

BMJ Open What the public in England know about antibiotic use and resistance in 2020: a face-to-face questionnaire survey

Clíodna McNulty ¹, Brieze Read ¹, Anna Quigley,² Neville Q Verlander,³ Donna M Lecky ¹

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¹Primary Care and Interventions Unit, UK Health Security Agency, Gloucester, UK

²Social Research Institute, Ipsos MORI UK Ltd, London, UK

³Statistics, Modelling and Economics Department, UK Health Security Agency, London, UK

Correspondence to

Dr Donna M Lecky;
Donna.lecky@phe.gov.uk

ABSTRACT

Objectives To describe public attitudes and knowledge around antibiotic activity, resistance and use.

Design Face-to-face household 18 question survey using computer-assisted data collection undertaken by Ipsos Market and Opinion Research International.

Setting Randomly selected households across England, January–February 2020.

Participants 2022 adults (aged 15+), including 521 black, Asian and minority ethnic (BAME) participants, and 406 aged 15–25 years olds.

Main outcome measures Responses to questions about antibiotic activity, resistance and expectations for antibiotics and trust in healthcare professionals. Analyses were weighted to obtain estimates representative of the population with multivariable analysis undertaken for questions with five or more significant univariate variables.

Results 84% stated they would be pleased if their general practitioner (GP) said they did not need antibiotics. Trust in GPs to make antibiotic decisions remains high (89%) and has increased for nurses (76%) and pharmacists (71%). Only 21% would challenge an antibiotic decision; this was significantly greater in BAME participants (OR 2.5; 95% CI 1.89 to 3.35). 70% reported receiving advice when prescribed antibiotics. Belief in benefits of antibiotics for ear infections was very high (68%). Similar to 2017, 81% agreed that antibiotics work for bacterial, 28% cold and influenza viruses. 84% agreed antibiotic resistant bacteria (ARB) are increasing, only 50% agreed healthy people can carry ARB and 39% agreed there was nothing they personally could do about ARB. Social grade DE and BAME participants, and those with less education had significantly less understanding about antibiotics and resistance.

Conclusions As trust in healthcare practitioners is high, we need to continue antibiotic education and other interventions at GP surgeries and community pharmacies but highlight that most ear infections are not benefitted by antibiotics. Targeted interventions are needed for socioeconomic DE, BAME groups and previous antibiotic users. We need to explore if increasing perceived personal responsibility for preventing ARB reduces antibiotic use.

INTRODUCTION

Antimicrobial resistance (AMR) continues to increase globally.^{1–3} The 2019 UK Department of Health and Social Care 5-year national

Strengths and limitations of this study

- The survey was undertaken in weeks 4–8 in 2020 at a similar time of year to previous surveys using identical or similar questions allowing direct comparisons.
- The base was boosted for black, Asian and minority ethnic groups in the UK and younger adults giving increased confidence in the data from these demographic groups.
- The survey was undertaken just before the UK COVID-19 pandemic lockdown, forming an excellent base for comparisons with any post pandemic surveys.
- It is difficult to design simple false statements around antibiotics and antibiotic resistance, therefore, there were more true statements than false which could have influenced results.
- Two questions asked participants about their antibiotic prescriptions and use in the last 12 months; these data may be subject to recall and acquiescence bias.

action plan states a need to raise public awareness about AMR and reduce expectations for antibiotics.⁴ UK public health bodies are rising to this challenge by increasing healthcare practitioners (HCPs) awareness of their important role in controlling AMR,⁵ public and HCP antibiotic awareness campaigns,⁶ healthy living pharmacy antibiotic initiatives, school educational projects and many other local initiatives.^{2 7 8} Total community antibiotic consumption fell by 8% between 2015 and 2019 and has been associated with a fall in Trimethoprim resistance following reduced use of this antibiotic.¹ However, we still need to improve antibiotic use because resistance in blood stream infections has continued to increase in England.² Repeated general public surveys using robust methods⁹ allows measurement of the impact of national public health campaigns and local awareness-raising activities on attitudes to, and understanding about, AMR and when to take antibiotics.

