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International promotion of e-Bug, an infection prevention and control educational intervention: survey of partners across 14 countries

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Background: Antimicrobial resistance (AMR) is a global threat to public health. e-Bug is an educational resource developed and promoted by a network of international partners. e-Bug seeks to reduce the spread of infection and use of antimicrobials in young people and the community, so helping to control AMR. This study aimed to explore how e-Bug is promoted by international partners and observe barriers to promotion, including the extent of education about antibiotics in schools.

Methods: A total of 29 e-Bug partners were invited to complete online questionnaires on (i) methods they use to promote e-Bug; and (ii) antibiotic topics covered in the national curriculum in their countries.

Results: Fourteen and 15 of 29 e-Bug partners across Europe and Palestine completed the promotional activities and curriculum questionnaires respectively. The most frequently reported methods of promotion included endorsement and collaboration with government and non-government sectors and involvement in national and global health awareness campaigns. Barriers to promotion included a lack of time and funding. The curriculum survey data showed variation in antibiotic education across Europe and Palestine, lack of antibiotic education for children under 11 years of age and little change in antibiotic topics included in the curriculum since 2006.

Conclusions: Future and existing e-Bug partners should be encouraged to follow promotional activities reported in this paper, including ministry endorsement, educator training, international campaigns and youth programmes. We encourage all countries to increase antibiotic topics in the school curriculum across all ages.

Introduction

Antimicrobial resistance in Europe

Antimicrobial resistance (AMR) is a substantial threat to the integrity of modern medicine.[1] Globally, strategies and action plans have been put in place to target AMR,[1–4] with commonalities across infection prevention and control and development of awareness initiatives to educate the public about appropriate antimicrobial use.[5]

Eurobarometer surveys of the European population over the last two decades show a continued lack of knowledge around AMR and a sustained belief by at least 30% of the public in each country that antibiotics are effective against viruses.[6,7] There has been little improvement between the surveys in 2010 and 2016,[6] supporting enhanced national and international education initiatives to improve appropriate antimicrobial use.[2]

The e-Bug programme

e-Bug is an international educational resource that educates children, young people and the community about microbes and the spread, prevention and treatment of infections. e-Bug aims to instil appropriate behaviours and knowledge around hygiene and antibiotic use in children to sustain and encourage these intentions into adulthood.[8]

The e-Bug website (www.e-bug.eu) consists of a teacher and student microsite, hosting a multitude of educational evidence-

based resources. Developed with input from teachers, students and educational authorities,[9] it has been evaluated across Europe, with evidence of significant improvements in knowledge in the school, family and community settings.[10–13] e-Bug has been endorsed in the UK by NICE.[14]

e-Bug began in 2006 with 10 associate European partner countries (Belgium, Czech Republic, Denmark, France, Greece, Italy, Poland, Portugal, Spain and England) who received European funding to assess the need for and to develop, translate, adapt, print and distribute educational resources to schools in 2009.[9] A further eight collaborating countries (Croatia, Finland, Hungary, Ireland, Latvia, Lithuania, Slovak Republic and Slovenia) were involved in development but did not receive funding.[9] Since 2009, PHE has continued to support e-Bug, which now has expanded resources and languages within and outside of Europe. As of 2019, e-Bug has partners in 29 countries with resources translated into 27 languages.

The translated e-Bug resources are freely available to all online; however, partners and other stakeholders within countries are integral to promoting the resources to schools and communities. Details of the initial implementation of e-Bug before 2010 in the 10 associate European partner countries are described elsewhere.[15–25]

Aims

The primary aim was to explore how e-Bug is promoted by international partners and the barriers faced by partners in order to inform recommendations for future promotion. A secondary aim was to provide an update on what antibiotic topics are covered in the school curriculum in e-Bug partner countries.

Materials and methods

Participants

Members of the e-Bug partner mailing list in 2016–17, representing 29 countries, were invited to complete the national curriculum questionnaire (available as Supplementary data at *JAC-AMR* Online) in May 2016 and the e-Bug promotion questionnaire in February 2017. Participants were contacted via e-mail and encouraged to participate during partner teleconference meetings.

e-Bug promotion questionnaire

Questions covered a range of promotional methods, were devised collectively by e-Bug partners during one face-to-face meeting and several teleconferences and piloted with two partners before data collection. The PHE SelectSurvey service hosted the online questionnaire, with 29 closed questions and open options to expand on answers. One representative from each country responded. Data collection was between February and August 2017.

Data were analysed using Microsoft Excel and visual graphs were created to represent the findings from the closed questions. The open responses were analysed and collated by two researchers to explore themes across e-Bug promotion and barriers; representative quotes were selected to reflect these themes.

