



# Antimicrobial stewardship: changing risk-related behaviours in the general population

NICE guideline

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## Your responsibility

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. It is not mandatory to apply the recommendations, and the guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and carers or guardian.

Local commissioners and providers of healthcare have a responsibility to enable the guideline to be applied when individual professionals and people using services wish to use it. They should do so in the context of local and national priorities for funding and developing services, and in light of their duties to have due regard to the need to eliminate unlawful discrimination, to advance equality of opportunity and to reduce health inequalities. Nothing in this guideline should be interpreted in a way that would be inconsistent with complying with those duties.

Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

## Contents

Overview .....	5
Who is it for? .....	5
Recommendations .....	6
1.1 Overarching principles .....	6
1.2 Local system-wide approaches to reducing inappropriate antimicrobial demand and use .....	6
1.3 Local system-wide approaches to preventing and limiting the spread of infection.....	9
1.4 Childcare and education providers .....	10
1.5 Prescribers, primary care and community pharmacy teams .....	13
Terms used in this guideline.....	15
Putting this guideline into practice .....	18
Context.....	20
Epidemiology .....	20
Interventions and UK policy .....	21
More information.....	21
The committee's discussion .....	22
Background .....	22
The evidence base – limitations .....	23
Evidence – effectiveness review .....	24
Supplementary evidence reviews.....	25
Action for both prescribers and the public .....	27
Population groups and settings .....	28
Antimicrobials and antimicrobial resistance – knowledge and behaviour .....	29
Points of receptiveness and types of information .....	32
The role of community pharmacists .....	33
Mass-media campaigns.....	33
Educational modules delivered by computers and websites.....	34
Preventing infection .....	34

Using resources effectively.....	36
Health economics.....	37
Evidence reviews.....	38
Gaps in the evidence.....	40
Recommendations for research.....	42
1 Cost effectiveness.....	42
2 Behavioural strategies and programmes .....	42
3 High-risk groups .....	42
4 Workplace .....	43
5 Older people in day and residential care .....	43

This guideline is the basis of QS121.

## Overview

This guideline covers making people aware of how to correctly use antimicrobial medicines (including antibiotics) and the dangers associated with their overuse and misuse. It also includes measures to prevent and control infection that can stop people needing antimicrobials or spreading infection to others. It aims to change people's behaviour to reduce antimicrobial resistance and the spread of resistant microbes.

NICE has also produced a guideline on [antimicrobial stewardship: systems and processes for effective antimicrobial medicine use](#).

### *Who is it for?*

- Local authority public health teams
- Commissioners, including clinical commissioning groups, and providers
- Childcare and education providers
- Prescribers, primary care and community pharmacy teams
- The general public

## Recommendations

[Making decisions using NICE guidelines](#) explains how we use words to show the strength (or certainty) of our recommendations, and has information about prescribing medicines (including off-label use), professional guidelines, standards and laws (including on consent and mental capacity), and safeguarding.

This guideline should be read in conjunction with NICE's guideline on [antimicrobial stewardship: systems and processes for effective antimicrobial medicine use](#).

### 1.1 *Overarching principles*

The following recommendations are for directors of public health:

1.1.1 Work with health and wellbeing boards, commissioners and local authorities to ensure that the following are a priority locally:

- the public health aspects of local [antimicrobial stewardship](#) programmes (see NICE's guideline on [antimicrobial stewardship: systems and processes for effective antimicrobial medicine use](#))
- local system-wide infection prevention programmes.

1.1.2 Ensure that:

- Local authorities and clinical commissioning groups work collaboratively to provide consistent information and advice to:
  - the public
  - healthcare professionals, including GPs, other prescribers and community pharmacists.
- Health and social care practitioners and organisations that commission, provide or support the provision of care are:
  - aware of NICE's guideline on [antimicrobial stewardship](#)
  - supported to implement it.

### 1.2 *Local system-wide approaches to reducing inappropriate antimicrobial*

## *demand and use*

The following recommendations are for clinical commissioning groups.

- 1.2.1 Ensure resources are available for healthcare professionals to use with the public to provide information about self-limiting infections. These resources should be used to encourage people to manage their infection themselves at home if it is safe to do so. The resources should include information on:
- How someone can recognise whether they, or someone they are caring for, have a self-limiting infection (for example, by checking the NHS Choices website).
  - How to seek further advice if they not sure whether their infection is self-limiting; for example, by:
    - contacting a community pharmacy
    - calling 111 or a local advice line or helpline
    - using other local triaging arrangements such as practice nurses.
  - Where to seek advice on managing self-limiting infections; for example, from:
    - community pharmacists
    - other reliable health resources, such as NHS Choices
    - other local triaging services.
  - The natural course of self-limiting infections, including the length of time symptoms are likely to last.
  - How people can self-care (for example, by resting, drinking plenty of fluids and taking over-the-counter preparations to relieve their symptoms, if needed).
  - Explicit advice on when to seek medical help, which symptoms should be considered red flags and safety-netting advice.
- 1.2.2 Ensure resources and advice are also available for people who are prescribed or supplied with antimicrobials, to ensure they take them as instructed by their healthcare professional (see NICE's guideline on medicines adherence: involving patients in decisions about prescribed medicines and supporting adherence).

This should include taking the correct dose for the time specified and via the correct route.

1.2.3 Ensure the resources advise people not to:

- Use or take prescription-only antimicrobials without a prescription and advice from a suitably qualified healthcare professional.
- Keep leftover antimicrobials for use another time.
- Share, or give, prescription-only antimicrobials to anyone other than the person they were prescribed or supplied for.
- Use or take antimicrobials prescribed for animals.
- Use or take prescription-only antimicrobials or give them to others if they have been obtained from anywhere other than their healthcare professional or pharmacist (for example, prescription-only antimicrobials bought online without a prescription).
- Ask for antimicrobials as a preventive measure against becoming ill or as a 'stand-by' measure; for example, when going on holiday (unless the person has a specific condition that makes this necessary or there is a specific risk; for example, if travelling to areas where malaria is endemic [see the [antimalarial medication](#) section on NHS Choices] or there is a high risk of travellers' diarrhoea).

The following recommendations are for local authority public health teams.

1.2.4 Consider linking to awareness-raising initiatives for the public on reducing [inappropriate antimicrobial demand and use](#) and [antimicrobial resistance](#) (for example, [European Antibiotic Awareness Day](#) and Public Health England's [Antibiotic Guardian](#)).

1.2.5 Use opportunities that may arise through other local authority activities to distribute information about antimicrobial resistance (for example, waste disposal and recycling information could include advice not to flush leftover antimicrobials down sinks or toilets but to return them to a community pharmacy for safe disposal).



### 1.3 *Local system-wide approaches to preventing and limiting the spread of infection*

For recommendations for clinical settings, see NICE's guideline on [healthcare-associated infections: prevention and control in primary and community care](#).

The following recommendations are for local authority public health teams.

