE" near/2 management):ti,ab |
| 44 | ("drug therapy" near/2 monitor* or dosage* near/2 monitor* or dose* near/2 monitor* or medication* near/2 monitor* or PRESCRIPTION* near/2 monitor* or PRESCRIB* |

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| | near/2 monitor* or PHARMACIST* near/2 monitor* or "PHARMACEUTICAL CARE" near/2 monitor*):ti,ab |
| 45 | ("drug* review*" or "drug* assess*" or "drug* audit*" or "drug* reconcil*"):ti,ab |
| 46 | ("drug utili*ation" near/2 review* or "drug utili*ation" near/2 reconcil* or "drug utili*ation" near/2 audit*):ab |
| 47 | (review* or reconcil* or audit*):ti and "drug utili*ation":ti |
| 48 | MeSH descriptor: [Medication Adherence] this term only |
| 49 | MeSH descriptor: [Pharmacists] this term only |
| 50 | MeSH descriptor: [Pharmacists' Aides] explode all trees |
| 51 | MeSH descriptor: [Pharmaceutical Services] this term only |
| 52 | MeSH descriptor: [Drug Information Services] this term only |
| 53 | MeSH descriptor: [Clinical Pharmacy Information Systems] this term only |
| 54 | MeSH descriptor: [Prescriptions] this term only |
| 55 | MeSH descriptor: [Drug Prescriptions] this term only |
| 56 | MeSH descriptor: [Drug Dosage Calculations] this term only |
| 57 | MeSH descriptor: [Pharmaceutical Preparations] this term only |
| 58 | MeSH descriptor: [Electronic Prescribing] this term only |
| 59 | MeSH descriptor: [Medication Systems] this term only |
| 60 | MeSH descriptor: [Drug Monitoring] this term only |
| 61 | MeSH descriptor: [Medication Therapy Management] this term only |
| 62 | MeSH descriptor: [Drug Therapy] this term only |
| 63 | MeSH descriptor: [Drug Therapy, Computer-Assisted] this term only |
| 64 | MeSH descriptor: [Medication Errors] this term only |
| 65 | MeSH descriptor: [Drug Utilization Review] this term only |
| 66 | MeSH descriptor: [Drug Utilization] this term only |
| 67 | MeSH descriptor: [Polypharmacy] this term only |
| 68 | Polypharm*:ti |
| 69 | Polypharmacy or polypharm*:ti |
| 70 | MeSH descriptor: [Inappropriate Prescribing] this term only |
| 71 | ((Medication or medications or prescrib* or prescription or prescriptions or drug therap*) near/2 assessment):ti,ab |
| 72 | (inappropriate* near/2 (medicine or medicines or medication or medications or prescrib* or drug or drugs)):ti,ab |
| 73 | (#23 or #24 or #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 or #46 or #47 or #48 or #49 or #50 or #51 or #52 or #53 or #54 or #55 or #56 or #57 or #58 or #59 or #60 or #61 or #62 or #63 or #64 or #65 or #66 or #67 or #68 or #69 or #70 or #71 or #72) |
| 74 | (#9 or (#22 and #73)) |
| 75 | limit to (2014,2015,2016,2017,2018,2019) |

