NICE National Institute for Health and Care Excellence

Surveillance proposal consultation document

2019 surveillance of medicines adherence and medicines optimisation

Surveillance proposal

We propose to not update the following guidelines on medicines adherence and medicines optimisation at this time:

- Medicines adherence: involving patients in decisions about prescribed medicines and supporting adherence (NICE guideline CG76)
- Medicines optimisation: the safe and effective use of medicines to enable the best possible outcomes (NICE guideline NG5).

Reasons for the proposal to not update the guidelines

NICE's guidelines on medicines adherence and optimisation contain recommendations on best practice for use of medicines across the healthcare system, covering all patient populations and healthcare settings. Therefore, many interventions intended to support adherence and optimising medicines in specific groups of patients are relevant to these guidelines. However, these guidelines make overarching recommendations on strategies that are broadly applicable across the healthcare system. They do not include recommendations on strategies or interventions for specific diseases or conditions.

Topic experts who advised us on this surveillance indicated that the recommendations remained valid and the principles underlying the recommendations remained unchanged. They were interested in evidence on new technologies, such as apps designed for patients through to large health service computer systems. The guideline on medicines optimisation noted that 'Better use of data and technology can give people more control over their health and support the medicines optimisation agenda.' Technological solutions should be appropriate for patients' needs and preferences in line with the principles of care as set out in NICE's guidelines on medicines adherence and medicines optimisation and the guideline on patient experience (NICE guideline CG138). More complex tools, such as clinical decision support, which integrates with local health service processes and systems, need to be kept up-to-date in terms of clinical information and software versions and be applicable to local healthcare needs, as noted by the medicines optimisation committee when developing recommendations on clinical decision support.

The new evidence indicated that many technological interventions may be effective, including individual components such as text messaging, reminders or alerts, and more complex mobile and telehealth interventions. However, specific components of interventions did not consistently show benefit and many interventions may not be directly applicable outside the populations studied. The evidence identified in this surveillance review will also be considered in the context of the relevant disease-specific guidelines during scheduled surveillance of those guidelines.

Overview of 2019 surveillance methods

NICE's surveillance team checked whether recommendations in the guidelines on medicines adherence and optimisation (NICE guidelines CG76 and NG5) remain up to date. The 2019 surveillance consisted of:

- Feedback from topic experts and NICE's medicines and prescribing team via a questionnaire.
- A search for new or updated Cochrane reviews and national policy.
- Consideration of evidence from previous surveillance.
- Examining related NICE guidance and quality standards and National Institute for Health Research (NIHR) signals.
- A search for ongoing research.
- Examining the NICE event tracker for relevant ongoing and published events.
- Literature searches to identify relevant evidence on approaches to improve medicines adherence and medicines optimisation using digital technologies.
- Assessing the new evidence against current recommendations to determine whether or not to update sections of the guideline, or the whole guideline.
- Consulting on the proposal with stakeholders (this document).

For further details about the process and the possible update decisions that are available, see ensuring that published guidelines are current and accurate in developing NICE guidelines: the manual.

Evidence considered in surveillance

Search and selection strategy

We searched for new evidence on using digital technologies for improving medicines adherence and optimisation. This focused search was based on feedback from topic experts indicating that this was an area of interest and growing relevance as NHS systems become increasingly digitised. Additionally, our initial intelligence gathering indicated no changes in

the principles underlying current recommendations, or the context of the guideline as it fits with other national policies and guidance. Studies were included in surveillance if they involved any digital component, including apps for patients or systems for healthcare staff use, and devices such as electronic pill bottles.

One search was conducted covering both guidelines. We found 1,645 studies in a search for randomised controlled trials and systematic reviews. For the guideline on medicines adherence, we included studies published after 1 July 2016 (the end search date for previous surveillance). For the guideline on medicines optimisation, we included studies published after 1 May 2014 (the end search date for the guideline). Searches for both guidelines included studies published before 30 November 2018.

We also included 1 relevant study from a total of 2 identified by topic experts. Topic experts also highlighted several policy documents.

From all sources, we considered 153 studies to be relevant to the guidelines. Of these:

- 102 studies were relevant to the guideline on medicines adherence
- 51 studies were relevant to the guideline on medicines optimisation.

See appendix A: summary of evidence from surveillance below for details of all evidence considered, and references.

Cochrane reviews

We searched for new Cochrane reviews related to the guidelines and found 20 relevant reviews. The search for Cochrane reviews included any interventions relevant to either guideline. The findings were considered alongside the rest of the evidence identified in searches.

Previous surveillance

The guideline on medicines optimisation has not undergone previous surveillance.

The guideline on medicines adherence has undergone surveillance in 2011, 2014, and 2016. All previous surveillance reviews indicated no need to update the guideline. See the guideline webpage for full details of previous surveillance. Studies identified in previous surveillance were not considered again at this time.

Ongoing research

We checked for relevant ongoing research; of the ongoing studies identified, 5 studies were assessed as having the potential to change recommendations; therefore we plan to check the publication status regularly, and evaluate the impact of the results on current recommendations as quickly as possible. These studies are:

- Hospital discharge study (ISRCTN18427377)

This study is assessing a systematic medicines review procedure for people being discharged from hospital.

- Northumbria osteoporosis project: group clinics (ISRCTN56916730)

  This NIHR-funded study is assessing pharmacist-led group clinics for people with high risk of fracture, with outcome measures including adherence to bisphosphonates.

- Medication adherence for patient support (ISRCTN10668149)

  This NIHR-funded study is assessing interactive text and voice messaging to promote adherence to medicines for type 2 diabetes.

- Supporting medicines management in older adults with multiple medical conditions (ISRCTN12752680)

  This study is assessing structured medicines review in people prescribed 15 or more medicines.

- The effect of audit and feedback on prescribing behaviour and engagement with data on OpenPrescribing.net – a randomised controlled trial (ISRCTN86418238).

  This study is assessing OpenPrescribing.net, an openly accessible service which transforms the monthly national prescribing datasets into meaningful charts on key measures of prescribing safety, efficacy and cost-effectiveness. This study targets general practices in England who are performing in the worst 20% for prescribing broad-spectrum antibiotics. The study aims to find out whether giving feedback on current prescribing performance affects information-seeking and prescribing behaviour.

Related NICE guidance

No specific overlaps with other NICE guidance were identified.

However, many disease-specific NICE guidelines cross-refer to the guidelines on medicines adherence and medicines optimisation. Additionally, many disease-specific guidelines have recommendations on medicines adherence, medicines optimisation, medicines review, and medicines reconciliation.

The recommendations across NICE's guidelines are complementary, for example, the guideline on chronic heart failure (NICE guideline NG106) has a recommendation on measuring digoxin concentration to confirm a clinical diagnosis of non-adherence. This disease-specific recommendation has no impact on the guideline on medicines adherence because it is not relevant to a wider population. Similarly, none of the recommendations in the guideline on medicines adherence has an impact on the recommendation in the guideline on chronic heart failure.

Overall, no impacts were identified between the guidelines on medicines adherence and medicines optimisation and any of the disease-specific recommendations dealing with medicines management.

Intelligence gathered during surveillance

Government policy and guidance

We identified several policy documents relevant to the guidelines:

- Polypharmacy Management by 2030: a patient safety challenge. 2nd edition (April 2017). The SYMPATHY consortium, funded by the European Union's Health Programme
- Polypharmacy getting our medicines right (July 2018) Draft for public consultation. Royal Pharmaceutical Society
- Polypharmacy guidance. Realistic prescribing 3rd edition (September 2018). Scottish Government and NHS Scotland
- The Report of the Short Life Working Group on reducing medication-related harm (February 2018) Department of Health & Social Care
- Integrating NHS Pharmacy and Medicines Optimisation into Sustainability & Transformation Partnerships and Integrated Care Systems (August 2018). NHS England.

These documents are broadly consistent with NICE's recommendations in the guidelines on medicines adherence and optimisation. Additionally, they indicate that there is interest in system-wide improvement, particularly through the Medicines Value Programme. These policies may lead to greater implementation of the guidelines.

Topic expert feedback

Views of topic experts

We considered the views of topic experts. For this surveillance review, topic experts completed a questionnaire about developments in evidence, policy and services related to both guidelines.

We sent questionnaires to 19 topic experts and received 9 responses. The topic experts were recruited to the NICE Centre for Guidelines Expert Advisers Panel to represent their specialty. We additionally asked colleagues who work with regional medicines optimisation committees to complete the questionnaire, and received 2 responses.

Topic experts indicated that the nature of these guidelines meant that recommendations were durable, but that they may not be well implemented in the health system. NICE has published shared learning examples of how NICE guidance and standards on medicine management have been put into practice in the NHS, local authorities, voluntary sector and a range of other organisations.

There was interest in assessing new technologies so we focused the literature search in this area.

Topic experts indicated that the guidelines would be better presented as a single guideline. Because no update is necessary at this time, merging the guidelines will not be undertaken. Merging the guidelines will be considered again if an update to the guidelines is proposed in the future.

Topic experts noted polypharmacy and deprescribing as areas in which additional guidance would be welcome. The guideline on medicines optimisation has several recommendations recognising people on multiple medicines as a group that may benefit from interventions such as medicines review or additional support on discharge from hospital. NICE also has a guideline on assessment and management of multimorbidity. No new evidence on polypharmacy indicating a need to update that guideline was identified.

