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EU Insights – Perceptions on the human health impact of antimicrobial resistance (AMR) and antibiotics use in animals across the EU

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Abstract

Tackling antimicrobial resistance (AMR) in animal farming and its impact on public health is a key priority for EFSA and other public health authorities in Europe. This study is a contribution to the joint effort by EFSA and EU member state authorities to address the issue. Focusing on the EU farming sector, it documents perceptions of the risks of AMR, associated behaviours, and the reasons and rationales behind them. Consumers, veterinarians and (pig and poultry) farmers in a sample of European countries were surveyed using a combination of methods (online survey, semi-structured interviews). The evidence gathered can inform communication strategies at national and EU level to increase awareness where these are designed to inform risk perception and change behaviours in relation to the use of antibiotics in animal farming and antibiotics' impact on human health.

Key words: antibiotics; antimicrobial resistance (AMR); risk; farmers; veterinarians; poultry farming; pig farming

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Summary

Objectives

This study is a contribution to the joint effort by EFSA and member state authorities to tackle the risks posed by the use of antibiotics and antimicrobial resistance (AMR) in animal populations, and their links to human health.

The specific objectives of this survey were to gather evidence on:

- Risk perceptions on the human health impact of antimicrobial resistance in animals, across the EU member states, considering in particular:
  - Antibiotics as animal feed additives[3];
  - Risk for occupational groups (e.g. veterinarians, farmers, meat handlers);
  - Risk of transmission of antibiotic resistant bacteria to consumers via food.
- Respondents' understanding of the relationship between antimicrobial use, antimicrobial resistance in animal populations and human health;
- The reasoning and rationales underpinning the risk perceptions; and
- The means and channels through which risk perceptions are formed and influenced.

Method

Qualitative research tools were used to achieve the study's aims. Consumers, veterinarians and farmers in a sample of European countries were surveyed using a combination of methods (online survey and semi-structured interviews).

An online survey of consumers was conducted in 12 countries chosen to be representative of significant variations within the European Union on the issues of interest to EFSA and the Advisory Forum Working Group on Communication.

Interviews of farmers and veterinarians were conducted in five countries – Spain, Romania, Denmark, Poland, and the United Kingdom – and two sectors – pig farming and poultry farming.

Main findings

Understanding

Veterinarians and farmers showed a far better understanding of the relationship between antimicrobial use, resistance in animal populations and human health, than consumers. Only a minority of consumers appeared to be aware of the relationship, or of the channels through which antibiotic-resistant bacteria may transfer from animals to humans. Nevertheless, a minority of farmers and half of the veterinarians questioned the proposition that the use of antibiotics in animal farming constitutes a threat to human health, even if they generally understood the mechanisms through which transfer may occur.

Risk perceptions

Veterinarians and farmers perceived the risks of antibiotic use in animal farming very differently to the way consumers perceived them.

Farmers and veterinarians consistently perceived the risk of AMR developing in animal farming as a result of antibiotics to be low. They indicated that they were not worried about this issue (with the notable exception of Spanish poultry farmers). Views among consumers were more diverse. A

[3] The EU banned the use of antibiotics as growth promoters in animal feed (Regulation (EC) No 1831/2003 on additives for use in animal nutrition). The ban came into effect in January 2006.

majority of consumers rated the risks of AMR as fairly or very likely for most possible uses of antibiotics, even for curative uses prescribed by a veterinarian.

While farmers and veterinarians consistently rated the risks to themselves and other professionals dealing with farm animals as low, and the risks to consumers as even lower, a majority of consumers considered it fairly or very likely that antibiotic-resistant bacteria may be transferred to them. Consumers ascribed a low probability to the likelihood of transfer to veterinarians, farmers, or meat handlers.

Reasons and rationales underpinning risk perceptions

Individuals tend to assess risks they have (or perceive to have) control over as less acute than those they do not have control over. Accordingly, farmers and veterinarians tended to downplay the risks of using antibiotics in farming, and emphasized their "reasoned" and "correct" use of antibiotics, whereas consumers tended to highlight the risks of using antibiotics in farming.

Consumers who had a better understanding of the issues expressed more concern than those who had a lesser understanding. At the same time, the relatively poor level of information and understanding recorded among consumers, and the perception that they were more at risk than farmers or veterinarians – which could be objectively disputed – indicates that better information could also lead consumers to revise down their assessment of the risks.

Farmers made frequent reference to their professionalism and the care with which they addressed animal health issues and used antibiotics on farm. They indicated that mass preventative use of antibiotics (metaphylaxis) and their use as growth promoters (which was banned in the EU in 2006) had become less frequent over time. This justified their perception that current uses of antibiotics were better aligned with the objective of minimising AMR. On risks to specific groups, farmers justified their assessment of the risks to consumers by making reference to the role of controls and checks, as well as the processing of meat, in protecting consumers by preventing contaminated meat from reaching them. A number of farmers also mentioned exposure of veterinarians to animals across multiple herds, or to sick animals,[4] as reasons to rate the risks to veterinarians higher than the risks to farmers.

Veterinarians were also confident that the use of antibiotics in farming creates little or no risk to different professional groups and for consumers. They thought that antibiotics are being used responsibly and that they are increasingly being replaced by alternative treatments.[5] They were aware of the issue of AMR in animals and of potential human health impacts, but believed that antibiotic use in human medicine creates far more risks than veterinary use. Veterinarians associated the transmission of resistance from animals to humans with frequent contact with live animals. Accordingly, veterinarians (especially in the UK and Denmark) believed that farmers are at higher risk of being colonised by antibiotic-resistant bacteria than veterinarians.

- **Means and channels of influence**

All three groups identified the general media as a key channel for information. Farmers and veterinarians also obtained information from professional journals, including – among veterinarians – scientific publications. Veterinarians were a key source of information for farmers. Competent authorities were a source of information on antibiotics use for veterinarians.

A number of channels were used to influence perceptions and practices of farmers and veterinarians: competent authorities were aiming to influence antibiotics use in farming, but industry actors were active too. These initiatives point towards the potential for some coordination in communication activities between public authorities and the industry.

[4] Exposure to healthy animals may, in fact, pose greater risks

[5] Sales of antibiotics in the European Union remain high (EMA, 2015), while alternatives to antibiotics and evidence of their effectiveness remains scarce (EFSA/EMA, RONAFA opinion, 2016).

The consumer survey points in the opposite direction. It indicates that consumers have greater confidence in information on AMR that comes from scientists and health professionals than in information provided by the industry.

The results indicate that efforts to influence AMR-related perceptions of risk would need to take a differentiated approach based on the target audience. To be effective, the strategy targeting farmers and veterinarians would need to be different to that targeting consumers.

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

This contract number RC/EFSA/COMMS/2016/01 was awarded by EFSA to ICF[6] under the Framework Contract No OC/EFSA/COMM/2014/01-CT01.

As per the terms of reference for this work, EFSA has procured this survey, "with the aim of identifying national differences and regional and EU-wide commonalities in risk perceptions on the topic of antimicrobial resistance (AMR) and animal production. The results will form the basis of an evidence-based European risk communications strategy which will be developed and implemented by the Advisory Forum Working Group on Communication (AFCWG) members."

AMR is a priority for public health authorities worldwide and at the European Union level. There has been a joint effort by EFSA, the European Medicines Agency (EMA), and the European Centre for Disease Prevention and Control (ECDC) to better assess and inform consumers and stakeholders on the scale of AMR, the risks posed by AMR for public health, and to contribute to public debate on ways of addressing these risks. This study contributes to this effort.

The specific objectives of this survey were to gather evidence on:

- Risk perceptions on the human health impact of antimicrobial resistance in animals, across the EU member states, considering in particular:
    - Antibiotics as animal feed additives;
    - Risk for occupational groups (e.g. veterinarians, farmers, meat handlers);
    - Risk of transmission of antibiotic resistant bacteria to consumers via food.
- Respondents' understanding of the relationship between antimicrobial use, antimicrobial resistance in animal populations and human health;
- The reasoning and rationales underpinning the risk perceptions; and
- The means and channels through which risk perceptions are formed and influenced.

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2. Approach and methodologies

2.1. Approach

The study has followed a mixed method approach consisting of an online survey of EU consumers and a campaign of qualitative interviews with farmers and veterinarians.

The chosen approach enabled the requirements of the brief to be addressed in a manner consistent with the scale of resources available. It was informed by previous research experience, as summarised below:

- An online survey is an effective approach to collecting consumer views on risks, in particular food-related risks. By adopting such a design the study could compare findings with those from other sources, such as Eurobarometer surveys;
- Large scale surveys of veterinarians and farmers are scarce; such surveys are high resource-intensive and researchers conducting surveys of veterinarians and farmers in the past have encountered problems in achieving satisfactory response rates, particularly when the surveys have been conducted in several countries (e.g. De Briyne et al. 2013; FVE 2015; Speksnijder et al. 2015);
- Qualitative interviews have been a tool of choice for many social science studies of veterinarians and farmers, being used to document views and practices of antibiotics use, including comparative studies (e.g. Buller et al. 2015; Coyne et al. 2014; Moreno 2014; Speksnijder et al. 2014; Swinkels 2015).
- Qualitative interviews are a more powerful tool than survey questionnaires for exploring the reasons and rationales behind perceptions and behaviours, particularly among those stakeholder groups whose behaviours may directly impact antibiotics use and contribute to antimicrobial resistance.

Interview topic guides and the online survey questionnaire were informed by a rapid literature review (Alarcon, 2013; BfR, 2015; Buller et al., 2015; Coyne et al., 2014; De Briyne et al., 2016; Dean et al., 2015; European Commission, 2005, 2010 and 2016; Fontané, 2015; Gibbons, 2013; Hughes, Hermans and Morgan, 2008; Jan et al., 2012; Laanen et al., 2014; Moreno, 2014; Schulze-Geisthövel et al., 2016; Speksnijder et al., 2014 and 2015; Swinkels, 2015; and Visschers et al., 2015).

2.2. Consumer survey

The consumer survey focused on 12 countries: Belgium, Denmark, Estonia, France, Germany, the United Kingdom, Italy, the Netherlands, Poland, Romania, Slovakia, and Spain. This sample of countries was selected to be representative of variation among EU countries in terms of:

- Consumer concerns about antibiotics in meat, as measured in the Special Eurobarometer Survey on Food Related Risks published in 2010;
- Population-corrected sales of veterinary antibiotics, as published by the EMA in 2015;
- GDP/capita;
- Geography.

The survey questionnaire was elaborated in close collaboration with EFSA. It was carefully designed to collect the evidence needed to address the specific objectives of the study.

The questionnaire built on similar questionnaires used in previous studies (including Eurobarometer surveys on antibiotics). It was revised several times so as to achieve a balance between accuracy and comprehension. Some simplification of the language used in such surveys is needed to achieve satisfactory response rates overall and avoid large proportions of "Don't know" responses, which may result from respondents' incapacity to understand questions. For example, the questionnaire included statements that simplified the processes through which antibiotics impact on bacterial infections –

"antibiotics (do not) kill bacteria" –, yet are in line with the wording used in Eurobarometer surveys on antibiotics ("antibiotics kill viruses"). Similarly, the distinction between prophylaxis and metaphylaxis was deemed too technical and potentially confusing to include in an online survey of consumers that may have no knowledge of human or health medicine. Instead, a simplifying reference to antibiotics use "to prevent infection in farm animals" was used in the questionnaire.

The survey was designed to have an average duration of around 10 minutes per respondent, and consisted of 14 closed questions. Three types of questions were used: (i) closed questions with "Yes", "No", "Don't know" options; (2) closed questions requesting respondents to choose one option on a Likert scale (e.g. "very likely", "fairly likely", "as likely as not", "fairly unlikely", "very unlikely"); and (iii) closed questions with multiple possible answers (e.g., to identify all sources from which the respondent had received information on antibiotic resistance).

The English version of the survey was cognitively tested with a native speaker, and amended further before it was translated in the official languages of the 12 countries selected.

The online survey was carried out between 1 August and 9 August 2016. The sample was drawn at random from GfK's consumer panels. GfK's panels are regularly updated by using off-line and on-line recruitment methods and transparent incentive schemes, and used for research purposes only to draw large and representative samples.

Respondents were invited via email to participate in the survey. Neither the survey topic nor EFSA were mentioned in the email invitation. Quotas were set on age and gender to ensure national representativeness of the sample.

The online survey was completed by 3,002 respondents, resulting in a sample of between 250 and 251 respondents per country. The sample was representative of the population in terms of gender and age (see details in Appendix C –). Results were weighted to national representative levels of age and gender as well as the proportion of the 12 tested countries.

The results of the consumer survey were analysed at aggregated and disaggregated level (by country, age, gender and level of education). The confidence level of the survey was 95%. The confidence intervals were 1.8% for the total sample and 6.2% within each country.

Significant differences between overall and disaggregated results were calculated by using a z-test with a confidence level of 95%.

Additional information on the survey design and methodology can be found in the Appendix C –. .

2.3. Semi-structured interviews with farmers and veterinarians

A semi-structured format was used for the interviews with farmers and veterinarians. Semi-structured interviews enable respondents to delve into different aspects of the topics covered in their own words. The format also allows interviewers to react to responses, inviting interviewees to develop or clarify.

Topics guides were developed to collect the evidence needed to address the specific objectives of the study. The range and format of the questions was informed by insights gathered from a number of previous social studies of farmers and veterinarians. Topics guides were revised several times to adjust the vocabulary to the audience and ensure that the interview could be undertaken within a reasonable amount of time (i.e. about 45 minutes).

Guides were tested with one veterinarian and one farmer (in English) before being translated and implemented in the countries chosen.

The interview programme was run in two sectors and five countries:

- Denmark – pig farming;
- Poland – pig farming;
- Romania – poultry farming;

- Spain – poultry farming;
- Spain – pig farming; and
- The United Kingdom – poultry farming.

This selection was informed by considerations of size / importance of animal production, type of farming, and geographical coverage.

To ensure that interviews were carried out in a consistent format, the study team applied a comprehensive process of interviewer briefing and project familiarisation:

- All interviewers were supplied with a briefing note and with topic guides[7]. The briefing note described study aims and scope, interviews' objectives and instructions to select, approach and recruit interviewees.
- ICF held a briefing meeting with interviewers to discuss the briefing note and topic guides.

To ensure a consistent and accurate approach to data collection and analysis, all interviewees were requested to audio-record interviews (subject to the interviewee's consent) and provide written notes in a standard format.

Veterinarians were selected randomly from databases based on the following criteria:

- Minimum of 2 years' experience working with farm animals;
- Currently working full time with farm animals;
- Working regularly with the species the study focused on (pigs or poultry, depending on the country);
- From different regions of the country.

Farmers were selected randomly from databases based on the following criteria:

- Working in the sector the study focused on;
- Operating a farm representative of the dominant type of pig or poultry farming in the country;
- From different regions of the country.