National curriculum questionnaire

The antibiotic curriculum questionnaire previously validated within the e-Bug development phase in 2007[26] was updated with seven additional questions and more specific age categories from age 7 to 18 years. The questionnaire was an editable Excel sheet and consisted of 20 closed questions around inclusion of different antibiotic topics in the school national curriculum. Partners were asked to provide their data source. Data collection was from May to October 2016.

Data were analysed using Microsoft Excel software. Country results were collated and ordered by antibiotic consumption according to the dose per day, per 1000 inhabitants in 2015 [data from the European Surveillance of Antimicrobial Consumption Network (ESAC-Net)].[27] Responses to 13 questions relating to antibiotics are presented in this report.

Ethics

All participants who completed the questionnaires were e-Bug partners, aware of the purpose of the research and over the age of 18 years. Consent was provided by participants on completion of questionnaires. This study was outside the NHS and was classed as a service evaluation and therefore did not require ethical approval.

Results

Promotion of e-Bug

A total of 14 out of 29 e-Bug partners from across Europe and Palestine completed the e-Bug promotion questionnaire to provide data on e-Bug activities from April 2016 to April 2017. See Table 1 for participant characteristics. Table 2 outlines qualitative themes and quotes from the survey responses.

Eight of 14 partners had received endorsement from a relevant national body in their country, including government ministries of health, education, environment and agriculture and non-government organizations such as the National Healthy Cities Network. Partners reported the benefit of these awards in gaining collaborations and increasing the ease of promotion to schools. Just under half of the partners (6/14) had printed the resources and distributed to schools, and two countries (France and England) had distributed resources multiple times on a national level since 2009.

Hungary reported using 'champions' in the different administrative divisions of the country to coordinate activities in their region, such as running science shows and outreach activities. England implemented training sessions for educators, professionals and community leaders on e-Bug, encouraging them to champion e-Bug in their school or community and to train others. England and France also promoted online training for educators on the e-Bug website.

Website statistics have been available on the website and automatically sent to partners with a live e-Bug website on a monthly or quarterly basis since 2009. Eight of 14 partners monitored website use of e-Bug and shared these at events, with stakeholders or through publication. Partners reported this as a helpful tool to monitor use of new resources and plan which areas of the website may need updates.

Nine of 14 partners promoted e-Bug during campaigns such as the European Antibiotic Awareness campaign or during the 'cold and flu' season and used these as a context for signposting to areas of the website. Six of 13 partners were aware of others who promoted e-Bug on their behalf, including organizations such as the Ministry of Education. A popular method of promotion was through events (9/14) such as teacher conferences. Three of 14 partners reported using an e-Bug social media account and that it was particularly useful for promoting e-Bug to other professionals and organizations who could subsequently promote e-Bug themselves.

Table 1. Characteristics of participants who completed the promotion and national curriculum questionnaires

Country and abbreviation	e-Bug promotion questionnaire completed by	National curriculum questionnaire	
		completed by	method
Austria (AT)	University of Innsbruck	teacher	access to curriculum/experience
Basque Country (BC)	University of the Basque Country (UPV/EHU)/ Department of Education, Government of the Basque Country	—	—
Denmark (DK)	Statens Serum Institut	teacher	access to curriculum/experience
England (EN)	PHE Primary Care & Interventions Unit	partner	access to online curriculum
France (FR)	Nice University Hospital	partner	provided by the Ministry of Education
Germany (DE)	Studienseminar Gymnasien Kassel	partner	access to curriculum
Greece (GR)	External Scientific Assistant to National School of Public Health	teacher	access to curriculum/experience
Hungary (HU)	Office of the Chief Medical Officer	partner	access to online curriculum
Ireland (IE)	—	Department of Education	access to curriculum
Italy (IT)	Istituto Superiore di Sanità	teacher	access to curriculum/experience
Malta (MT)	—	Department of Education	access to curriculum
Palestine (PS)	Islamic University of Gaza	partner	online curricula
Portugal (PT)	Unidade Local de Saúde de Matosinhos	teacher	access to curriculum/experience
Scotland (SC)	Health Protection Scotland	—	—
Slovak Republic (SK)	—	Ministry of Education	access to curriculum
Slovenia (SI)	University Medical Centre, Ljubljana	teacher	access to curriculum/experience
Wales (WA)	—	partner	access to online curriculum
Turkey (TR)	Turkish Society of Microbiology	—	—

—, country did not complete questionnaire.

e-Bug partners reported barriers to promotional activities. The main barrier was a lack of time, with many working on a voluntary basis and giving their personal time. Another common barrier was lack of money and budget for activities. Other barriers reported included lack of resources, such as a specific e-Bug website for the country (reported by Palestine) or the lack of organizational structure to enable collaborations and use of e-Bug champions. A lack of skills needed for promoting e-Bug via social media was also reported.

