

# What are school children in Europe being taught about hygiene and antibiotic use?

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e-Bug is a pan-European antibiotic and hygiene teaching resource that aims to reinforce awareness in school children of microbes, prudent antibiotic use, hygiene and the transmission of infection. Prior to the production of the resource, it was essential to examine the educational structure across each partner country and assess what school children were being taught on these topics. A questionnaire was devised for distribution to each European partner (Belgium, Czech Republic, Denmark, England, France, Greece, Italy, Poland, Portugal and Spain), exploring their educational structure and examining educational resources or campaigns currently available. From the data collected it was evident that the majority of European schools have structured hand hygiene practices in place from a young age. The curricula in all countries cover the topic of human health and hygiene, but limited information is provided on antibiotics and their prudent use. School educational resources that link to the national curriculum and implement National Advice to the Public campaigns in the classroom are limited. The Microbes en question mobile health education campaign in France is an example of a successful children's education campaign and an innovative programme. Evaluation of the impact of school education on attitude and change of behaviour is also limited throughout many European countries. Not enough is currently being done across Europe to educate school children on the importance of appropriate antibiotic use and antibiotic resistance. The data from this research were used to develop e-Bug, a European Union-funded antibiotic and hygiene teaching resource.

Keywords: education, national curriculum, antibiotic resistance

## Introduction

The prevalence of antibiotic resistance is increasing across Europe<sup>1</sup> and is a therapeutic problem in the community, with patients playing an important role in its emergence and spread.<sup>2</sup> Major resources have been used in public and healthcare-setting campaigns to improve hygiene and antibiotic use.<sup>3,4</sup> However, there have been few educational initiatives in this area aimed at school children. The *Bug Investigator* project in England<sup>5</sup> and a peer teaching programme in Moldova<sup>6</sup> are

the only national antibiotic educational campaigns that target school children, and teach them how and why antibiotics should be used rationally and how improved hygiene could reduce the spread of infections.

e-Bug is a pan-European educational initiative that is 60% funded by the Directorate General for Health and Consumer Protection (DG SANCO) of the European Commission. The object of e-Bug is to develop and disseminate across Europe both a teaching pack for the classroom and an accompanying web site for junior and senior school children. The resource aims to raise

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awareness of the benefits of antibiotics, but will also teach about their prudent use, and how inappropriate use can have adverse effects on an individual's useful microbes and antibiotic resistance in the community. As the e-Bug resource also aims to teach about microbes, and the spread and prevention of infection, it may help to reduce infections in schools, so further reducing antibiotic use. As a pan-European resource, e-Bug has the added benefit of providing a consistent and homogeneous health-education message across Europe. As people under the age of 30 years represent ~35% of the population of the 27 European countries that make up the European Union (EU),<sup>7</sup> e-Bug may encourage EU-wide behavioural changes in the future by targeting school children in their early learning environment.

To attain maximum implementation, a pan-European educational resource needs to be targeted at the most suitable age group, so that the learning objectives can be understood and the subject is taught within the most appropriate part of the school curriculum. We aimed to determine where the teaching objectives of e-Bug may fit in to the educational structure and curriculum of each partner country.

## Methods

### *The research questionnaire*

Teachers and other stakeholders in the areas of health and education in the 10 associate partner countries participating in the e-Bug Project (Belgium, Denmark, England, France, Czech Republic, Greece, Italy, Poland, Portugal and Spain) were contacted by e-Bug national coordination teams, and completed a questionnaire on the educational structure and curriculum of each country. The questionnaire was developed at a mind-mapping meeting of partners involved in the e-Bug Project. It asked for details on the educational structure and school curriculum, particularly in relation to microorganisms, hand and respiratory hygiene, and antibiotic use (the questionnaire is available as Supplementary data at JAC online).

## Results

### *The educational structure across Europe*

Although the educational structure in Europe varies considerably between countries, it can still be divided into the six levels recognized by the International Standard Classification for Education (ISCED). The first four of these levels are of relevance to the e-Bug resource (Table 1). Teaching is compulsory for children aged 7–14 years across the EU partners (Figure 1). The majority of schoolchildren throughout Europe (with the exception of Belgium) attend public institutions of education.