Search run at 13-09-2019 using The Cochrane Library

Supplementary Table S14. Electronic search strategy CINAHL

| Search Line | Search Terms |
|-------------|--|
| 1 | (MH "Pharmacy Service") |
| 2 | TI (pharmaceutical care or pharmacy or pharmacies or pharmacist* or prescribing) |
| 3 | (MH "Medication Systems") OR TI (medication* n2 system) or (prescribing n2 system) or (prescription* n2 system) or (dispensing n2 system) OR TI (medication* n2 systems) or (prescribing n2 systems) or (prescription* n2 systems) or (dispensing n2 systems) OR TI ((medication N2 assessment) or (prescrib* N2 assessment) or (prescription N2 assessment) or (drug therap* N2 assessment)) OR AB ((medication N2 assessment) or (prescrib* N2 assessment) or (prescription N2 assessment) or (drug therap* N2 ass ... |
| 4 | TI (hospital* OR inpatient ward or wards or intensive care or ICU or emergency department* or unit) OR MW (hospital* OR inpatient ward or wards or intensive care or ICU or emergency department*) |
| 5 | (MH "Adolescent, Hospitalized") OR (MH "Aged, Hospitalized") OR (MH "Child, Hospitalized") OR (MH "Emergency Patients") OR (MH "Infant, Hospitalized") OR (MH "Inpatients") |
| 6 | (MH "Hospitals+") OR (MH "Hospital Units+") OR TI (inpatient* or hospital\$ or WARD* or UNIT or UNITS) |
| 7 | (MH "Hospitalization") OR (MH "Length of Stay") OR (MH "Patient Admission") OR (MH "Patient Discharge") OR (MH "Discharge Planning+") OR (MH "Patient Discharge Education") OR (MH "Early Patient Discharge") OR (MH "Transfer, Discharge") OR (MH "Patient Dumping") OR (MH "Readmission") OR (MH "Transfer, Intrahospital") |
| 8 | (MH "Medication Reconciliation") |
| 9 | TI ((drug therapy N2 reconcil*) or (drug therapy N2 audit*) or (drug therapy N2 review*)) or AB ((drug therapy N2 reconcil*) or (drug therapy N2 audit*) or (drug therapy N2 review*)) OR TI ((medicine* N2 reconcil*) or (medicine* N2 audit*) or (medicine* N2 review*)) or AB ((medicine* N2 reconcil*) or (medicine* N2 audit*) or (medicine* N2 review*)) |
| 10 | (MH "Nursing Audit") OR (MH "Audit") |
| 11 | TI (medication* or medicine* or drug therap* or prescrib* or prescript* or medication*) or MW (medication* or medicine* or drug therap* or prescrib* or prescript* or medication*) |
| 12 | S10 and S11 |
| 13 | S1 or S2 or S3 |
| 14 | S4 or S5 or S6 or S7 |
| 15 | S8 or S9 or S12 |
| 16 | S13 and S14 |
| 17 | S14 and S15 |
| 18 | TI ((multicent* n2 design*) or (multicent* n2 study) or (multicent* n2 studies) or (multicent* n2 trial*)) or AB ((multicent* n2 design*) or (multicent* n2 study) or (multicent* n2 studies) or (multicent* n2 trial*)) |
| 19 | (MM "Clinical Trials+") |
| 20 | TI ("clinical study" or "clinical studies") or AB ("clinical study" or "clinical studies") |
| 21 | TI random* or AB random* |
| 22 | TI controlled or AB controlled |
| 23 | TI ("control* N1 clinical" or "control* N1 group*" or "control* N1 trial*" or "control* N1 study" or "control* N1 studies" or "control* N1 design*" or "control* N1 method*") or AB ("control* N1 clinical" or "control* N1 group*" or "control* N1 |