Public Health England (PHE) have conducted triennial household surveys since 2003 to gauge public understanding about antibiotics and AMR which have informed campaigns and public facing resources.^{5 10–12} The 2017, public survey highlighted some misunderstanding about the activity of antibiotics and found that black, Asian and minority ethnic (BAME) and younger groups reported less knowledge and greater antibiotic use.¹² Since 2017 the Keep Antibiotics Working campaign¹⁰ and development of patient facing resources for use by community pharmacists and primary healthcare professionals have continued,¹³ but we do not know if these have influenced the public's attitudes to antibiotics. This report presents the findings of the January/February 2020 household survey undertaken before the first UK COVID-19 pandemic lockdown and has an additional focus on BAME, to explore the differences highlighted in the 2017 survey. The results will help inform public and professional education and interventions to improve antibiotic use and provides a baseline to any analysis of the general public's behaviour with infections post-COVID-19.

METHODS

Questionnaire development

The questionnaire was based on the previously published PHE public survey questionnaires around antibiotics (online supplemental appendix 1).¹² Questions were developed in collaboration with general practitioners (GPs), non-healthcare advisors, PHE's marketing team and Ipsos Market and Opinion Research International (MORI) health questionnaire team, and formed part of a larger survey asking about hygiene and health-seeking behaviour for infections. To allow consistency and to facilitate comparison with previous surveys, many of the questions were asked in an identical manner to the surveys in 2014 and 2017, with the new questions in 2020 covering understanding about antibiotic resistance and the usefulness of antibiotics for different conditions added at the end so that inclusion of new questions did not disrupt the compatibility of subsequent questions with previous years' results. Respondents were also asked standard demographic questions including their age, gender, ethnicity, education (exams at 16, 18 years, vocational qualification, or university/college degree or above), employment, income, number and age of any children. Social grade of the household is determined by the occupation of the Chief Income Earner. Social grade AB comprises high or intermediate managerial, administrative or professional workers; C1 Supervisory, clerical and junior managerial, administrative or professional workers; C2 skilled manual workers; D semi and unskilled manual workers; E state pensioners, casual or lowest grade workers, unemployed with state benefits only.

Survey roll-out

The surveys were completed between 24 January 2020 and 24 February 2020, 1 month before the first lockdown in

England. Survey administration was identical to previous surveys,^{11 12} using the Ipsos MORI weekly Capibus (Computer Assisted Personal Interviewing face-to-face) survey¹⁴ of the public, aged 15+, in their own homes, using computer-assisted interviewing. A second and third survey wave were undertaken to boost BAME participants from 11%, in line with the English population,¹⁵ to 25% to give more robust results, and to capture more data from young people aged 15–19 years. Two-stage random location sampling was used. The initial sampling frame is a bespoke amalgamation of Output Areas (used for output from the Census in Great Britain) which are regrouped into Primary Sampling Units (PSUs) taking account of their ACORN (A Classification of Residential Neighbourhood) characteristics. The use of ACORN ensures all types of area are fully represented and respondent selection is not determined by interviewers, helping to eliminate any possible bias in the sample caused by interviewing people all with the same background. A total of 170–180 of these PSUs are then randomly selected with probability of selection proportional to size. At the second stage, from each PSU typically two adjacent output areas are randomly selected, each area includes about 125 addresses. Interviewers were given age, gender, household tenure and working status quotas of participants. Households were visited throughout the day and week; partially completed interviews were excluded (if participants terminated the interview). Interviewers go door-to-door and invite people who are at home and are over 15 years old to participate (the interview does not proceed if the respondent falls within a filled quota). Only one individual is interviewed per household. Interviewers do not revisit non-responding households. One interview is completed on average for every 3–4 doors knocked. Questions were a mixture of 'single' or 'multi' choice and Likert scale providing five possible answers to a statement or question that allowed respondents to indicate their positive-to-negative strength of agreement or strength of feeling regarding the question or statement, and even point scale; the response scales were reversed for half of participants.