Antibiotic education in Europe and Palestine

A total of 15 of 29 e-Bug partners from Europe and Palestine completed the national curriculum questionnaire. See Table 1 for the sources of information.

Figure 1 shows the inclusion of 13 different antibiotics topics in the primary and secondary school national curriculum of the reporting countries. Countries are ordered by level of antibiotic consumption for reference. The data showed an inconsistency of antibiotic teaching across levels of schooling, with consistently more education occurring at secondary level (age 11–18 years) and very little to no teaching of children under 11 years of age except for Greece and Austria. More countries reported inclusion of topics relating to the effects of antibiotics (that they are effective against bacteria and not viruses) and less on appropriate antibiotic use (that antibiotics should not be shared).

Discussion

Promotion of e-Bug

The most common method of promotion reported by partners was endorsement of the e-Bug resources and collaboration with organizations that have direct influence on teaching materials used by schools. A less reported promotional method was utilizing e-Bug champions or accredited trainers to disseminate materials directly to specific regions, schools or communities. Use of champions has the potential to greatly increase promotion while concurrently reducing the time needed by partners themselves, which was a barrier to promotion. e-Bug partners also reported health campaigns, conferences and events as effective promotional methods. Campaigns such as 'European Antibiotic Awareness Day' can provide a collaborative context for promotion,[28] which the e-Bug programme could support with specific content around antibiotics. There was little reported use of social media by partners. Smart Insights found that as of 2019 there were over 3 billion social media users worldwide, including 462 million (55%) of Europe's population.[29] Social media is recognized as an effective tool for health promotion[30] and users are increasingly using it professionally to share content, discuss issues and seek collaboration.[31] For e-Bug it offers the opportunity to engage with other organizations and directly with service users; therefore, its use by partners should be encouraged.

Table 2. Qualitative themes from e-Bug partners on the promotion of e-Bug in their country

Theme	Quote
Endorsement and collaboration with organizations	'Ministry of Education sent out an information letter about e-Bug to all schools when we started to implement e-Bug' (partner from Hungary)
	'Endorsement by the department of Health, Education and more recently NICE, have been pivotal in increasing implementation across the UK' (partner from England)
Printing and distribution	'In 2009, 2011 and 2013 as well as 2017. . .135 063 brochures for junior schools and 35 787 brochures for senior schools have been distributed' (partner from France)
Monitoring of e-Bug website	'I use the evolution of weblogs in my yearly report to the Ministry of Health and other partners as well as on posters or presentations of e-Bug' (partner from France)
e-Bug champions and accredited trainers	'Professional health educators working for the Regional Public Health Offices [e-Bug champions] can rent out the Science Road Show from the Budapest Office' (partner from Hungary)
	'Over 60 educators, community leaders and public health professionals were trained on the resources in the 2016–2017 academic year and can act as accredited trainers championing the resources by training others in their schools/communities' (partner from England)
Campaigns	'The Ministry of Education also sends out information to teachers and we have a message on the e-Bug web-site. For 2017 the central theme in France will be education around antimicrobial resistance with the 4 involved ministries' (partner from France)
External promotion and conferences	'[e-Bug is promoted by] Infection control nurses, infection control doctors, teachers. . .' (partner from Denmark)
	'Every year we present a poster about the Hungarian e-Bug performance at the Forum of the Society of Hygiene' (partner from Hungary)
	'In 2016 I presented e-Bug to all school practitioners at their yearly Continuing Professional Development (CPD) day and we have often been invited to present e-Bug at various occasions such as science teachers inspectors or teachers CPD' (partner from France)
Social media	'Social media is particularly useful for promoting e-Bug to other organisations and professionals and has helped us to gain new collaborators' (partner from England)
Barriers to promotion of e-Bug: time	'. . .we work on a voluntary basis and it is difficult to have time or resources available' (partner from Italy)
	'I would like to [analyse website visits] I am a professor. . .with many duties (research, lab work and education). Therefore I have limited time.' (partner from Turkey)
	'. . .I dedicate personal time to e-Bug, without any assistance of a Greek team. So my main priority rests to provide translations to new material and participate in activities.' (partner from Greece)
Barriers to promotion of e-Bug: lack of money and resources	'No funds available [for printing]' (partner from Greece)
	'Do not have the resources to promote it any further' (partner from Denmark)
	'I hope I can have an access to a website for Palestine' (partner from Palestine)
	'I would like to do that [conferences] but one needs collaborations. . .' (partner from Greece)
Barriers to promotion of e-Bug: lack of skills	'I have to work on that [social media] with relevantly skilled persons' (partner from France)