A few studies were identified that reported on deprescribing, such as reducing proton pump inhibitor use. However, the evidence was applicable to a few specific populations and was insufficient to indicate a need to update the guidelines. Guidance on deprescribing of specific drugs is covered in disease-specific guidelines. For example, NICE's guideline on gastro-oesophageal reflux disease in adults recommends reducing the dose or frequency of PPIs in long term use.

We also received feedback on concerns about multi-compartment medicines systems, which are used to aid adherence; however no studies eligible for consideration in surveillance were identified. Observational studies of this issue are limited by the inability to determine whether multi-compartment medicines systems are themselves problematic, or if they are a marker of polypharmacy and possible inappropriate prescribing. The guideline suggests these systems as one of several options to overcome practical problems associated with non-adherence if a specific need is identified.

Feedback also suggested that there has been progress in aspects of care covered by the guidelines, including shared decision-making. NICE is part of a shared decision making collaborative that aims to make shared decision-making part of everyday care. NICE is also developing a guideline on shared decision-making.

Implementation of the guideline

Although topic experts questioned whether the guidelines were being fully implemented, no information was identified to suggest that an update could influence barriers to implementation.

NICE has published shared learning examples of how NICE guidance and standards on medicine management have been put into practice in the NHS, local authorities, voluntary sector and a range of other organisations.

Views of stakeholders

Stakeholders are consulted on all surveillance reviews except if the whole guideline will be updated and replaced. Because this surveillance proposal is to not update either of the guidelines, we are consulting with stakeholders.

See ensuring that published guidelines are current and accurate in developing NICE guidelines: the manual for more details on our consultation processes.

Equalities

No equalities issues were identified during the surveillance process.

Editorial amendments

During surveillance of the guidelines we identified the following points in the guidelines that should be amended.

Medicines adherence (NICE CG76)

The reference to the Disability Discrimination Act (2005) in the preamble to the recommendations in NICE CG76 should be updated to refer to the Equalities Act (2010).

In recommendation 1.1.31, the reference to 'NHS Choices' should be updated to 'the NHS website'.

In recommendation 1.1.16, a cross reference should be added to Decision-making and mental capacity (NICE NG108).

Medicines optimisation (NICE NG5)

In the footnote to recommendation 1.2.1, the hyperlink to the Health and Social Care Information Centre's A guide to confidentiality in health and social care (2013) should be updated to reflect its current home on the NHS Digital website – the Health and Social Care Information Centre website has been archived.

A cross reference to Decision-making and mental capacity (NICE NG108) should be added at the sections dealing with self-management and patient decision aids.

Overall surveillance proposal

After considering all evidence and other intelligence and the impact on current recommendations, we propose that no update is necessary.

Appendix A2: Summary of evidence from surveillance

2019 surveillance of medicines optimisation (2015) NICE guideline NG5

Summary of evidence from surveillance

Studies identified in searches are summarised from the information presented in their abstracts.

Feedback from topic experts who advised us on the approach to this surveillance review, was considered alongside the evidence to reach a view on the need to update each section of the guideline.

Systems for identifying, reporting and learning from medicines-related patient safety incidents

Recommendations in this section of the guideline

Improving learning from medicines-related patient safety incidents is important to guide practice and minimise patient harm. Medicines-related patient safety incidents are unintended or unexpected incidents that are specifically related to medicines use, which could have or did lead to patient harm. These include potentially avoidable medicines-related hospital admissions and re-admissions, medication errors, near misses and potentially avoidable adverse events.

1.1.1 Organisations should support a person-centred, 'fair blame' culture that encourages reporting and learning from medicines-related patient safety incidents.

1.1.2 Health and social care practitioners should explain to patients, and their family members or carers where appropriate, how to identify and report medicines-related patient safety incidents.

1.1.3 Organisations should ensure that robust and transparent processes are in place to identify, report, prioritise, investigate and learn from medicines-related patient safety incidents, in line with national patient safety reporting systems – for example, the National Reporting and Learning System.

1.1.4 Organisations should consider using multiple methods to identify medicines-related patient safety incidents – for example, health record review, patient surveys and direct observation of medicines administration. They should agree the approach locally and review arrangements regularly to reflect local and national learning.

1.1.5 Organisations should ensure that national medicines safety guidance, such as patient safety alerts, are actioned within a specified or locally agreed timeframe.

1.1.6 Organisations should consider assessing the training and education needs of health and social care practitioners to help patients and practitioners to identify and report medicines-related patient safety incidents.

1.1.7 Health and social care practitioners should report all identified medicines-related patient safety incidents consistently and in a timely manner, in line with local and national patient safety reporting systems, to ensure that patient safety is not compromised.

1.1.8 Organisations and health professionals should consider applying the principles of the PINCER intervention to reduce the number of medicines-related patient safety incidents, taking account of existing systems and resource implications. These principles include:

- using information technology support
- using educational outreach with regular reinforcement of educational messages
- actively involving a multidisciplinary team, including GPs, nurses and support staff
- having dedicated pharmacist support
- agreeing an action plan with clear objectives
- providing regular feedback on progress
- providing clear, concise, evidence-based information.

1.1.9 Consider using a screening tool – for example, the STOPP/START* tool in older people – to identify potential medicines-related patient safety incidents in some groups. These groups may include:

- adults, children and young people taking multiple medicines (polypharmacy)
- adults, children and young people with chronic or long-term conditions
- older people.

*STOPP, Screening Tool of Older Persons' potentially inappropriate Prescriptions; START, Screening Tool to Alert to Right Treatment

1.1.10 Organisations should consider exploring what barriers exist that may reduce reporting and learning from medicines-related patient safety incidents. Any barriers identified should be addressed – for example, using a documented action plan.

1.1.11 Health and social care organisations and practitioners should:

- ensure that action is taken to reduce further risk when medicines-related patient safety incidents are identified

- apply and share learning in the organisation and across the local health economy, including feedback on trends or significant incidents to support continuing professional development. This may be through a medicines safety officer, controlled drugs accountable officer or other medicines safety lead.

Surveillance proposal

This section of the guideline should not be updated.

2019 surveillance summary

A systematic review(1) of 4 studies (n=1,925) assessed the STOPP/START tool compared with control in older adults. There was a reduction in potentially inappropriate medicine prescriptions, although meta-analysis was not possible because of heterogeneity.

An RCT(2) assessing computerised STOPP alerts for GPs (n= 23,976) compared with no alerts had no effect on prescriptions of potentially inappropriate medicines.

Intelligence gathering

No information relevant to this section was identified.

Impact statement

The findings from 2 studies suggest that the STOP/START tool may be effective for reducing potentially inappropriate prescribing in older adults whereas alerts based on STOPP criteria may not be effective in general practice. This could be because of the differences in populations, with older people possibly more likely to benefit from this intervention. These findings are consistent with current recommendations on screening tools in specific groups such as older people.

New evidence is unlikely to change guideline recommendations.

Medicines-related communication systems when patients move from one care setting to another

Relevant information about medicines should be shared with patients, and their family members or carers, where appropriate, and between health and social care practitioners when a person moves from one care setting to another, to support high-quality care. This includes transfers within an organisation – for example, when a person moves from intensive care to a hospital ward – or from one organisation to another – for example, when a person is admitted to hospital, or discharged from hospital to their home or other location.

Recommendations in this section update and replace recommendation 1.4.2 in Medicines adherence: Involving patients in decisions about prescribed medicines and supporting adherence (NICE guideline CG76).

1.2.1 Organisations should ensure that robust and transparent processes are in place, so that when a person is transferred from one care setting to another:

- the current care provider shares† complete and accurate information about the person's medicines with the new care provider and
- the new care provider receives and documents this information, and acts on it.

Organisational and individual roles and responsibilities should be clearly defined. Regularly review and monitor the effectiveness of these processes. See also section 1.3 on medicines reconciliation.

† Take into account the 5 rules set out in the Health and Social Care Information Centre's A guide to confidentiality in health and social care (2013) when sharing information.

1.2.2 For all care settings, health and social care practitioners should proactively share complete and accurate information about medicines:

- ideally within 24 hours of the person being transferred, to ensure that patient safety is not compromised and
- in the most effective and secure way, such as by secure electronic communication, recognising that more than one approach may be needed.

1.2.3 Health and social care practitioners should share relevant information about the person and their medicines when a person transfers from one care setting to another. This should include, but is not limited to, all of the following:

- contact details of the person and their GP
- details of other relevant contacts identified by the person and their family members or carers where appropriate – for example, their nominated community pharmacy
- known drug allergies and reactions to medicines or their ingredients, and the type of reaction experienced (see the NICE guideline on drug allergy)
- details of the medicines the person is currently taking (including prescribed, over-the-counter and complementary medicines) – name, strength, form, dose, timing, frequency and duration, how the medicines are taken and what they are being taken for
- changes to medicines, including medicines started or stopped, or dosage changes, and reason for the change
- date and time of the last dose, such as for weekly or monthly medicines, including injections

- what information has been given to the person, and their family members or carers where appropriate
- any other information needed – for example, when the medicines should be reviewed, ongoing monitoring needs and any support the person needs to carry on taking the medicines. Additional information may be needed for specific groups of people, such as children.

1.2.4 Health and social care practitioners should discuss relevant information about medicines with the person, and their family members or carers where appropriate, at the time of transfer. They should give the person, and their family members or carers where appropriate, a complete and accurate list of their medicines in a format that is suitable for them. This should include all current medicines and any changes to medicines made during their stay.