Veterinarian and farmer databases were obtained from various sources, depending on the country studied. While registries of farmers and veterinarians were publicly available in some countries, they were not available or accessible in other countries (for example, for confidentiality reasons). For this reason, it was not possible to adopt the same approach to interviewee recruitment across all countries. Interviewees were recruited by email and/or phone. Ten interviews were carried out by phone in each country/sector, split evenly between farmers and veterinarians. A total of 60 interviews were completed. In practice, recruiting interviewees from these two stakeholder groups in the Summer of 2016 proved challenging: many of the farmers and veterinarians contacted were not available or unwilling to participate. Thus, to interview 30 farmers, the research team contacted 152, and to interview 30 veterinarians, the research team contacted 193. Table 1: and Table 2: provide details of the approaches to recruitment and selection of interviewees for each country and sector.

Interviews were then transcribed and a thematic analysis of transcripts was undertaken, supported by the use of the NVivo software[8]. Thematic analysis requires the researcher to identify a limited number of themes to adequately describe the information contained in qualitative data.

Interviews did not aim to explore the diversity of views across all countries for farmers and veterinarians. Given the small size of the sample, instances where interviewees from a given country expressed different views provided little indication of how representative each view may be within the

[7] Guides were provided in English, Danish, Polish, Romanian, and Spanish. The English version of the topic guide is available in Appendix C –.
[8] NVivo is a software application used for the analysis of qualitative research evidence.

country. Instead the analysis focused on documenting dominant views. Accordingly, the recruitment of interviewees focused on those applying the dominant production models in each selected country and sector (for example, intensive/extensive farming; large/small/medium sized farms). Instances where all or almost all interviewees from a country appeared in agreement with one another provide indications of dominant views within the country. When it comes to country level findings, only these instances are presented in this report. Otherwise, the report presents trends documented across the whole sample of 60 interviewees (30 interviewees per professional group).

Table 1: Approach to recruitment – veterinarians

Country and sector	Summary of approach to selection and recruitment of interviewees	Total number of veterinarians or veterinarian practices contacted	Number who refused or where not available to participate in the interview	Number who agreed to participate and were interviewed
Denmark – pig farming	The following data sources were used: • The Danish Veterinary Association's website (Den Danske Dyrlægeforening, www.ddd.dk). The website was used to identify veterinary clinics working with production animals. • This was complemented with web searches to identify which of these veterinary clinics worked with pigs.	22	17	5
Poland – pig farming	The national register maintained by the National Veterinary Chamber was used to select randomly the vets specialized in pigs diseases (www.vetpol.org.pl/lista-lekarzy-weterynarii-specjalistow).	30	25	5
Romania – poultry farming	Veterinarians were selected and identified based on: • Recommendations and contact details provided by the College of Veterinarians in Romania; and • Recommendations from the veterinarians already interviewed.	14	8	6[9]
Spain – poultry farming	Contacts were provided by the Spanish Poultry Science Association, the Spanish Poultry Meat Association, and other farmers and veterinarians who were interviewed The full list of organisations which were contacted to gather veterinarians' contacts, but either did not hold contact registries, could not share them due to confidentiality rules/concerns or declined to provide contact details is provided below (the list covers both poultry and pig farming): • Spanish Ministry of Health (MSSSI); • Spanish Ministry of Agriculture (MAGRAMA); • National Medicine Agency (AEMPS); • National Council of Veterinarian Colleges (COLVET); • Local Colleges of Veterinarians; and	8	3	5

[9] One was excluded from the analysis due to the limited information provided.

Country and sector	Summary of approach to selection and recruitment of interviewees	Total number of veterinarians or veterinarian practices contacted	Number who refused or where not available to participate in the interview	Number who agreed to participate and were interviewed
	• Spanish Pig Veterinarians Association.			
Spain – pig farming	Most contacts were found through the list of users registered to a specialised pig news website (www.3tres3.com); one contact was identified through the Spanish Pig Producer Association.	101	96	5
UK – poultry farming	Details of relevant veterinary practices were obtained through poultrykeeper.com which had a publicly available list of practices in the UK with poultry veterinarians. Practices were contacted systematically, to find out whether they dealt with commercial poultry and if any vets working in those practices were available for a telephone interview. Poultry veterinarians dealing only with small poultry flocks were not approached.	18	13	5

Table 2: Approach to recruitment – farmers

Country and sector	Summary of approach to selection and recruitment of interviewees	Total number of farmers or companies/farms contacted	Number who refused or where not available to participate in the interview	Number who agreed to participate and were interviewed
Denmark – pig farming	The online Central Husbandry Register (Det Centrale Husdyrbrugsregister) was used to search for pig farmers with herds.	40	35	5
Poland – pig farming	The data on farmers with specific breakdown by region and size of the farm was provided by the Polish Pig Breeders and Producers Association.	22	17	5
Romania – poultry farming	Farmers were identified and selected based on the suggestions and contact details provided by the Association of Poultry Breeders in Romania. Other farmers were identified based on recommendations from the vets interviewed and from desk research, by using the online list of farms registered in Romania (http://www.infocompanies.com/firme/companiiromaniadetalii.php-c=b.a.2.html).	36	31	5
Spain – poultry farming	Contacts of potential interviewees were identified through the Spanish Egg Producer Association, the Spanish Poultry Meat Association, and by web searches focussing on the largest Spanish producers. The MSSSI and MAGRAMA were also contacted to gather farmers' contacts (both for pig and poultry farmers), but either did not hold contact registries or could not share them due to confidentiality issues.	39	34	5
Spain – pig farming	Contacts were identified through the National Pig Producer Association and a pig veterinarian.	6	1	5
UK – poultry farming	Details of poultry farmers were obtained from the Department for Environment, Food and Rural Affairs (Defra). A random sample of 50 large broiler farms and layer operations was provided upon request by ICF, from which farmers were approached for interview.	9	3	6[10]

[10] One was excluded from the analysis due to the limited information provided and because the farm did not meet the selection criteria for the study.

3. Results

3.1. Consumer survey

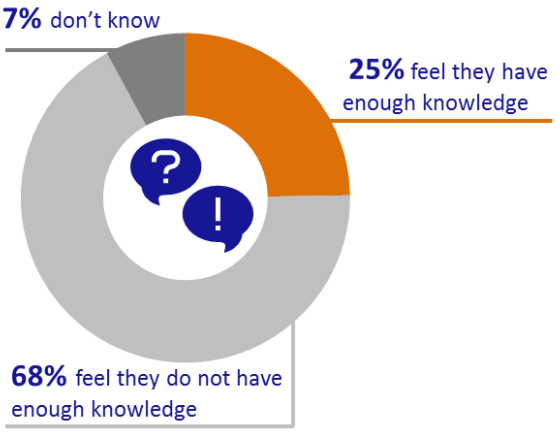
This section presents the main findings from the consumer survey, organised into four sub-sections: awareness, communication, risk perception, and behavioural change.

3.1.1. Awareness

Respondents felt that they lack knowledge about resistance to antibiotics

Only 25% of those surveyed felt that they had enough knowledge about the use of antibiotics in animal farming, whereas 68% felt that they did not have enough knowledge. 7% answered "don't know" (question 10 of the consumer survey (Q10); see **Error! Reference source not found.**). This ack of knowledge is also reflected in low levels of awareness regarding antibiotics.

Figure 1: Q10. "To what extent do you agree or not with the following statement: 'I feel like I have enough knowledge about the topic of antibiotics in farm animals'" (N = 3,002)



Awareness of antibiotic use in farm animals was low

General awareness of antibiotics was low. Respondents gave, on average, 3.4 correct answers for seven statements on antibiotics; this means that respondents were able to reply correctly to 49% of the statements. On average 17% of respondents answered "don't know" (see **Error! Reference ource not found.**).

There were only three statements for which the majority of the respondents gave correct answers:

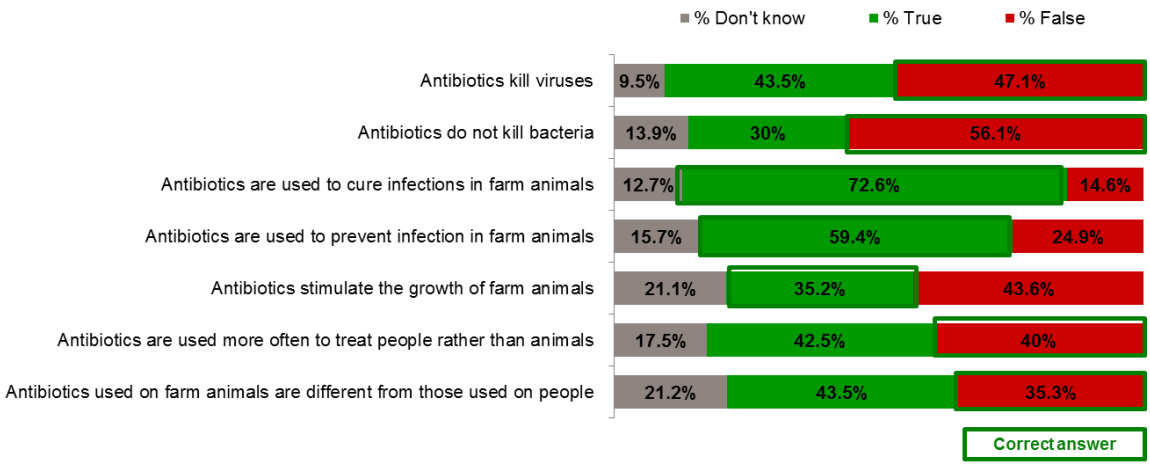
- Antibiotics are used to cure infections in farm animals (73% correctly answered "true"[11]).
- Antibiotics are used to prevent infection in farm animals (59% correctly answered "true"[12]).
- Antibiotics do not kill bacteria (56% correctly answered "false"[13]).

Less than 50% of the respondents could assess correctly the remaining four statements:

[11] This statement refers to the curative use of antibiotics in animal health.
[12] This statement refers to the preventive use of antibiotics in animal health, which may apply to a single individual (prophylaxis) or herds and flocks (metaphylaxis).
[13] This statement reverses a statement used in Eurobarometer surveys on antibiotics ("antibiotics kill viruses"). Antibiotics are not effective against viruses, but are effective against bacterial infections, unless bacteria have developed specific resistance.

- Antibiotics kill viruses (47% correctly answered "false"; this is on par with 43% of correct responses to that same statement from a June 2016 Eurobarometer survey).
- Antibiotics are used more to treat people rather than animals (40% correctly answered "false"; 18% answered "don't know").[14]
- Antibiotics stimulate the growth of farm animals (35% correctly answered "true"; 21% answered "don't know").[15]
- Antibiotics used on farm animals are different from those used on people (35% correctly answered "false"; 21% answered "don't know").[16]

Figure 2: Q1. "For each of the following statements, please indicate whether you think they are true or false" (N = 3,002)



Respondents from Denmark, Germany, the Netherlands and Poland were more likely to provide correct answers than the average respondent. Respondents from Estonia, United Kingdom, Romania, Slovakia and Spain were less likely to reply correctly.

The relatively low level of awareness regarding antibiotics use in farming is consistent with findings from a June 2016 Eurobarometer survey in which only 37% of respondents were aware of the EU ban on the use of antibiotics as growth promoters in farming.

General awareness of resistance to antibiotics was high, but respondents were not cognisant that resistance is widespread in the farming industry

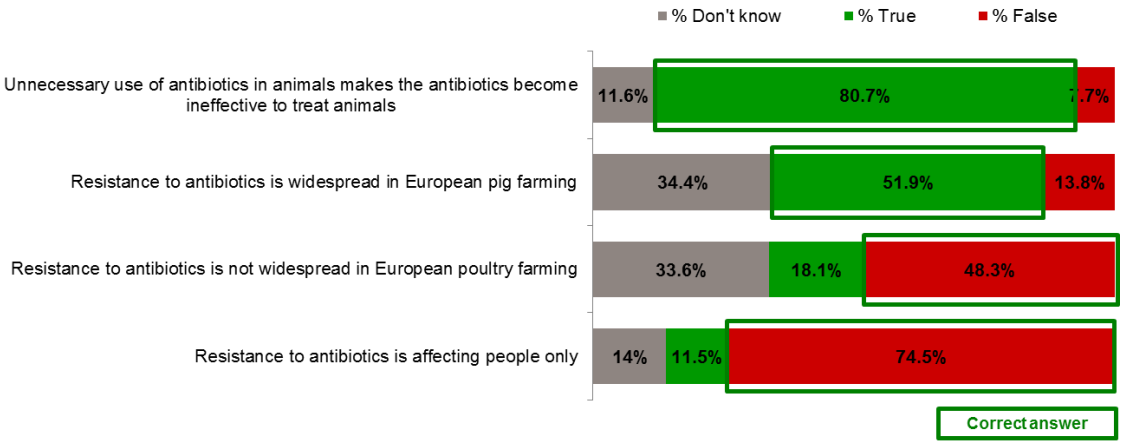
Awareness of resistance to antibiotics was higher than awareness of antibiotics in general. Overall, respondents knew that resistance to antibiotics is an issue, but lacked more general knowledge about antibiotics. On average, respondents correctly assessed 2.9 out of 4 general statements on resistance to antibiotics (i.e., 65% of all statements were assessed correctly) and 23% answered "don't know" (see **Error! Reference source not found.**).

[14] The ECDC/EFSA/EMA first joint report on the integrated consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from humans and food-producing animals (2015) has found that: "Comparison of antimicrobial consumption data in animals and humans in 2012, both expressed in milligrams per kilogram of estimated biomass, revealed that overall antimicrobial consumption was higher in animals than in humans, although contrasting situations were observed between countries." (ECDC/EFSA/EMA 2015). Similarly, 2012 data published by the U.S. Food and Drugs Administration (FDA 2012) indicates that about 70% of all antibiotics consumed are consumed by animals, and 30% by humans.

[15] The use of antibiotics as growth promoters is well documented and has been banned in the European Union in 2003 (Regulation (EC) No 1831/2003 on additives for use in animal nutrition). The ban entered into force in 2006.

[16] Numerous antibiotics used in animal medicine are also used as last resort in human medicine. The loss of these last resort antibiotics as a result of antimicrobial resistance in animals is a core concern. In 2012, the FDA has indicated that, of 41 antibiotics authorised for use in animals, 31 were considered important for human health (FDA 2012).

Figure 3: Q2. "For each of the following statements, please indicate whether you think it is true or false. Please only indicate 'Don't know' if you really don't know." (N = 3,002)



The following statements on resistance were common knowledge for the respondents (i.e., the share of correct answers is higher than 75%):

- Unnecessary use of antibiotics in animals makes antibiotics become ineffective to treat animals (81% correctly answered "true"; this is on par with 84% of correct responses to the same statement in a June 2016 Eurobarometer survey).
- Resistance to antibiotics is affecting people only (74.5% correctly answered "false").