| | |
|----|--|
| | trial*" or "control* N1 study" or "control* N1 studies" or "control* N1 design*" or "control* N1 method*") |
| 24 | S18 or S19 or S20 or S21 or S22 or S23 |
| 25 | TI ((stopp or "beer's criteria") OR AB ((stopp or "beer's criteria")) |
| 26 | S16 or S17 or S25 |
| 27 | S24 and S26 |
| 28 | TI medication review* |
| 29 | S27 or S28 |
| 30 | (MH "Pharmacy Service") |
| 31 | TI (pharmaceutical care or pharmacy or pharmacies or pharmacist* or prescribing) |
| 32 | (MH "Medication Systems") OR TI (medication* n2 system) or (prescribing n2 system) or (prescription* n2 system) or (dispensing n2 system) OR TI (medication* n2 systems) or (prescribing n2 systems) or (prescription* n2 systems) or (dispensing n2 systems) OR TI ((medication N2 assessment) or (prescrib* N2 assessment) or (prescription N2 assessment) or (drug therap* N2 assessment)) OR AB ((medication N2 assessment) or (prescrib* N2 assessment) or (prescription N2 assessment) or (drug therap* N2 ass ... |
| 33 | TI (hospital* OR inpatient ward or wards or intensive care or ICU or emergency department* or unit) OR MW (hospital* OR inpatient ward or wards or intensive care or ICU or emergency department*) |
| 34 | (MH "Adolescent, Hospitalized") OR (MH "Aged, Hospitalized") OR (MH "Child, Hospitalized") OR (MH "Emergency Patients") OR (MH "Infant, Hospitalized") OR (MH "Inpatients") |
| 35 | (MH "Hospitals+") OR (MH "Hospital Units+") OR TI (inpatient* or hospital\$ or WARD* or UNIT or UNITS) |
| 36 | (MH "Hospitalization") OR (MH "Length of Stay") OR (MH "Patient Admission") OR (MH "Patient Discharge") OR (MH "Discharge Planning+") OR (MH "Patient Discharge Education") OR (MH "Early Patient Discharge") OR (MH "Transfer, Discharge") OR (MH "Patient Dumping") OR (MH "Readmission") OR (MH "Transfer, Intrahospital") |
| 37 | (MH "Medication Reconciliation") |
| 38 | TI ((drug therapy N2 reconcil*) or (drug therapy N2 audit*) or (drug therapy N2 review*)) or AB ((drug therapy N2 reconcil*) or (drug therapy N2 audit*) or (drug therapy N2 review*)) OR TI ((medicine* N2 reconcil*) or (medicine* N2 audit*) or (medicine* N2 review*)) or AB ((medicine* N2 reconcil*) or (medicine* N2 audit*) or (medicine* N2 review*)) |
| 39 | (MH "Nursing Audit") OR (MH "Audit") |
| 40 | TI (medication* or medicine* or drug therap* or prescrib* or prescript* or medication*) or MW (medication* or medicine* or drug therap* or prescrib* or prescript* or medication*) |
| 41 | S39 and S40 |
| 42 | S30 or S31 or S32 |
| 43 | S33 or S34 or S35 or S36 |
| 44 | S37 or S38 or S41 |
| 45 | S42 and S43 |
| 46 | S43 and S44 |
| 47 | TI ((multicent* n2 design*) or (multicent* n2 study) or (multicent* n2 studies) or (multicent* n2 trial*)) or AB ((multicent* n2 design*) or (multicent* n2 study) or (multicent* n2 studies) or (multicent* n2 trial*)) |
| 48 | (MM "Clinical Trials+") |
| 49 | TI ("clinical study" or "clinical studies") or AB ("clinical study" or "clinical studies") |

| | |
|----|--|
| 50 | TI random* or AB random* |
| 51 | TI controlled or AB controlled |
| 52 | TI (“control* N1 clinical” or “control* N1 group*” or “control* N1 trial*” or “control* N1 study” or “control* N1 studies” or “control* N1 design*” or “control* N1 method*”) or AB (“control* N1 clinical” or “control* N1 group*” or “control* N1 trial*” or “control* N1 study” or “control* N1 studies” or “control* N1 design*” or “control* N1 method*”) |
| 53 | S47 or S48 or S49 or S50 or S51 or S52 |
| 54 | TI ((stopp or "beer's criteria")) OR AB ((stopp or "beer's criteria")) |
| 55 | S45 or S46 or S54 |
| 56 | S53 and S55 |
| 57 | TI medication review* |
| 58 | S56 or S57 |
| 59 | S56 or S57 (limit: Publicationdate: 20140101-20191231) |

Search run at 13-09-2019 using CINAHL

Supplementary Table S15. List and definition of all variable data collected

| Variable name | Definition |
|--|---|
| <i>Study characteristics and patient characteristics</i> | |
| 1 st author | Name |
| Year | Publication year |
| Country | Country of study |
| Study design RCT | Parallel, cluster, cross-over, quasi, other |
| Sample size | Total number of participants analyzed |
| Mean age | Mean age study population in years |
| Median age | Median age study population in years |
| % Female | % Female of the study population |
| Mean follow-up | Mean follow-up duration in weeks |
| Regular used med | Mean number of regularly used medication |
| Medication appropriateness index | Mean medication appropriateness index |
| Chronic conditions | Mean number of chronic conditions |
| Study setting | Hospital, community, community pharmacy, other |
| Study sites | Single center, multicenter |
| ITT/PP | Intention to treat analysis, per-protocol analysis, not reported |
| Funding source of study | Governmental organisation, research funding body, commercial organisation, mixed, charitable trust, no funding, other |
| Inclusion criteria | Applied inclusion criteria |
| Exclusion criteria | Applied exclusion criteria |
| Intervention - arm 1 | Description of the intervention in words |
| Intervention type - arm 1 | Single component, multiple component |
| N - arm 1 | Number of participants that received intervention arm 1 |

