In the winter of 2007–08 a new public-facing antimicrobial campaign was agreed by the Advisory Committee on Antimicrobial Resistance and Healthcare-Associated Infection (ARHAI) Education sub-Group (later divided into subgroups for professional and public education): it comprised posters with a positive message on how the public could help themselves when they had a cold. However, the poster campaign, used in isolation in England, did not improve antibiotic use; therefore, the Public Education sub-Group took forward educational approaches to change the behaviour of the public and health professionals. Professionals have been encouraged to give patients clear information about the likely duration of symptoms, self-care, and benefits and harms of antibiotics, reinforcing the public poster campaigns in surgeries, hospitals and pharmacies. Since 2008, campaigns have been launched in England to coincide with European Antibiotic Awareness Day (EAAD) on 18 November, using Department of Health and EAAD materials. Professional education has been facilitated by the 2008 National Institute for Health and Clinical Excellence respiratory tract infection delayed prescribing guidance for general practitioners. A toolkit of materials for medicines management teams, to facilitate good antimicrobial stewardship in primary care (ASPIC), is being taken forward by the Public Education sub-Group and professional societies. After advice from ARHAI, in 2009 the General Medical Council requested that all postgraduate deans and Royal Colleges ensure infection prevention and control and antimicrobial prescribing become standard practice implemented in all clinical settings, and that they are emphasized strongly in undergraduate and postgraduate medical training. ARHAI has also taken a keen interest in reviewing, advising and leading on a number of European Union initiatives dealing with professional education.

Keywords: Antimicrobial stewardship, antimicrobial resistance, health campaigns, infection prevention and control
expectations for antimicrobials were taken on by the Education sub-Group of ARHAI. A campaign brief was agreed by the sub-Group and tendered. The sub-Group then agreed several new-look antibiotic campaign materials with positive messages that were trialled with members of the public. Focus groups indicated that the Andybiotic character was now considered too ‘retro’ and the sub-Group agreed that ‘Andy’ should be replaced with cartoons (Figure 1) with a positive message underneath the catch phrase on how the public could help themselves when they had a cold. The campaign was again targeted at those with respiratory infections (RTIs), as these accounted for 80% of antimicrobial prescriptions. The campaign featured three posters displayed in magazines and newspapers (Figure 1). The key message was: ‘The best way to treat most colds, coughs or sore throats is plenty of fluids and rest; for advice talk to your pharmacist or doctor’. A copy of the posters and some copies of an A5 patient non-prescription advice leaflet (to be given to patients instead of antibiotic prescriptions) were sent, by post, to English general practice surgeries and independent pharmacies. This prescribing strategy was reinforced by National Institute for Health and Clinical Excellence (NICE) guidance that in 2008 recommended that general practitioners (GPs) should agree a ‘no antibiotic prescribing strategy’ or a ‘delayed antibiotic prescribing strategy’ for most patients with RTIs, and that they should give advice about the usual natural history of the illness and the lack of value of antibiotics in this scenario. This guidance acted as an impetus for primary care prescribing advisors to include delayed antimicrobial advice in their local guidance for general practitioners and a 2010 survey of medicines managers indicated that 73% of primary care trusts (PCTs) reported providing guidance on delayed prescribing strategies. Furthermore, the 2009 Department of Health (DH)-sponsored English Omnibus survey showed that 20% of respondents reported discussing antibiotics with their GP in the previous year, and 19% were offered a delayed antibiotic prescription.

**European Antibiotic Awareness Day**

In November 2008 the European Centre for Disease Prevention and Control (ECDC) organized a European Antibiotic Awareness Day (EAAD) campaign, which was aimed at the general public and had a similar message to the previous English campaigns. This was the first of what was to become an annual event each November. The ECDC encouraged all European Union (EU) countries to participate in the EAAD by running antimicrobial awareness campaigns, and this spurred the English DH to repeat the poster campaign before the peak in RTI and antimicrobial prescribing in November 2008 to coincide with EAAD. On this day, ARHAI also organized a press conference and professional meeting to promote EAAD and increase awareness of antimicrobial resistance and the importance of prudent antimicrobial use. Thus, the EAAD ECDC initiative has been a driving force behind the antimicrobial campaigns in England.

In 2009, ECDC again promoted EAAD and produced materials for primary care prescribers to increase understanding of the importance of antimicrobial resistance and prudent antimicrobial use and to encourage targeted antimicrobial prescribing and a patient-centred approach to antimicrobial prescribing. Two primary care videos were also developed for use in public areas or television. However, in England these materials were not used and there was no public antibiotic campaign in the winter of 2009–10, to avoid conflict with the messages developed for the influenza pandemic that encouraged the public to contact NHS Direct for advice about flu-like symptoms.