In the 2016–17 academic year, data from Google analytics showed that the UK received the highest visits to the e-Bug website (24.6% of whole) followed by France (9.2%). These countries also reported high amounts of promotional activity in the questionnaire. France developed new content and collaborated with ministries of agriculture, health and education for World Antibiotic Awareness Week. The UK received endorsement and recommendation in national guidance,[14] while both countries also distributed printed packs nationally and promoted training for educators. This suggests higher amounts of partner activity and governmental collaborations could lead to increased use of the resource.

Barriers to promotion of e-Bug

A major barrier to promoting e-Bug is the lack of topics concerning antibiotics and hygiene in the school curriculum. There was a variation in antibiotics topics included in the national curriculum of partner countries; however, AMR is a global issue and it is imperative all countries educate about the topic to a similar level. There was very little education about antibiotics before the age of 11 years. Increasing education in primary schools could help embed understanding of antibiotics from an earlier age, especially if materials are taken home to share with families. Furthermore, promoting health and wellbeing across communities through increased school health education provides the greatest value to children living in areas of social deprivation.[32]

In comparison with the same data collected a decade ago during e-Bug development,[26] there has been little change in the extent of education on appropriate antibiotic use and antibiotic resistance in those countries common to both sets of data (France, Greece, Italy and England). While France, Greece and Italy had increased antibiotics topics in the curriculum at the secondary