- 1.3.1 Ensure information and advice directed at the general public aims to prevent and reduce the spread of infections. [Resources](#) such as posters, leaflets and digital resources should be made available through multiple routes to provide a coordinated system of information.
- 1.3.2 Ensure information is available in a variety of formats to meet people's literacy and language needs and the needs of people with sensory disabilities.
- 1.3.3 Consider distributing information and advice through facilities and services operated by local authorities, such as leisure centres and libraries.
- 1.3.4 When deciding where to distribute information, prioritise settings in which people are more vulnerable to infection or where there is a high risk of transmitting infection to others, for example:
  - childcare settings
  - residential and day care settings for older people.
- 1.3.5 Give people information on handwashing that emphasises why it is necessary and effective to thoroughly wash and dry hands to reduce the risk of getting an infection, or passing infection on to their family and other people. Include information on:
  - When hands should be washed and dried; for example, after using the toilet, before eating meals or snacks and after being in close contact with people with colds or other infections.
  - How hands should be washed and dried, including the need to use liquid soap and tepid running water (a [handrub](#) can be used if soap and water are unavailable). See the standard principles in NICE's guideline on [infection control](#).

- Use resources shown to be effective in helping people develop and use personalised plans to increase handwashing. (See [putting this guideline into practice](#) for examples of resources that may be helpful).

1.3.6 Give people advice on food hygiene and signpost them to resources. Include information on:

- Key points at which it is particularly important to thoroughly wash and dry hands (see recommendation 1.3.5); for example:
  - before eating or preparing food
  - after using the toilet or touching the bin
  - before and after handling raw food.
- Safe food preparation and cooking methods (this includes ensuring food is cooked at the right temperature and properly heated throughout before eating).
- How to store food safely, including advice on:
  - fridge temperatures
  - 'use by' and 'best before' dates
  - freezing, defrosting and refreezing food.
- Using food leftovers safely.

See the [food safety](#) section on NHS Choices for more advice on food safety and how to prevent infections from spreading.

## 1.4 *Childcare and education providers*

The following recommendations are for preschool settings.

- 1.4.1 Display information or direct parents and carers to [resources](#) about managing the symptoms of infection in children, when to seek medical advice and the appropriate use of antimicrobials.
- 1.4.2 Ensure there are always good standards of food hygiene (see the [food safety](#)

section on NHS Choices).

- 1.4.3 Provide facilities for thoroughly washing and drying hands for children, staff and visitors. These should include liquid soap and tepid running water, and [handrubs](#) when these are not available.
- 1.4.4 Ensure staff talk to children about the importance of thoroughly washing and drying hands, including:
- explaining when to wash and dry hands (for example, after using the toilet and before eating)
  - showing them how to wash hands with liquid soap and tepid running water (see the standard principles in NICE's guideline on [infection control](#)).
- 1.4.5 Refer to Public Health England's [guidance on infection control in schools and other childcare settings](#) for details of how long children should be kept away from childcare when they have an infection.

The following recommendations are for schools.

- 1.4.6 Teach all children, in an appropriate way for their age and ability, about the need to reduce [inappropriate antimicrobial demand and use](#). Use existing teaching resources if available (see [putting this guideline into practice](#) for examples of resources that may be helpful).
- 1.4.7 Promote a 'whole-school' approach to preventing infections from spreading. The school environment and staff should support children to act in a way that prevents or minimises infection.
- 1.4.8 Ensure that there are always good standards of food hygiene (see the [food safety](#) section on NHS Choices).
- 1.4.9 Provide facilities for washing and drying hands. These should include liquid soap and tepid running water, and handrubs if these are not available (see the standard principles in NICE's guideline on [infection control](#)).
- 1.4.10 Refer to Public Health England's [guidance on infection control in schools and other childcare settings](#) for details of the length of time children should be kept

away from school when they have an infection.

- 1.4.11 Teach all children, in an appropriate way for their age and ability, about the importance of washing and drying hands to prevent infections and stop them from spreading. Discuss when and how hands should be washed. Use existing teaching resources if available (see [putting this guideline into practice](#) for examples of resources that may be helpful).
- 1.4.12 Consider giving children information to take home about when and how to wash their hands.
- 1.4.13 Share information with parents and carers that can support their children's learning. This could include teaching their children how and when to wash their hands.
- 1.4.14 Give parents and carers advice on other ways to help prevent infections. This should include advice on being up to date with vaccinations (see NICE's guideline on [immunisations: reducing differences in uptake in under 19s](#)) and preventing the spread of airborne infections.

The following recommendations are for educational and residential settings for young people.

- 1.4.15 Display information or direct young people to resources that aim to reduce inappropriate antimicrobial demand and use. The information should:
- Take into account that many young people will be managing infections on their own for the first time.
  - Explain to young people how to recognise the signs and symptoms associated with a [self-limiting infection](#), when they can safely [self-care](#), how to do so and when they need to seek medical help (see [recommendation 1.2.1](#) and information on [NHS Choices](#)).
  - Promote community pharmacies and minor ailment services, where they are available, as a source of advice and care (see the section on [common problems your pharmacist can help with](#) on NHS Choices).
- 1.4.16 Introduce a regularly repeated programme to improve young people's infection prevention knowledge and behaviour. Include:

- Posters promoting handwashing displayed in various locations, such as public areas of the campus, cafeterias, bulletin boards in halls of residence and public toilets.
- Signposts to online awareness-raising resources, with links to information on infection control (see [putting this guideline into practice](#) for examples of resources that may be helpful).
- One-off events providing free handrubs.
- Food safety campaigns such as:
  - face-to-face lectures
  - education materials delivered via the web, including digital and social media
  - promotional materials
  - other ways to help prevent infections, such as advice on being up to date with vaccinations and preventing the spread of airborne infections.

## 1.5 *Prescribers, primary care and community pharmacy teams*

This section should be read alongside the recommendations on prescribing (recommendations 1.1.24 to 1.1.37) in NICE's guideline on [antimicrobial stewardship](#). See also NICE's guideline on [sepsis: recognition, diagnosis and early management](#).

### 1.5.1 When people ask about managing [self-limiting infections](#):

- Share advice on [self-care](#) for each of the symptoms.
- Use and share [resources](#) that provide written advice to encourage people to change their behaviour (see [recommendation 1.2.1](#)).
- Verbally emphasise the key messages given in the written resources.
- Display resources that provide or signpost to advice and information about self-care; for example, [NHS Choices](#), 111 and local advice or helplines.
- Signpost them to further information to read at home, such as online advice.
- Discuss with them whether taking or using an antimicrobial is the most appropriate option (see the recommendation on discussions with patients and family members or carers under 'antimicrobial prescribing' in NICE's guideline on [antimicrobial](#)

- stewardship).
- Raise awareness of community pharmacists as an easily accessible first point of contact for advice about managing a self-limiting infection.

1.5.2 Consider using computer prompts or decision support aids to prompt healthcare professionals to share information with people on the appropriate use of antimicrobials, self-care and safety netting (see NICE's guideline on antimicrobial stewardship).

## If antimicrobials are prescribed or supplied

1.5.3 Share verbal advice and written information that people can take away (see recommendation 1.5.1) about how to use antimicrobials correctly, including:

- not sharing prescription-only antimicrobials with anyone other than the person they were prescribed or supplied for
- not keeping them for use another time
- returning unused antimicrobials to the pharmacy for safe disposal and not flushing them down toilets or sinks.