Patient and public involvement

The public had no direct involvement in the design of the questionnaire but their responses to previous surveys shaped the questions asked. Patients were not part of the recruitment process. Participants can access results to the survey by request to Ipsos MORI.

Data analysis

Weights provided by Ipsos MORI were used to correct for known selection biases; a Random Iterative Method weighting system was used, weighting to the latest set of census data or mid-year estimates and National Readership Survey profiles for age, social grade, region and working status, within gender and additional profiles on tenure and ethnicity. Pearson's χ^2 test, corrected for survey design,¹⁶ was used to test for differences in

proportions across levels of categorical variables and between responses to identical questions in the current, the 2014 and 2017 surveys.^{11 17} Unweighted frequencies and weighted percentages are shown for all results. As respondents could answer yes to more than one option, for example type of information received, percentages do not necessarily add to 100%. Fixed effects weighted multivariable logistic regression on dichotomised versions of questions was performed on three even point scale questions, where middle option categories were excluded from the analysis. The covariates used differed according to outcome; p values were obtained by means of the (composite) Wald χ^2 test to determine if explanatory variables in the model were significant. The significance level was taken to be 5% and measure of effect the OR. Stata V.16.1 was used for all analyses. Non-significance between groups can be assumed unless specifically stated otherwise.

RESULTS

There were 2022 adult participants, including 521 BAME participants, 406 aged 15–25years old and 186 aged 15–19years old. Compared with participants of white ethnicity, BAME participants were significantly more likely to be within social grade DE, have lower income, aged 15–44 years, or to be a parent.

Attitudes towards taking antibiotics

The majority of participants had a positive attitude to avoiding antibiotic use with over four-fifths stating they would be pleased if the GP said they, or their child did not

need an antibiotic for an infection (figure 1A); more so in 45–64years old (88%) vs 15–34years old (80%) $p < 0.001$, social grade ABC1 (87%) vs DE (77%), $p < 0.001$, and white (86%) vs BAME participants (74%) $p < 0.001$; 17% of participants who used vs 11% who did not use antibiotics stated that they would not be pleased ($p = 0.03$). A half to two-thirds (57%–64%) of participants correctly answered all five antibiotic knowledge questions (figure 1A); correct responses increased with social grade and age, peaking between 45 and 64 years, and was greater in white than BAME participants. Participants who reported taking antibiotics in the last year were significantly more likely to say, ‘antibiotics will always speed up my recovery’ (43% vs 36% if no antibiotics, $p = 0.015$).

Most participants agreed that they would trust a doctor, nurse, or pharmacist about the need for an antibiotic (figure 1B); with a significant increase in trust in nurse and pharmacist advice compared with 2014, but not 2017; BAME participants were significantly more likely to disagree (GP: BAME participants 11% vs 7% white, $p = 0.005$). Only 21% of participants stated they would challenge the GP’s decision not to prescribe antibiotics (figure 1C). Those significantly more likely to challenge were BAME participants, those with lower income, social grades C2 and DE, mothers, 25–45years old, or who had taken antibiotics in the past year. On multivariable analysis, BAME participants had significantly higher odds of being likely to challenge antibiotic decisions than white participants (OR 2.52, 95% CI 1.89 to 3.35, $p < 0.001$). In 2020, only 8% asked for advice at a pharmacy with their most recent respiratory tract infection, compared with 23% who contacted a GP surgery and 7% who asked family or friends.

Public information regarding antibiotics

Fifty-eight per cent of 385 participants who contacted a health professional with their most recent infection (irrespective of whether they received antibiotics or not) and 70% of the 597 participants who recalled taking antibiotics anytime in the last year reported receiving some information about antibiotics and/or their infection. Information included: taking antibiotics, their side effects and effectiveness, expected illness duration, alternative remedies and safety netting. Most information was received verbally 83%, 21% written and 65% in the GP surgery. Few participants during their most recent infection reported using National Health Service websites (2020, 3%, 2017, 3%), other health websites (2%) or social media (1%).