1.2.5 Consider sending a person's medicines discharge information to their nominated community pharmacy, when possible and in agreement with the person.

1.2.6 Organisations should consider arranging additional support for some groups of people when they have been discharged from hospital, such as pharmacist counselling, telephone follow-up, and GP or nurse follow-up home visits. These groups may include:

- adults, children and young people taking multiple medicines (polypharmacy)
- adults, children and young people with chronic or long-term conditions
- older people.

Surveillance proposal

No new information was identified.

This section of the guideline should not be updated.

Editorial amendments

In the footnote to recommendation 1.2.1, the hyperlink to the Health and Social Care Information Centre's A guide to confidentiality in health and social care (2013) should be updated to reflect its current home on the NHS Digital website – the Health and Social Care Information Centre website has been archived.

Medicines reconciliation

Medicines reconciliation, as defined by the Institute for Healthcare Improvement, is the process of identifying an accurate list of a person's current medicines and comparing them with the current list in use, recognising any discrepancies, and documenting any changes, thereby resulting in a complete list of medicines, accurately communicated. The term

'medicines' also includes over-the-counter or complementary medicines, and any discrepancies should be resolved. The medicines reconciliation process will vary depending on the care setting that the person has just moved into – for example, from primary care into hospital, or from hospital to a care home.

1.3.1 In an acute setting, accurately list all of the person's medicines (including prescribed, over-the-counter and complementary medicines) and carry out medicines reconciliation within 24 hours or sooner if clinically necessary, when the person moves from one care setting to another – for example, if they are admitted to hospital.

1.3.2 Recognise that medicines reconciliation may need to be carried out on more than one occasion during a hospital stay – for example, when the person is admitted, transferred between wards or discharged.

1.3.3 In primary care, carry out medicines reconciliation for all people who have been discharged from hospital or another care setting. This should happen as soon as is practically possible, before a prescription or new supply of medicines is issued and within 1 week of the GP practice receiving the information.

1.3.4 In all care settings organisations should ensure that a designated health professional has overall organisational responsibility for the medicines reconciliation process. The process should be determined locally and include:

- organisational responsibilities
- responsibilities of health and social care practitioners involved in the process (including who they are accountable to)
- individual training and competency needs.

1.3.5 Organisations should ensure that medicines reconciliation is carried out by a trained and competent health professional – ideally a pharmacist, pharmacy technician, nurse or doctor – with the necessary knowledge, skills and expertise including:

- effective communication skills
- technical knowledge of processes for managing medicines
- therapeutic knowledge of medicines use.

1.3.6 Involve patients and their family members or carers, where appropriate, in the medicines reconciliation process.

1.3.7 When carrying out medicines reconciliation, record relevant information on an electronic or paper-based form. See section 1.2 on medicines-related communication systems.

Surveillance proposal

This section of the guideline should not be updated.

2019 surveillance summary

We found 6 studies on medicines reconciliation interventions (see Table 1 below), including a Cochrane review, 4 other systematic reviews and 2 randomised controlled trials (RCTs), all in mixed populations. Overall, the evidence for medicines reconciliation interventions was inconsistent. Medicines discrepancies were reported in 4 systematic reviews, which performed 9 analyses of slightly different measures, including number of discrepancies per person and number of discrepancies per medicine. Overall, no effect was seen in 5 of the 9 analyses.

One study of an intervention including both medicines reconciliation and medicines review found a reduction in preventable adverse drug reactions, whereas 3 studies of medicines reconciliation interventions saw no effect on preventable or potential adverse drug reactions. No effects were seen on admissions to hospital or healthcare service resource use.

Intelligence gathering

No information relevant to this section was identified.

Impact statement

The evidence identified in surveillance indicates that medicines reconciliation interventions may not be effective for improving adverse events or healthcare use outcomes. Although this appears to be inconsistent with NICE's recommendations to conduct medicines reconciliation, the evidence available when developing the guideline was also inconsistent. In developing the guideline, 1 study (moderate quality evidence) found no effects of medicines reconciliation on medicines related outcomes, whereas 3 studies (very low quality evidence) did find improvements in medicines related outcomes. Many of the recommendations in this section of the guideline were developed by consensus. The committee noted that 'medicines reconciliation helps to identify unintentional discrepancies that might otherwise be unresolved' and that identifying discrepancies would be difficult in the control group of RCTs without having undergone medicines reconciliation. Additionally, it was not possible to tell much about the components of these interventions from the abstract-level review of these studies. So they may not cover the system-wide best practice approach recommended in the guideline.

Additionally, one study suggesting that conducting both medicines reconciliation and medicines review may reduce preventable adverse drug reactions. This finding is consistent with current guidance, which recommends both processes. For example, the process of medicines reconciliation may provide healthcare professionals with the information necessary for selecting patients for a structured medicines review.

New evidence is unlikely to change guideline recommendations.

Medication review

Medication review can have several different interpretations and there are also different types which vary in their quality and effectiveness. Medication reviews are carried out in people of all ages. In this guideline medication review is defined as 'a structured, critical examination of a person's medicines with the objective of reaching an agreement with the person about treatment, optimising the impact of medicines, minimising the number of medication-related problems and reducing waste'. See also recommendation 1.6.3.

1.4.1 Consider carrying out a structured medication review for some groups of people when a clear purpose for the review has been identified. These groups may include:

- adults, children and young people taking multiple medicines (polypharmacy)
- adults, children and young people with chronic or long-term conditions
- older people.

1.4.2 Organisations should determine locally the most appropriate health professional to carry out a structured medication review, based on their knowledge and skills, including all of the following:

- technical knowledge of processes for managing medicines
- therapeutic knowledge on medicines use
- effective communication skills.

The medication review may be led, for example, by a pharmacist or by an appropriate health professional who is part of a multidisciplinary team.

1.4.3 During a structured medication review, take into account:

- the person's, and their family members or carers where appropriate, views and understanding about their medicines
- the person's, and their family members' or carers' where appropriate, concerns, questions or problems with the medicines
- all prescribed, over-the-counter and complementary medicines that the person is taking or using, and what these are for
- how safe the medicines are, how well they work for the person, how appropriate they are, and whether their use is in line with national guidance
- whether the person has had or has any risk factors for developing adverse drug reactions (report adverse drug reactions in line with the yellow card scheme)
- any monitoring that is needed.

Surveillance proposal

This section of the guideline should not be updated.

2019 surveillance summary

We identified 11 studies (reported in 12 publications) of medicines review (see

Table 2), including 2 Cochrane reviews, 5 other systematic reviews and 4 RCTs. Of these, 7 studies looked at older adult populations.

Overall, medicines review improved outcomes in 18 of 39 analyses (46%). This included medicines omissions in older adults. Reductions in potentially inappropriate prescriptions in older people showed inconsistent effects across studies. Additionally, mortality, admissions to hospital or attending the emergency department were not influenced by medicines reviews.

Intelligence gathering

No information relevant to this section was identified.

Impact statement

The inconsistent findings on the effect of medicines review appears to be at odds with NICE's recommendations to conduct medicines reviews in some people. However, in developing the guideline, the committee noted that the evidence on medicines review considered in developing the guideline also had 'mixed findings'.

However, in The committee 'discussed and agreed that the purpose of doing a medication review is important in practice as it may be driven by a clinical need or by national/local incentives, which may lead to different clinical or patient-reported outcomes.'

New evidence is unlikely to change guideline recommendations.

Self-management plans

Self-management plans can be patient-led or professional-led and they aim to support people to be empowered and involved in managing their condition. Different types of self-management plan exist and they vary in their content depending on the needs of the individual person. Self-management plans can be used in different settings. In this guideline self-management plans are structured, documented plans that are developed to support a person's self management of their condition using medicines. People using self-management plans can be supported to use them by their family members or carers who can also be involved when appropriate during discussions – for example, a child and their parent(s) using a self-management plan.

1.5.1 When discussing medicines with people who have chronic or long-term conditions, consider using an individualised, documented self-management plan to support people who want to be involved in managing their medicines. Discuss at least all of the following:

- the person's knowledge and skills needed to use the plan, using a risk assessment if needed
- the benefits and risks of using the plan
- the person's values and preferences
- how to use the plan
- any support, signposting or monitoring the person needs.

Record the discussion in the person's medical notes or care plan as appropriate.

1.5.2 When developing an individualised, documented self-management plan, provide it in an accessible format for the person and consider including:

- the plan's start and review dates
- the condition(s) being managed
- a description of medicines being taken under the plan (including the timing)
- a list of the medicines that may be self-administered under the plan and their permitted frequency of use, including any strength or dose restrictions and how long a medicine may be taken for
- known drug allergies and reactions to medicines or their ingredients, and the type of reaction experienced (see the NICE guideline on drug allergy)
- arrangements for the person to report suspected or known adverse reactions to medicines
- circumstances in which the person should refer to, or seek advice from, a health professional
- the individual responsibilities of the health professional and the person
- any other instructions the person needs to safely and effectively self-manage their medicines.

1.5.3 Review the self-management plan to ensure the person does not have problems using it.

Surveillance proposal

This section of the guideline should not be updated.

Editorial amendments

A cross reference to Decision-making and mental capacity (NICE NG108) should be added in this section.

2019 surveillance summary

We identified 5 studies of patient self-management interventions, including 1 systematic review, 1 NIHR-funded randomised controlled trial, and 3 other RCTs (see Table 3).