1.5.4 If the person has been given a back-up (delayed) prescription, tell them:

- How to self-care to manage their symptoms.
- What the antimicrobials would be used for, if needed.
- How to recognise whether they need to use the antimicrobials, and if so:
  - how to get them
  - when to start taking or using them
  - how to take or use them.

## If antimicrobials are not prescribed or supplied

1.5.5 Give people verbal advice and share written information that they can take away about how to manage their infection themselves (see recommendation 1.5.1).

## General advice in primary care and community pharmacies

1.5.6 Share [safety-netting advice](#) with everyone who has an infection (regardless of whether or not they are prescribed or supplied with antimicrobials). This should include:

- how long symptoms are likely to last with and without antimicrobials
- what to do if symptoms get worse
- what to do if they experience adverse effects from the treatment
- when they should ask again for medical advice.

### *Terms used in this guideline*

#### **Antimicrobial resistance**

Loss of effectiveness of any anti-infective medicine, including antiviral, antifungal, antibacterial and antiparasitic medicines.

#### **Antimicrobial stewardship**

An organisational or healthcare system-wide approach to promoting and monitoring judicious use of antimicrobials to preserve their future effectiveness.

#### **Capability, opportunity and motivation**

A theory of behaviour change that can guide interventions to change individual behaviour patterns. For any change in behaviour to occur, a person must:

- be physically and psychologically capable of performing the necessary actions
- have the physical and social opportunity to make the change
- be more motivated to adopt the new, rather than the old behaviour, whenever necessary.

This is known as the COM-B model (see [The behaviour change wheel: a new method for characterising and designing behaviour change interventions](#) Michie et al. 2011).

## Handrub

A preparation applied to the hands to reduce the number of viable microorganisms. This guideline refers to handrubs compliant with British standards (BS EN1500; standard for efficacy of hygienic handrubs using a reference of 60% isopropyl alcohol).

## Inappropriate antimicrobial demand and use

'Inappropriate antimicrobial demand' refers to people asking for antimicrobials for conditions against which they are ineffective (for example, antibiotics to treat a viral infection such as a cold) or for self-limiting infections that will resolve on their own, with no long-term harm to the person's health.

'Inappropriate antimicrobial use' refers to the way in which people may misuse antimicrobials that they have been prescribed or supplied with, and which may result in the antimicrobials becoming ineffective in treating infections. This is because the bacteria, virus, fungus or parasite they are designed to treat may become resistant to the antimicrobial. Examples of inappropriate use include not taking or using the antimicrobials as prescribed and sharing them with others.

## Local triaging arrangements

Services that can advise people whether they have a self-limiting infection that they can safely manage themselves or whether their infection needs medical attention. Examples include community pharmacies, practice nurses, 111, other locally developed advice and helplines, and emergency and out-of-hours primary care services.

## Red flags

Signs and symptoms of a more serious illness or condition.

## Resources

Evidence-based materials that have been developed through a research-based approach with the target audience, wherever possible. They may be in a variety of formats, including posters, leaflets, digital and online resources.

## Safety-netting advice

Advising people what to do if their condition deteriorates or does not improve within a certain time, or if they develop adverse effects as a result of the treatment.



## **Self-care**

Approaches a person can use to look after themselves in a healthy way; for example, drinking plenty of fluids and getting sufficient rest when you have a cold.

## **Self-limiting infection**

An infection that resolves on its own and has no long-term harmful effect on a person's health (assuming that they are not immunosuppressed). Examples include colds, flu, oral thrush, winter vomiting bug.

## Putting this guideline into practice

NICE has produced [tools and resources](#) to help you put this guideline into practice. Examples of other resources that may be helpful include the University of Southampton's [Germ Defence](#) (see recommendation 1.3.5) and Public Health England's [e-Bug](#) website (see recommendations 1.4.6, 1.4.11 and 1.4.16).

Putting recommendations into practice can take time. How long may vary from guideline to guideline, and depends on how much change in practice or services is needed. Implementing change is most effective when aligned with local priorities.

Changes should be implemented as soon as possible, unless there is a good reason for not doing so (for example, if it would be better value for money if a package of recommendations were all implemented at once).

Different organisations may need different approaches to implementation, depending on their size and function. Sometimes individual practitioners may be able to respond to recommendations to improve their practice more quickly than large organisations.

Here are some pointers to help organisations put NICE guidelines into practice:

1. **Raise awareness** through routine communication channels, such as email or newsletters, regular meetings, internal staff briefings and other communications with all relevant partner organisations. Identify things staff can include in their own practice straight away.
2. **Identify a lead** with an interest in the topic to champion the guideline and motivate others to support its use and make service changes, and to find out any significant issues locally.
3. **Carry out a baseline assessment** against the recommendations to find out whether there are gaps in current service provision.
4. **Think about what data you need to measure improvement** and plan how you will collect it. You may want to work with other health and social care organisations and specialist groups to compare current practice with the recommendations. This may also help identify local issues that will slow or prevent implementation.
5. **Develop an action plan**, with the steps needed to put the guideline into practice, and make sure it is ready as soon as possible. Big, complex changes may take longer to implement, but some may be

quick and easy to do. An action plan will help in both cases.

6. For very big changes include milestones and a business case, which will set out additional costs, savings and possible areas for disinvestment. A small project group could develop the action plan. The group might include the guideline champion, a senior organisational sponsor, staff involved in the associated services, finance and information professionals.

7. Implement the action plan with oversight from the lead and the project group. Big projects may also need project management support.

8. Review and monitor how well the guideline is being implemented through the project group. Share progress with those involved in making improvements, as well as relevant boards and local partners.

NICE provides a comprehensive programme of support and resources to maximise uptake and use of evidence and guidance. See our [into practice](#) pages for more information.

Also see Leng G, Moore V, Abraham S, editors (2014) Achieving high quality care – practical experience from NICE. Chichester: Wiley.

## Context

Antimicrobial stewardship refers to an organisational or healthcare-system-wide approach to promoting and monitoring judicious use of antimicrobials to preserve their future effectiveness.

Antimicrobial resistance may lead to standard treatments becoming ineffective, causing infections to persist and increasing the risk of them spreading. Although resistance evolves naturally, the use (and misuse) of antimicrobials speeds up this process. Inadequate infection prevention and control practices, poor sanitary conditions and inappropriate food handling encourage the spread of infections that may need the use of antibiotics.

Improvements in nutrition, hygiene and sanitation, and reductions in overcrowded housing, have all helped prevent and decrease the transmission of infectious diseases (Davies 2013<sup>[1]</sup>). The World Health Organization estimates that, along with these broad environmental factors, antimicrobials add on average 20 years to life expectancy ([Self-prescription of antibiotics boosts superbugs epidemic in the European region](#)).

But antimicrobial resistance is increasing and there is a lack of new antimicrobials to treat resistant diseases. It is important to ensure the antimicrobials that are currently effective remain so for as long as possible.

## Epidemiology

Infectious diseases are a major cause of illness in the UK. In 2013, for example, 21% of all days lost at work (approximately 27 million days) were caused by coughs, colds and flu and other infectious diseases ([Sickness absence in the labour market: February 2014](#) Office for National Statistics).