Half of the respondents (52%) responded that resistance to antibiotics is widespread in EU pig and poultry farming, while 14% responded that is was not.[17] One out of three (34%) answered "don't know".

Respondents from Denmark, Germany[18] and the Netherlands were able to reply correctly to a higher proportion of statements compared to the overall average. Respondents from Estonia, United Kingdom and Spain gave a higher proportion of incorrect answers.

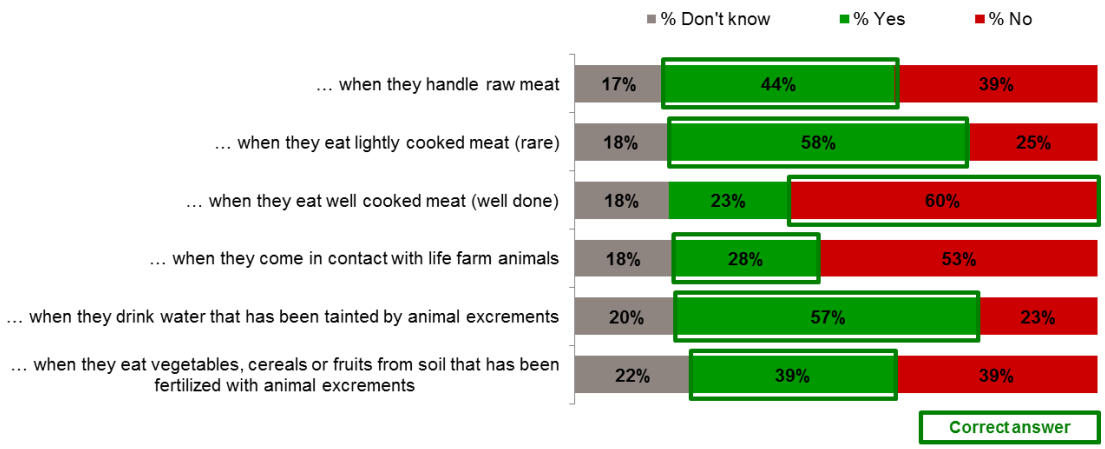
Respondents were not always aware of how resistant bacteria can be transferred from animals to humans

Respondents were, in general, somewhat confused about how antibiotic resistant bacteria can be transferred from animals to humans. On average, respondents correctly assessed 2.9 out of 6 statements on AMR transferability (48% of correct answers), while 18% answered "don't know" (see **Error! Reference source not found.**4).

[17] EFSA/ECDC (2016).

[18] This is consistent with results from a BfR survey, undertaken in 2015, which found that German consumers attributed responsibility to animal farming for the growing problem of antimicrobial resistance (BfR 2015).

Figure 4: Q3. "Do you think that resistance to antibiotics in animals can be transferred to people:
Please only indicate 'Don't know' if you really don't know." (N = 3,002)



Most respondents correctly answered that antibiotic-resistant bacteria can be transferred when eating lightly cooked meat (58% replied correctly to this statement) and when drinking water tainted by animal excrement (57%). Most respondents also knew that well-cooked meat does not pose a risk in this regard (60%).[19]

However, respondents underestimated the risk of transfer from contact with live farm animals (only 28% assessed this statement correctly), through consumption of food from soil that has been fertilized with animal excrement (39%) and from handling raw meat (44%).

On average respondents correctly assessed transferability for 2.9 statements. Consumers from Estonia, France, and the United Kingdom gave fewer correct answers than those of other countries. Respondents in Germany, Italy and the Netherlands gave more correct answers.

Awareness was influenced by several factors

- Education

Compared to other respondents, those who had completed higher education[20] were more knowledgeable about antibiotics, resistance to antibiotics and transferability of resistance. There was a small difference between highly educated respondents, who gave an average of 53% correct answers, and respondents with lower levels of education, who gave 47% correct answers.

- Age

A similar difference could be observed with age: older respondents were more knowledgeable about antibiotics, resistance to antibiotics and transferability of resistance compared to younger respondents. Younger respondents (18-34 years) gave 49% correct answers while the oldest group of respondents (55+ years) gave 54% correct answers.

- Level of concern

As discussed below, respondents were asked how often they think about the human health impact from AMR in farm animals. Those who indicated they thought about the impact often were more knowledgeable about antibiotics, resistance to antibiotics and transferability of resistance compared to others. Respondents who indicated they thought about these impacts often were able to answer 61%

[19] National food safety authorities have advised consumers to cook meat thoroughly to kill harmful bacteria; e.g. https://www.food.gov.uk/news-updates/campaigns/campylobacter/fsw-2014

[20] The education levels used in this report are based on the International Standard Classification of Education (ISCED) to facilitate comparisons of education across countries. The levels used are low (primary and lower secondary education), medium ((post)secondary education) and high education (tertiary education).

of the awareness statements correctly, while other respondents could only answer correctly to 42% of the statements.

- Perceived knowledge

Respondents who indicated that they did not have enough knowledge replied correctly to fewer answers (45%) than those who stated that they had enough knowledge (55%).

- Information

Respondents who noticed information about the resistance to antibiotics also gave more correct answers (63%) than respondents who did not notice any such information (48%).

3.1.2. Communication

Most respondents did not come into contact with information about resistance to antibiotics

Most respondents (57%) had not noticed any information on AMR in the 12 months prior to the survey. Only 43% noticed information about AMR, either referring to humans or animals (see **Error! eference source not found.** and **Error! Reference source not found.**).

Information about resistance to antibiotics in farm animals was less noticed than information about resistance in humans: 16% of respondents noticed information on AMR in farm animals, which is less than half of the percentage of respondents who noticed information about AMR in humans (39%).

Figure 5: Q6. "Where did you notice this information about resistance to antibiotics in farm animals?" (N = 492)

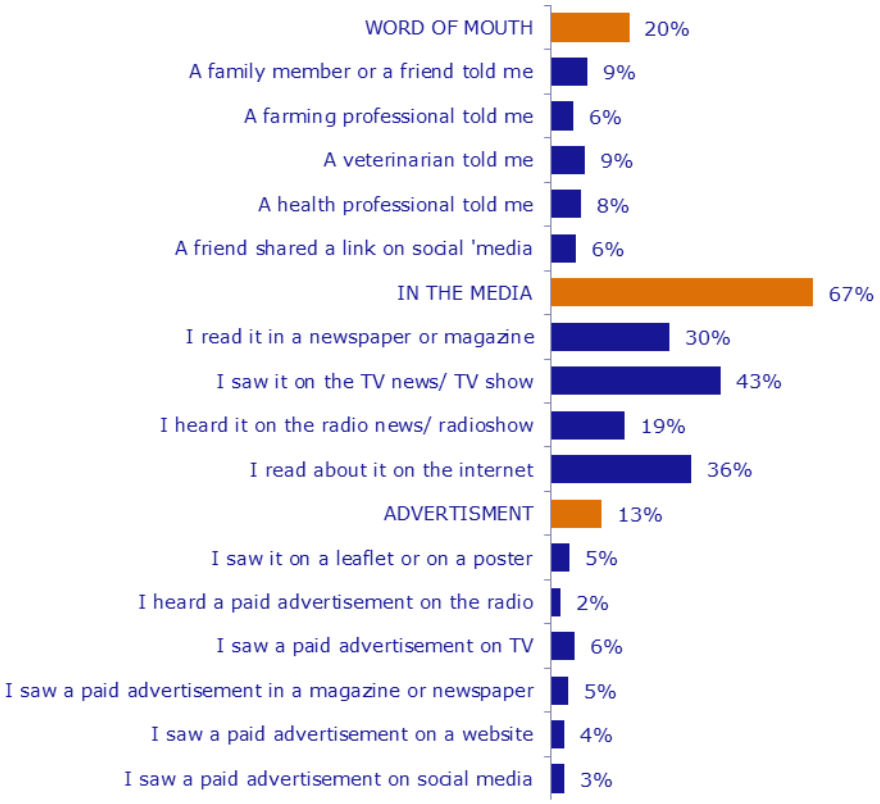
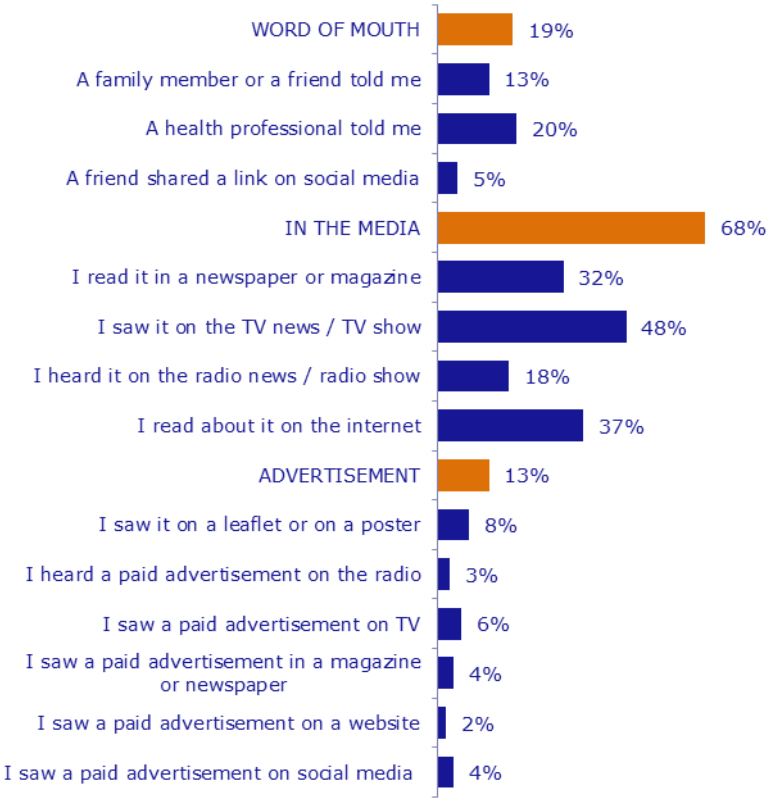


Figure 6: Q5. "Where did you notice this information about resistance to antibiotics in humans?" (N = 1,144)



Communication regarding resistance in farm animals was noticed more in Denmark, the Netherlands and Romania. Communication about resistance in humans was noticed more in the UK and Romania. Estonia and France scored the lowest on both topics.

Information about resistance to antibiotics was seen in the media, but campaigns were not noticed

Most respondents got information on AMR from the media (67% for information on AMR in farm animals and 68% for information on humans), followed by word of mouth (20%-19%) and advertisements (13%-13%).

The top three most used information channels on resistance to antibiotics (either in human or in farm animals) were television, newspapers or magazines, and the internet.

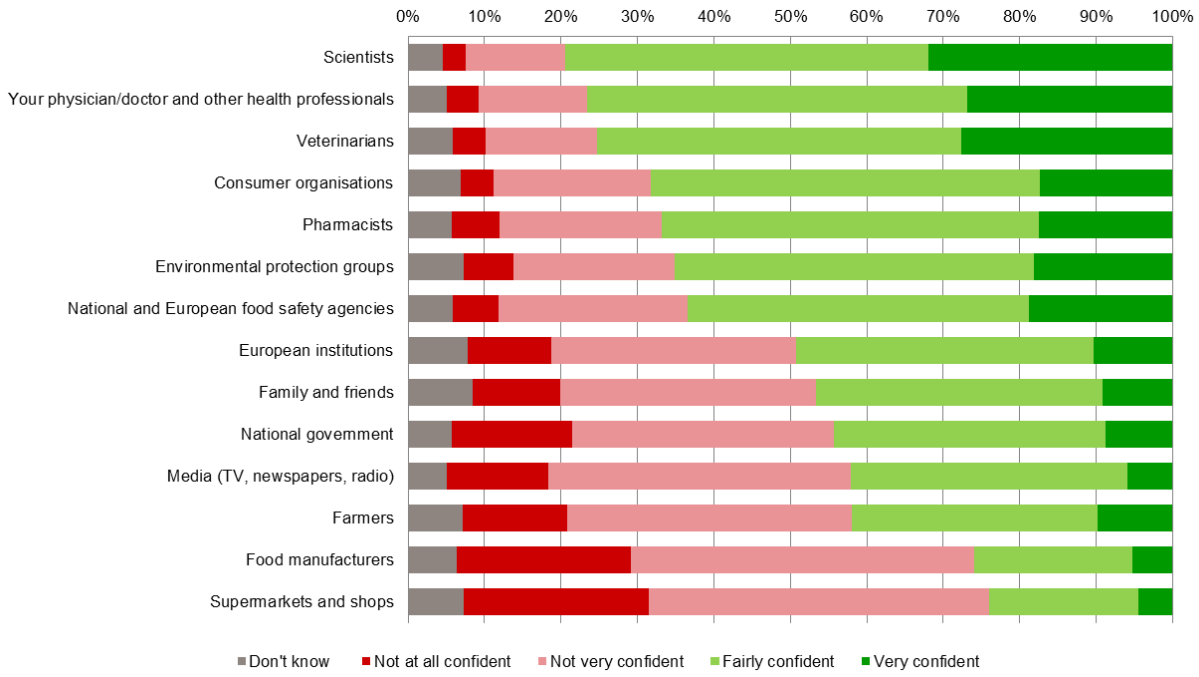
Scientists and health professionals were the most credible sources of information on AMR in animals

Not all sources were equally trusted to give accurate information on AMR in animals. The most trusted sources were (see **Error! Reference source not found.**):

- Scientists (79% either fairly or very confident that information from scientists is accurate).
- Personal physician (77% fairly/very confident).
- Veterinarians (75% fairly/very confident).

These were the three most trusted sources across most countries.

Figure 7: Q7. "How confident are you that the information about resistance to antibiotics in farm animals provided by the following sources is accurate information?" (N = 3,002)



In Estonia, respondents also showed high trust in national and European food safety agencies, whereas in Germany consumer organisations were highly trusted. In Italy, environmental protection groups were also a highly trusted source.

Overall, nine out of the 14 sources were deemed trustworthy, while five sources were perceived as being less or unreliable (i.e., most respondents were not very confident to not confident at all in these sources):

- Supermarkets and shops (69% not very/not at all confident).
- Food manufacturers (68% not very/not at all confident).
- Media (53% not very/not at all confident).
- Farmers (51% not very/not at all confident).
- National government (50% not very/not at all confident).

In Estonia and France, national governments were among the least trusted sources. Family and friends were not viewed as credible sources in the United Kingdom and the Netherlands. The media were not trusted to give accurate information in Estonia, Poland, Romania, Slovakia and Spain.

Overall, national and European food safety agencies received positive views on trustworthiness, with 64% that were confident and 31% that were not confident.