### *The primary and secondary school curriculum*

The government departments for education in each country are directly responsible for the curriculum content at both the primary and secondary school level. The curriculum is mandatory for all public sector schools. State examinations are based on the curriculum, but there are no mandatory teaching resources. Teachers may extend the curriculum topics to provide more detail. Although every country does have private sector education, many of these institutions choose to follow the national curriculum; institutions that do not follow the national curriculum have their own set of examinations.

The primary education curriculum consists of the same compulsory subjects across Europe, with the exception of foreign languages, information technology and religion.<sup>7</sup> In Belgium, Spain, Italy, Poland, Portugal and England, schools are free to determine what portion of their teaching time is allocated to each subject.<sup>7</sup> The majority of school lessons average 40–50 min.

Throughout Europe, schoolchildren choose between different branches or types of education from the age of 15 or at ISCED 3 (upper secondary). Although teaching time is evenly spread across subjects, increasingly more time is being dedicated to the natural and social sciences, with the majority of teaching time already spent on the natural sciences in the Czech Republic.<sup>7</sup>

### *The science curriculum*

Health and microbiology are generally taught in the science sector of the curriculum; however, e-Bug may also be suitable for other subject areas (Tables 2 and 3). Six countries (Czech Republic, France, England, Greece, Italy and Poland) provided data on the science curriculum in their country in relation to microbiology, hand hygiene, respiratory hygiene and antibiotic use (Figures 2–5).

### *Microbiology*

Microbiology is an integral part of the science curriculum in all six countries at both the junior and senior school level. In junior schools, children are taught very basic microbiology, e.g. that there are useful and harmful microbes, and that these can be found everywhere. According to teachers in England, junior school children are taught that there are three different types of microbes (bacteria, viruses and fungi) during the introduction session; however, from this point on the emphasis is on bacteria. At the senior level, equal emphasis is given to bacteria, viruses and fungi. The lessons learned at junior school are reiterated with more detailed information provided. For example, junior school children learn that there are three different types of microbes of different shapes and sizes, whereas at the senior level this message will be reinforced with children also being taught the basic biological structure of each.

### *Hand hygiene*

The topic of hand hygiene is extremely well covered throughout Europe (Figure 3). Many countries teach pre-primary school children how to wash their hands. This message is repeated at both the junior and senior school level, and schoolchildren are taught that handwashing can help prevent the spread of infection. None of the six responding countries teaches the six steps of handwashing at junior schools. Only Greece, England and Poland teach how to wash hands at the senior level; however, this may not necessarily refer to the six steps of handwashing.

### *Respiratory hygiene*

Like hand hygiene, this topic is taught in a more structured manner in junior schools than in senior schools, i.e. as a standalone topic. In senior schools, respiratory hygiene is generally taught within the spread of infection topic. All six countries

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Table 1. Description of International Standard Classification for Education (ISCED) levels of relevance to the junior and senior e-Bug resources

Level	Type of education	Description
0	Pre-primary	Available from 3 years, with the exception of Greece and Liechtenstein where the starting age is 4 years. The general objectives are pan-European structuring on the development of independence, well-being, self-confidence, citizenship, and preparation for life and learning at school. Attendances at pre-primary education institutions are compulsory in Latvia, Luxembourg, Slovenia, Hungary and Poland.
1	Primary	The starting age varies considerably, ranging from 4 (Northern Ireland and Ireland) to 7 (Denmark, Poland, Finland and Latvia) years of age, with the length of time spent in primary education (ISCED 1) varying from 5 to 8 years. In most of these countries, age is the main criterion for admission into primary education, with location and school reputation being secondary considerations. Schoolchildren may be allocated admission to either a public or private sector school, with the parents making the final choice. In one-third of all European countries, the government can intervene if the enrolment capacity is at its maximum. Only in Belgium, Ireland, Luxembourg and the Netherlands can parents freely choose a school for their child with no interference from public authorities.
2	Lower secondary	The length of time spent in ISCED 2 varies from 2 to 6 years, with the pupil's place of residence being high priority for enrolment in many schools. This being said, in the majority of countries, greater importance is placed on academic achievement through placement tests or school reports. The general age range is 10 – 16 years of age.
3	Upper secondary	In many countries, ISCED levels 2 and 3 are taught within the same educational establishments, resulting in larger student numbers in secondary schools than in primary schools. At this level, schoolchildren narrow their subject range and specialize in certain areas where more in-depth teaching is provided in the chosen subjects. The student age range at ISCED 3 is 14– 19 years.