For the EAAD held in November 2010, ECDC developed educational materials for hospital prescribers, with posters, a tick-list of factors to check before prescribing antimicrobials, presentations and screensavers. The DH distributed materials to hospitals and antimicrobial prescribers via the professional societies that have infection as their major focus. Thus, the 2010–11 campaign was very dependent on the enthusiasm of local antimicrobial prescribers and prescribing leads. Increasing awareness of the EAAD among professionals has been key, and to this end more than 10 editorials and news items written by members of ARHAI have been published in a range of professional journals since 2008 to coincide with the day. These have been aimed at microbiologists, pharmacists, surgeons, dentists, veterinary surgeons, paediatricians and infection control.
In 2009 the English-led e-Bug project, which was supported and part-financed by the English DH, was launched across Europe. This educational project, aimed at 9–11-year-olds and 13–15-year-olds, provides fun activities that teach young people about the different types of microbes and their spread, prevention of infection (including vaccines), and the importance of prudent antibiotic use and antibiotic resistance. It is hoped that this will reduce expectations for antimicrobials in our future generation of antimicrobial users and parents, and an evaluation of over 1000 schoolchildren showed that it improved knowledge and attitudes around antibiotic use.

**Evaluation of antibiotic campaigns**

There have been several formal evaluations of interventions and campaigns aimed at improving antimicrobial prescribing, which have helped inform ARHAI’s current and future educational campaign plans. In January 2008 and January 2009, before and after the English antibiotic campaigns, a sample of English and Scottish (acting as controls) adults aged ≥15 years were questioned face-to-face about their attitudes to, and use of, antibiotics. There was a small increase in recollection of the campaign posters used in 2008 by English respondents, but this increase was only 2.3% higher in England than in Scotland, where they were not distributed. There was no improvement in either England or Scotland, or any differences between England and Scotland in the understanding of the lack of benefit of antibiotics for coughs and colds, and there was no improvement in antibiotic use. Indeed, there was a significant increase in respondents retaining leftover antibiotics. This indicated that the English poster campaign used in isolation was ineffective at improving antimicrobial use. Other campaigns that have also educated the antimicrobial prescribers themselves or involved marketing within the media have been more successful. The Moxy Malone campaign in Northern England, which ran for 2 years to 2005 with accompanying local radio and television, and some professional education and prescribing support, attained a 5% reduction in prescribing, when the rest of England had a 10% increase. The very successful campaigns in Belgium that were also linked with high media coverage, including television, and education targeted at primary care doctors have led to a substantial reduction in prescribing, although initial prescribing in Belgium was higher than in most other EU countries. Systematic reviews of interventions to change prescribing behaviour have found that multi-faceted interventions that included wide media coverage were most successful and, in the primary care setting, patient-based interventions have been the most consistently effective in reducing antimicrobial use. Patient-based strategies include patient leaflets, non-prescription pads and improving prescribers’ communication skills with patients. However, despite all these campaigns total antimicrobial prescriptions in the community have risen by 20% since 2000.

**Educating the public and primary care professionals in parallel**

Between 2009 and 2011 the DH funded a series of workshops to determine how to take forward multi-faceted interventions to improve antimicrobial stewardship in primary care. Participants agreed that antimicrobial education campaigns should be repeated during peak prescribing periods, located in pharmacies, clinical waiting areas and schools, and reinforced verbally during patient consultations for infections. Workshop participants were asked to consider educational approaches within the context of a behaviour change model in which readiness to change antimicrobial prescribing is recognized as a product of the individual’s perception of the importance of change (‘Why should I change my antimicrobial prescribing?’) and their confidence that they can achieve a change (‘How do I change?’). It was agreed that patients should receive clear information, ideally reinforced with leaflets, about the likely duration of symptoms, self-care and the likely benefits and harms of antimicrobials. Education for clinicians needs to focus on increasing awareness of the importance of antimicrobial resistance and providing tools to increase confidence, such as videos to demonstrate strategies to improve prescribing and patient information to use in consultations.