The incidence of infectious disease tends to be higher in groups with lower socioeconomic status and outcomes tend to be poorer. For example, they are more likely to have tuberculosis, transmit it to others and to have a drug-resistant strain ([Annual report of the Chief Medical Officer 2011: volume one](#) Department of Health).

Although viruses (such as HIV), parasites (such as malaria) and fungi (such as *Candida*) are showing resistance to antivirals, antiparasitics and antifungals respectively, for the general population antibiotic resistance is the main concern. However for some population subgroups, resistance to antivirals and antifungals may be of equal concern. This includes people who are particularly vulnerable to infection due to suppressed immune systems; for example, because of HIV, an inherited condition or treatment they may be having for conditions such as cancer or an organ

transplant.

In the UK, the spread of multidrug-resistant tuberculosis and gonorrhoea is also of public health concern (see the 'Annual report of the Chief Medical Officer 2011: volume one').

## *Interventions and UK policy*

National campaigns to raise public and professional awareness of antibiotic resistance may reduce antibiotic prescribing and demand ([European antibiotic awareness day 2013 evaluation report](#) Department of Health). But a 2013 survey of 2,033 people in the UK by Ipsos MORI ([Antibiotics: a cure for the common cold?](#)) showed that:

- 16% wrongly believe antibiotics work on colds or flu
- around 40% think antibiotics can kill viruses
- around 7% do not complete a course of antibiotics.

There is also evidence that most people who ask a healthcare professional for antibiotics to treat a cough are given them ([Antibiotic prescribing for acute cough: the effect of perceived patient demand](#) Coenen et al. 2006).

For details on UK policy see the [scope](#) for this guideline.

## *More information*

You can also see this guideline in the NICE pathway on [antimicrobial stewardship](#).  
To find out what NICE has said on topics related to this guideline, see our web pages on [antibiotic use](#), [behaviour change](#), [healthcare-associated infections](#), [immunisation](#), [infectious disease prevention and control](#) and [respiratory conditions: general and other](#).

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<sup>[1]</sup> Davies SC (2013) The drugs don't work. A global threat. London: Penguin

## The committee's discussion

This section describes the factors and issues the public health advisory committee considered when developing the recommendations. Please note: this section does not contain recommendations (see [Recommendations](#)).

### *Background*

The committee recognised that the threat of [antimicrobial resistance](#) can only be tackled by a combination of interventions and measures that address:

- the prescribing decisions of healthcare professionals
- people's behaviour relating to infection prevention and control, antimicrobial use and antimicrobial resistance
- surveillance to track antimicrobial use and resistance in microbes
- the development of new drugs, treatments and diagnostics
- antimicrobial use in animal husbandry
- political commitment to prioritise antimicrobial resistance as a major area of concern for the UK and globally.

Changing when and how people use antimicrobials and changing their behaviour to prevent infection helps to keep current medicines effective for as long as possible. But action is also needed by prescribers, dispensers and regulators.

The committee noted the importance of ensuring sustained action is taken to reduce antimicrobial resistance. It emphasised that antimicrobial resistance is a long-term problem. It noted that at publication of this guideline, the UK will be 3 years into the [UK 5-year antimicrobial resistance strategy 2013 to 2018](#).

The committee reflected on NICE's guideline on [antimicrobial stewardship: systems and processes for effective antimicrobial medicine use](#), which covers prescribers' knowledge and behaviour. It wanted to ensure the 2 guidelines complement each other and are read together. It also wanted to ensure interventions that target both the public and prescribers are included in this guideline if they are not already covered in the related antimicrobial stewardship guideline. That is because, otherwise, the committee felt that evidence of effectiveness on these interventions may be missed.

The committee also noted that NICE's guidelines on behaviour change: individual approaches, medicines optimisation: the safe and effective use of medicines to enable the best possible outcomes and immunisations: reducing differences in uptake in under 19s are all relevant to changing knowledge about use and misuse of antimicrobials.

### *The evidence base – limitations*

The committee made some recommendations for interventions for which the evidence from the reviews is limited.

The committee recommended that clinical commissioning groups provide information to encourage people to manage self-limiting infections at home, if it is safe to do so, to reduce inappropriate antimicrobial demand and use. These recommendations are based on:

- evidence from expert papers
- committee members' combined expertise and experience
- comments received during stakeholder consultation.

The committee also made recommendations for primary care teams and community pharmacies about reducing inappropriate antimicrobial demand and use.

It agreed that it was important to make recommendations in this area to support and complement those in NICE's guideline on antimicrobial stewardship: systems and processes for effective antimicrobial medicine use. The evidence for review 1 was weak and inconsistent, so members also drew on expert papers and their own expertise and experience. The recommendations support existing good practice in this area.

Members considered that there are some simple and practical steps that can help prevent the spread of infection and reduce the threat of antimicrobial resistance, and cause no anticipated harm.

Examples include:

- ensuring hands are thoroughly washed and dried before eating meals or snacks
- advice on storing food and using leftovers safely
- avoiding flushing unused antimicrobials down sinks or toilets.

In taking this pragmatic approach they have drawn on good practice, standard advice from respected sources and their collective expertise, in addition to the published evidence.

In considering the cost effectiveness of interventions in this area, the committee have drawn on the 'precautionary principle' (principle 15 of the United Nations Environment Programme Rio Declaration on Environment and Development). The precautionary principle is a conservative principle. The conservative approach is to assume that the intervention should be used unless it can be shown with sufficiently high probability that it does more harm than good.

### *Evidence – effectiveness review*

The committee found little good-quality published evidence about the effectiveness of interventions to change risk-related behaviours in the general population (review 1). Study methods were often not well reported or had potential biases that may have significantly affected results. This is reflected in the quality ratings for studies, with the majority rated as weak, 12 rated as moderate and none as strong.

The committee questioned whether the studies were underpowered (had too few participants) to detect any significant differences. It also questioned whether the effect sizes could be pooled for meta-analysis, but this was not possible because of the diversity of the study outcomes.

Most studies measured knowledge rather than behaviour, and when behaviour was measured it was often self-reported rather than observed. The committee noted that behaviour change needs to be the goal of any intervention, and that changes in knowledge do not necessarily lead to changes in behaviour. It agreed that more research is needed to evaluate changes in behaviour (see research recommendations).

The way people's knowledge was measured differed between studies and the committee questioned the validity of the measures. Some studies only reported an overall 'knowledge score' for a particular topic.

Some used different measures to evaluate an outcome. For example, statements to classify as 'true' or 'false' on handwashing ranged from: "you need to wash your hands after playing in the garden" to "you need to wash your hands after coughing". So an overall score described as 'knowledge of hand hygiene' may be a compilation of different knowledge measures and may not be comparable between studies.

In some studies, the baseline levels of knowledge were high. This may have left little room for



improvement. Other studies report significant changes, but with the overall level of knowledge remaining low. So an 'effective' result may not be 'clinically significant' (it may not demonstrate a meaningful difference).

There was also a lack of long-term follow-up of changes in knowledge or behaviour.