Self-management interventions resulted in reduced viral load in people with HIV, and improved cholesterol, blood pressure and blood glucose in people with diabetes. However, self-management interventions did not improve patients' quality of life in 2 studies (in people with asthma and in uncontrolled epilepsy). In one study in people with asthma, quality of life was improved by online self-management after 3 months but not after 6 months.

Intelligence gathering

No information relevant to this section was identified.

Impact statement

Self-management interventions appear to have benefits for patient-oriented outcomes in asthma, diabetes and HIV, although quality of life may not be improved. The evidence therefore is consistent with the guideline, which recommends the use of self-management plans.

New evidence is unlikely to change guideline recommendations.

Patient decision aids used in consultations involving medicines

Many people wish to be active participants in their own healthcare, and to be involved in making decisions about their medicines. Patient decision aids can support health professionals to adopt a shared decision-making approach in a consultation, to ensure that patients, and their family members or carers where appropriate, are able to make well-informed choices that are consistent with the person's values and preferences.

1.6.1 Offer all people the opportunity to be involved in making decisions about their medicines. Find out what level of involvement in decision-making the person would like and avoid making assumptions about this.

1.6.2 Find out about a person's values and preferences by discussing what is important to them about managing their condition(s) and their medicines. Recognise that the person's values and preferences may be different from those of the health professional and avoid making assumptions about these.

1.6.3 Apply the principles of evidence-based medicine when discussing the available treatment options with a person in a consultation about medicines. Use the best available evidence when making decisions with or for individuals, together with clinical expertise and the person's values and preferences.

1.6.4 In a consultation about medicines, offer the person, and their family members or carers where appropriate, the opportunity to use a patient decision aid (when one is available) to help them make a preference-sensitive decision that involves trade-offs between benefits and harms. Ensure the patient decision aid is appropriate in the context of the consultation as a whole.

1.6.5 Do not use a patient decision aid to replace discussions with a person in a consultation about medicines.

1.6.6 Recognise that it may be appropriate to have more than one consultation to ensure that a person can make an informed decision about their medicines. Give the person the opportunity to review their decision, because this may change over time – for example, a person's baseline risk may change.

1.6.7 Ensure that patient decision aids used in consultations about medicines have followed a robust and transparent development process, in line with the IPDAS criteria.

1.6.8 Before using a patient decision aid with a person in a consultation about medicines, read and understand its content, paying particular attention to its limitations and the need to adjust discussions according to the person's baseline risk.

1.6.9 Ensure that the necessary knowledge, skills and expertise have been obtained before using a patient decision aid. This includes:

- relevant clinical knowledge
- effective communication and consultation skills, especially when finding out patients' values and preferences
- effective numeracy skills, especially when explaining the benefits and harms in natural frequencies, and relative and absolute risk
- explaining the trade-offs between particular benefits and harms.

1.6.10 Organisations should consider training and education needs for health professionals in developing the skills and expertise to use patient decision aids effectively in consultations about medicines with patients, and their family members or carers where appropriate.

1.6.11 Organisations should consider identifying and prioritising which patient decision aids are needed for their patient population through, for example, a local medicines decision-making group. They should agree a consistent, targeted approach in line with local pathways and review the use of these patient decision aids regularly.

1.6.12 Organisations and health professionals should ensure that patient decision aids prioritised for use locally are disseminated to all relevant health professionals and stakeholder groups, such as clinical networks.

Surveillance proposal

This section of the guideline should not be updated.

Editorial amendments

A cross reference to Decision-making and mental capacity (NICE NG108) should be added in this section.

2019 surveillance summary

An RCT(3) (number of participants not reported in the abstract) assessed a patient decision aid for primary prevention of fracture in people with osteoporosis, which included 10 year fracture risk, medicines risks and benefits, and value elicitation. The intervention improved 'decisional conflict' but had no effect on making decision about treatment or starting treatment.

Intelligence gathering

No information relevant to this section was identified.

Impact statement

This study suggests that there may be little benefit of decision aids for people with osteoporosis. Because this population had no previous fractures, people may be less likely to choose to take drug treatments than people who have a symptomatic long-term condition such as chronic obstructive pulmonary disease. Additionally, it was not possible to tell whether the decision aid was used as part of a consultation process (as recommended in the guideline) or for patients use in their own time (not covered by the guideline) from the abstract-level review of this study.

New evidence is unlikely to change guideline recommendations.

Clinical decision support

Clinical decision support software is a component of an integrated clinical IT system providing support to clinical services, such as in a GP practice or secondary care setting. These integrated clinical IT systems are used to support health professionals to manage a person's condition. In this guideline the clinical decision support software relates to computerised clinical decision support, which may be active or interactive, at the point of prescribing medicines.

1.7.1 Organisations should consider computerised clinical decision support systems (taking account of existing systems and resource implications) to support clinical decision-making and prescribing, but ensure that these do not replace clinical judgement.

1.7.2 Organisations should ensure that robust and transparent processes are in place for developing, using, reviewing and updating computerised clinical decision support systems.

1.7.3 Organisations should ensure that health professionals using computerised clinical decision support systems at the point of prescribing have the necessary knowledge and skills to use the system, including an understanding of its limitations.

1.7.4 When using a computerised clinical decision support system to support clinical decision-making and prescribing, ensure that it:

- identifies important safety issues
- includes a system for health professionals to acknowledge mandatory alerts. This should not be customisable for alerts relating to medicines-related 'never events'
- reflects the best available evidence and is up-to-date
- contains useful clinical information that is relevant to the health professional to reduce 'alert fatigue' (when a prescriber's responsiveness to a particular type of alert declines as they are repeatedly exposed to that alert over time).

Surveillance proposal

This section of the guideline should not be updated.

2019 surveillance summary

We identified 17 studies including a clinical decision support element (see Table 4), including 2 Cochrane reviews, 6 other systematic reviews and 9 RCTs. Overall, decision support interventions were effective in 33 of 48 analyses (69%). This included:

- In 5 studies of cardiometabolic conditions including cardiovascular disease and diabetes, interventions involving decision support resulted in improved prescribing of antiplatelets, anticoagulants, and lipid-lowering drugs. Clinical outcomes showed variable effects, with blood pressure reduction seen in one study, but no effect on the more serious outcomes of haemorrhage and stroke. In one study, transient ischaemic attack was increased, which could have been because of improved detection as a result of increased awareness.

Psychological outcomes were improved in people with diabetes, including distress about diabetes and patients' satisfaction with medication.

- In 5 studies of infection, antibiotic prescribing increased in 2 studies, was not influenced by clinical decision support in one study and was reduced in one study that needed a typed justification for the prescription. However, in 2 studies improvements were seen in prescribing antibiotics appropriately or according to guidelines. Mortality was improved in a systematic review of decision support in hospital.
- In a Cochrane review of 12 studies (n=4,052), decision support in older people on 4 or more medicines improved appropriate prescriptions, prescribing omissions, but had inconsistent effects in potentially inappropriate medicines prescribing. Additionally, there was little or no effect on quality of life or admissions to hospital.
- In a systematic review of 34 studies, medicines errors were reduced in children in intensive care with several different interventions, including clinical decision support, protocols and guidelines, education interventions and computerised physician order entry systems.

Intelligence gathering

No information relevant to this section was identified.

Impact statement

The evidence suggests that clinical decision support tools may improve prescribing. However, significant effects on clinical and patient-oriented outcomes were less common. Overall, the evidence supports the recommendations to consider computerised clinical decision support systems (taking account of existing systems and resource implications) to support clinical decision-making and prescribing.

It was not possible to tell whether all the interventions met the guideline's definition of decision support from the abstract-level review of these studies. In developing the guideline, the committee 'recognised that clinical decision support would need to be kept up-to-date in terms of clinical information and software versions and be applicable to local healthcare needs.' Therefore, the committee made consensus-based recommendations on the principles behind the information integrated into clinical decision support. The new evidence does not impact on the broad principles for clinical decision support systems noted in current recommendations.

New evidence is unlikely to change guideline recommendations.

Medicines-related models of organisational and cross-sector working

The introduction of skill mixing of various health and social care practitioners to meet the needs of different groups of people has led to different types of models of care emerging across health and social care settings. Cross-organisational working further provides seamless care during the patient care pathway when using health and social care services. The type of model of care used will be determined locally based on the resources and health and social care needs of the population in relation to medicines.

1.8.1 Organisations should consider a multidisciplinary team approach to improve outcomes for people who have long-term conditions and take multiple medicines (polypharmacy).

1.8.2 Organisations should involve a pharmacist with relevant clinical knowledge and skills when making strategic decisions about medicines use or when developing care pathways that involve medicines use.

Surveillance proposal

No new information was identified.

Areas not currently covered in the guideline

In surveillance, evidence was identified for areas not covered by the guideline. This new evidence has been considered for possible addition as a new section of the guideline.

Surveillance proposal

New sections of the guideline should not be added.