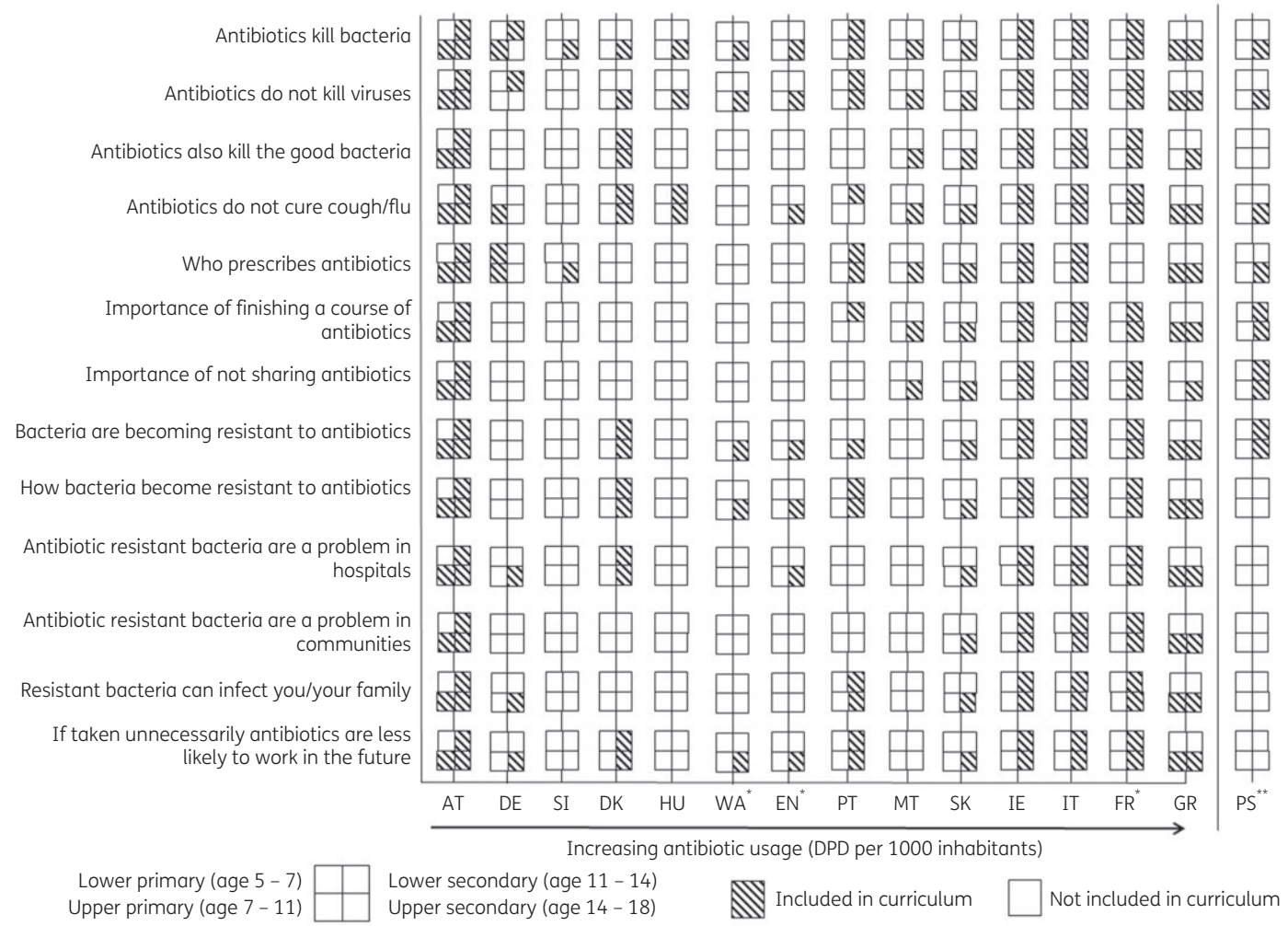

Figure 1. Inclusion of antibiotic topics in the national curriculum of e-Bug Partner countries. European countries are ordered by antibiotic consumption data from ECDC.[27] *Upper secondary streams of study are dependent on subject choice and examination board. **No antibiotic usage data were available for Palestine. See Table 1 for full names of countries. Age brackets for primary and secondary overlap due to the age range of students in each school grade.

school level, there was no change at the primary level (with no teaching at primary level at all in France and Italy) and England had reduced antibiotic curriculum content at the primary level from 2009. Governments should be encouraged to include these topics in their school curriculum at all teaching levels to help embed behaviour from a young age.

Many partners identified barriers to their promotion of e-Bug, which must be overcome to sustain and improve e-Bug expansion internationally. To address the lack of time and funding, multiple champions from different specialities (education, public health and teaching) could be involved to provide a multidisciplinary approach to promotion. Another method is the direct involvement of students and young people in promotion of health topics, as pioneered by the Royal Society for Public Health (RSPH) Youth Health Champion Programme.[33] Young people could advocate the e-Bug resources in their schools and community, and engage and educate their peers on AMR topics, which is supported by previous research on e-Bug peer education on this topic.[13]

Strengths and limitations

The questionnaires were completed by partners from different regions of Europe and Palestine, therefore providing a detailed view of pan-European e-Bug promotion and barriers. Although promoted to all current partners in 2016, only half completed the questionnaires; therefore, this sample may be biased to those countries who completed more promotional activities. A further drawback of this method is that partners may not have been aware of all promotional activities in their country. Further work is needed to evaluate the effectiveness of activities reported by partners, by encouraging them to survey schools in their countries, to measure use of e-Bug, and evaluating the visits to the website, as demonstrated by England, elsewhere.[34,35] Collecting national curriculum data provides a good overview of education happening at a country level. Although usually compulsory, the definition and publicly available details of the teaching curriculum can vary across Europe and Palestine and can in some cases be open to interpretation by teachers.

Implications

This survey of e-Bug partners highlighted popular methods and activities that could increase awareness of e-Bug and AMR education, which should be utilized more widely:

1. Inclusion of antibiotics topics in the national curriculum of all levels of schooling from age 7 to 18 years.
2. Endorsement and promotion of the e-Bug resource and education about antibiotics and AMR by ministries of health and education.
3. Direct involvement with international campaigns such as European Antibiotic Awareness Day and World Antibiotic Awareness Day; development of specific content and collaboration with the campaign coordinators ECDC and WHO.
4. e-Bug country partners should be encouraged to evaluate use of e-Bug through monitoring visits to the website and surveys.
5. Implementation of 'train the trainer' workshops to facilitate dissemination of e-Bug teaching through accredited e-Bug trainers and champions, reducing partner workload.
6. Engagement of youth to champion e-Bug and AMR in schools and community settings.

Standardizing AMR curriculum content and education across Europe may be highly effective at increasing AMR awareness in young people. We therefore call for the European Commission and WHO to recommend education on infection prevention topics, antibiotic resistance and prudent antibiotic use in all schools globally at each level of schooling to facilitate reinforcement into adulthood. This united approach should lead to every child leaving education with an understanding of how to wash their hands, prevent infections and use antimicrobials appropriately.

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Transparency declarations

At the time this work was conducted, all authors either worked for PHE on the e-Bug project or were partners involved in the e-Bug project.

Supplementary data

The Questionnaires are available as Supplementary data at *JAC-AMR* Online.

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