The focus of the review was on changing risk-related behaviours, so changes in antimicrobial resistance was not a selected outcome measure and the review did not report it. The committee discussed why some studies that measured only prescribing rates as an outcome were excluded. The rationale was that prescribing is under the control of the prescriber, not the patient. Without any direct measure of patients' knowledge or behaviour (for example, changes in consultation rates) it is not possible to determine whether changes in prescribing were caused by changes in patients' or prescribers' behaviour.

But the committee felt that if an intervention solely targeted patients or the public, then prescribing rates may be a reasonable outcome measure. This is because changes in patient behaviour may affect doctors' prescribing habits. As a result, supplementary reviews were carried out.

### *Supplementary evidence reviews*

NICE carried out another evidence review ([review 2](#)) to look at studies that were excluded from the effectiveness review. These studies targeted patients or the general public only and measured antibiotic prescribing rates.

Papers previously excluded because they reported only the incidence of infection were also included in the review, because changes in infection incidence after an intervention may be due to changes in behaviour.

Ten studies were included in the review, 3 of which were good quality, 5 moderate quality and 2 weak.

### **Antibiotic prescribing**

The review showed that evidence on the effectiveness of parental education interventions for reducing antibiotic prescribing for children's respiratory tract infections in primary care is inconsistent. Three US studies found no effect, and the 1 UK study found a significant decrease in antibiotic prescribing.

The interventions all involved written materials but differed in format, content, additional components and mode of delivery. Baseline prescribing levels also differed between studies. The committee noted that the 1 effective study involved training GPs to discuss written materials with parents, and to give them information on prognosis, treatment options and reasons for re-consultation (warning symptoms to look out for).

The committee also noted that an educational intervention based in primary care may be effective in reducing antibiotic prescribing for respiratory tract infections in adults under 65. But this was not the case for older adults. It noted that GPs (and older patients) may think that older people face greater health complications, so GPs may be more likely to prescribe antimicrobials. The committee noted the importance of ensuring interventions are designed to address the beliefs of particular groups such as older adults.

## Hand hygiene

Five studies (2 good quality, 1 moderate and 2 weak) measured changes in the incidence of infection. These all focused on hand-hygiene interventions. Three of these studies (1 good quality, 1 moderate and 1 weak) were based in childcare settings. The good-quality study reported that changes to hand hygiene did not reduce the incidence of respiratory or gastrointestinal illnesses but could reduce the transmission of a gastrointestinal illness to other family members.

Committee members noted that there was 1 good-quality UK study of a bespoke web-based intervention. This reduced the incidence of respiratory illnesses. The committee heard expert testimony that gave further detail about the web-based intervention to promote handwashing. This included motivational messages that explain how infection can be transmitted by hand and how hand hygiene can reduce the risk of infection in oneself and one's family. It also included an interactive tool that aims to translate knowledge into changes in behaviour through a personalised planner to help people to identify situations during the day when they could increase handwashing.

The committee also agreed that it is important to give people the opportunity to change (for example, by providing handwashing facilities).

## Multi-targeted interventions

NICE's public health team carried out a rapid review of systematic reviews ([review 3](#)) that:

- evaluated the effectiveness of educational interventions on the public's knowledge and behaviour in relation to antimicrobial use or antimicrobial resistance

- targeted both the public and healthcare professionals.

The committee noted that these multi-targeted interventions did improve people's knowledge of appropriate antimicrobial use (specifically in relation to antibiotics) and did reduce antibiotic prescribing for respiratory illnesses.

However, it was not possible to determine whether it is better to provide support to help change someone's behaviour alone, support for changing healthcare professionals' behaviour alone, or a combination of both. Nor was it possible to determine which components of interventions were more effective than others.

As for the main review, the focus of this supplementary review was on changing knowledge and behaviour. Change in antimicrobial resistance was not selected as an outcome measure. Although 4 of the 9 included reviews did report changes in antibiotic resistance as an outcome, the results were mixed. Because this outcome was not actively sought, and there were only a limited number of studies, it would be inappropriate to draw any conclusions about the effect of these interventions on antimicrobial resistance.

### *Action for both prescribers and the public*

The committee was conscious that to reduce inappropriate antimicrobial demand and use, changes in the behaviour of both prescribers and the public are necessary. It stressed the importance of this guideline being implemented alongside the recommendations for prescribers in NICE's guideline on [antimicrobial stewardship: systems and processes for effective antimicrobial medicine use](#).

The committee noted evidence identified by review 3 that multi-component, educational interventions that target both clinicians and patients or the public are effective at reducing antibiotic prescribing for self-limiting infections. This evidence did not allow members to determine whether it is better to target patients' behaviour alone, healthcare professionals' behaviour alone or a combination of both. However, they heard [expert testimony](#) that drew on additional studies of public information campaigns to reduce antimicrobial resistance.

The findings of these studies of repeated 'through the line' campaigns (those that include using mass media such as television and internet as well as leaflet and poster campaigns) have shown some substantial reductions in antibiotic prescribing. But these were often delivered alongside locally targeted community activities, including those focused on prescribing practice by healthcare professionals.

The committee noted from this testimony that improved antimicrobial stewardship was most likely

to be achieved through interventions that are:

- strategically coordinated
- focused on both reducing inappropriate antimicrobial demand and use and preventing and limiting the spread of infection
- delivered at national and local level
- aimed at both the public and health professionals.

Members noted that directors of public health have an important role to play in working with health and wellbeing boards, commissioners and local authorities to ensure that the following are a priority:

- public health aspects of local antimicrobial stewardship programmes
- local system-wide infection prevention programmes.

They made a recommendation to this effect (see [recommendation 1.1.1](#)).

### *Population groups and settings*

The committee noted that in the evidence reviews, interventions targeted specific age groups and life stages. It felt this was a useful way to frame the recommendations. In addition, educational interventions for school-aged children (such as Public Health England's [e-Bug](#) website) often combine teaching about antibiotic use, antimicrobial resistance, handwashing and food hygiene. It decided that these should also be combined in the recommendations.

The committee made recommendations in [section 1.4](#) for:

- preschool settings
- schools
- education and residential settings for young people.

Preschool and school settings were considered important by the committee because of the high rate of infection in young children and the transmission of infection between them. Although the committee was unable to make recommendations about environmental cleanliness, because this was outside the scope of the guideline, it noted the importance of keeping the environment,

facilities and equipment clean. In making recommendations for schools it was keen to take a whole-school approach in which both the environment and teaching support the desired behaviour.

The committee noted that young people aged 16 to 24 are some of the highest users of antibiotics. They also misuse antibiotics more than any other age group, in particular through sharing them with others. The committee noted that young people in this age group who have recently moved away from home may not have previous experience of looking after themselves during a self-limiting illness. It noted that this should be considered when offering them advice.

People over 65 are the other group that use the most antibiotics. In addition, they may be more vulnerable to infection due to having chronic conditions. People in day or residential care may also be at greater risk of infection being transferred from others.

The committee noted the importance of interventions that target these age groups. But although evidence was identified for interventions in preschool, school and university settings, none was identified in settings focusing on older people, including those in day or residential care.