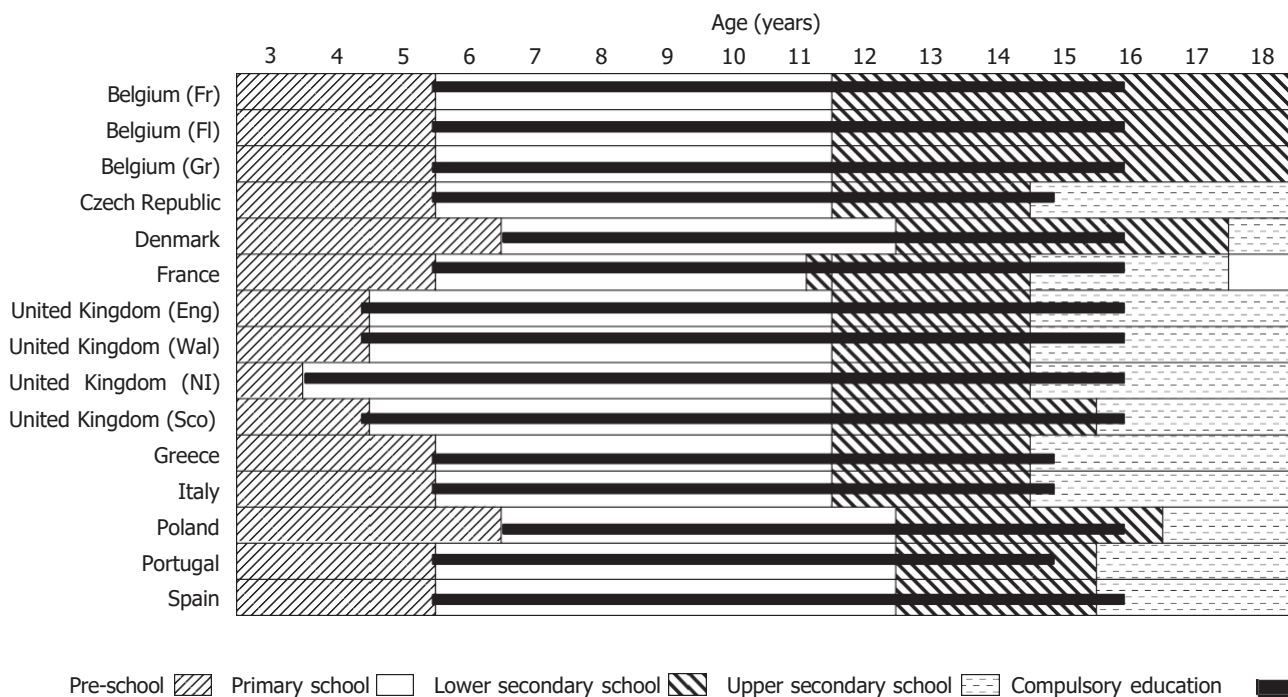


Figure 1. Educational structure outline across countries, highlighting compulsory full-time education. Abbreviations: Fr, French speaking; Fl, Flemish speaking; Gr, German speaking; Eng, England; Wal, Wales; NI, Northern Ireland; Sco, Scotland.

teach that covering your mouth when you sneeze can help prevent the spread of infection (Figure 4). Since the onset of the H1N1 influenza pandemic, schoolchildren are more aware of respiratory hygiene, with schools encouraging children to sneeze into a tissue, throw it in the bin and then wash their hands.<sup>8,9</sup>

All countries teach that influenza is a viral infection. France and England teach this in senior schools only. Greece and Poland

teach the difference between a cold and influenza at

the junior level; the Czech Republic and Italy do not distinguish between the two at either level.