2019 surveillance summary

We identified 11 studies of interventions that are not currently covered by the guideline, including 2 Cochrane reviews, 4 other systematic reviews and 5 RCTs (see

Table 5). This included:

- A Cochrane review of 'medicines errors interventions' that found no effects on admissions to hospital, emergency department attendance or mortality.
- A Cochrane review suggesting that nurse-led titration in cardiovascular disease increased the chance of reaching the target dose, reduced admissions to hospital and all-cause mortality and increased event-free survival.
- Genetic profiling for people taking medicines with known genetic-based interactions had no effect on readmission to hospital or emergency department use at 1 month, but both outcomes were lower after 2 months (1 study, n=110).
- Feedback to healthcare staff on prescribing of steroids (1 study, n=721) or peers' antibiotic prescribing patterns (1 study, n=16,959) resulted in reduced parenteral steroid doses and antibiotic prescriptions.
- Educational or training interventions for healthcare workers, which were assessed in 4 studies. In one study, educational interventions increased quality of prescribing, but in 3 studies, educational interventions did not affect prescribing of medicines with potential interactions, prescription of potentially inappropriate medicines, medicines administration errors, admission to hospital, mortality or administration of prophylaxis for venous thromboembolism in people in hospital.
- Several interventions reporting effects on prescribing included too little detail to know if they were relevant to any of the sections of the current guideline, for example, 'computerised interventions' 'pharmacist involvement' or 'interventions to reduce antimicrobial prescribing'.

Intelligence gathering

No information relevant to this section was identified.

Impact statement

Of the identified interventions, two appear to have promise: genetic profiling and giving doctors feedback on their prescribing or how their prescribing relates to their peers. However, the study on genetic profiling had follow-up of only 2 months, which is too short to evaluate effects on patients' outcomes.

The studies on providing feedback to healthcare staff suggest that this is a useful mechanism for improving prescribing. However, the identified evidence is relevant to only two populations – people being prescribed steroids and antibiotics for upper respiratory tract infections. This is consistent with NICE's guideline on antimicrobial stewardship recommends considering developing systems and processes for providing regular updates to prescribers and prescribing leads on individual prescribing benchmarked against local and national antimicrobial prescribing rates and trends. The evidence suggesting that feedback may also be useful for

reducing prescribed doses of parenteral steroids was based on one study from Iran, which may limit its applicability to the UK setting, particularly if parenteral steroid prescribing patterns differ between these countries.	New evidence is unlikely to impact on the guideline.

Research recommendations

Is a medication review more clinically and cost effective at reducing the suboptimal use of medicines and medicines-related patient safety incidents, compared with usual care or other interventions, in children?

Summary of findings

No new evidence relevant to population specified in the research recommendation (that is, children) was found and no ongoing studies were identified.

Surveillance proposal

This research recommendation will be considered again at the next surveillance point.

Is a medication review more clinically and cost effective at reducing the suboptimal use of medicines and improving patient-reported outcomes, compared with usual care or other intervention in the UK setting?

Summary of findings

New evidence relevant to the research recommendation was found (see

Table 2). Overall, the evidence appears to be inconsistent so is insufficient to answer this research recommendation at this time. See the section on medicines review above for discussion of the evidence and its impact on the guideline.

The proposed format of the research recommendation noted that a follow-up duration of 1–2 years would be useful to capture longer-term outcomes. The abstracts of studies identified in surveillance rarely reported the duration of follow-up, and of those that did, almost all were of 1 year or shorter. Therefore, no conclusions could be drawn on the frequency of medicines reviews.

Surveillance decision

This research recommendation will be considered again at the next surveillance point.

What is the clinical and cost effectiveness of using clinical decision support systems to reduce the suboptimal use of medicines and improve patient outcomes from medicines, compared with usual care, in the UK setting?

Summary of findings

New evidence relevant to the research recommendation was found (see Table 4

Table 2). Overall, the evidence appears to be support current recommendations but is insufficient to answer inform the use of decision support tools in the NHS. See the section on clinical decision support above for discussion of the evidence and its impact on the guideline.

Surveillance decision

This research recommendation will be considered again at the next surveillance point.

What models of cross-organisational working improve clinical and cost effectiveness in relation to the suboptimal prescribing of medicines – for example, between NHS and social care, or primary and secondary care, or between NHS and commercial organisations?

Summary of findings

No new evidence relevant to the research recommendation was found and no ongoing studies were identified.

Surveillance decision

This research recommendation will be considered again at the next surveillance point.

Evidence tables

Table 1 Medicines reconciliation interventions

Study	Type*	Studies	n	Population	Intervention	Comparator	Outcome	Result
Redmond et al. 2018(4)	SR-C	4	597	Mixed	Medicines reconciliation intervention	Usual care	Admission to hospital or emergency department use	No significant effect with intervention
		4	1,363				Adverse drug reactions	No significant effect with intervention
		20	4,629				Medication discrepancies	Improved with intervention
		2	3,595				Medicines discrepancies (number per medicine)	No significant effect with intervention
		4	1,963				Medicines discrepancies (number per person)	No significant effect with intervention
		3	1,253				Preventable adverse drug reactions	No significant effect with intervention
		5	1,206				Readmission to hospital (unplanned)	No significant effect with intervention
Cheema et al. 2018(5)	SR	18	6,038	Mixed	Medicines reconciliation (pharmacist-led)	Unspecified control	Adverse drug reactions (potential)	No significant effect with intervention
							Health service resource use	No significant effect with intervention
							Medication discrepancies	Improved with intervention
							Preventable adverse drug reactions	No significant effect with intervention
Mekonnen et al. 2016(6)	SR	10		Mixed (in hospital)	Medicines reconciliation	Usual care	Medicine omission errors	Improved with intervention
							Medicines discrepancies (number of discrepancies)	Improved with intervention

							Medicines discrepancies (number of discrepancies)	No significant effect with intervention
							Medicines discrepancies (number of people)	No significant effect with intervention
Wang et al. 2018(7)	SR	13		Mixed	Medicines reconciliation interventions	Unspecified control	Medicines discrepancies (number of discrepancies)	Improved with intervention
							Medicines discrepancies (number of people)	No significant effect with intervention
Al-Hashar et al. 2018(8)	RCT		587	Mixed	Medicines intervention (reconciliation, review and counselling)	Usual care	Health service resource use	No significant effect with intervention
							Preventable adverse drug reactions	Improved with intervention
Tamblyn et al. 2018(9)	RCT			Mixed	Computerised medicines reconciliation	Unspecified control	Completed medicines reconciliations	Improved with intervention

*Type of study SR = systematic review; SR-C = Cochrane review; SR-HTA = NIHR-funded systematic review (Health Technology Assessment); SR-NMA = systematic review with network meta-analysis; RCT = randomised controlled trial; RCT-NIHR = NIHR-funded randomised controlled trial; CE = cost-effectiveness study.

n = number of participants. The number of participants was not always reported in the abstract.

Table 2 Medicines review interventions

Study	Type*	Studies	n	Population	Intervention	Comparator	Outcome	Result
Alldred et al. 2016(10)	SR-C	2		Mixed (65 years or older living in care homes)	Medicines optimisation intervention†	Unspecified control	Adverse drug reactions	No significant effect with intervention‡
		8					Duration of hospital admission	Little or no effect with intervention‡
		2					Health-related quality of life	Mixed success of intervention‡
		5					Medicines appropriateness	Improved with intervention‡
		5					Medicines costs	No significant effect with intervention‡

		7					Medicines-related problems (identification and resolution)	Improved with intervention‡
		6					Mortality	No significant effect with intervention‡
Christensen and Lundh 2016(11)	SR-C	7	2,843	Mixed (adults in hospital)	Medicines review (by a physician, pharmacist or other healthcare professional)	Usual care	Emergency department use	No significant effect with intervention
		9	3,218				Mortality	No significant effect with intervention
		7	2,843				Readmission to hospital	No significant effect with intervention
Hohl et al. 2015(12)	SR	7	3,292	Mixed (in hospital)	Medicines review (pharmacist-led)	Unspecified control	Duration of hospital admission	No significant effect with intervention
							Emergency department use	No significant effect with intervention
							Mortality	No significant effect with intervention
							Readmission to hospital	No significant effect with intervention
Loh et al. 2016(13)	SR	25	15,341	Mixed (65 years and older, community-based)	Medicines review (pharmacist-led)	Unspecified control	Costs	No significant effect with intervention
							Health perception	Worse with intervention
							Pain	Worse with intervention
							Quality of life	No significant effect with intervention
Meid et al. 2015(14)	SR	6	1,469	Mixed (65 years and older)	Medicines review	Unspecified control	Medicines omitted (mean)	Improved with intervention
		8	1,833				Medicines omitted (number of patients)	Improved with intervention
Tesfaye et al. 2017(15)	SR	49		Kidney disease (chronic)	Clinical pharmacist feedback	Unspecified control	Inappropriate prescribing	Improved with intervention
Thomas et al. 2014(16)	SR	3		Cardiovascular disease (heart failure, older adults)	Pharmacist-led interventions	Unspecified control	Admission to hospital	Improved with intervention (meta-analysis not possible because of heterogeneity)

		27		Mixed (older adults)			Admission to hospital (unplanned)	No significant effect with intervention
Clyne et al. 2015, Clyne et al. 2016(17,18)	RCT		196	Mixed (70 years and older in general practice)	Medicines review (internet-based algorithm with recommended alternative treatment suggestions) plus academic detailing plus tailored patient information leaflets	Usual care with simple patient-level feedback on potentially inappropriate prescribing	Number of people prescribed potentially inappropriate medicines	Improved with intervention
							Number of potentially inappropriate medicines prescribed	Improved with intervention
							Potentially inappropriate medicines prescribed (any)	No significant effect with intervention
							Prescription of proton pump inhibitors (reduction)	Improved with intervention
							Proton pump inhibitors prescribed (reduction)	Improved with intervention
Lalonde et al. 2017(19)	RCT		442	Kidney disease (chronic)	Medicines management intervention (pharmacists' online training tool, access to patients' clinical summaries and to the chronic kidney disease clinic)	Unspecified control	Medication-related problems	Improved with intervention
							Patients' clinical attributes (such as blood pressure and glycated haemoglobin concentration)	No significant effect with intervention
							Pharmacists' clinical competencies	Improved with intervention
							Pharmacists' knowledge	Improved with intervention
Nipp et al. 2018(20)	RCT		60	Cancer (breast, gastrointestinal or lung, undergoing first-line chemotherapy,	Pharmacist-led medicines management and vaccination administration	Unspecified control	Medicine discrepancies	No significant effect with intervention
							Potentially inappropriate medicines prescribed	No significant effect with intervention