The committee therefore noted the need for further research in older age groups, along with studies focusing on populations whose social and economic circumstances or health put them at greater risk of getting or transmitting infectious diseases and antimicrobial-resistant strains.

Most interventions took place in healthcare or education settings. Healthcare interventions mainly took place in primary care, but some were in A&E or pharmacies. Other settings included homes and the wider community; for example, targeting the general public via [mass media](#) or web-based interventions.

The committee was concerned that there were no interventions in the workplace or social care, other than preschool settings. It discussed whether it was possible to generalise findings from preschool settings to other social care settings. Members agreed that the aim of the intervention would be the same. But there was no evidence on how interventions could be effectively delivered in these alternative settings and to different population groups.

The committee also noted that the reviews looked only at educational interventions, but there may be other types of intervention that focus on these populations.

## *Antimicrobials and antimicrobial resistance – knowledge and behaviour*

The committee noted that most studies focused on improving knowledge of antibiotics rather than

antivirals, antifungals or antiparasitics. Interventions usually focused on reducing unnecessary antibiotic use for self-limiting respiratory illnesses (colds and flu).

There is growing concern about the increase in antimicrobial resistance to common treatments, particularly in bacteria that cause urinary tract infections (for example, *Escherichia coli* resistance to third-generation cephalosporins and fluoroquinolones).

The committee noted that educational interventions did not tend to improve knowledge of antimicrobial resistance and its implications. The committee agreed that focusing messages on the effects on the whole population was unlikely to lead to changes in behaviour. But making the messages relevant to individual people could be effective. Messages could include the fact that losing effective treatments could directly affect someone's own health, or the health of those close to them.

The committee also felt that it is important to get across the fact that you do not have to feel unwell to carry an antimicrobial-resistant organism (for example, you could be a carrier of multi-drug resistant *E. coli* without having symptoms).

It agreed that the fact that someone can spread an antimicrobial-resistant infection to others is a key message. The committee noted that interventions to prevent infection have been shown to be more effective during epidemics. This is because people are more likely to act in a way to prevent or minimise the spread of infection if they can see it may help them.

The committee discussed the importance of creating a cultural shift and changing social norms so that people use antimicrobials responsibly.

The committee felt that self-care needs to become the 'easy choice' for people. It noted the importance of raising awareness of where to seek advice on managing a self-limiting infection; for example, community pharmacists and other reliable health resources such as NHS Choices. It saw the role of the community pharmacist as very important. However, it noted that there are also cost considerations for people, because prescribed medicines may be cheaper than over-the-counter medicines, or free for some.

The committee discussed the importance of people knowing the natural course of an illness – with and without using antimicrobials – and that there is often very little difference in recovery times. The committee also discussed other ways to improve motivation, such as increasing people's confidence in the effectiveness of over-the-counter preparations to manage the symptoms of self-limiting illnesses, taking into account recommendations for specific populations such as the

Medicines and Healthcare products Regulatory Agency's advice on over-the-counter cough and cold medicines for children.

The committee noted the importance of consistency in the advice people receive from different sources, such as GPs and community pharmacists.

The committee discussed the possible unintended consequences of interventions that aim to reduce inappropriate antimicrobial demand and use. It noted that people need to know the warning signs (or red flags) that indicate they should seek help from a healthcare professional and that they should be given advice about what to do if their condition becomes worse or if, when antimicrobials are prescribed, they experience adverse effects from the treatment (safety-netting advice).

It also did not want to deter the prudent and appropriate use of antimicrobials. The practice of back-up (delayed) prescribing was discussed as a strategy that is increasingly used to reduce antimicrobial use. The committee noted the importance of people being aware of the circumstances that indicate they should start to take the antimicrobial and how to do so.

The committee noted the potential cost benefits to the NHS of interventions that reduce GP consultation rates. There was also evidence that primary care interventions, such as providing information on antibiotic use, can increase people's knowledge of when and how to use antibiotics.

Although leaflets alone led to improvements in knowledge among adults, this was not the case for parents of young children. There was evidence for both population groups that leaflets, in combination with structured discussion either face-to-face or via a video presentation, improved antibiotic knowledge and behaviour.

The committee noted that most healthcare interventions took place in general practices. There were only 2 studies in pharmacies and 1 in an A&E setting. The committee discussed the importance of ensuring people receive the right information at the right time and in a format that meets their language and literacy needs. It discussed providing information at the following points:

- before going to see a GP (getting information online or visiting a pharmacy)
- while waiting for a GP or hospital consultation
- during a consultation.

Education on antibiotic use and antimicrobial resistance in schools was more likely to be effective if students were given this information directly while they were in class or by taking part in practical

activities rather than through computer games, mass media campaigns and videos alone. However, the committee noted that there were no direct comparisons of these different types of school activity.

There were also some methodological issues with studies of self-learning that did not show a significant effect. A lack of significant intervention effect could be due to the studies being insufficiently powered, or because the intervention needs to be further developed. For example, the e-Bug computer game was made a tedious rather than 'fun' experience by making children complete all levels of the game in a single sitting (hence the low completion rate). Because of these methodological issues, the committee warned against assuming that such interventions are not effective.

Expert paper 1 reports on the public's awareness and understanding of appropriate antibiotic use, prescribing and antibiotic resistance in the UK. The qualitative evidence identified core behaviours that could reduce people's use of antibiotics for a self-limiting infection:

- self-care or getting advice from a community pharmacist for colds, runny nose or flu and other self-limiting infections
- not requesting antibiotics at a GP appointment
- acting on advice given by their GP or other prescriber if antibiotics are not prescribed immediately. This is known as back-up (or delayed) prescribing.

The qualitative evidence was categorised in relation to the capability, opportunity and motivation model of behaviour (COM-B). The model was also used as a theoretical basis for proposing areas that could potentially be effective in changing people's behaviour.

The committee noted that this model is recommended in NICE's guideline on behaviour change: individual approaches and is relevant to how interventions for infection prevention and antimicrobial use are designed and delivered.

### *Points of receptiveness and types of information*

The committee noted that people may be more receptive to information about reducing inappropriate antimicrobial demand and use and preventing and limiting the spread of infection if:

- they (or a family member) are ill, or particularly vulnerable to infection, or
- they perceive that there is a particular risk of illness; for example, during an outbreak of flu.



Committee members highlighted that the information and advice given by health professionals at these points differs from 'general public information' about reducing inappropriate antimicrobial demand and use and preventing and limiting the spread of infection.

The committee heard expert testimony on the varying roles and remits of different agencies that might be involved in providing such information. Members made recommendations for both clinical commissioning groups (on ensuring information and resources are available for people seeking advice about managing self-limiting infections) and local authorities (on raising awareness of the need to reduce inappropriate antimicrobial demand and use and preventing and limiting the spread of infections).

### *The role of community pharmacists*

The committee heard expert testimony on the role of community pharmacists. Members noted that community pharmacists are often under-used by the public and were keen to promote them as an easily accessible first point of contact for people seeking advice on managing self-limiting infections.

Members recognised the important stewardship role community pharmacists play in relation to local antimicrobial prescribing policy and noted the close collaboration between community pharmacists and GP practices in this area. The committee noted the potential for similarly close collaboration in promoting self-care for managing self-limiting infections.