3.1.3. Risk perception

Treating healthy animals with antibiotics was generally viewed as a factor contributing to antimicrobial resistance

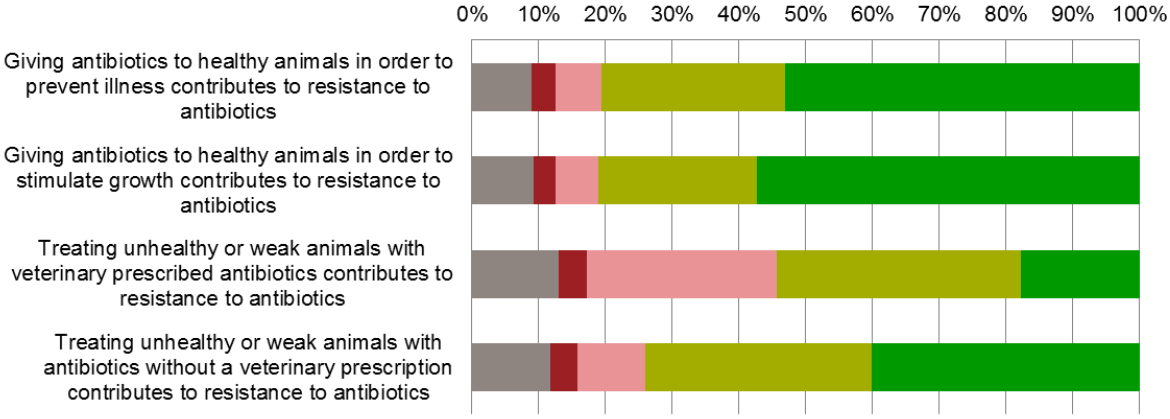
Respondents believed that treating sick animals with veterinary prescribed antibiotics was less likely to contribute to resistance compared to other uses of antibiotics. More specifically (see Figure 8:):

- 81% of respondents considered that giving antibiotics to healthy animals to prevent illness or to stimulate growth is likely to contribute to resistance to antibiotics.

- 74% believed that treating unhealthy animals without a veterinary prescription is likely to contribute to resistance to antibiotics.
- When a veterinarian is involved, 54% believed that giving antibiotics to unhealthy animals is likely to contribute to resistance to antibiotics.

Compared to the overall average, fewer respondents from Estonia and France believed that treating animals with antibiotics was likely to contribute to resistance. Older respondents and highly educated respondents more frequently answered that it was fairly or very likely that treating animals with antibiotics contributes to resistance to antibiotics.

Figure 8: Q12. "How likely do you think it is that these uses are contributing to resistance to antibiotics?" (N = 3,002)



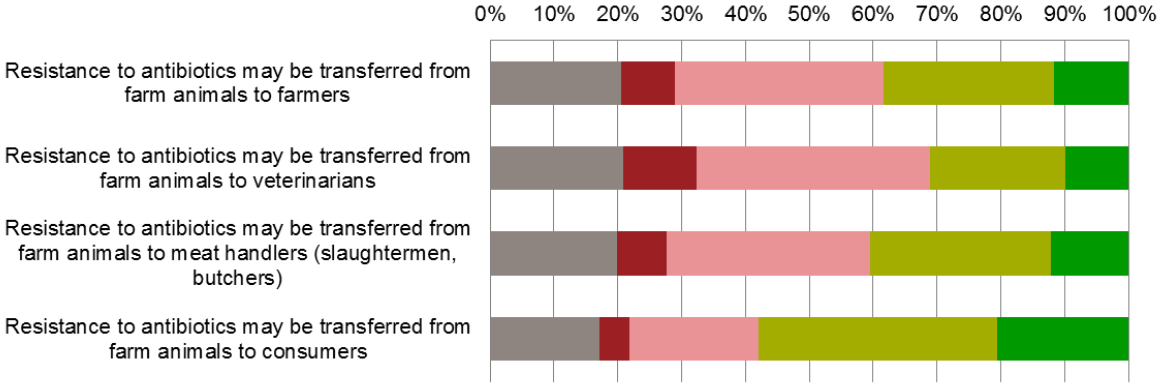
	Treating unhealthy or weak animals with antibiotics without a veterinary prescription contributes to resistance to antibiotics	Treating unhealthy or weak animals with veterinary prescribed antibiotics contributes to resistance to antibiotics	Giving antibiotics to healthy animals in order to stimulate growth contributes to resistance to antibiotics	Giving antibiotics to healthy animals in order to prevent illness contributes to resistance to antibiotics
Don't know	11.8%	13.0%	9.2%	8.9%
Not at all likely	4.0%	4.2%	3.3%	3.6%
Not very likely	10.2%	28.5%	6.5%	6.9%
Fairly likely	33.9%	36.6%	23.7%	27.5%
Very likely	40.0%	17.7%	57.3%	53.1%

Respondents thought antibiotic resistant bacteria from animal farming were more likely to be transferred to consumers than to veterinarians or farmers

58% of the respondents believed that resistance to antibiotics is (fairly or very) likely to be transferred from farm animals to consumers; 41% answered it is (fairly or very) likely to be transferred to meat handlers; 38% answered it is (fairly or very) likely to be transferred to farmers; and 31% answered it is (fairly or very) likely to be transferred to veterinarians (see Figure 9:). Such responses likely reflect the perceived lack of control of consumers over the risk, leading to perceptions of a high risk.

Respondents had difficulties answering the transferability statements: about 20% of them answered "don't know" to each statement. In the United Kingdom, a very high proportion of respondents (39%) answered "don't know" to at least one of the four statements.

Figure 9: Q13. "Below you can find a list of statements. Please rate each statement on a scale from very likely, fairly likely, not very likely and not at all likely." (N = 3,002)

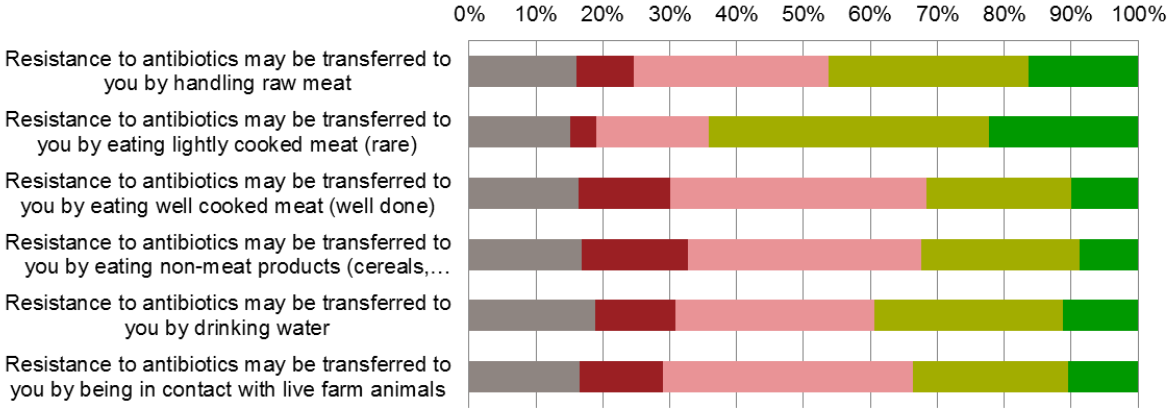


	Resistance to antibiotics may be transferred from farm animals to consumers	Resistance to antibiotics may be transferred from farm animals to meat handlers (slaughtermen, butchers)	Resistance to antibiotics may be transferred from farm animals to veterinarians	Resistance to antibiotics may be transferred from farm animals to farmers
Don't know	17.1%	19.8%	20.8%	20.5%
Not at all likely	4.7%	7.9%	11.5%	8.4%
Not very likely	20.3%	31.8%	36.6%	32.6%
Fairly likely	37.4%	28.3%	21.2%	26.8%
Very likely	20.5%	12.2%	9.9%	11.6%

Respondents thought that the risks of transferring resistance were the highest when consuming rare meat

More respondents considered that antibiotic resistant bacteria are likely to be transferred to humans from eating lightly cooked meat (64% answered "fairly" or "very likely") or handling raw meat (46% answered "fairly" or "very likely"), than considered it is not likely. By contrast, more respondents considered it not likely that antibiotic resistant bacteria would be transferred to humans by eating well cooked meat (52% answered "not very" or "not at all likely"), eating non-meat products (51% answered "not very" or "not at all likely"), being in contact with live farm animals (50% answered "not very" or "not at all likely") and drinking water (42% answered "not very" or "not at all likely") (see Figure 10:).

Figure 10: Q14. "Here is a list of statements. Please rate each statement on a scale from very likely, fairly likely, not very likely and not at all likely." (N = 3,002)



	Resistance to antibiotics may be transferred to you by being in contact with live farm animals	Resistance to antibiotics may be transferred to you by drinking water	Resistance to antibiotics may be transferred to you by eating non-meat products (cereals, vegetables, fruits)	Resistance to antibiotics may be transferred to you by eating well cooked meat (well done)	Resistance to antibiotics may be transferred to you by eating lightly cooked meat (rare)	Resistance to antibiotics may be transferred to you by handling raw meat
Don't know	16.6%	18.8%	16.8%	16.3%	15.2%	16.0%
Not at all likely	12.4%	12.0%	16.0%	13.8%	3.8%	8.6%
Not very likely	37.4%	29.7%	34.8%	38.3%	16.8%	29.2%
Fairly likely	23.2%	28.2%	23.8%	21.6%	41.9%	29.9%
Very likely	10.5%	11.2%	8.7%	10.0%	22.3%	16.3%

3.1.4. Behavioural changes

Half of the respondents thought about whether the resistance to antibiotics in farm animals may have an impact on human health

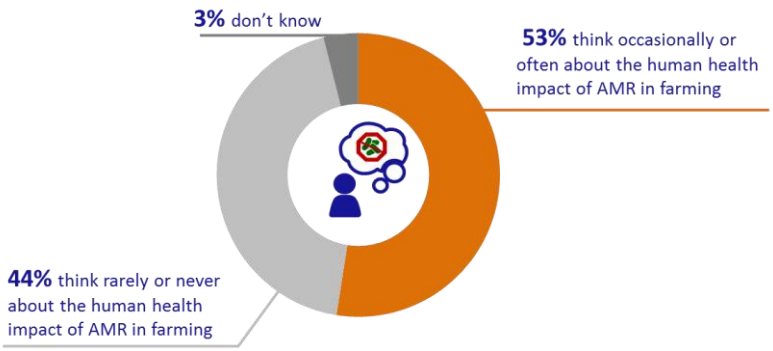
53% of respondents indicated they thought about the impact on human health occasionally or often, while 44% never or rarely thought about it[21] (see **Error! Reference source not found.**11). There is strong link between high involvement in the AMR topic, higher awareness levels, higher levels of information noticed and higher risk perception.

In Germany, Italy and Romania, respondents tended to think about the impact more than average, while respondents in Belgium, Estonia, United Kingdom and Spain tended to think less about these impacts than average.

Older respondents and highly educated respondents tended to think about human health impacts more often than average.

[21] The remaining 3% of respondents could not answer this question.

Figure 11: Q8. "Do you give any thought about whether resistance to antibiotics in farm animals may have an impact on human health?" (N = 3,002)



Respondents generally believed that resistance to antibiotics in farm animals needed to be addressed

The majority of respondents (71%) felt that not enough actions were being undertaken to control or prevent over-use of antibiotics in farm animals (16% answered "don't know") (see **Error! Reference ource not found.**12). 40% felt that actions were being undertaken, and an equal amount of respondents disagreed (20% answered "don't know") (see **Error! Reference source not found.**3).

Figure 12: Q10. "To what extent do you agree or not with each of the following statements? 'Not enough actions are undertaken to control or prevent overuse of antibiotics in farm animals'" (N = 3,002)

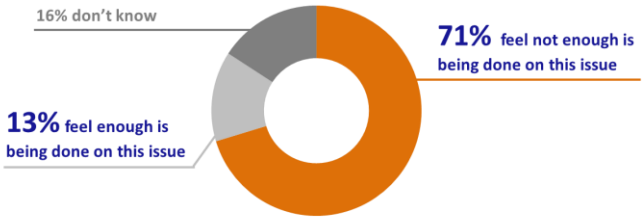
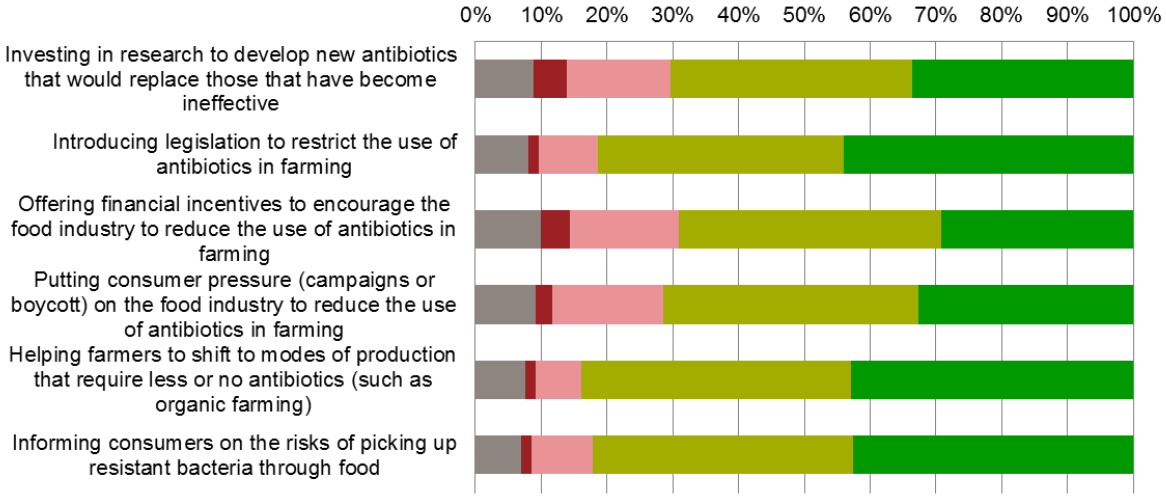


Figure 13: Q10. "To what extent do you agree or not with each of the following statements? 'Actions are being undertaken to control or prevent overuse of antibiotics in farm animals.'" (N = 3,002)

Respondents gave high priority to numerous potential actions to prevent or control resistance to antibiotics in animal farming

Respondents were provided with a list of six actions to reduce resistance to antibiotics in animal farming and asked to indicate what priority they thought each should be given. All actions were rated as fairly or very high priority, receiving a priority score within the range of 69% and 84% (see Figure 14:).