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### *Antibiotic use*

Whilst the topic of antibiotic use was covered throughout the six European countries, the level of detail varied (Figure 5). With the exception of the French junior schools, junior and senior school

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Table 2. A detailed examination of microbiology in the science curriculum of junior schools in each associate partner country relevant to the e-Bug Project for the academic year 2009/10

Country	Topic	Subtopics related to e-Bug
Belgium (Flemish-speaking region)	Living nature	<i>The world of humans, animals and plants</i> <i>Characteristics of organisms and how they can be affected</i>
	Health education	<i>Good habits concerning general health</i> <i>The existence of disease, parasites, etc. and how to avoid them</i> <i>Elementary first aid application</i>
Belgium (French-speaking region)	Science	<i>The world of living organisms</i>
	Technology	<i>Difference between living and non-living</i> <i>The immune system</i> <i>Biotechnology: the importance of bacteria in purifying mechanisms</i>
	The body and the environment	<i>Food technology: conservation of food</i> <i>Structure and function of the body</i> <i>Important rules for healthy living</i> <i>Important rules for good hygiene (hand hygiene, food hygiene and personal hygiene)</i>
	Learning styles	<i>Collect, categorize, analyse and register data, build model, work in laboratory, and present data</i>
Czech Republic	Man and his world	<i>Health and illness</i> <i>Hand and respiratory hygiene</i> <i>Basics of illness prevention and health precaution</i>
England	Life processes and living things	<i>Health</i> <i>Microorganisms</i>
France	Experimental science and technology	<i>Diversity within the living world</i>
	The human body and health education	<i>Consequences of hygiene</i> <i>Basic principles of first aid</i>
Greece	Science	<i>Parts of the ecosystem</i>
		<i>Agents of disease</i>
Italy	Human beings and the human organism	<i>The cell and the unicellular organisms</i> <i>From unicellular to multicellular organisms</i> <i>Structure and function of the human body</i>
Poland	Science	<i>Basic microbiology</i>
		<i>Basic hygiene</i>
		<i>Causes of infectious disease</i>
		<i>Disease prevention</i>
Portugal	Science	<i>Microorganisms and their ecology</i>
		<i>Importance of health protection</i>
		<i>Prevention of disease</i>
		<i>Personal hygiene</i>
Spain	Knowledge of the natural social and cultural environment	<i>Diversity of living beings</i> <i>Health and personal development</i>
	Physical education	<i>Physical activity and health</i>
	Education for citizenship	<i>Life in community</i>

children from the six countries are taught that antibiotics kill bacteria; however, it is mainly at the senior school level (except in Poland) that children learn that antibiotics can also kill your useful bacterial flora. The information provided to schoolchildren on antibiotics is limited at junior schools, but taught in more

detail at the senior level. Education on antibiotic resistance is sparse, with only two of the six countries (England and Poland) teaching that antibiotic resistance is a serious problem in hospitals. At the senior level, all countries, with the exception of France and Italy, educate schoolchildren on how bacteria become

Table 3. A detailed examination of microbiology in the science curriculum of senior schools in each associate partner country relevant to the e-Bug Project for the academic year 2009/10

Country	Topic	Sub topic
Belgium (Flemish-speaking region)	Natural sciences (physics, chemistry and biology)	<i>Living creatures and their structures</i> <i>Risks and dangers of general health and how to avoid them</i> <i>Food in relation to health</i> <i>Good respiratory, vascular and intestinal health</i>
	Scientific enquiry	<i>Microscope techniques</i> <i>Making observations</i>
	Health education	<i>Healthy and active lifestyle</i> <i>Relations and sexuality</i>
Belgium (French-speaking region)	Basic sciences	<i>Living in society: hygiene</i> <i>Living in family: sexuality and reproduction</i> <i>Living in family: food and human nutrition</i> <i>Living in a body: the human organism</i> <i>Living in a body: prevention of health issues</i> <i>Living in a body: the immune system</i>
	General sciences	<i>Nutrition: fermentation</i> <i>Regulation and maintenance of integrity</i> <i>Defence mechanisms: phagocytosis, lymphocytes etc.</i> <i>Reproduction: contraception</i> <i>Reproduction: ethical issues in reproduction</i> <i>Diversity and evolution: living creatures</i> <i>Diversity and evolution: essential characteristics of viruses, prokaryotes, fungi and animals</i>
Czech Republic	Man and nature	<i>Chemistry: pharmaceuticals</i> <i>Biology: sense of viruses and bacteria</i> <i>Biology: the difference between viruses and bacteria</i> <i>Biology: main types of illness</i> <i>Biology: symptoms and causes of basic disease</i> <i>Biology: how infections spread</i> <i>Biology: basics of primary and secondary prevention</i>
	Man and health	<i>What is and what is not healthy</i> <i>Primary and secondary prevention of disease</i> <i>Healthy life ways</i> <i>Physical and mental hygiene</i> <i>Spread of infection and protection</i> <i>Chain of infection and site of entrance</i> <i>Types and examples of infection</i> <i>Acute and chronic diseases</i> <i>Sense of vaccinations</i>
Denmark	Biology	<i>Living organisms, the environment and health</i>
	Man and nature Man and health	<i>Diversity, relationship and unity of living organisms</i> <i>Protection of the organism (body's natural defence against viruses and bacteria)</i> <i>Lifestyle and living conditions, and their relation to health</i> <i>Local and global health problems</i>
	Learning styles	<i>Planning, performing and evaluation of work</i> <i>Collect, categorize, analyse and register data, build model, work in laboratory, and present data. Critical reflection</i>