### *Mass-media campaigns*

The committee noted that although mass-media campaigns could raise the profile of antimicrobial resistance and correct use of antibiotics, they had only a small impact on people's knowledge and behaviour.

There was some evidence from the effectiveness review that these campaigns can increase parents' knowledge of antimicrobial resistance and reduce their desire for antibiotics for their child. But only if they are combined with direct communication from healthcare professionals and staff at childcare centres, and with the education of healthcare professionals.

The committee discussed [expert paper 2](#). This reported the impact of international and national awareness-raising campaigns on people's knowledge of appropriate antimicrobial use and antimicrobial resistance. It also reported how people, as a result, changed their behaviour in relation to antibiotics.

## *Educational modules delivered by computers and websites*

In the effectiveness review, evidence statements about using educational modules delivered through computers and websites were also based on only 1 or 2 studies.

The committee therefore decided to look at the antimicrobial use, resistance and infection prevention studies to determine whether education delivered via computer and websites does help change knowledge or behaviour. It concluded that educational modules delivered this way could help reduce inappropriate expectations of antibiotics and improve food safety knowledge and hand hygiene. However, members believed that the key to success was not the format of delivery, but the content and quality of the intervention.

The committee noted that interventions need to go beyond raising knowledge and awareness. It discussed the need to give people the motivation to change and the tools to help them to start behaving differently.

## *Preventing infection*

The committee noted that the effectiveness review had no studies on interventions designed to improve behaviour when coughing and sneezing (such as using and disposing of tissues). So it could not make any recommendations in this area.

Recommendations could be made only on hand hygiene and food hygiene interventions. These are for local authorities and for preschool settings, schools and educational and residential settings for young people. While the evidence for young people was from university settings, the committee felt it was transferrable to other similar educational and residential settings for this age group.

Most of the evidence from the reviews considered by the committee was weak or inconsistent. But these recommendations support and signpost people to existing good practice advice issued by other national agencies, such as Public Health England and [NHS Choices](#).

The committee also noted the importance of infection prevention activities that were outside the scope of the guideline such as vaccination programmes and promoting safer sex.

The majority of studies of hand hygiene took place with children and young people in preschools, primary and secondary schools and university settings. They indicated that it is possible to improve young children's handwashing behaviour through interactive education, including instruction and use of handwashing training kits.

The committee noted the importance of teachers being role models for preventing the spread of infection. It also noted the importance of providing the right facilities and the opportunity to support children to prevent or minimise the spread of infection (for example, by providing liquid soap and tepid running water or [handrubs](#) if these are not available). As with the studies on antibiotic use and antimicrobial resistance, the evidence on the effectiveness of hand-hygiene education (based on use of Public Health England's [e-Bug](#) website) was mixed. The committee noted that a possible reason was the high level of existing knowledge before the start of an intervention in some of the study populations.

The committee was concerned that some may misinterpret this finding and wrongly believe that education in schools was not needed. It felt that education in schools was vital, particularly among students who have little or no knowledge of antibiotics. In addition, it agreed that handwashing behaviour is a habitual practice that, if established when young, is more likely to continue throughout life.

The committee agreed that the combination of education and provision of handrubs may lead to improvements in handwashing behaviour in some populations. For example, there was weak evidence for the effectiveness of providing handrubs along with information posters to university students, and for educational interventions in which people were given handrubs to use at home.

Food hygiene interventions were more likely to be targeted at high-risk groups. The studies found were mostly in the US and were community based. Many focused on improving people's knowledge and behaviour about chilling, cooking and washing food. They targeted adults and young people, including:

- young people in inner cities
- parents with low incomes
- women who were pregnant or caregivers
- older people with a high school education or less
- older women
- Latino communities (people of Latin American origin or descent living in North America).

There were very few studies of educational interventions for schoolchildren on food safety knowledge or practice and the findings were inconsistent.

The committee noted that some food safety interventions appeared to improve food safety knowledge and practices in the short term. These were:

- food safety campaigns delivered to university students
- mass-media campaigns targeting adults or parents
- campaigns delivered through traditional or social media.

### *Using resources effectively*

The committee heard expert testimony about the broad and diverse range of national evidence-based resources that are available. These focus both on reducing inappropriate antimicrobial demand and use and on preventing and limiting the spread of infection.

The committee noted some resources provide information directly to the public in a variety of formats such as videos, posters, leaflets and websites. There are also resources specifically designed to support discussions between people seeking advice on managing self-limiting infections and prescribers and other professionals (such as community pharmacists) who may talk to people about using antimicrobials.

The committee noted the importance of using or directing people to resources that have been developed through a research-based approach with the target group wherever possible. This ensures consistent, evidence-based messages and an effective use of resources.

Members also noted the importance of ensuring resources are used effectively. Expert testimony distinguished between using resources passively (for example, displaying posters or leaving leaflets in GP waiting rooms or community pharmacies) and actively referring to them in discussions with people.

The committee noted the importance of actively sharing resources to support shared decision-making about whether antimicrobials are prescribed. It also noted the potential for using such resources as a tool to convert knowledge into intention to change behaviour and to actual change in behaviour. This is reflected in the recommendations that stress the importance of verbally emphasising key messages in written materials and directing people to further information they can read at home.

## *Health economics*

Infections and infectious diseases in England cost the NHS an estimated £30 billion per year. Many of these costs are caused by respiratory or gastrointestinal infections ([Annual report of the Chief Medical Officer 2011: volume two](#) Department of Health).

The economic costs of antimicrobial resistance are largely unknown ([Antimicrobial resistance: global report on surveillance 2014](#) World Health Organization). The loss of many of the advances in medical care that antimicrobials have supported will be the main economic burden of antimicrobial resistance.

Extremely large economic losses would almost certainly occur if all antimicrobials were rendered ineffectual in the future, even without taking into account the impact on health. So finding ways to delay this will almost certainly be cost effective. However, this cannot be confirmed by modelling because a model would need to be based on assumptions that are not evidence-based.

The committee agreed that the 'precautionary principle' could be applied. This is about avoiding or delaying catastrophes by ensuring effective measures are in place. In such circumstances, the burden of proof in relation to effectiveness is on those who do not wish to put precautionary measures in place.

In the case of antimicrobial resistance, interventions to reduce the spread of resistance could be assumed to be effective unless there was sufficient proof that such interventions are not needed.

Given that it is most unlikely that the effectiveness of such interventions can be disproved, we also need to determine whether a package of such measures is cost effective compared with no intervention. The rules of decision theory for cost effectiveness no longer apply when analysing antimicrobial stewardship. The effects of antimicrobial resistance are so pervasive that it can be assumed the public sector will no longer act as if they were risk-neutral in assessing an intervention but will be risk averse.

The scale of the risk of antimicrobial resistance and the complexity of the issue implies that a package of interventions will be needed. The composition of the most cost effective package cannot be determined because of the limitations in the evidence base, but educational components that are cheap and have a potentially large reach are likely to be highly cost effective.

## *Evidence reviews*

Details of the evidence discussed are in the [evidence reviews](#).

The evidence statements are short summaries of evidence, in a review, report or paper (provided by an expert in the topic area). Each statement has a short code indicating which document the evidence has come from.