Figure 14: Q11. "What priority would you give to the following actions in order to reduce resistance to antibiotics in animal farming?" (N = 3,002)



	Informing consumers on the risks of picking up resistant bacteria through food	Helping farmers to shift to modes of production that require less or no antibiotics (such as organic farming)	Putting consumer pressure (campaigns or boycott) on the food industry to reduce the use of antibiotics in farming	Offering financial incentives to encourage the food industry to reduce the use of antibiotics in farming	Introducing legislation to restrict the use of antibiotics in farming	Investing in research to develop new antibiotics that would replace those that have become ineffective
Don't know	7.0%	7.5%	9.2%	9.9%	8.0%	8.8%
Very low priority	1.6%	1.7%	2.5%	4.5%	1.6%	5.1%
Fairly low priority	9.2%	6.9%	16.9%	16.5%	9.0%	15.7%
Fairly high priority	39.7%	41.0%	38.8%	40.0%	37.5%	36.8%
Very high priority	42.6%	42.9%	32.6%	29.2%	44.0%	33.6%

The following actions received a very high priority score (higher than 80%):

- Helping farmers to shift to modes of production that require less or no antibiotics (84%).
- Informing consumers on the risks of picking up resistant bacteria through food (82%).
- Introducing legislation to restrict the use of antibiotics in farming (82%).

Although there are differences in the country scores, the top three priorities are the same for all countries. In Italy and Romania respondents gave higher priority scores than average.

The remainder of the statements were given a high priority:

- Putting consumer pressure (campaigns or boycott) on the food industry to reduce the use of antibiotics in farming (71%).
- Investing in research to develop new antibiotics that would replace those that have become ineffective (70%).

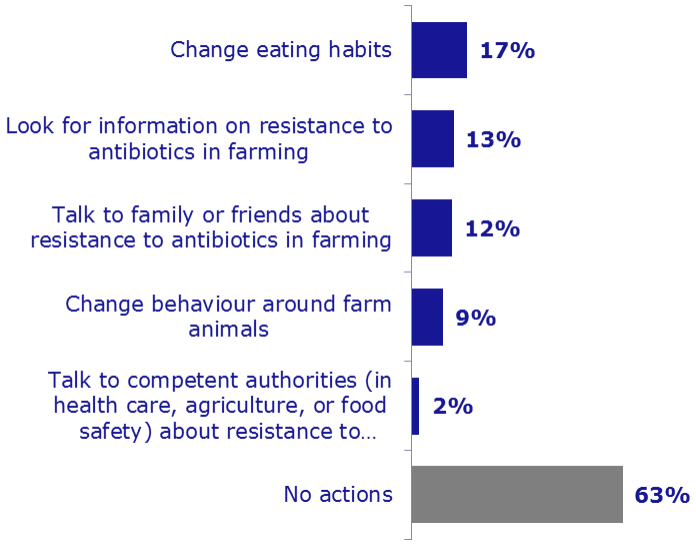
- Offering financial incentives to encourage the food industry to reduce the use of antibiotics in farming (69%).

Although respondents felt that action is needed, they seldom changed their behaviour

In the 12 months prior to the survey, 63% of respondents had not changed their behaviour as a result of resistance to antibiotics in farm animals. Other respondents changed behaviour[22] (see **Error! eference source not found.**5):

- 17% of all respondents changed their eating habits.
- 13% looked for information on resistance to antibiotics in farm animals.
- 12% talked about the resistance to antibiotics in farming with friends or family.

Figure 15: Q9. "In the past 12 months, has resistance to antibiotics in farm animals led you to:" (N=3,002)



Most respondents only undertook one action (69%), 21% undertook two types of actions and 10% more than two actions.

Older respondents had more knowledge and felt more involved with the AMR topic than younger respondents. However, younger respondents indicated that they had looked for information and changed their behaviour more often.

3.1.5. Summary

The online survey has identified low awareness of antibiotics use and antimicrobial resistance in animal farming among consumers in the European Union. Consumers' awareness of how antibiotic-resistant bacteria may infect humans was also low.

Consumers indicated that they were obtaining information on such topics principally through traditional mass media (TV, newspapers and magazines) and the internet. The most trusted sources on such matters were scientists and (human and animal) health professionals. There was far less trust of industry, farmers and the media as sources of reliable information. National and European food safety authorities were generally seen a trusted sources by a majority of respondents.

[22] Respondents who did change their behaviour could select more than one option.

A majority of consumers identified all uses of antibiotics in farming as factors contributing to AMR. They also assessed the risks to themselves as being higher than the risks to any other group, including farmers, veterinarians, and meat handlers. Accordingly, consumers identified consumption of meat products as a key vector for transfer of antibiotic resistant bacteria from animals to humans, underestimating the risks posed by contacts with live animals.

Consumers strongly support initiatives to tackle the risks posed by AMR in animal farming. However, they reported having seldom taken initiatives or changed behaviours because of AMR risks.

3.2. Interviews with veterinarians

This section presents the main findings from the survey of veterinarians. As for the previous section, it is organised into four sub-sections: awareness, communication, risk perception, and behavioural change.

3.2.1. Awareness and understanding of AMR

In the year before the consultation, all veterinarians interviewed had **noticed information** on resistance to antibiotics in their respective sectors (pigs or poultry farming) (question 4 of the topic guide for veterinarians, provided in Appendix C – (Q4)). Information was obtained through word of mouth (a majority of veterinarians obtained information from this source), from media (newspapers and magazines), scientific publications and communications from competent authorities.

A majority[23] of veterinarians had **observed a decline in the effectiveness** of antibiotics on pigs/poultry (Q5, see Table 3:).

Table 3: AMR in animals: observed decline in effectiveness of antibiotics

Q5. Have you directly or indirectly (e.g. hearing from other veterinarians) observed a decline in the effectiveness of antibiotics on pigs/poultry, compared to in the past?

	Number of interviewees
Yes	**20**
Yes – directly	12
Yes – indirectly	5
Yes – not specified	7
No	**10**
Does not know	**0**

Source: ICF, interviews with veterinarians. N = 30
Note: more than one answer was allowed per interviewee

Most of the veterinarians consulted believed that **the way antibiotics are used in pig/poultry farming could contribute to antibiotic resistance in animals** (Q7). Most veterinarians who did not believe that antibiotic use creates resistance were Spanish poultry veterinarians.

The main types of uses that were thought to create resistance were (Q7):

- The misuse of antibiotics to treat illnesses (such as under or over dosage and inappropriate duration of the treatment);
- The continuous use of antibiotics, or the use of antibiotics when this is not necessary to cure or prevent diseases (such as the use of antibiotics as growth promoters); and
- The preventative use of antibiotics.

[23] The text "small minority" or "a minority" refers to less than 10 respondents, a "large" or "strong minority" between 10 and 15, a "small majority" between 15 and 20, a "large majority" more than 20 (out of a total of 30 interviewees).

The use of antibiotics was not considered to be the only factor that contributes to antibiotic resistance in animals. A majority of veterinarians identified **other causes**, the most common being inappropriate farm biosecurity measures (such as scarce hygiene) (Q8).

In the year prior to the consultation, most veterinarians had **noticed information about how the use of antibiotics in pigs/poultry farming could lead to antibiotic resistance in humans** (Q9). The main information sources on AMR in humans were the general media, scientific publications, word of mouth, and competent authorities.

Veterinarians identified different factors contributing to the transmission of resistance from animals to humans, the most common being the contact with animals and the consumption of meat products (raw or cooked) (Q10).

About half of the veterinarians interviewed were sceptical about the proposition that the use of antibiotics in farming makes people resistant to antibiotics. Spanish and Romanian veterinarians overwhelmingly shared that view. Many thought that the excessive or inappropriate use of antibiotics in human medicine is the cause of resistance in humans (Q6 and Q10).

3.2.2. Risk perception

Most veterinarians believed that they face little or no risk of being infected by antibiotic-resistant bacteria from pigs/poultry (Q11). A majority also believed that risks for other groups (farmers, meat handlers and consumers) were similar, or lower than the risks faced by veterinarians (Q12, 13 and 14) (see Table 4: 4 and Table 5: 5).

Table 4: Risk perception for different groups: veterinarians

Q11. How high would you say is the risk to you as a veterinarian of picking up antibiotic resistant bacteria from pigs/poultry?

Risk perceived	Number of interviewees
High risk	3
Little or no risk	27
Does not know	0

Source: ICF, interviews with veterinarians. N = 30

Table 5: Risk perception for different groups: veterinarians and consumers

Q14. Do you consider yourself more or less at risk than consumers? Why?

Risk perceived	Number of interviewees
Consumers face a higher risk than veterinarians	4
Consumer face the same risk as veterinarians	8
Consumers face a lower or no risk	17
Did not respond	1

Source: ICF, interviews with veterinarians. N = 30

Veterinarians from the UK and Denmark were unanimous in their evaluation of there being no risk for consumers, while opinions on this matter were less consistent in the other countries. Almost all British and Danish interviewees considered that farmers were at higher risk than veterinarians, whereas the majority of respondents in other countries considered that farmers were as much at risk from being colonised by antibiotic resistant bacteria as veterinarians.

3.2.3. Behaviour and contributing factors

Veterinarians mainly obtained information on antibiotic use from competent authorities, word of mouth and scientific publications. The most common channels were national or local competent authorities, followed by other farmers or vets and professional or scientific journals and books (Q20).

Most veterinarians stated that they consider antibiotic resistance when prescribing antibiotics (Q15):

- A small majority tried ensuring that antibiotics are applied correctly and that dosage and length of treatment are appropriate.
- A large minority reduced the use of antibiotics (for example, by replacing them with alternative treatments such as vaccines).
- A minority replaced ineffective antibiotics with different and newer antibiotics.

Over half of the veterinarians interviewed believed that they have a similar prescribing behaviour to other veterinarians operating in their sector (i.e., pig or poultry farming). A large minority believed that their prescription behaviour was different, in that they prescribed fewer antibiotics, or ensured a better use of antibiotics (e.g. by ensuring that the right doses and withdrawal periods apply). The few veterinarians who mentioned prescribing more antibiotics justified this by making reference to the particular circumstances of their work (size and proximity between farms they attended to) (Q16).

Most interviewees indicated that the decision to use antibiotics is mostly (or exclusively) their own, while a minority advised that it is a decision taken together with the farmer (Q17). This points to veterinarian influence on the use of antibiotics in those sectors. A majority of veterinarians indicated they have either high or average trust in farmers to follow properly the veterinarian's advice on animal welfare and health, including on the use of antibiotics (Q19). None declared to have no trust in farmers, but a minority indicated that their confidence varied from farmer to farmer.

Twenty-five veterinarians believed that other actors are able to influence decisions on antibiotic use, the most relevant being (Q18):

- Competent authorities, by discouraging antibiotic use through legislation or voluntary initiatives, such as the development of good practice guidance and information exchange platforms on antibiotic use; and
- Supply chain operators (such as food processors, wholesalers and retailers).

A large minority of the veterinarians that were interviewed both prescribed and sold antibiotics, while a majority prescribed antibiotics but did not sell them (Q3). Veterinarians who sold antibiotics were based in the UK, Poland and Spain (and worked in the pig farming sector). Most of them declared that they would still earn a decent income in absence of earnings from their practice pharmacies (Q21). Most Spanish and UK veterinarians who sold antibiotics indicated that they would not need to increase their hourly tariffs substantially to maintain the same level of income. By contrast, all Polish veterinarians who sold antibiotics declared that they would need to increase significantly their tariff to match any losses from their practice pharmacy (Q22).

This indicates how economic interests may vary from country to country (and from sector to sector), even when veterinarians in all those countries are drawing revenues from their pharmacies.

3.2.4. Behavioural change

A majority of veterinarians indicated that they had changed the way they advised pig/poultry farmers on animal health in the year prior to the consultation, particularly with regard to antibiotic use (Q23):

- Most veterinarians advised farmers to reduce the use of antibiotics and to replace them with alternative measures, such as vaccines or improved nutrition.
- A minority of them also recommended to use different types of antibiotics and to rotate them in order to ensure more effectiveness.

- A minority ensured a better use of antibiotics, recommended to use less antibiotics in general, changed the way antibiotics were administered, raised awareness and provided training on antibiotics use and prescribed the same amount of antibiotics but ensured more prevention.

All the UK veterinarians surveyed indicated that they had changed their practices. In all other countries there were some veterinarians who had not done so. In some cases, however, these vets had already been replacing antibiotics with alternative treatments for several years, or were testing ways to obtain a reduced use.

Veterinarians were divided on their views on these alternatives, as some regarded them as less effective than antibiotics to prevent or cure diseases, while others believed that alternatives were as effective or even more effective (Q24).

According to veterinarians, the main barriers to changing use of antibiotics in pig/poultry farming were (Q25):

- Cultural barriers, such as farmers' mentality and their reluctance to change antibiotic practices or to accept alternatives;
- Economic barriers linked with the costs of reducing antibiotics use, such as the excessive cost of alternative treatment; and
- Supply chain barriers, such as the high concentration of animals in modern farms which leads to increased risk of outbreaks.

To address these barriers and to ensure a better use of antibiotics, veterinarians suggested the following main measures (Q26):

- Raise awareness and provide training and information on antibiotics (this measure was recommended by half of all interviewees);
- Increase consumer pressure to reduce antibiotic use in farming (recommended by a strong minority);
- Invest in research and development, including in new antibiotics or in alternative treatments (also recommended by a strong minority); and
- Introduce legislation on antibiotic use.

3.2.5. Summary

The survey of veterinarians documented high levels of awareness on antibiotics and antimicrobial resistance in animal farming. It also identified that many veterinarians were sceptical of there being a link between AMR in animals and AMR in humans.

In terms of risk perception, veterinarians considered themselves to be at low risk, and thought others - including consumers - were also at low risk. British and Danish veterinarians had firmer and more consistent views than veterinarians from other countries about the risk to consumers and the risk to farmers compared to the risk to veterinarians.

Most veterinarians indicated that they were taking the risks of AMR into account in their prescribing behaviour. These responses may reflect both desirability bias, as well as the result of self-selection in the process of recruiting interviewees. Interviews indicated also that they had control over the decision to prescribe, while farmers only occasionally were contributing to the decision to prescribe. Veterinarians in the UK, Spain and Poland were obtaining additional income from sale of antibiotics, but only the Polish veterinarians were economically dependent on that aspect of their activity.

The veterinarians highlighted cultural, economic, and structural obstacles to changes in use of antibiotics in farming. They also indicated their preference for education and third party pressure, over legislation as mechanisms that could be used to curb the use of antibiotics in animal farming.

3.3. Interviews with farmers

This section presents the main findings of a survey of farmers. It is organised into four sub-sections: awareness, communication, risk perception, and behavioural change.

3.3.1. Awareness and understanding of AMR

A minority of farmers interviewed indicated that they had not noticed information on antimicrobial resistance in animal farming. Farmers who had noticed information on AMR mentioned veterinarians and fellow farmers as key sources of information on that topic, alongside the press (general and professional) (Q5 of the topic guide for farmers, provided in Appendix C –).

A minority of farmers had experienced diminishing effectiveness of antibiotics as a result of growing antibiotic resistance, either directly (in their farm) or indirectly (in neighbours' farms). Most of them (20 out of 30) had not (Q6) (see Table 6:).

Table 6: AMR in animals: observed decline in effectiveness of antibiotics

Q6. Have you directly or indirectly (e.g. hearing from other farmers) observed a decline in the effectiveness of antibiotics compared to in the past?