**The Antimicrobial Stewardship in Primary Care (ASPIC) group**

In 2010 the ASPIC group was formed. The initiative has the support of ARHAI and the DH (who funded the workshop), the HPA, the BSAC, the Royal College of General Practitioners (RCGP), the Care Quality Commission (CQC), the British Infection Association (BIA), the National Prescribing Centre (NPC), the British Paediatric Allergy Immunity Infection Group (BPAIIG), Health Protection Scotland and Public Health Wales. Other members of ARHAI, the NHS Information Centre for Health and Social Care, GPs, pharmacists and microbiologists have contributed. The ASPIC group has agreed that the most important indicator of good antimicrobial stewardship is total antimicrobial use measured in items (specific therapeutic group age-sex related prescribing unit; STAR PU), with a target initially set at below the English antibiotic campaigns, a sample of English and Scottish (acting as controls) adults aged ≥15 years were questioned face-to-face about their attitudes to, and use of, antibiotics. Indeed, there was a significant increase in respondents retaining leftover antibiotics. This indicated that the English poster campaign used in isolation was ineffective at improving antimicrobial use. Other campaigns that have also educated the antimicrobial prescribers themselves or involved marketing within the media have been more successful. The Moxy Malone campaign in Northern England, which ran for 2 years to 2005 with accompanying local radio and television, and some professional education and prescribing support, attained a 5% reduction in prescribing, when the rest of England had a 10% increase. The very successful campaigns in Belgium that were also linked with high media coverage, including television, and education targeted at primary care doctors have led to a substantial reduction in prescribing, although initial prescribing in Belgium was higher than in most other EU countries. Systematic reviews of interventions to change prescribing behaviour have found that multi-faceted interventions that included wide media coverage were most successful and, in the primary care setting, patient-based interventions have been the most consistently effective in reducing antimicrobial use. Patient-based strategies include patient leaflets, non-prescription pads and improving prescribers’ communication skills with patients. However, despite all these campaigns total antimicrobial prescriptions in the community have risen by 20% since 2000.

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Developing an ASPIC toolkit

The ASPIC group has agreed that the other approaches within the context of the ‘how and why’ behaviour change model could be incorporated into a toolkit for primary care prescribers that could be cascaded down to the prescribers via websites used by primary care prescribers, the NPC training network and the local integrated medicines management teams. The toolkit would contain evidence-based multifaceted approaches with patient leaflets, antimicrobial indicators and feedback, interactive workshop materials and online modules such as the STAR (Stemming the Tide of Antibiotic Resistance) project intervention in Wales, or the online RCGP respiratory module. These resources can be national, but will need to be piloted and tailored locally, by the integrated medicines managers’ team, to individual GP practices with feedback, and dialogue with the GPs about local cases and how they would manage them. We hope to launch such a toolkit in November 2012 in time for European Antibiotic Awareness Day.

Professional initiatives

In the 2000s there had been several EU-funded projects that explored approaches to improving antimicrobial stewardship. The first of these (HARMONY; the International Union of Microbiology Societies’ European Staphylococcal Typing Network) developed a consensual approach to designing antimicrobial policies and this informed other key projects. The Council of the European Union adopted the ‘Council Recommendation on the Prudent Use of Antimicrobial Agents in Human Medicine’ (2002/77/EC) and progress has been reviewed regularly by ECDC and DG SANCO. This recommendation asked member states to put in place specific strategies on the prudent use of antimicrobial agents, which included education and training of healthcare professionals. SACAR’s focus on training was largely related to antimicrobial stewardship. However, infection prevention and control, which are just as important in controlling AMR, were not addressed. Neither were they a focus of the HCAI committee predecessor to ARHAI. An article summarizing the work performed by the Professional Education sub-Group of SACAR was published in 2007. The authors pointed out that, as long ago as 2000, the DH had produced its UK Antimicrobial Resistance Strategy and Action Plan. This had outlined specific objectives to promote prudent antimicrobial use in humans, namely: (i) to take the lead in continuing to press for greater coverage of prudent antimicrobial use in undergraduate and postgraduate curricula (medicine, dental, nursing and pharmacy); and (ii) to take the lead in continuing professional development, through the GMC, the Royal Colleges, Nursing Boards and the NHS, and for better integration of antimicrobial teaching into teaching about the infections for which they are to be used.

However, this strategy was not implemented. SACAR’s subgroups continued to identify issues that needed to be addressed through appropriate training and competency development in antimicrobial stewardship. Many of these issues resonated with the media and the public’s general concerns about the competencies of prescribers. They also were in line with the calls for the need to improve prescribing standards raised at several meetings to discuss the global issues of antimicrobial resistance and paucity of new antimicrobial agents.

This need for improved competency in antimicrobial prescribing was made all the more urgent following changes to legislation. Prescribing was now no longer limited to doctors and dentists, but included nurses, pharmacists and optometrists. It also allowed allied health professionals such as physiotherapists, chiroprists or podiatrists and radiographers to train as supplementary prescribers, so that they could prescribe medicines within an agreed clinical management plan for a patient. These changes brought the issues of effective training and competency development to a head, in that it was already well established that antimicrobial stewardship required a focused multi-disciplinary team approach. It did not just involve the prescriber, but also consideration of all those involved in the patient’s journey from presentation to diagnosis, prescribing, dispensing and appropriate administration of antimicrobials.