**Evidence statement (ES) number 1.1(1)** indicates that the linked statement is numbered 1 in review 1 and relates to key question 1. **ES1.1(2)** indicates that the linked statement is numbered 1 in review 1 and relates to key question 2. **ES2.1(1)** indicates that the linked statement is numbered 1 in review 2 and relates to key question 1. **EP1** indicates that expert paper 1 'Behaviour change and antibiotic prescribing in healthcare settings: Findings from a literature review and behavioural analysis' is linked to a recommendation. **EP2** indicates that expert paper 2 'The effectiveness of local and national campaigns in changing the public's behaviour to ensure they only ask for antimicrobials when appropriate and use them correctly' is linked to a recommendation.

If a recommendation is not directly taken from the evidence statements, but is inferred from the evidence, this is indicated by IDE (inference derived from the evidence).

**Recommendation 1.1.1:** ES3.2(1); EP3, EP7; IDE

**Recommendation 1.1.2:** ES3.2(1); EP3, EP7; IDE

**Recommendation 1.2.1:** EP1, EP3; IDE

**Recommendation 1.2.2:** EP3; IDE

**Recommendation 1.2.3:** EP1, EP2; IDE

**Recommendation 1.2.4:** EP2, EP3, EP7; IDE

**Recommendation 1.2.5:** EP3; IDE

**Recommendation 1.3.1:** IDE

**Recommendation 1.3.2:** IDE

**Recommendation 1.3.3:** EP3; IDE

**Recommendation 1.3.4:** IDE

**Recommendation 1.3.5:** ES1.8(2), ES1.9(2), ES1.10(2), ES1.11(2), ES2.3(2); EP6; IDE

**Recommendation 1.3.6:** ES1.1(3), ES1.4(3); IDE

**Recommendation 1.4.1:** ES1.10(1); IDE

**Recommendation 1.4.2:** IDE

**Recommendation 1.4.3:** IDE

**Recommendation 1.4.4:** ES1.4(2), ES2.1(2)

**Recommendation 1.4.5:** IDE

**Recommendation 1.4.6:** ES1.9(1); IDE

**Recommendation 1.4.7:** IDE

**Recommendation 1.4.8:** IDE

**Recommendation 1.4.9:** IDE

**Recommendation 1.4.10:** IDE

**Recommendation 1.4.11:** ES1.6(2), ES1.7(2), ES2.2(2); IDE

**Recommendation 1.4.12:** IDE

**Recommendation 1.4.13:** IDE

**Recommendation 1.4.14:** IDE

**Recommendation 1.4.15:** EP1, EP4; IDE

**Recommendation 1.4.16:** ES1.4(3), ES1.8(2), ES1.9(2); IDE

**Recommendation 1.5.1:** ES1.1(1), ES1.2(1), ES1.4(1); EP1, EP4, EP5

**Recommendation 1.5.2:** IDE

**Recommendation 1.5.3:** ES1.3(1), ES1.7(1); EP1, EP5; IDE

**Recommendation 1.5.4:** ES1.5(1); IDE

**Recommendation 1.5.5:** ES1.3(1), ES1.5(1); EP1, EP5; IDE

**Recommendation 1.5.6:** IDE

### *Gaps in the evidence*

The committee's assessment of the evidence and stakeholder and expert comment on antimicrobial stewardship identified a number of gaps. These gaps are set out below.

1. A lack of studies on the feasibility and effectiveness of interventions to change people's behaviour in relation to using antimicrobials for conditions other than respiratory illnesses.

(Source: evidence reviews 1, 2 and 3)

2. A lack of studies looking at people in diverse social, cultural and economic circumstances.

(Source: evidence review 1)

3. A lack of studies evaluating the effectiveness of interventions to change people's behaviour relating to antimicrobial use, antimicrobial resistance or infection prevention in workplace settings.

(Source: evidence review 1)

4. A lack of studies evaluating the effectiveness of interventions to change people's behaviour relating to antimicrobial use, antimicrobial resistance or infection prevention in day and residential care settings for older people.

(Source: evidence review 1)



5. A lack of studies with robust measures of cost effectiveness.

(Source: evidence review 1)

## Recommendations for research

The guideline committee has made the following recommendations for research to reduce antimicrobial resistance.

### 1 *Cost effectiveness*

What is the cost effectiveness of interventions to prevent infection and promote the appropriate use of antimicrobials?

#### Why this is important

Lack of studies reporting the costs associated with interventions for either infection prevention or antimicrobial use may act as a barrier to their implementation. Studies with high quality research designs and appropriate cost effectiveness measures are needed to assess this. If research funding bodies ensure cost effectiveness measures are included in research, this will provide the data needed to support the analysis of cost effectiveness.

### 2 *Behavioural strategies and programmes*

What is the feasibility and effectiveness of specific behavioural strategies and programmes to reduce inappropriate antimicrobial demand and use and to prevent infections occurring and spreading?

#### Why this is important

Although the committee has based its recommendations on the best available evidence, little good-quality published evidence was found about the effectiveness of interventions to reduce antimicrobial resistance and prevent the spread of infection. Better quality studies are needed in this area.

### 3 *High-risk groups*

What interventions to prevent infection and reduce antimicrobial resistance are effective for groups of people at high risk of infection? This includes people who:

- have suppressed immune systems (for example, because of HIV, an inherited condition or treatment they may be having for conditions such as cancer or an organ transplant)

- have a chronic disease
- live in crowded conditions (see [Shelter's](#) definition)
- are homeless
- have been in prison
- have migrated from countries with a high prevalence of infectious diseases such as tuberculosis (examples include South Asia and sub-Saharan Africa).

### Why this is important

Most interventions have not been designed for people at high risk of acquiring or transmitting infectious diseases and antimicrobial-resistant strains. Interventions for these groups have focused on reducing the use of antibiotics for respiratory illnesses. More interventions are needed to address antimicrobial use for other high-risk conditions.

Interventions that effectively improve handwashing and food safety practices and reduce antimicrobial use in low-risk populations cannot be assumed to be effective for high-risk groups. In addition, the lessons learnt from interventions that lead to appropriate use of antimicrobials in low-risk populations cannot necessarily be transferred to high-risk groups.

## 4 Workplace

How effective are interventions in the workplace that aim to prevent infection and reduce antimicrobial resistance?

### Why this is important

The workplace is an important setting for helping to prevent the spread of infection among large numbers of people. Information on what works will have a positive impact on the economy by reducing the potential rise in sickness absence caused by the spread of infectious diseases.

More UK randomised control trials are needed in a range of workplace settings.

## 5 Older people in day and residential care

How effective are interventions in day and residential care for older people that aim to prevent infection and to reduce antimicrobial resistance?

## Why this is important

Day and residential care settings for older people are 2 settings where preventing the spread of infection and reducing the risk of antimicrobial resistance are particularly important. This is because many older people are vulnerable to infection as a result of chronic conditions, and there is the risk of infection spreading among large numbers of people. In addition, antimicrobial resistance is increasing in older people, particularly in relation to *E. coli* infections of the urinary tract.

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## Accreditation