| | |
|--|---|
| Performed by – arm 1 | Who performed the medication review? Pharmacist or clinical pharmacologist, pharmacist and clinical pharmacologist, pharmacist and pharmacy technician, pharmacist and trial nurse, geriatrician |
| Context – arm 1 | What was the context of the medication review? Solely a medication review or the medication review was part of a Comprehensive Geriatric Assessment |
| Times performed – arm 1 | How many times was the medication review performed? Once, daily, multiple times. |
| Delivery – arm 1 | The way the recommendations were delivered: directly executed, written report, oral report/deliberation, both written and oral, not reported |
| Arm 2 and 3 | All arm 1 variables are repeated for arm 2 and 3 (if indicated) |
| Component 1 | Medication review: is medication review part of the study intervention? |
| Component 2 | Medication reconciliation: is medication reconciliation part of the study intervention? |
| Component 3 | Shared decision making: is shared decision making part of the study intervention? |
| Component 4 | Patient education/ medication counselling: is patient education/medication counselling part of the study intervention? |
| Component 5 | Health professional education: is health professional education part of the study intervention? |
| Component 6 | Use of validated methods: is the use of validated methods part of the study intervention? |
| Component 7 | Use of Computerized Decision Support: is the use of a Computerized Decision Support part of the study intervention? |
| Component 8 | Compliance aid: is the application of a compliance aid part of the study intervention? |
| Component 9 | Transitional care: is transitional care part of the study intervention? |
| Missing data | Have any attempts been made to impute missing data |
| Missing data >10% | Is more than 10% of the data missing? |
| Data extraction results: Dichotomous outcomes | |
| Timepoint | Timepoint at which the result was measured in weeks |
| Outcome | Which outcome was addressed? Persons experiencing all cause hospital readmissions at any time Persons experiencing all cause hospital readmissions within 30 days Persons experiencing all cause hospital readmissions within 180 days Persons experiencing all cause hospital readmissions within 1 year Persons experiencing medication-related readmissions at any time |
| Subgroup analysis | For which subgroup analysis can we use this data? None Participants aged 65-75 year Participants aged >75 years Participants with 2 or less comorbidities Participants with 3 or more comorbidities Community residents Nursing home residents |
| Events | Number of events in arm 1, 2 and 3 (when indicated) |
| Comparison | Which arms are compared |
| Effect size | Type of effect size, effect size value, lower bound 95% confidence interval, upper bound 95% confidence interval. Is the effect size adjusted for confounding factors? |

| <i>Data extraction results: rate outcomes</i> | |
|--|---|
| Timepoint | Timepoint at which the result was measured in weeks |
| Outcome | Which outcome was addressed? Hospital readmission rate |
| Subgroup analysis | For which subgroup analysis can we use this data? None Participants aged 65-75 year Participants aged >75 years Participants with 2 or less comorbidities Participants with 3 or more comorbidities Community residents Nursing home residents |
| Events | Number of events in arm 1, 2 and 3 + total person time at risk (when indicated) |
| Rate | Rate and 95% confidence interval arm 1, 2, 3 + person time |
| Comparison | Which arms are compared |
| Rate ratio | Rate ratio + 95% confidence interval. Is the rate ratio adjusted for confounding factors? |
| <i>Risk of bias</i> | |
| 1. Was the allocation sequence adequately generated? | |
| 2. Was allocation adequately concealed? | |
| 3. Were baseline outcome measurements similar? | |
| 4. Were baseline characteristics similar? | |
| 5. Were incomplete outcome data adequately addressed? | |
| 6. Was knowledge of the allocated intervention adequately prevented during the study? | |
| 7. Was the study adequately protected against contamination? | |
| 8. Is there evidence that outcomes have been reported selectively? | |
| 9. Other sources of bias | |
| Directness | Are there any issues affecting directness? |
| <i>Data extraction notes</i> | |

| | |
|--------------|------------------------------------|
| Notes | Additional notes by review authors |
|--------------|------------------------------------|

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