	Number of interviewees
Yes	**8**
Yes – directly	7
Yes – indirectly	0
Yes – not specified	1
No	**20**
Does not know	**2**

Source: ICF, interviews with farmers. N = 30
Note: more than one answer was allowed per interviewee

Overall, the farmers had **high levels of awareness on antibiotic resistance** in general. They mentioned a variety of circumstances in which antibiotics use could contribute to antimicrobial resistance, including the use of antibiotics as growth stimulators, the blanket or mass treatment of animals, non-observance of withdrawal period, or preventative use of antibiotics. At the same time, many interviewees referred to such misuse of antibiotics as a past, rather than current, practice (Q3 and Q5). Farmers in Romania and the United Kingdom referenced the contribution to antimicrobial resistance of lapses in farm biosecurity measures, while Spanish farmers mentioned the natural evolution and selection process of bacteria (Q9).

A minority of farmers had not noticed information on the links between the use of antibiotics in animal farming and AMR in humans. Those who had noticed information cited the press and other farmers and vet as the main information sources (Q10).

There was more variation across the sample when interviewees were asked about the transfer of antibiotic resistance from animal farming to humans. **A strong minority were unaware or doubtful of any link between AMR in farming and AMR in humans**. Among those, a handful of farmers mentioned the misuse of antibiotics in human medicine as a more important source of problems. **A small majority was able to discuss a number of factors and vectors through which antimicrobial resistance in animal farming might then affect human health**, including contact with animals, the use of similar antibiotics in human and animal medicine, and the risks of contamination through consumption of meat (Q11).

3.3.2. Risk perception

A majority of farmers indicated they thought about antimicrobial resistance, and how it might result from the use of antibiotics. However, **most indicated that they were not worried about their**

own use of antibiotics (Q7). Farmers believed that antibiotic use in animal production is highly regulated, and is subject to stricter controls than antibiotic use in human medicine. For example, some reported that antibiotic sensitivity tests (antibiograms) are often used in farming, but not so often with humans. Besides, most considered that they were making good use of antibiotics, either as a farmer or in collaboration with the veterinarian, so that the risks were minimal. However, a minority of farmers also indicated that they were worried, particularly Spanish poultry farmers. Farmers ascribed higher risks to "indiscriminate" or "blanket" treatment of animals, as opposed to targeted uses.

Farmers across all countries and sectors consistently rated the risk to themselves of being colonised with antibiotic-resistant bacteria **as being very low** (Q12) (see Table 7:).

A handful of interviewees considered meat handlers to be at higher risk, while a majority considered them to be exposed to the same level of risk as farmers (Q14). Veterinarians were seen as equally at risk as farmers, although a strong minority also perceived the risks to veterinarians as greater, because veterinarians would be exposed to many different herds, or because they would spend more time than farmers with ill animals (Q13). All farmers consistently rated the risk to consumers as being similar (i.e. low) or smaller than the risk to farmers (Q15) (see Table 8: 8). The latter view was a matter of consensus in Denmark. This perception was justified by reference to two main reasons:

- Consumers are not in contact with live animals, and
- Health checks prevent contaminated meat from reaching consumers.

Table 7: Risk perception for different groups: farmers

Q12. How high would you say is the risk to you as a farmer of picking up antibiotic resistant bacteria from pigs/poultry?

Risk perceived	Number of interviewees
High risk	4
Little or no risk	23
Does not know	3

Source: ICF, interviews with farmers. N = 30

Table 8: Risk perception for different groups: farmers and consumers

Q15. Do you consider yourself more or less at risk than consumers? Why?

Risk perceived	Number of interviewees
Consumers face a higher risk than farmers	2
Consumer face the same risk as farmers	11
Consumers face a lower or no risk	15
Did not respond	2

Source: ICF, interviews with farmers. N = 30

3.3.3. Behaviour and contributing factors

The overwhelming majority of farmers consulted indicated that they used antibiotics to cure diseases. There were very few references to preventative use of antibiotics in interviews (Q16).

In fact, about half of the interviewees considered themselves to use fewer antibiotics, or (for a couple of them) to use them better, than their peers. No one answered that they used more antibiotics than their peers. A large number of interviewees in all countries agreed that they had been compelled to use antibiotics, when animals were sick and no alternatives could be found, or else animals would suffer and die or would have to be put down (Q21).

A majority of respondents indicated that they took into account the risks of antimicrobial resistance when using antibiotics (Q17). While UK poultry farmers essentially relied on veterinarians to act appropriately for that matter, Spanish farmers (for both poultry and pigs) emphasized their own contribution, including performing laboratory testing, reviewing biosecurity processes, management and infrastructures to ensure minimal risks. Pig farmers in Denmark similarly referenced their own contribution rather than that of veterinarians when answering this question (Q18).

To the question "who's taking the decision to use antibiotics", most farmers responded that it was the veterinarian, whereas Danish farmers consistently declared that it was both farmer and veterinarian who took the decision.

All but one of the farmers interviewed indicated that their relationship with the veterinarian was good, and that they trusted his/her judgment when it came to pig/poultry welfare and health. However, a number of interviewees also pointed to potential conflicts of interest biasing veterinarian judgment. (Q24 and Q25).

A minority (10/30) of farmers did not feel they were being either encouraged or discouraged to use antibiotics in their farms. **A minority (10/30) (including all UK poultry farmers) indicated also that they felt discouraged to use antibiotics** by veterinarians (sometimes acting in concert with competent authorities). In the UK, there was additional pressure not to use antibiotics originating from the industry itself, either in the form of corporate policy, or the industry association (Q20).

Most interviewees have found the costs of antibiotics to be high, suggesting that these costs were an additional motivation not to use antibiotics (Q22). However, **a majority of farmers also contended that the costs of not using antibiotics would be higher than the costs of using them**, particularly because of the loss of animals that would ensue (Q23).

3.3.4. Behavioural change

Over a third of farmers (spread across all countries and sectors covered by the consultation) had not changed their use of antibiotics during the year before the consultation. However, a majority had changed behaviour. In most cases they had reduced antibiotic use and increasingly used alternative measures, such as vaccines or better nutrition. Some farmers had also rotated antibiotics to prevent resistance issues (Q26).

Interviewees saw vaccines as being the most viable alternatives to antibiotics, followed by improved nutrition, improved biosecurity measures and better equipment and facilities. Farmers had mixed views on the effectiveness and costs of alternatives as compared to antibiotics. Some considered the evidence on the effectiveness of nutrition (such as probiotics and essential oils) and vaccines to be insufficient (Q27).

Most farmers mentioned barriers to changes in antibiotics use. The most significant barriers mentioned were (Q28):

- The necessity of using antibiotics when animals get ill in a context where no alternative treatments are available;
- The presence of cultural barriers;
- Economic barriers linked with the costs of not using antibiotics, such as the costs of alternatives (vaccines) and the costs of animal losses; and
- Structural barriers, such as the implementation of an intensive mode of production.

The main initiatives that could change antibiotic use were thought to be (Q29):

- Improved information, awareness raising and training regarding antibiotics;
- Research and development; and

- Increased consumer pressure and willingness to pay an increased price for antibiotic-free products, which would relieve farmers from some of the economic pressure to use antibiotics.

3.3.5. Summary

Farmers showed good awareness of antibiotics and antimicrobial resistance in animals. They were also aware of the link between AMR in animals and AMR in humans, although a strong minority of them were unaware and/or expressed scepticism that such a link exists.

Farmers generally rated the risks of antibiotics bacteria colonising them as low, and the risk to other groups as being equally low or lower.

Farmers consistently claimed to be taking the risks of AMR into account in their behaviour. That sometimes meant relying on veterinarians, and sometimes taking additional steps to ensure that animals remained healthy. These answers may reflect "desirability" biases. There may also be self-selection effects at play: while many farmers declined to participate to the survey in all the countries, those who did may well be relatively low users of antibiotics relative to their peers. When farmers felt influenced in their use of antibiotics, it was generally to discourage antibiotics use. Although interviewees generally emphasized their reasonable and careful use of antibiotics, most contended that not using antibiotics would be more costly and harmful than using them.

In terms of behavioural change, a majority of interviewees indicated having changed their practices to reduce or improve their use of antibiotics. They also noted a variety of obstacles to reducing the use of antibiotics, and chiefly the usefulness and necessity of using antibiotics to cure sick animals, followed by cultural and economic factors. In order to improve further the use of antibiotics and tackle the risks of AMR, farmers indicated their preference for capacity building initiatives, research, consumer pressure, and greater willingness among consumers to pay higher prices for antibiotic-free meat.

4. Conclusions

This "EU Insights" study on antimicrobial resistance in farming and its impact on human health has generated a number of findings to inform EFSA's and member states' strategy to communicate and change behaviours on this important topic. The key findings are organised below in four sub-sections: understanding; risk perceptions; reasons and rationales behind risk perceptions, and means and channels for shaping and influencing risk perceptions.

4.1. Understanding

This study has assessed understanding of the relationship between use of antibiotics and bacterial resistance to antibiotics in animal populations and the link to human health in three groups - consumers, veterinarians and farmers. As might be expected, veterinarians and farmers have a far better understanding of the relationship between antimicrobial use, resistance in animal populations and human health, than consumers. Only a minority of consumers appeared to be aware of the relationship, or of the channels through which antibiotic-resistant bacteria may transfer from animals to humans. Nevertheless, a minority of farmers and half of the veterinarians questioned the proposition that the use of antibiotics in animal farming constitutes a threat to human health, even if they generally understood the mechanisms through which transfer may occur. This is consistent with earlier research on that topic: studies on farmers have found that they had limited concerns regarding the potential links between antibiotic use in farming and AMR in humans (Schulze-Geisthövel et al., 2016; Buller et al., 2015); and studies on veterinarians have found that some believed there is little scientific evidence of these risks (Coyne et al, 2014).

The study identified variations from country to country. Thus, the consumer survey indicated that Danish and Polish consumers tended to have a better grasp of these issues than British, Romanian and Spanish consumers. These variations are, to some extent, replicated in the responses to questions on risk perceptions.

4.2. Risk perceptions

Veterinarians and farmers perceived the risks of antibiotic use in animal farming very differently to the way consumers perceived them.

Farmers and veterinarians consistently perceived the risk of AMR developing in animal farming as a result of antibiotics to be low. They indicated that they were not worried about this issue (with the notable exception of Spanish poultry farmers). This is consistent with findings from earlier studies, in which farmers showed low risk perception levels regarding AMR in farming (e.g., Alarcon et al., 2014; Moreno, 2014; Visschers et al, 2015), and so did veterinarians (e.g, Buller et al., 2015). Views among consumers were more diverse, which may reflect variation in their level of awareness and understanding. A majority of consumers rated the risks of AMR as fairly or very likely for most possible uses of antibiotics, even for curative uses prescribed by a veterinarian. By contrast, farmers ascribed higher risks to "indiscriminate" or "blanket" treatment of animals, as opposed to targeted uses.

There is another salient difference between the perceptions of farmers and veterinarians, on the one hand, and consumers on the other hand, on the matter of the risks to different groups. While farmers and veterinarians consistently rated the risks to themselves and other professionals dealing with farm animals as low, and the risks to consumers as even lower, a majority of consumers considered it fairly or very likely that antibiotic-resistant bacteria may be transferred to them, and ascribed a low probability to the likelihood of transfer to veterinarians, farmers, or meat handlers.

Country variations in the consumer survey were broadly consistent with those observed for measures of understanding and awareness. Danish and Polish consumers tended to perceive risks to be higher than their British, Romanian and Spanish counterparts.

The veterinarian and farmers surveys indicated discrepancies in the Spanish poultry sector, with farmers mentioning concerns about AMR that veterinarians did not share.

4.3. Reasons and rationales behind risk perceptions

The study's findings on perceived risks to different stakeholder / professional groups are consistent with the broader literature on risk perception and its relation to perceived (or actual) control over the risk. Individuals tend to assess risks they have (or perceive to have) control over as less acute than those they do not have control over. Accordingly, farmers and veterinarians tended to downplay the risks of using antibiotics in farming, and emphasized their "reasoned" and "correct" use of antibiotics, whereas consumers tended to highlight the risks of using antibiotics in farming.

The consumer survey, being in the form of a closed questionnaire, provides limited insight into the reasons and rationales behind the risk perceptions of consumers. However, it would appear that knowledge contributes to a heightened perception of risk: consumers who had a better understanding of the issues expressed more concern than those who had a lesser understanding. At the same time, the relatively poor level of information and understanding recorded among consumers, and the perception that they were more at risk than farmers or veterinarians – which could be objectively disputed – indicates that better information could also lead consumers to revise down their assessment of the risks.

The interviews with farmers and veterinarians provide more information on the reasons and rationales informing their perceptions.

Farmers made frequent reference to their professionalism and the care with which they addressed animal health issues and used antibiotics on farm. They indicated that mass preventative use of antibiotics (metaphylaxis) and their use as growth promoters had become less frequent over time (the latter use was outlawed in the EU in 2006). This justified their perception that current uses of antibiotics were better aligned with the objective of minimising AMR. For example, Danish pig farmers mentioned how the uses of antibiotics had been considerably reduced in Denmark, which they appeared to support, but they also questioned whether further reduction would actually cause more harm than benefit.

On risks to specific groups, farmers justified their assessment of the risks to consumers by making reference to the role of controls and checks, as well as the processing of meat, in protecting consumers by preventing contaminated meat from reaching them. A number of farmers also mentioned exposure of veterinarians to live animals across multiple herds[24] as a reason to rate the risks to veterinarians higher than the risks to farmers.

Veterinarians were also confident that the use of antibiotics in farming creates little or no risk to different professional groups and for consumers. They thought that antibiotics are being used responsibly and that they are increasingly being replaced by alternative treatments. They were aware of the issue of AMR in animals and of potential human health impacts, but believed that antibiotic use in human medicine creates far more risks than veterinary use.

Veterinarians associated the transmission of resistance from animals to humans with frequent contact with live animals. Accordingly, veterinarians believed that farmers are at higher risks of being colonised by antibiotic-resistant bacteria than veterinarians.

4.4. Means and channels of influence

The three surveys provided various insights on the factors that shape the risk perceptions of consumers, farmers, and veterinarians on antibiotic use, anti-microbial resistance in animal populations, and the link to human health.

All three groups identified the general media as a key channel for information. Farmers and veterinarians also obtained information from professional journals, including – among veterinarians –

[24] A few farmers also mentioned veterinarian exposure to sick animals as another source of risk, even though exposure to healthy animals is more likely to contribute to transfer of AMR from animals to humans.

scientific publications. Veterinarians were a key source of information for farmers. Competent authorities were a source of information on antibiotics use for veterinarians.