ARHAI Professional Education sub-Group

The series of regional workshops on translating evidence into practice started by the SACAR Professional Education sub-Group have continued; however SACAR’s initiative to coordinate the definition of learning outcomes across all professions and the four health administrations of the UK (2006–07) has not, thus far, been progressed. However, several other initiatives to improve antimicrobial stewardship have been taken forward. The Health and Social Care Act (2008) Code of Practice has to be taken into account by the CQC and providers of healthcare when considering the national registration requirement for cleanliness and infection control. This also specifies the need for a strong systems approach and specifically refers to antimicrobial prescribing practice. In recent years there has also been a much more target-driven agenda within the NHS and this has also influenced policy around HCAI and antimicrobial stewardship. Through high-profile multi-faceted campaigns within the hospital setting, including improved education and antimicrobial stewardship initiatives, computer prompts and screensavers, and ward ownership of infection rates, this has led to improved infection control, antimicrobial use and lower rates of MRSA bacteraemia and C. difficile infection.

These hospital campaigns again show how multi-faceted interventions can influence behaviour and have raised awareness of the importance of antimicrobial resistance.

ARHAI and its Education sub-Group influenced the content of the annual report of the Chief Medical Officer (CMO) in March 2009, which commented on priorities to control AMR. The work of SACAR was taken on by the ARHAI Education sub-Group. The questions raised by the CMO are shown in Figure 2. Whilst these areas were being explored, the GMC responded to a CMO request, prompted by ARHAI, to ensure that infection prevention and control and antimicrobial prescribing become standard practice implemented in all clinical settings, and that they were emphasized more strongly in under- and postgraduate medical training and, indeed, in nursing, dentistry and other healthcare professions. This was pursued with the postgraduate deans and the Royal Colleges to ensure the:

- inclusion of basic hand hygiene and aseptic practice in the induction for the foundation years
• How is training in prescribing principles and practice, and particularly antimicrobial prescribing, dealt with in the formal guidance that governs the curricula of the schools of medicine, dentistry, pharmacy and nursing and the postgraduate training in the four professions?
• What are the existing mechanisms for education in antimicrobial prescribing at undergraduate and within postgraduate education for the four professions?
• What is happening in the four countries and what agency (if any) is coordinating this education and training?
• What assessments, if any, are done to determine undergraduate and postgraduate competence in antimicrobial prescribing?
• Are the assessments in antimicrobial prescribing graduated to define progress?
• Is there a measurement of the effectiveness of antimicrobial prescribing training included in current teaching practice?

**Figure 2.** Questions raised by the CMO in his 2009 annual report about training of undergraduates and postgraduates in control of antimicrobial resistance.

- sign-off of infection control procedures as key competencies at the end of the F2 year
- inclusion of infection control as part of the annual appraisal for foundation year and specialist registrar trainees
- incorporation of infection control elements within the examination requirements of the Royal Colleges.

The CMO commented ‘These discussions also raised the issue of continued competence beyond the trainee years and it was suggested that infection control could become one of the standard competences to be maintained as part of CPD and required for revalidation.’

It should be noted that the GMC completed comprehensive reviews of ‘Tomorrow’s Doctors’ in 2003 and 2009.59,60 The 2003 edition continues to apply to courses in medicine. It has incorporated many of the above recommendations proposed by ARHAI and communicated via the CMO. The ARHAI Professional Education sub-Group, established in February 2011, has written to several professional bodies inviting membership, so that undergraduate and postgraduate education around AMR and antimicrobial stewardship across all health professional groups can be addressed in parallel and collaboratively. Recently, we have been made aware of another initiative to develop generic antimicrobial prescribing competencies via a contract between the DH and NICE and will work closely with this initiative to achieve our goals of improved competencies, initially in antimicrobial stewardship and then infection prevention and control. Furthermore, the Professional Education sub-Group is of the opinion that these competencies should be considered across the EU, so that, for example, clinicians working in the UK, but trained outside it, also prescribe antimicrobials appropriately. In the 2010 EU Commission’s report to the Council, on the basis of member states’ reports on the implementation of the council recommendation 2002/77/EC on the prudent use of antimicrobials, most countries reported that curricula for health professionals included issues related to antimicrobial resistance, hygiene and infection control, appropriate use of antimicrobials, and vaccination programmes.61 Fifteen countries had in place requirements for non-sponsored continuous education for healthcare professionals, mainly covering hygiene and infection control measures. However, this did not cover all healthcare professions, nor did it solve the problem of the inappropriate use of antimicrobials in every country.61

Antimicrobial resistance and the need to produce sustained improvements in antimicrobial stewardship have been major issues almost from the moment antibiotics were first used therapeutically. To address these challenges requires multi-disciplinary and multi-faceted interventions. Many such interventions are under way and just some of these are described in this paper. However, it is essential that such efforts have the support of policy makers and that resources to research and monitor their effectiveness remain a high priority.
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References
20 Ashiru-Oredope DAI, Howard P. Eight ways community pharmacists can help reduce antibiotic resistance. Chemist and Druggist CPD Zone 18 November 2010 http://www.chemistanddruggist.co.uk/archive/10/11/00000000000.html (05 August 2011, date last accessed).