Continued

Table 3. *Continued*

Country	Topic	Sub topic
England	Life processes and living things	<i>Cells and cell functions</i> <i>Humans as organisms</i> <i>Health: drugs affect health</i> <i>Health: how bacteria and viruses affect health</i> <i>Classification</i> <i>Living things and their environment</i>
France	Science	<i>Human food sources and methods to provide food</i> <i>Diversity, relationships and unity of living creatures</i> <i>Connections within the organism</i> <i>Protecting the organism</i> <i>Human responsibility: health and the environment</i>
Greece	Biology	<i>Cells: structure and function</i> <i>Human tissues and organs</i> <i>Forms of life</i> <i>Infections and disease agents</i>
Italy	Basic elements	<i>Definition of living being</i> <i>Cells: unicellular and multicellular organisation</i> <i>Systems and apparatus of the human body</i> <i>Ecosystems on Earth</i>
	Principles of health education	<i>Correct behaviour</i> <i>Smoking and health</i> <i>Biotechnologies</i>
	Principles of alimentary education	<i>Consequences of mal-, hypo- and hypernutrition</i>
Poland	Science	<i>Health and disease</i> <i>Health-conditioning behaviours and risk factors</i> <i>Recognizing health threats</i> <i>Effects of infectious disease</i> <i>Basics of specific infectious disease (respiratory, sexually transmitted infections etc.)</i>
Portugal	Science	<i>Individual and community health</i> <i>Identification of risk behaviours</i> <i>Health promotion</i>
Spain	Natural science/Biology and geology Education for citizenship/Civic and ethical education	<i>Living beings and their diversity</i> <i>People and health</i> <i>The evolution of life</i> <i>Citizenship in a global world</i> <i>Social problems of today's world</i>

resistant to antibiotics. Greece teaches that antibiotic resistance is not exclusive to hospitals. Although schoolchildren in France are not taught how bacteria become resistant to antibiotics, they are taught that bacterial resistance to antibiotics is a problem.

## Discussion

### *Implications for e-Bug*

The European educational structure from pre-primary through upper secondary indicated that the 9 – 11 and 12 – 15-year-old

age groups were the most appropriate at which to aim the e-Bug resource, in order to teach all children within compulsory education. In many European countries, schoolchildren narrow their subject choices from age 15 onwards or on the move to ISCED 3. Therefore, it is essential that e-Bug is implemented before this age to ensure capturing the largest target audience in senior schools. Across Europe, the level of education provided in junior schools is basic and, therefore, teaching children just before they leave junior school at 9 – 11 years will allow the greatest understanding of these quite difficult concepts.

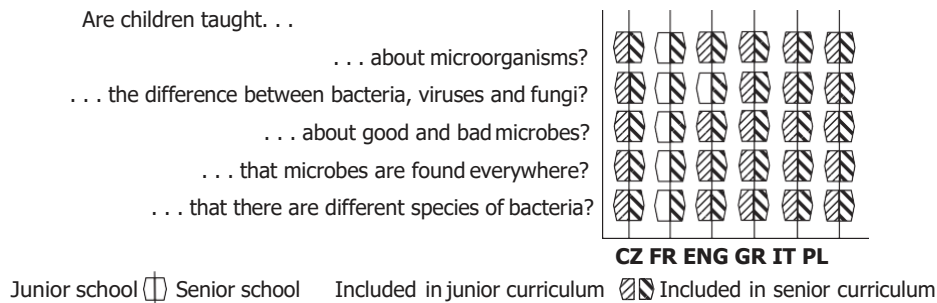


Figure 2. What children are taught in primary and lower secondary schools in associate partner countries in relation to microorganisms, hand hygiene, respiratory hygiene and antibiotic use. The science curriculum content of associate partner countries in relation to microorganisms. Abbreviations: CZ, Czech Republic; FR, France; ENG, England; GR, Greece; IT, Italy; PL, Poland.