A number of channels were used to influence perceptions and practices of farmers and veterinarians: competent authorities were aiming to influence antibiotics use in farming, but industry actors were active too. Some large integrated farms have developed policies specifically to address the risks of AMR (including a policy to hire a permanent veterinarian in-house, notably to resolve any conflicts of interest that may bias veterinarian decisions towards prescribing more antibiotics than may be necessary), while some sector associations have coordinated efforts to document practices as well as to inform and influence their members, advocating effective animal health practices that require less use of antibiotics. These initiatives point towards the potential for some coordination in communication activities between public authorities and the industry, at a time when some private sector organisations (e.g. some industry associations) have begun addressing the risks posed by AMR.

The consumer survey points in the opposite direction. It indicates that consumers have greater confidence in information on AMR that comes from scientists and health professionals than they do information provided by the industry.

The results indicate that efforts to influence AMR-related perceptions of risk would need to take a differentiated approach based on the target audience. To be effective, the strategy targeting farmers and veterinarians would need to be different to that targeting consumers.

Glossary [and/ Abbreviations

antibiogram	A profile of the antimicrobial resistance and susceptibility of a particular microorganism.
EFSA	European Food Safety Authority
EMA	European Medicines Agency
ECDC	European Centre for Disease Prevention and Control
AMR	Antimicrobial Resistance
EU	European Union

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Appendix B – Findings from desk research

This appendix presents a brief overview of findings from the literature on attitudes, perception and/or behaviours of consumers, farmers and veterinarians regarding AMR and antibiotics use in EU animal farming.

Consumer surveys

A limited number of consumer studies were identified and reviewed, namely: three Eurobarometer surveys (European Commission, 2005, 2010, and 2016) and a survey conducted by the German Federal Institute for Risk Assessment (BfR, 2015). The most relevant findings were as follows:

- The 2005 and 2010 Eurobarometer surveys measured consumer worries in relation to food risks, including risks associated with the presence of residues such as antibiotics and hormones in meat. These studies provided an indication of how consumers perceived human health risks resulting from the use of antibiotics in animal farming. Both surveys found that about a third of respondents were "very worried" about issues associated with residues like antibiotics or hormones in meat.
- The 2016 Eurobarometer survey investigated awareness and concerns concerning AMR and the use of antibiotics in human medicine and animal farming. It found that a minority of respondents (37%) were aware of the EU ban on the use of antibiotics as growth promoters in farming.
- The BfR survey also investigated awareness and concerns associated with AMR, and found that a majority of German consumers (53%) "identify the use of antibiotics in animal farming as the cause for the development and spread of antimicrobial resistance."

Studies on farmers

A number of qualitative studies of farmers have used interview based methodologies to better understand farmer knowledge, perceptions and behaviours in relation to antibiotics use and the risks of AMR.

Some farmer studies found good awareness levels regarding AMR issues in both human medicine and animal farming (e.g., Buller et al, 2015), although lower awareness levels were identified in some instances (see the case of some Spanish pig producer, Moreno, 2014).

Farmers showed low risk perception levels regarding AMR in farming (e.g., Alarcon et al., 2014; Moreno, 2014; Visschers et al, 2015) and limited concerns regarding the potential links between antibiotic use in farming and AMR in humans (Schulze-Geisthövel et al., 2016; Buller et al., 2015).

A close relationship between farmers and veterinarians was found to influence strategies for antibiotics use (Fortané et al., 2015). Jan et al (2012) indicated that social pressure, including consumer pressure, is another important factor influencing antibiotic use in farming.

Some studies suggested that education of farmers about AMR can be a channel to make them more aware of AMR risks and influence their behaviour (Moreno, 2014; Schulze-Geisthövel, 2016). Other studies, however, report that increased awareness does not necessary result in behavioural change (Buller et al., 2015). Laanen et al. (2013) suggest that information on the economic benefits of preventative measures could also affect behaviour and lead to reduced antibiotics use.

Studies on veterinarians

A combination of survey-based and interview-based studies have explored veterinarian knowledge, views, and behaviours in relation antibiotics use and AMR.

In those studies, veterinarians showed good awareness of AMR issues in humans and animals, and recognised the need to adopt responsible antibiotic prescribing behaviour (Buller et al, 2015; Speksnijder et al, 2015; De Briyne et al., 2016).

Similarly to farmers, veterinarians showed little concerns that antibiotics use in farming creates AMR risks in humans (e.g, Buller et al., 2015), and some believed there is little scientific evidence of these risks (Coyne et al, 2014).

The literature suggest that factors affecting veterinarians' antibiotic prescribing behaviour include pressure from farmers and economic benefits from antibiotics use (Coyne et al, 2014; Speksnijder et al, 2014; Dean et al, 2011), pressure from other actors, such as veterinarians (Dean et al, 2011) and legislation (Coyne et al, 2014).

Appendix C – Consultation tools: survey questionnaire and interview topic guides

Appendix C.1. – Survey questionnaire

Master Questionnaire Template

Length of survey: 10 minutes

Start fieldwork: 28 July 2016

End fieldwork: 12 August 2016

Methodology: Cawi

Multicountry survey: Belgium (NL/FR), Denmark, France, Germany, Great Britain, Italy, The Netherlands, Poland, Slovakia, Spain, Estonia, Romania

N= 250 respondents/country

I. SAMPLE VARIABLES

National representative sample

II. QUOTA CHECK

Quota: Gender & Age (18-34, 35-54, 55+)

Variable	N=250	Gender		Age		
Country		Male	Female	18-34	35-54	55+
=1	Belgium	48,7%	51,3%	26,7%	34,5%	38,8%
=2	Denmark	50,0%	50,0%	26,3%	35,0%	38,6%
=3	Estonia	45,5%	54,5%	26,8%	33,4%	39,8%
=4	France	48,3%	51,7%	26,3%	33,6%	40,2%
=5	Germany	48,7%	51,3%	23,5%	34,5%	42,0%
=6	Great Britain	49,3%	50,7%	28,5%	34,5%	37,0%
=7	Italy	49,2%	50,8%	22,2%	37,1%	40,7%
=8	Netherlands	49,1%	50,9%	26,2%	34,9%	38,9%
=9	Poland	47,8%	52,2%	29,7%	33,6%	36,7%
=10	Romania	48,1%	51,9%	28,1%	37,1%	34,8%
=11	Slovakia	47,9%	52,1%	29,2%	36,7%	34,1%
=12	Spain	48,9%	51,1%	23,9%	40,1%	36,0%

Variable	N=250	Gender		Age		
Country		Male	Female	18-34	35-54	55+
=1	Belgium	122	128	67	86	97
=2	Denmark	125	125	66	87	97
=3	Estonia	114	136	66	84	100

=4	France	121	129	66	84	100
=5	Germany	122	128	59	86	105
=6	Great Britain	123	127	71	86	93
=7	Italy	123	127	56	93	101
=8	Netherlands	123	127	66	87	97
=9	Poland	120	130	74	84	92
=10	Romania	120	130	70	93	87
=11	Slovakia	120	130	73	92	85
=12	Spain	122	128	60	100	90

III. INTRODUCTION

<Standard introduction text is provided in CAWI surveys>

IV. SCREENER QUESTIONS – All respondents

For our statistics, please indicate the following:

Base: all respondents

Please indicate your age

AGE_CAT = 1 =S1 = 18 – 34

AGE_CAT = 2 =S1 = 35 – 54

AGE_CAT = 3 =S1 = 55+

Base: all respondents

Please indicate your gender

1. Male

2. Female

V. MAIN QUESTIONNAIRE

A OVERALL AWARENESS

EFSA aims to understand the overall level of awareness/understanding of the topic

Base: all respondents

Q1

For each of the following statements, please indicate whether you think they are true or false.
Please only indicate 'Don't know' if you really don't know.

Columns:

1. True

2. False

3. Don't know

Rows (randomize):

1. Antibiotics **kill viruses**
2. Antibiotics **do not kill bacteria**
3. Antibiotics are used **to cure** infections in farm animals
4. Antibiotics are used **to prevent** infections in farm animals
5. Antibiotics **stimulate the growth** of farm animals
6. Antibiotics are used **more often to treat people** rather than animals
7. Antibiotics used on farm animals **are different** from those used on people

Base: all respondents

Q2

For each of the following statements, please indicate whether you think it is true or false.
Please only indicate 'Don't know' if you really don't know.

Columns:

1. True

2. False

3. Don't know

Rows (randomize):

1. Unnecessary use of antibiotics in animals makes the antibiotics become ineffective to treat animals
2. Resistance to antibiotics is widespread in European pig farming
3. Resistance to antibiotics **is not** widespread in European poultry farming
4. Resistance to antibiotics is affecting people only

Base: all respondents

Q3

Do you think that resistance to antibiotics in animals can be transferred to people:
Please only indicate 'Don't know' if you really don't know.

Columns:

1. Yes

2. No

3. Don't know

Rows (randomize):

1. When they handle raw meat
2. When they eat lightly cooked meat (rare)
3. When they eat well cooked meat (well done)
4. When they come in contact with live farm animals
5. When they drink water that has been tainted by animal excrements
6. When they eat vegetables, cereals, or fruits from soil that has been fertilized with animal excrements

B INFORMATION

How target audiences are informed about the topic

Base: all respondents

Q4

In the last 12 months do you remember noticing any information about resistance to antibiotics…?

Columns:

Q4_1…. in humans

Q4_2…. in farm animals

Rows (randomize):

1. Yes
2. No

Base: IF Q4_1 = 1

Q5 *(randomize blocks and randomize within the blocks)*

Where did you notice this information about resistance to antibiotics in **humans**?
You can tick multiple answers.

WORD OF MOUTH

1. A family member or a friend told me
2. A health professional told me
3. A friend shared a link on social media

IN THE MEDIA

4. I read it in a newspaper or magazine
5. I saw it on the TV news/ TV show
6. I heard it on the radio news/ radio show
7. I read about it on the internet

ADVERTISMENT

8. I saw it on a leaflet or on a poster
9. I heard a paid advertisement on the radio
10. I saw a paid advertisement on TV
11. I saw a paid advertisement in a magazine or newspaper
12. I saw a paid advertisement on a website
13. I saw a paid advertisement on social media (Facebook, Twitter…)

99. Don't know*(fixed, exclude)*

Base: IF Q4_2 = 1

Q6. *(randomize blocks and randomize within the blocks)*

Where did you notice this information about resistance to antibiotics in **farm animals**?
You can tick multiple answers.

WORD OF MOUTH

1. A family member or a friend told me
2. A farming professional told me
3. A veterinarian told me
4. A health professional told me
5. A friend shared a link on social media

IN THE MEDIA

6. I read it in a newspaper or magazine
7. I saw it on the TV news/ TV show
8. I heard it on the radio news/ radio show
9. I read about it on the internet

ADVERTISMENT

10. I saw it on a leaflet or on a poster
11. I heard a paid advertisement on the radio
12. I saw a paid advertisement on TV
13. I saw a paid advertisement in a magazine or newspaper
14. I saw a paid advertisement on a website
15. I saw a paid advertisement on social media (Facebook, Twitter…)

16. Don't know *(fixed, exclude)*

Base: all respondents

Q7.

How confident are you that the information about resistance to antibiotics in farm animals provided by the following sources is **accurate information**?

Columns:

1. Not at all confident
2. Not very confident
3. Fairly confident
4. Very confident

5. Don't know

Rows (randomize):

1. Media (TV, newspapers, radio)
2. Scientists
3. National and European food safety agencies
4. European institutions
5. National government
6. Consumer organisations
7. Environmental protection groups
8. Farmers
9. Veterinarians
10. Food manufacturers
11. Supermarkets and shops
12. Your physician/doctor and other health professionals
13. Pharmacists
14. Family and friends

C BEHAVIOUR ANTIBIOTICS

How and whether behaviour has changed due to the risk perception

Base: all respondents

Q8.

Do you give any thought about whether resistance to antibiotics in **farm animals** may have an impact on human health?

1. I never think about it
2. I rarely think about it
3. I occasionally think about it
4. I think about it often

5. Don't know

Base: all respondents

Q9.

In the past 12 months, has resistance to antibiotics in **farm animals** led you to:

You can tick more than one answer. Please tick all the answers that apply to you.

1. Change your eating habits
2. Change your behaviour around farm animals
3. Look for information on resistance to antibiotics in farming
4. Talk to family or friends about resistance to antibiotics in farming
5. Talk to the competent authorities (in health care, agriculture, or food safety) about resistance to antibiotics in farming
6. I did not undertake any actions

Base: all respondents

Q10.

To what extent do you agree or not with each of the following statements?

Rows (randomize):

1. Actions are being undertaken to control or prevent overuse of antibiotics in farm animals
2. I feel like I have enough knowledge about the topic of antibiotics in farm animals
3. Not enough actions are undertaken to control or prevent overuse of antibiotics in farm animals

Columns:

1. Totally disagree
2. Tend to disagree
3. Tend to agree
4. Totally agree

5. Don't know

Base: all respondents

Q11.
What priority would you give to the following actions in order **to reduce resistance to antibiotics** in animal farming?

Rows (randomize):

1. Investing in research to develop new antibiotics that would replace those that have become ineffective
2. Introducing legislation to restrict the use of antibiotics in farming
3. Offering financial incentives to encourage the food industry to reduce the use of antibiotics in farming
4. Putting consumer pressure (through campaigns, or boycott) on the food industry to reduce the use of antibiotics in farming
5. Helping farmers to shift to modes of production that require less or no antibiotics (such as organic farming)
6. Informing consumers on the risks of picking up resistant bacteria through food

Columns

1. Very low priority
2. Fairly low priority
3. Fairly high priority
4. Very high priority
5. Don't know

D LEVEL OF THE RISK PERCEIVED

Level of the risk perceived

Base: all respondents

Q12.
Below you see a list of potential uses of antibiotics in animal farming.

How likely do you think it is that these uses are **contributing to resistance to antibiotics**?
Please rate each item on a scale from very likely, fairly likely, not very likely and not at all likely:

Columns:

1. Not at all likely
2. Not very likely
3. Fairly likely
4. Very likely
5. Don't know

Rows (randomize):

1. Giving antibiotics to **healthy animals** in order **to prevent illness** contributes to resistance to antibiotics
2. Giving antibiotics to **healthy animals** in order **to stimulate growth** contributes to resistance to antibiotics
3. Treating **unhealthy or weak animals** with **veterinary prescribed antibiotics** contributes to resistance to antibiotics
4. Treating **unhealthy or weak animals** with antibiotics **without a veterinary prescription** contributes to resistance to antibiotics

Base: all respondents

Q13.