				65 years or older)			Uptake of influenza vaccination	Improved with intervention
							Uptake of pneumonia vaccination	Improved with intervention
Tsuyuki et al. 2015(21)	RCT		248	Cardiovascular disease (hypertension, uncontrolled)	Pharmacist-led cardiovascular risk assessment, patient education about hypertension, prescribing antihypertensives	Paper-based blood pressure recording	Blood pressure (controlled)	Improved with intervention
							Blood pressure (systolic)	Improved with intervention

*Type of study SR = systematic review; SR-C = Cochrane review; SR-HTA = NIHR-funded systematic review (Health Technology Assessment); SR-NMA = systematic review with network meta-analysis; RCT = randomised controlled trial; RCT-NIHR = NIHR-funded randomised controlled trial; CE = cost-effectiveness study.

n = number of participants. The number of participants was not always reported in the abstract.

†Medication review was a component of 10 studies. 4 studies involved multidisciplinary case-conferencing, 5 studies involved an educational element for health and care professionals and 1 study evaluated the use of clinical decision support technology. ‡ Meta-analysis not possible because of heterogeneity.

Table 3 Self management interventions

Study	Type*	Studies	n	Population	Intervention	Comparator	Outcome	Result
Ahmed et al. 2016(22)	RCT		100	Asthma (adolescents)	Online self management	Usual care	Quality of life (asthma-related)	Improved with intervention at 3 months
								No significant effect with intervention at 6 months
de Bruin et al. 2017(23)	RCT		221	Infection (HIV)	Nurse-led self management strategy (aiming to improve adherence)	Usual care	Viral load	Improved with intervention
Morrison et al. 2016(24)	RCT		51	Asthma	Online self management	Unspecified control	Quality of life (asthma-related)	No significant effect with intervention
Ridsdale et al. 2018(25)	RCT-NIHR		404	Epilepsy (uncontrolled on at least 2 antiepilptics)	Self management education (intensive 2-day training)	Usual care	Quality of life	No significant effect with intervention
van Eikenhorst et al. 2017(26)	SR	24	3,610	Diabetes (unspecified)	Pharmacist-led self management (such as education on medicines, complications,	Unspecified control	Cholesterol	Improved with intervention
							Blood pressure (diastolic)	Improved with intervention

					lifestyle and teaching self management skills)		Blood pressure (systolic)	Improved with intervention
							Glycated haemoglobin	Improved with intervention

*Type of study SR = systematic review; SR-C = Cochrane review; SR-HTA = NIHR-funded systematic review (Health Technology Assessment); SR-NMA = systematic review with network meta-analysis; RCT = randomised controlled trial; RCT-NIHR = NIHR-funded randomised controlled trial; CE = cost-effectiveness study.

n = number of participants. The number of participants was not always reported in the abstract.

Table 4 Clinical decision support interventions

Study	Type*	Studies	n	Population	Intervention	Comparator	Outcome	Result
Mazzaglia et al. 2016(27)	RCT		27,317	Cardiometabolic conditions (diabetes type, myocardial infarction, stroke)	Computerised decision support (primary care)	Standard software	Antiplatelets prescribed to people with diabetes	Improved with intervention
							Days on medicines with potential interactions (people with stroke only)	Improved with intervention
							Lipid-lowering drugs prescribed to people with diabetes	Improved with intervention
Silbernagel et al. 2016(28)	RCT		889	Cardiovascular disease (atrial fibrillation suspected, not on oral anticoagulants)	Computerised alert recommending prescription of oral anticoagulants	Usual care	Oral anticoagulants or antiplatelets prescribed	Improved with intervention
							Oral anticoagulants prescribed	Improved with intervention
Holt et al. 2017(29)	RCT			Cardiovascular disease (atrial fibrillation)	Electronic reminders about starting oral anticoagulants (in general practice consultations)	Usual care	Incidence of haemorrhage	No significant effect with intervention
							Incidence of stroke	No significant effect with intervention
							Incidence of transient ischaemic attack	Worse with intervention
							Oral anticoagulants prescribed	No significant effect with intervention
Duan et al. 2017(30)	SR	46	13,875	Cardiovascular disease (hypertension)	Telemonitoring plus additional support (such as counselling, education, behavioural management, medicines	Telemonitoring without additional support	Blood pressure (diastolic)	Improved with intervention
							Blood pressure (systolic)	Improved with intervention

					management with decision support)			
Heisler et al. 2014(31)	RCT		188	Diabetes	Decision support tool	Standard educational material	Patient distress about diabetes	Improved with intervention
							Patient satisfaction (with medication)	Improved with intervention
Baysari et al. 2016(32)	SR	45		Infection (antibiotics)	Computerised intervention (decision support, computerised provider order entry, antimicrobial approval, or surveillance systems)	Unspecified control	Appropriate antimicrobial use	Improved with intervention
Curtis et al. 2017(33)	SR	13		Infection (antibiotics, hospital-based)	Computerised decision support	Unspecified control	Antibiotic coverage adequacy	Improved with intervention
		20					Mortality	Improved with intervention
Blair et al. 2017(34)	RCT		501	Infection (respiratory, antibiotics, children)	Clinical decision support	Usual care	Antimicrobial prescribing (reduction)	Worse with intervention (evidence of recruitment of sicker children into the intervention arm)
Meeker et al. 2016(35)	RCT		16,959	Infection (upper respiratory tract, antibiotics in general practice)	Typed justification for prescription	Usual care	Antimicrobial prescribing (reduction)	Improved with intervention
					Reminders about non-antimicrobial alternatives			No significant effect with intervention
Vellinga et al. 2016(36)	RCT			Infection (urinary tract antibiotics)	Antimicrobial prescribing intervention (clinician education, practice audit report, with computerised reminders about first-line treatment or delayed prescribing)	Unspecified control	Antimicrobial prescribing (reduction)	Worse with intervention
							Antimicrobial prescribing according to guidelines	Improved with intervention
Awdishu et al. 2016(37)	RCT		1,278	Kidney disease	Decision support tool for doctors with alerts recommending dose adjustment or stopping medicines)	Decision support tool without alerts	Appropriate medicines prescribed	Improved with intervention

Rankin et al. 2018(38)	SR-C	12	4,052	Mixed (65 years and older, on 4 or more medicines)	Polypharmacy care (computerised decision support or multicomponent pharmaceutical care intervention)	Unspecified control	Admission to hospital	Little or no effect with intervention‡
		5	517				Appropriate medicines prescribed	Improved with intervention
		11	3,079				Number of people prescribed potentially inappropriate medicines	No significant effect with intervention
		7	1,832				Number of potentially inappropriate medicines prescribed	Improved with intervention
		2	569				Potential prescribing omission (number of omissions)	Improved with intervention
		5	1,310				Potential prescribing omission (number of people)	Improved with intervention
		12	3,211				Quality of life	Little or no effect with intervention‡
Maaskant et al. 2015(39)	SR-C	7		Mixed (children in hospital)	Medication errors intervention (pharmacist-led, or computerised order or administration systems or structured prescribing form or checklist plus feedback)	Unspecified control	Medicines errors	Improved with intervention‡
							Patient harm caused by medicines errors	No significant effect with intervention
Manias et al. 2014(40)	SR	34		Mixed (children in intensive care)	Computerised physician order entry	Unspecified control	Medicines errors	Improved with intervention
					Education interventions	Unspecified control	Medicines errors	Improved with intervention
					Protocols and guidelines	Unspecified control	Medicines errors	No significant effect with intervention
					Clinical decision support	Unspecified control	Medicines errors	No significant effect with intervention
					Pharmacist involvement	Unspecified control	Medicines errors	No significant effect with intervention

Nuckols et al. 2014(41)	SR	16		Mixed (hospital-based)	Computerised physician order entry	Unspecified control	Medicines errors	Improved with intervention
							Preventable adverse drug reactions	Improved with intervention
Liebschutz et al. 2017(42)	RCT		985	Mixed (opioid prescriptions)	Digital decision tools, electronic registry, nurse care management, 1-on-1 'academic detailing'	Digital decision tools	Dose reduction by 10% or stopping treatment	Improved with intervention
							Early prescription refill (fewer considered better)	No significant effect with intervention
							Guideline-concordant care†	Improved with intervention
							Morphine-equivalent daily dose (lower)	Improved with intervention
							Patient–primary care clinician agreement	Improved with intervention
							Undergone at least 1 urinary drug test	Improved with intervention

*Type of study SR = systematic review; SR-C = Cochrane review; SR-HTA = NIHR-funded systematic review (Health Technology Assessment); SR-NMA = systematic review with network meta-analysis; RCT = randomised controlled trial; RCT-NIHR = NIHR-funded randomised controlled trial; CE = cost-effectiveness study.

n = number of participants. The number of participants was not always reported in the abstract.