Knowledge about antibiotic use for specific conditions

When asked in an open question ‘what is an antibiotic?’ only 23% mentioned the word ‘bacteria’ specifically. In contrast 81% selected bacteria from a list when asked ‘which conditions can be treated effectively by antibiotics?’ which was similar to 2017 and 2014 (figure 2A). About one third incorrectly stated antibiotics effectively treat viral or fungal infections. Respondents who reported a respiratory tract infection in the previous 12 months

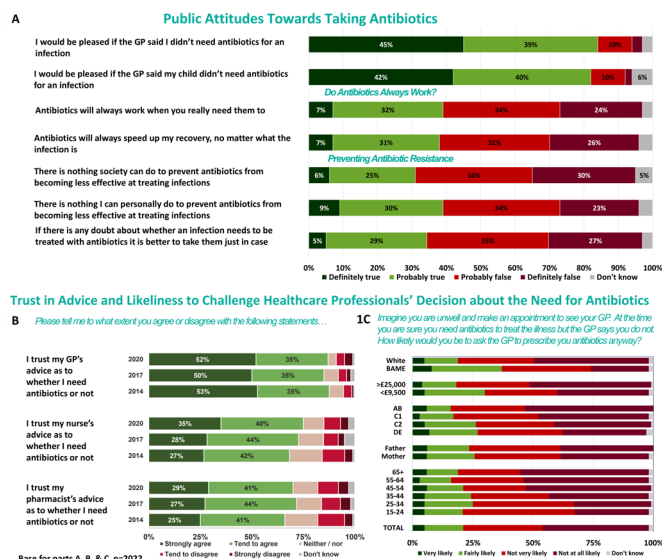
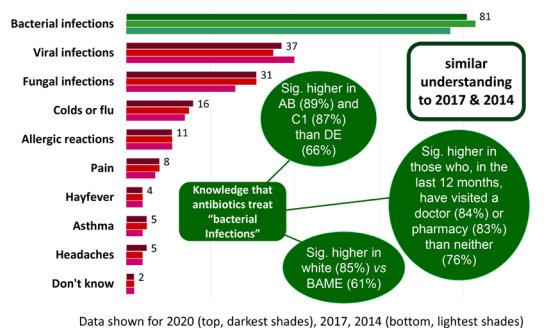


Figure 1 Attitudes to taking antibiotics. (A) Percentage of participants reporting if statements about antibiotic use were true (in green) or false (in red); (B) trust (in green) of health professionals’ advice around need for antibiotics in 2014, 2017 and 2020; (C) percentage of different groups stating they would be likely to challenge a GP’s decision not to prescribe an antibiotic in 2020. All 2022 participants. GP, general practitioner.

Awareness that antibiotics can treat bacterial infections similar in 2020, 2017 and 2014

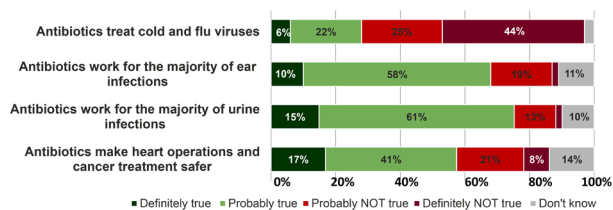
A Which of the following conditions, if any, do you think can be effectively treated by antibiotics?



Data shown for 2020 (top, darkest shades), 2017, 2014 (bottom, lightest shades)

B Knowledge of Antibiotic Use for Specific Conditions

You will see a series of statements, please tell me whether you think it is true or not



Base for parts A, & B: n=2022 participants in England

Figure 2 Knowledge about antibiotics. Percentage of all 2022 respondents indicating which conditions can be effectively treated or not by antibiotics. Correct responses in green. BAME, black, Asian and minority ethnic.

had greater understanding and were significantly more likely to state antibiotics treat bacteria (86% vs 68% if no infection) ($p < 0.001$). Many respondents did not know that antibiotics work for 'the majority of urine infections' (25%) or 'make heart operations and cancer treatments safer' (43%) (figure 2B).