Below you can find a list of statements. Please rate each statement on a scale from very likely, fairly likely, not very likely and not at all likely:

Columns:

1. Not at all likely
2. Not very likely
3. Fairly likely
4. Very likely
5. Don't know

Rows (randomise):

1. Resistance to antibiotics may be transferred from farm animals **to farmers**
2. Resistance to antibiotics may be transferred from farm animals **to veterinarians**
3. Resistance to antibiotics may be transferred from farm animals **to meat handlers** (slaughtermen, butchers)
4. Resistance to antibiotics may be transferred from farm animals **to consumers**

Base: all respondents

Q14

Here is a list of statements. Please rate each statement on a scale from very likely, fairly likely, not very likely and not at all likely:

Columns:

1. Not at all likely
2. Not very likely
3. Fairly likely
4. Very likely
5. Don't know

Rows (randomise):

1. Resistance to antibiotics may be transferred to you by **handling raw meat**
2. Resistance to antibiotics may be transferred to you by **eating lightly cooked meat** (rare)
3. Resistance to antibiotics may be transferred to you by **eating well cooked meat** (well done)
4. Resistance to antibiotics may be transferred to you by **eating non-meat products** (cereals, vegetables, fruits)
5. Resistance to antibiotics may be transferred to you by **drinking water**
6. Resistance to antibiotics may be transferred to you by **being in contact with live farm animals**

E SOCIO DEMOGRAPHICS

Base: all respondents

What is your religion?

1. Catholic
2. Protestant
3. Muslim
4. Hindu
5. Buddhist
6. Jewish
7. Other
8. None/Atheist/Agnostic

9. I don't want to answer this question

Base: all respondents

What is the highest level of education you have successfully completed (usually by obtaining a certificate or diploma)?

Country code	ISCED level	Educational category labels in English
UK	0	No qualification, left school before age 11
UK	1	No qualification, left school between age 11 and 14
UK	2	No qualification, left school after age 14
UK	2	One or more of the following: • Key Skills, Skills for Life Level 1, Functional Skills Level 1• NVQ Level 1 •GNVQ or GSVQ Foundation Level •BTEC or SCOTVEC Introductory, First or General Certificate •RSA Levels 1-3 •City & Guilds Part 1 •YT or YTP Certificate •Other equivalent qualification
UK	2	One or more of the following: •NVQ Level 2 •GNVQ Intermediate Level •BTEC or SCOTVEC First or General Diploma •RSA Diploma •City & Guilds Part 2 •Other equivalent qualification
UK	2	One or more of the following: •One or more CSEs below Grade 1 •one or more GCSEs below Grade C •One or more O Levels •One or more GCSEs Grades A-C or equivalent •Other equivalent qualification
UK	3	One or more A Levels or AS Levels •One or more SCE Higher Grade •Scottish Certificate of Sixth Year Studies •Other equivalent qualification
UK	3	NVQ Level 3 •GNVQ or GSVQ Advanced Level •Other equivalent qualification
UK	4	Higher Education Access Course, or equivalent qualification
UK	5	NVQ Level 4 •HNC or HND •Diploma in Higher Education •Teaching qualification, e.g. Teaching Certificate, PGCE •Nursing qualification •RSA Higher Diploma •Other equivalent qualification
UK	5	NVQ Level 5, or equivalent qualification
UK	5	First degree: BA or BSc, or equivalent qualification
UK	5	Higher degree, e.g. MA, MBA, MSc, Mphil or equivalent qualification
UK	6	Doctorate: PhD or Dphil

Appendix C.3. – Veterinarian topic guide

EFSA study on risk perception regarding antimicrobial resistance in animals

Interview topic guide

This topic guide will be used by interviewers to introduce themselves and the project to consultees. The text is likely to be adjusted on a case-by-case basis depending on the knowledge of the consultee about the project.

Objectives of the interview

The European Food Safety Authority (EFSA) has launched a study to gather evidence on risk perceptions on the human health impact of antimicrobial resistance (AMR) in animals across the EU Member States.

This interview will explore your awareness, understanding and behaviour regarding the topic of AMR in animals and its effects on human health.

Data confidentiality

- All interviews are being undertaken confidentially and no individual name or contact details will be identified in the final report or any information from which an individual respondent may be identifiable. **Participation in this interview is voluntary**.
- Researchers from ICF store information in encrypted folders on secure servers, ensuring that your data is protected according to state-of-the-art practise against unauthorised access or unlawful processing.
- Your personal information will not be shared with anyone outside the research team. The information we obtain from this interview will be kept until maximum three months after the final report is delivered to EFSA. All data and recordings will be permanently deleted from the ICF system after the end of the retention period.
- We would like to record the interview for accuracy in reporting. You have the right to opt-out. The recording is only meant for the purposes of facilitating the drafting of the final report to EFSA.
- Processing of personal data shall be compliant with Regulation 45/2001, applicable to EFSA as controller and UK branch of ICF as the contracted processor in the sense of Article 23 of the Regulation.

Use of interview outcomes

The results of this interview will be used by ICF to produce a report for EFSA that will summarise evidence collected from different stakeholders regarding risk perception of AMR. The study is expected to end in September 2016.

Interview questions

General information

- Name of interviewee:
- Organisation:
- Animal species discussed for this interview: [pigs or poultry]

Veterinarian topic guide

General information

1. How long have you been working as a veterinarian with pigs / poultry?
2. What sort of pig/poultry farms have you got most experience working in?

   Prompts: large/medium/small; conventional/organic; broilers/layers; caged/free range

3. Do you both prescribe and dispense (sell) antibiotics?

Awareness and understanding of AMR (relationship between antimicrobial use and resistance in animal populations and human health)

4. In the past year have you been noticing information on resistance to antibiotics in pigs/poultry?

   If yes, where did you notice this information?

   Prompts: from newspapers; from scientific publications; from veterinarian associations; from communications by national authorities; from communications by international organisations (e.g. WHO, EFSA)

5. Have you directly or indirectly (e.g. hearing from other veterinarians) observed a decline in the effectiveness of antibiotics on pigs/poultry, compared to in the past?
6. Is this something you think about? How worried are you about antibiotic resistance in pigs/poultry?
7. Do you think the way antibiotics are used in pig/poultry farming could be contributing to antibiotic resistance in animals? If yes, how?

   Prompts: use of antibiotics as feed additives / mass treatment of the flock / preventive or curative use of antibiotics

8. Do you think other factors than the use of antibiotics could be contributing to resistance to antibiotics in pigs/poultry?
9. Have you been getting information about how the use of antibiotics in pigs/poultry could lead to antibiotic resistance **in people** too?

   If yes, where did you get that information from?

   Prompts: newspapers; scientific publications; other farmers; veterinarian; communications by national or international authorities;

10. In your opinion, why would the use of antibiotics in pig/poultry farming make people resistant to antibiotics? Why not?

    Prompts: antibiotics used in pig/poultry farming are the same as those used to treat people in last resort; people can catch resistant bacteria from animals/food or drink contaminated with resistant bacteria.

Risk perceptions (and underpinning reasons/rationales)

11. How high would you say is the risk to you as a veterinarian of picking up antibiotic resistant bacteria from pigs/poultry?
12. In that regard, do you consider yourself more or less at risk than pig/poultry farmers? Why?
13. Do you consider yourself more or less at risk than meat handlers (slaughtermen, butchers)? Why?
14. Do you consider yourself more or less at risk than consumers? Why?

Behaviours and contributing factors

15. How do you consider antibiotic resistance in your prescribing behaviour?

16. How do you compare with other pig/poultry veterinarians in terms of antibiotics prescription?
17. Would you say that the decision to use antibiotics on pig/poultry farms is mostly yours? Or the farmer's? Or is it a common decision?

    Prompt: 'autonomy' of the farmer in use of antibiotics, in the absence of the vet; pressure from farmers on vets to prescribe antibiotics

18. Are there others who influence the use of antibiotics in pig/poultry farming? In what way?

    Prompts: retailers, certification bodies, nutritionists, competent authorities

19. How much trust do you have in pig/poultry farmers to follow properly your advice on animal welfare and health, including on the use of antibiotics? Why?
20. Where do you take your information on the use of antibiotics from?

    Prompts: professional association; pharmaceutical manufacturer; competent national authority

21. Would you be able to earn a decent income without earnings from your practice pharmacy?
22. If you did not have your pharmacy incomes, would you need to increase your hourly tariffs substantially to maintain the same level of income?

Changes to behaviours

23. In the past year, have you changed the way you advise pig/poultry farmers on animal health, and particularly with regard to antibiotic use?

    If yes, how?

    Prompts: did you reduce the amount of antibiotics prescribed? Did you recommend changes to the type of antibiotic used?

    If yes, why?

    Prompts: information on the risks of antibiotic resistance; costs and economic factors; pressure from others; new antibiotics becoming available

24. What are your views on alternatives to antibiotics in pig/poultry farming?

    Prompts: vaccination; better hygiene; better feed; better housing

25. What barriers do you see for changing antibiotics use in pig/poultry farming?

    Prompts: costs and benefits of antibiotics; type of production (intensive, integrated…); mentality;

26. What could help change antibiotics use in pig/poultry farming?

    Prompts: better information; legislation; pressure from consumers; pressure from retailers; financial assistance;

    Prompts: costs and benefits of using antibiotics; role of veterinary pharmacy for the veterinarian's income; type of production (intensive, integrated…)

Appendix C.4. – Farmers topic guide

EFSA study on risk perception regarding antimicrobial resistance in animals

Interview topic guide

This topic guide will be used by interviewers to introduce themselves and the project to consultees. The text is likely to be adjusted on a case-by-case basis depending on the knowledge of the consultee about the project.

Objectives of the interview

The European Food Safety Authority (EFSA) has launched a study to gather evidence on risk perceptions on the human health impact of antimicrobial resistance (AMR) in animals across the EU Member States.

This interview will explore your awareness, understanding and behaviour regarding the topic of AMR in animals and its effects on human health.

Data confidentiality

- All interviews are being undertaken confidentially and no individual name or contact details will be identified in the final report nor any information from which an individual respondent may be identifiable. **Participation in this interview is voluntary**.
- Researchers from ICF store information in encrypted folders on secure servers, ensuring that your data is protected according to state-of-the-art practise against unauthorised access or unlawful processing.
- Your personal information will not be shared with anyone outside the research team. The information we obtain from this interview will be kept until maximum three months after the final report is delivered to EFSA. All data and recordings will be permanently deleted from the ICF system after the end of the retention period.
- We would like to record the interview for accuracy in reporting. You have the right to opt-out. The recording is only meant for the purposes of facilitating the drafting of the final report to EFSA.
- Processing of personal data shall be compliant with Regulation 45/2001, applicable to EFSA as controller and UK branch of ICF as the contracted processor in the sense of Article 23 of the Regulation.

Use of interview outcomes

The results of this interviews will be used by ICF to produce a report for EFSA that will summarise evidence collected from different stakeholders regarding risk perception of AMR. The study is expected to end in September 2016.

Interview questions

General information

- Name of interviewee:
- Organisation:
- Animal species discussed for this interview: [pigs or poultry]

Farmers topic guide

General information

1. How long have you been a pig / poultry farmer?
2. What are the main features of your farm (size, type of production)?

Awareness and understanding of AMR (relationship between antibiotics use and resistance in animal populations and human health)

3. How familiar are you with the use of antibiotics on pigs/poultry?
4. How do antibiotics benefit your farm?

   Prompts: cure diseases; prevent diseases; improve performance; ensure productivity; ensure the welfare of the animals

5. In the past year, have you noticed any information about antibiotics losing their ability to cure farm animal diseases?

   If yes, where did you notice this information?

   Prompts: from newspapers; from scientific publications; from other farmers; from my veterinarian; from communications by national authorities; from communications by international organisations (e.g. WHO, EFSA)

6. Have you directly or indirectly (e.g. hearing from other farmers) observed a decline in the effectiveness of antibiotics compared to in the past?
7. Is this something you think about? How worried are you about antibiotic resistance in pigs/poultry?
8. Do you think the way antibiotics are used in farming could be contributing to antibiotic resistance in pigs/poultry? If yes, how?

   Prompts: use of antibiotics as feed additives / mass treatment of the flock / preventive or curative use of antibiotics

9. Do you think other factors than antibiotics use are contributing to resistance to antibiotics in pigs/poultry?
10. Have you been getting information about how the use of antibiotics in pigs/poultry could lead to antibiotic resistance **in people** too?

    If yes, where did you get that information from?

    Prompts: newspapers; scientific publications; other farmers; veterinarian; communications by national or international authorities;

11. In your opinion, why would the use of antibiotics in pig/poultry farming make people resistant to antibiotics? Why not?

Prompts: antibiotics used in farming are the same as those used to treat people in last resort; people can catch resistant bacteria from animals/food or drink contaminated with resistant bacteria.

Risk perceptions (and underpinning reasons/rationales)

12. How high would you say is the risk to you as a farmer of picking up antibiotic resistant bacteria from pigs/poultry?
13. In that regard, do you consider yourself more or less at risk than pig/poultry veterinarians? Why?
14. Do you consider yourself more or less at risk than meat handlers (slaughtermen, butchers)? Why?
15. Do you consider yourself more or less at risk than consumers? Why?

Behaviours and contributing factors

16. On your farm, what have you used antibiotics for this year?

    Prompts: on a continuous basis, integrated in animal feed; to prevent diseases; to cure sick animals;

17. How do you consider the risk of resistance to antibiotics in the way you use antibiotics?
18. Would you say that the decision to use antibiotics on your farm is mostly yours? Or the veterinarian's? Or is it a common decision?

    Prompt: 'autonomy' of the farmer to use of antibiotics, in the absence of the veterinarian

19. How do you compare with your colleagues / other pig/poultry farmers in terms of antibiotics use?
20. Have you felt encouraged or discouraged by others to use antibiotics in your farm? By whom? How?

    Prompt: vets, other farmers, nutritionists, competent authorities

21. Have you felt compelled to use antibiotics in your farm (i.e. there are no alternatives)? Please explain?
22. Do you feel that the costs of using antibiotics are high?
23. Do you feel that the costs of not using antibiotics are/would be lower or higher than that?

    Prompt: cost of losing sick animals; relative cost of alternative approaches (eg vaccination); relative prices of meat

24. How would you describe your relationship with your veterinarian?
25. How much trust do you have in the veterinarian to advise you properly on pig/poultry welfare and health?

Changes to behaviours

26. In the past year, have you changed the way you use antibiotics on your farm?

    If yes, how?

    Prompts: did you use fewer antibiotics? Did you use different antibiotics? Did you change other aspects of the farm to enhance animal welfare? Did you vaccinate animals?

    If yes, why?

    Prompts: information on the risks of antibiotic resistance; costs and economic factors; pressure from others; new antibiotics becoming available

27. What are your views on alternatives to antibiotics in pig/poultry farming?

    Prompts: vaccination; better hygiene; better feed; better housing

28. What barriers do you see for changing antibiotics use in pig/poultry farming?

    Prompts: costs and benefits of antibiotics; type of production (intensive, integrated…); mentality;

29. What could help change antibiotics use in pig / poultry farming?

    Prompts: better information; legislation; pressure from consumers; pressure from retailers; financial assistance;

Thank you and close