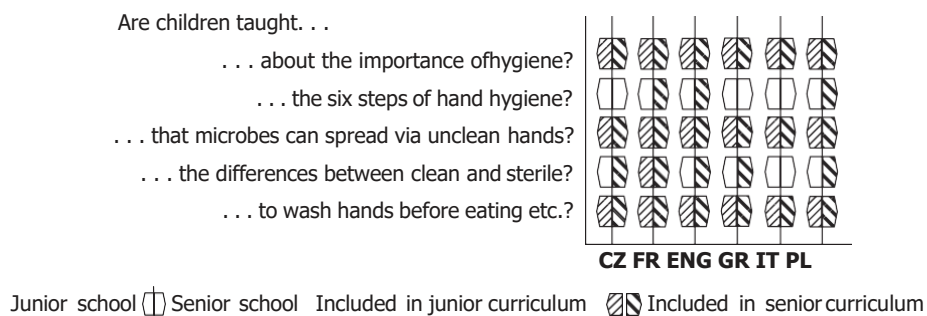


Figure 3. What children are taught in primary and lower secondary schools in associate partner countries in relation to microorganisms, hand hygiene, respiratory hygiene and antibiotic use. The science curriculum content of associate partner countries in relation to hand hygiene. For abbreviations see Figure 2 legend.

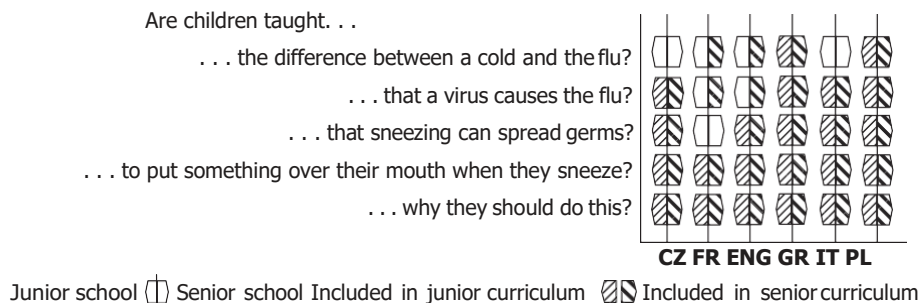


Figure 4. What children are taught in primary and lower secondary schools in associate partner countries in relation to microorganisms, hand hygiene, respiratory hygiene and antibiotic use. The science curriculum content of associate partner countries in relation to respiratory hygiene. For abbreviations see Figure 2 legend.

### A cross-curricular resource

As science is a compulsory school subject at both the junior and senior level across Europe, initial thoughts were that e-Bug should be developed to become integrated into the science curriculum. However, this research has brought to light a number of key reasons why it may be better to have e-Bug as a cross-curricular resource.

Although the key messages of e-Bug are covered in the science curriculum, it is also evident that, particularly in senior schools, hand and respiratory hygiene are covered or duplicated

in part (Czech Republic, England and Poland) in other areas such as cooking, home economics, and personal and social health education. Therefore, each country should indicate within the teaching activities where e-Bug fits into the areas of the national curriculum and countries should be able to market the e-Bug resource as cross-curricular if appropriate.

Throughout Europe there has been a trend towards school autonomy, allowing teachers and schools more freedom to choose educational resources and improve the quality of education.<sup>7</sup> Half of the e-Bug associate partner countries (Belgium, Czech Republic, Denmark, England and Spain) allow full