† Guideline-concordant care defined as a patient and primary care clinician agreement recorded in the electronic health record and at least 1 urine drug test. ‡ Meta-analysis not possible because of heterogeneity.

Table 5 Interventions not currently covered by the guideline

Study	Type*	Studies	n	Population	Intervention	Comparator	Outcome	Result
Driscoll et al. 2015(43)	SR-C	4	556	Cardiovascular disease (heart failure, beta blockers or angiotensin receptor blockers)	Nurse-led titration	Usual care	Admissions to hospital	Improved with intervention
		4	556				Admissions to hospital for heart failure	Improved with intervention
		9	902				Mortality (all cause)	Improved with intervention
		3	370				Survival (event free)	Improved with intervention
		5	966				Target dose reached	Improved with intervention
Khalil et al. 2017(44)	SR-C	13	152,237	Mixed	Medication errors intervention (organisational-level)	Unspecified control	Admissions to hospital (number of people)	No significant effect with intervention
		11	6,203				Admissions to hospital (total number)	No significant effect with intervention
		5	1,819				Emergency department use	No significant effect with intervention
		12	154,962				Mortality	No significant effect with intervention
		1	3,661		Medication errors intervention (healthcare professional-level)	Unspecified control	Admissions to hospital (number of people)	No significant effect with intervention
		2	3,889				Admissions to hospital (total number)	No significant effect with intervention
		2	1,067				Emergency department use	No significant effect with intervention
		1	3,538				Mortality	No significant effect with intervention
Berdot et al. 2016(45)	SR	7		Mixed (in hospital)	Nurse training or technology intervention	Unspecified control	Medicines administration errors	No significant effect with intervention

Hu et al. 2016(46)	SR	13		Infection (upper respiratory tract infection in children, antibiotics)	Patient-doctor communication about antimicrobial prescribing	Usual care	Antimicrobial prescribing (reduction)	Improved with intervention
					Interventions to reduce antimicrobial prescribing (any type)		Antimicrobial prescribing (reduction)	Improved with intervention
					Interventions to reduce antimicrobial prescribing aimed at both patients and doctors		Antimicrobial prescribing (reduction)	Improved with intervention
					Interventions to reduce antimicrobial prescribing aimed at either patients or doctors		Antimicrobial prescribing (reduction)	No significant effect with intervention
Zavala-Gonzalez et al. 2017(47)	SR	12		Mixed (general practice)	Computerised interventions	Unspecified control	Quality of prescribing	Improved with intervention
					Pharmacist involvement in healthcare team		Quality of prescribing	Improved with intervention
					Educational interventions		Quality of prescribing	Improved with intervention
Elliott et al. 2017(48)	RCT		110	Mixed (50 years and older, taking a medicine with known genetic-based interactions)	Genetic profiling	Usual care including pharmacist-led medicines management	Emergency department use (at 1 month)	No significant effect with intervention
							Emergency department use (at 2 months)	Improved with intervention
							Readmission to hospital (at 2 months)	Improved with intervention
							Readmission to hospital) at 1 month)	No significant effect with intervention
Franchi et al. 2016(49)	RCT		697	Mixed (65 years and older, in hospital)	Online educational programme for healthcare workers	Usual care	Medicines with potential interactions prescribed	No significant effect with intervention
							Medicines with potential severe interactions prescribed	No significant effect with intervention
							Mortality	No significant effect with intervention

							Potentially inappropriate medicines prescribed	No significant effect with intervention
							Readmission to hospital	No significant effect with intervention
Lau et al. 2017(50)	RCT		933	Mixed (in hospital)	Interactive education for nurses	Non-interactive education	Administering prophylaxis for venous thromboembolism	No significant effect with intervention
Meeker et al. 2016(35)	RCT		16,959	Infection (upper respiratory tract, antibiotics in general practice)	Peer-comparison with lowest antibiotic prescribers	Usual care	Antimicrobial prescribing (reduction)	Improved with intervention
Nejad et al. 2016(51)	RCT		721	Mixed (general practice)	Text messaging for healthcare staff (feedback on defined daily doses of parenteral steroids prescribed)	Paper-based feedback	Defined daily doses of steroids prescribed (reduction considered better)	No significant effect with intervention
					Text messaging or paper-based feedback for healthcare staff on defined daily doses of parenteral steroids prescribed	Unspecified control	Defined daily doses of steroids prescribed (reduction considered better)	Improved with intervention

*Type of study SR = systematic review; SR-C = Cochrane review; SR-HTA = NIHR-funded systematic review (Health Technology Assessment); SR-NMA = systematic review with network meta-analysis; RCT = randomised controlled trial; RCT-NIHR = NIHR-funded randomised controlled trial; CE = cost-effectiveness study.

n = number of participants. The number of participants was not always reported in the abstract.

References

1. Hill-Taylor B, Walsh KA, Stewart S, Hayden J, Byrne S, Sketris IS (2016) Effectiveness of the STOPP/START (Screening Tool of Older Persons' potentially inappropriate Prescriptions/Screening Tool to Alert doctors to the Right Treatment) criteria: systematic review and meta-analysis of randomized controlled studies. Journal of Clinical Pharmacy & Therapeutics 41(2):158–69

2. Price M, Davies I, Rusk R, Lesperance M, Weber J (2017) Applying STOPP Guidelines in Primary Care Through Electronic Medical Record Decision Support: Randomized Control Trial Highlighting the Importance of Data Quality. JMIR Medical Informatics 5(2):e15

3. Smallwood AJ, Schapira MM, Fedders M, Neuner JM (2017) A pilot randomized controlled trial of a decision aid with tailored fracture risk tool delivered via a patient portal. Osteoporosis International 28(2):567–76

4. Redmond P, Grimes TC, McDonnell R, Boland F, Hughes C, Fahey T (2018) Impact of medication reconciliation for improving transitions of care. Cochrane Database of Systematic Reviews (8)

5. Cheema E, Alhomoud FK, Kinsara ASA, Alsiddik J, Barnawi MH, Al-Muwallad MA, et al. (2018) The impact of pharmacists-led medicines reconciliation on healthcare outcomes in secondary care: A systematic review and meta-analysis of randomized controlled trials. PLoS ONE [Electronic Resource] 13(3):e0193510

6. Mekonnen AB, Abebe TB, McLachlan AJ, Brien JA (2016) Impact of electronic medication reconciliation interventions on medication discrepancies at hospital transitions: a systematic review and meta-analysis. BMC Medical Informatics & Decision Making 16:112

7. Wang H, Meng L, Song J, Yang J, Li J, Qiu F (2018) Electronic medication reconciliation in hospitals: A systematic review and meta-analysis. European Journal of Hospital Pharmacy 25(5):245–50

8. Al-Hashar A, Al-Zakwani I, Eriksson T, Sarakbi A, Al-Zadjali B, Al Mubaihsi S, et al. (2018) Impact of medication reconciliation and review and counselling, on adverse drug events and healthcare resource use. International Journal of Clinical Pharmacy 40(5):1154–64

9. Tamblyn R, Winslade N, Lee TC, Motulsky A, Meguerditchian A, Bustillo M, et al. (2018) Improving patient safety and efficiency of medication reconciliation through the development and adoption of a computer-assisted tool with automated electronic integration of population-based community drug data: the RightRx project. Journal of the American Medical Informatics Association 25(5):482–95

10. Alldred DP, Kennedy MC, Hughes C, Chen TF, Miller P (2016) Interventions to optimise prescribing for older people in care homes. Cochrane Database of Systematic Reviews (2)

11. Christensen M, Lundh A (2016) Medication review in hospitalised patients to reduce morbidity and mortality. Cochrane Database of Systematic Reviews (2)

12. Hohl CM, Wickham ME, Sobolev B, Perry JJ, Sivilotti ML, Garrison S, et al. (2015) The effect of early in-hospital medication review on health outcomes: a systematic review. British Journal of Clinical Pharmacology 80(1):51–61

13. Loh ZW, Cheen MH, Wee HL (2016) Humanistic and economic outcomes of pharmacist-provided medication review in the community-dwelling elderly: A systematic review and meta-analysis. Journal of Clinical Pharmacy & Therapeutics 41(6):621–33

14. Meid AD, Lampert A, Burnett A, Seidling HM, Haefeli WE (2015 [cited 2019 Jan 14]) The impact of pharmaceutical care interventions for medication underuse in older people: a systematic review and meta-analysis. British Journal of Clinical Pharmacology 80(4):768–76

15. Tesfaye WH, Castelino RL, Wimmer BC, Zaidi STR (2017) Inappropriate prescribing in chronic kidney disease: A systematic review of prevalence, associated clinical outcomes and impact of interventions. International Journal of Clinical Practice 71(7)

16. Thomas R, Huntley AL, Mann M, Huws D, Elwyn G, Paranjothy S, et al. (2014) Pharmacist-led interventions to reduce unplanned admissions for older people: a systematic review and meta-analysis of randomised controlled trials. Age & Ageing 43(2):174–87

17. Clyne B, Smith SM, Hughes CM, Boland F, Cooper JA, Fahey T, et al. (2016) Sustained effectiveness of a multifaceted intervention to reduce potentially inappropriate prescribing in older patients in primary care (OPTI-SCRIPT study). Implementation Science 11(1):79

18. Clyne B, Smith SM, Hughes CM, Boland F, Bradley MC, Cooper JA, et al. (2015) Effectiveness of a Multifaceted Intervention for Potentially Inappropriate Prescribing in Older Patients in Primary Care: A Cluster-Randomized Controlled Trial (OPTI-SCRIPT Study). Annals of Family Medicine 13(6):545–53

19. Lalonde L, Quintana-Barcena P, Lord A, Bell R, Clement V, Daigneault AM, et al. (2017) Community Pharmacist Training-and-Communication Network and Drug-Related Problems in Patients With CKD: A Multicenter, Cluster-Randomized, Controlled Trial. American Journal of Kidney Diseases 70(3):386–96

20. Nipp RD, Ruddy M, Fuh CX, Zangardi ML, Chio C, Kim EB, et al. (2018) Pilot Randomized Trial of a Pharmacy Intervention for Older Adults with Cancer. Oncologist.

21. Tsuyuki RT, Houle SK, Charrois TL, Kolber MR, Rosenthal MM, Lewanczuk R, et al. (2015) Randomized Trial of the Effect of Pharmacist Prescribing on Improving Blood Pressure in the Community: the Alberta Clinical Trial in Optimizing Hypertension (RxACTION). Circulation 132(2):93–100

22. Ahmed S, Ernst P, Bartlett SJ, Valois MF, Zaihra T, Pare G, et al. (2016) The Effectiveness of Web-Based Asthma Self-Management System, My Asthma Portal (MAP): A Pilot Randomized Controlled Trial. Journal of Medical Internet Research 18(12):e313

23. de Bruin M, Oberjé EJM, Viechtbauer W, Nobel H-E, Hiligsmann M, van Nieuwkoop C, et al. (2017 [cited 2019 Jan 14]) Effectiveness and cost-effectiveness of a nurse-delivered intervention to improve adherence to treatment for HIV: a pragmatic, multicentre, open-label, randomised clinical trial. The Lancet. Infectious diseases 17(6):595–604

24. Morrison D, Wyke S, Saunderson K, McConnachie A, Agur K, Chaudhuri R, et al. (2016) Findings from a pilot Randomised trial of an Asthma Internet Self-management Intervention (RAISIN). BMJ Open 6(5):e009254

25. Ridsdale L, McKinlay A, Wojewodka G, Robinson EJ, Mosweu I, Feehan SJ, et al. (2018) Self-Management education for adults with poorly controlled epILEpsy [SMILE (UK)]: a randomised controlled trial. Health Technology Assessment (Winchester, England) 22(21):1–142

26. van Eikenhorst L, Taxis K, van Dijk L, de Gier H (2017) Pharmacist-Led Self-management Interventions to Improve Diabetes Outcomes. A Systematic Literature Review and Meta-Analysis. Frontiers in Pharmacology 8:891

27. Mazzaglia G, Piccinni C, Filippi A, Sini G, Lapi F, Sessa E, et al. (2016) Effects of a computerized decision support system in improving pharmacological management in high-risk cardiovascular patients: a cluster-randomized open-label controlled trial. Health informatics journal 22(2):232–47

28. Silbernagel G, Spirk D, Hager A, Baumgartner I, Kucher N (2016) Electronic Alert System for Improving Stroke Prevention Among Hospitalized Oral-Anticoagulation-Na?ve Patients With Atrial Fibrillation: a Randomized Trial. Journal of the american heart association 5(7)

29. Holt TA, Dalton A, Marshall T, Fay M, Qureshi N, Kirkpatrick S, et al. (2017 [cited 2019 Jan 14]) Automated Software System to Promote Anticoagulation and Reduce Stroke Risk. Stroke 48(3):787–90

30. Duan Y, Xie Z, Dong F, Wu Z, Lin Z, Sun N, et al. (2017) Effectiveness of home blood pressure telemonitoring: A systematic review and meta-analysis of randomised controlled studies. Journal of Human Hypertension 31(7):427–37

31. Heisler M, Choi H, Palmisano G, Mase R, Richardson C, Fagerlin A, et al. (2014) Comparison of community health worker-led diabetes medication decision-making support for low-income Latino and African American adults with diabetes using e-health tools versus print materials: a randomized, controlled trial. Annals of internal medicine 161(10suppl):S13-22

32. Baysari MT, Lehnbom EC, Li L, Hargreaves A, Day RO, Westbrook JI (2016) The effectiveness of information technology to improve antimicrobial prescribing in hospitals: A systematic review and meta-analysis. International Journal of Medical Informatics 92:15–34

33. Curtis CE, Al Bahar F, Marriott JF (2017) The effectiveness of computerised decision support on antibiotic use in hospitals: A systematic review. PLoS ONE [Electronic Resource] 12(8):e0183062

34. Blair PS, Turnbull S, Ingram J, Redmond N, Lucas PJ, Cabral C, et al. (2017) Feasibility cluster randomised controlled trial of a within-consultation intervention to reduce antibiotic prescribing for children presenting to primary care with acute respiratory tract infection and cough. BMJ Open 7(5):e014506

35. Meeker D, Linder JA, Fox CR, Friedberg MW, Persell SD, Goldstein NJ, et al. (2016) Effect of Behavioral Interventions on Inappropriate Antibiotic Prescribing Among Primary Care Practices: A Randomized Clinical Trial. JAMA 315(6):562–70

36. Vellinga A, Galvin S, Duane S, Callan A, Bennett K, Cormican M, et al. (2016) Intervention to improve the quality of antimicrobial prescribing for urinary tract infection: a cluster randomized trial. CMAJ Canadian Medical Association Journal 188(2):108–15

37. Awdishu L, Coates CR, Lyddane A, Tran K, Daniels CE, Lee J, et al. (2016) The impact

of real-time alerting on appropriate prescribing in kidney disease: a cluster randomized controlled trial. Journal of the American Medical Informatics Association 23(3):609–16

38. Rankin A, Cadogan CA, Patterson SM, Kerse N, Cardwell CR, Bradley MC, et al. (2018) Interventions to improve the appropriate use of polypharmacy for older people. Cochrane Database of Systematic Reviews 9:cd008165

39. Maaskant JM, Vermeulen H, Apampa B, Fernando B, Ghaleb MA, Neubert A, et al. (2015) Interventions for reducing medication errors in children in hospital. Cochrane Database of Systematic Reviews (3)

40. Manias E, Kinney S, Cranswick N, Williams A, Borrott N (2014) Interventions to reduce medication errors in pediatric intensive care. Annals of Pharmacotherapy 48(10):1313–31

41. Nuckols TK, Smith-Spangler C, Morton SC, Asch SM, Patel VM, Anderson LJ, et al. (2014) The effectiveness of computerized order entry at reducing preventable adverse drug events and medication errors in hospital settings: a systematic review and meta-analysis. Systematic Reviews 3:56

42. Liebschutz JM, Xuan Z, Shanahan CW, LaRochelle M, Keosaian J, Beers D, et al. (2017) Improving Adherence to Long-term Opioid Therapy Guidelines to Reduce Opioid Misuse in Primary Care: A Cluster-Randomized Clinical Trial. JAMA Internal Medicine 177(9):1265–72

43. Driscoll A, Currey J, Tonkin A, Krum H (2015) Nurse?led titration of angiotensin converting enzyme inhibitors, beta?adrenergic blocking agents, and angiotensin receptor blockers for people with heart failure with reduced ejection fraction. Cochrane Database of Systematic Reviews (12)

44. Khalil H, Bell B, Chambers H, Sheikh A, Avery AJ (2017) Professional, structural and organisational interventions in primary care for reducing medication errors. Cochrane Database of Systematic Reviews (10)

45. Berdot S, Roudot M, Schramm C, Katsahian S, Durieux P, Sabatier B (2016) Interventions to reduce nurses' medication administration errors in inpatient settings: A systematic review and meta-analysis. International Journal of Nursing Studies 53:342–50

46. Hu Y, Walley J, Chou R, Tucker JD, Harwell JI, Wu X, et al. (2016) Interventions to reduce childhood antibiotic prescribing for upper respiratory infections: systematic review and meta-analysis. Journal of Epidemiology & Community Health 70(12):1162–70

47. Zavala-Gonzalez MA, Cabrera-Pivaral CE, Orozco-Valerio MDJ, Ramos-Herrera IM (2017) Effectiveness of interventions for improving drug prescribing in Primary Health Care. Atencion Primaria 49(1):13–20

48. Elliott LS, Henderson JC, Neradilek MB, Moyer NA, Ashcraft KC, Thirumaran RK (2017) Clinical impact of pharmacogenetic profiling with a clinical decision support tool in polypharmacy home health patients: A prospective pilot randomized controlled trial. PLoS ONE [Electronic Resource] 12(2):e0170905

49. Franchi C, Tettamanti M, Djade CD, Pasina L, Mannucci PM, Onder G, et al. (2016) E-learning in order to improve drug prescription for hospitalized older patients: a cluster-randomized controlled study. British Journal of Clinical Pharmacology 82(1):53–63

50. Lau BD, Shaffer DL, Hobson DB, Yenokyan G, Wang J, Sugar EA, et al. (2017) Effectiveness of two distinct web-based education tools for bedside nurses on medication administration practice for venous thromboembolism prevention: A randomized clinical trial. PLoS ONE [Electronic Resource] 12(8):e0181664

51. Nejad AS, Noori MR, Haghdoost AA, Bahaadinbeigy K, Abu-Hanna A, Eslami S (2016) The effect of registry-based performance feedback via short text messages and traditional postal letters on prescribing parenteral steroids by general practitioners--A randomized controlled trial. International Journal of Medical Informatics 87:36–43