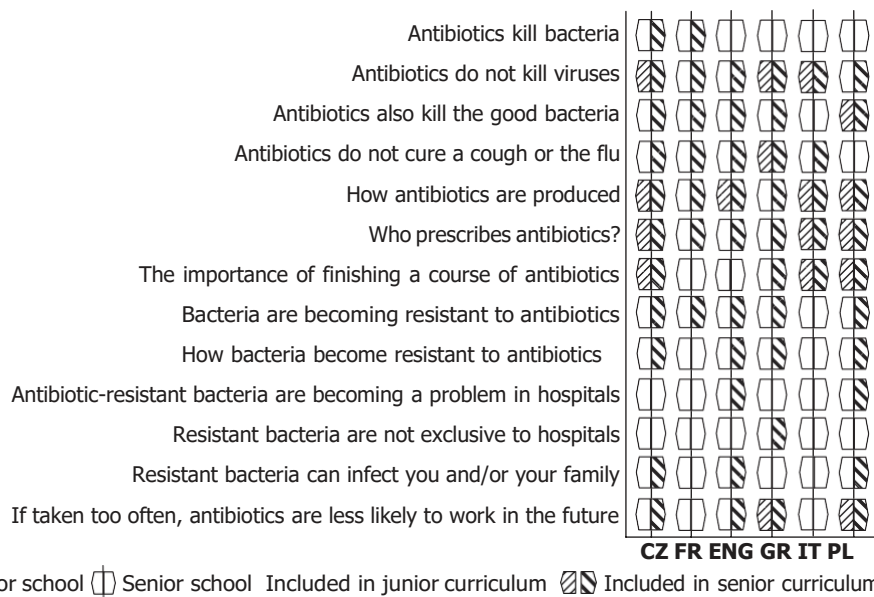


Figure 5. What children are taught in primary and lower secondary schools in associate partner countries in relation to micro-organisms, hand hygiene, respiratory hygiene and antibiotic use. The science curriculum content of associate partner countries in relation to antibiotics. For abbreviations see Figure 2 legend.

autonomy regarding the duties and responsibilities of the teachers,<sup>7</sup> and, as some teachers teach more than one subject, particularly in junior schools, this favours a cross-curricular resource.

As all e-Bug resources are on the Internet in 10 European languages, with the remaining 17 EU languages being added in coming years, e-Bug may also be used as a language tool, assisting young migrants in each country to learn this aspect of the school curriculum. In recent years there has been a gradual increase in migration across member states.<sup>10</sup> Recent data, from countries where this information was available, indicates that up to 10% of young people under the age of 15 are non-nationals (1.7% in the Czech Republic, 10% in Spain).<sup>7</sup>

### Country individualization

The aim of e-Bug is to create a united European message on hygiene and prudent antibiotic use. However, it is essential within each country that the key messages in e-Bug correspond to those issued by the government departments for health, even though this may lead to slight variations between countries. In relation to respiratory hygiene, in some countries the government departments for health promoted sneezing into a tissue, whereas some followed the extended US Centers for Disease Control and Prevention message of 'sneeze on your sleeve'<sup>11</sup> (to cover your mouth and nose with a tissue, but if you don't have a tissue then cough and sneeze into the upper sleeve, not the hands). For the countries promoting the 'sneeze on your sleeve' message, it was essential that we include this in the packs.

In the majority of European countries, patients require a prescription to obtain antibiotics. However, antibiotics can be bought without one in Greece and Spain.<sup>12</sup> As inhabitants and holidaymakers in these two countries can purchase over-the-counter antibiotics, it was necessary in the resources

to indicate or emphasize strongly the risks involved. The level of detail on antibiotic use in the classroom is also extremely varied, highlighting the need for a unified message on prudent antibiotic use and antibiotic resistance.

Based on the research, the suggested learning outcomes for the antibiotic section of the resource are as follows:

### Junior schools

- (i) Most common infections get better on their own through time, bed rest, liquid intake and healthy living.
- (ii) If antibiotics are taken, it is important to finish the course.

### Senior schools

- (i) Most common infections get better on their own through time, bed rest, liquid intake and healthy living.
- (ii) If antibiotics are taken, it is important to finish the course.
- (iii) Do not use other people's or leftover antibiotics.
- (iv) Overuse of antibiotics can damage our normal/useful bacteria.
- (v) Bacteria are becoming resistant to antibiotics due to inappropriate use.

### Limitations of this research

Although the national curriculum is a compulsory teaching guideline for European countries, in many cases it is open for interpretation by teachers. Some teachers may choose to teach the minimum requirement, especially with lower ability schoolchildren, whilst others may teach a wider range of information per topic. Some of the returned questionnaires were

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completed by teachers and, as such, may not be representative of the country as a whole but of their own interpretation of the curriculum.

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## Members of the e-Bug working group

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## Supplementary data

The questionnaire is available as Supplementary data at JAC Online (<http://jac.oxfordjournals.org/>).

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