Coughs/colds

Similar proportions in 2014, 2017 and 2020 correctly agreed or strongly agreed that 'coughs, colds and sore throats get better on their own without the need for antibiotics' (2014 86%, vs 2017 85% vs 2020 84%); correct responses were significantly lower by at least 10% points in social grade DE than AB,C1, those without formal education and BAME vs white participants.

Ear infections

Sixty-eight per cent of all participants incorrectly stated that 'antibiotics work for the majority of ear infections' (figure 2B) with no significant differences between any demographic groups. This misunderstanding was greater in respondents reporting an ear infection in the last year. Eighty per cent of 85 respondents reporting ear infections stated that antibiotics work, and 44% reported taking one or more antibiotics courses for them.

The microbiome

All oral antibiotics will affect the human microbiome. Although 68% of participants agreed that 'antibiotics kill

bacteria living in our gut', 39% agreed that 'antibiotics do not affect other bacteria in our bodies'. Multivariable analysis (table 1) indicated social grade AB, more education and ethnic group were independent determinants of knowledge about the effect of antibiotics on our microbiome.

Antibiotic resistance

Concern and knowledge about antibiotic resistance

Over half of participants were concerned (Likert scale score of 5–7) about antibiotic resistance (figure 3A). Concern (score 5–7) was lowest in younger adults (41%) and social grade DE (43%), and greatest in 35–65 years old (62%) and social grade AB (65%), but was not influenced by participant's reported antibiotic use.

Cause and spread of antibiotic resistance

The vast majority of participants recognised that 'overuse' or 'taking any' antibiotics caused resistance, whereas less understood that 'recent' antibiotic use was important. Some participants also considered that 'antibiotic resistance is caused by taking painkillers'. There was a wide range of understanding about the six statements covering the carriage of antibiotic resistance and spread. Participants in 2020 had significantly greater knowledge about antibiotic resistant bacteria (ARB) compared to 2017. For example, 'healthy people carry ARB' 2020 50% vs 2017 42% $p < 0.001$; and 'people can carry ARB for over a year' 63% vs 58%, $p = 0.013$. Social grade AB vs DE, and white vs BAME participants were significantly more likely to give correct responses to all antibiotic resistance questions (figure 3B).

DISCUSSION

Summary of main results

The majority of participants had a positive attitude to avoiding antibiotic use with over four-fifths stating they 'would be pleased if the GP said they did not need an antibiotic'. Understanding about antibiotic use was variable with half to two-thirds correctly answering the general antibiotic use questions, however over two-thirds across all demographic groups incorrectly stated that 'antibiotics work for the majority of ear infections,' and participants who reported taking antibiotics in the last year were significantly more likely to say 'antibiotics will always speed up my recovery'. Although participants understood that antibiotics affect their gut bacteria, there was much less understanding that 'antibiotics affect other bacteria in our bodies'. There was a wide range of understanding about the carriage of antibiotic resistance and spread with only half agreeing that 'healthy people carry ARB'. Social grade DE, BAME participants and those with lower educational qualifications had significantly less knowledge in all areas and were independent determinants of knowledge about the effect of antibiotics on the microbiome. Seventy per cent of participants who reported taking antibiotics in the last year stated that they had received

Table 1 Knowledge of the human microbiome: percentage of respondents in each demographic group answering each question about the microbiome correctly and multivariable analyses comparing responses by demographic group

Variable	Demographic group	Antibiotics kill bacteria that are causing infections, but do not affect other bacteria in our bodies (not true)				Antibiotics kill bacteria living in our gut (true)			
		Correct Response (%)	OR	95% CI	P value	Correct Response (%)	OR	95% CI	P value
Overall (N=1691)	All	45				68			
Age (years)	15–24 years	45	1.00		0.4	61	1.00		0.01
	25–34 years	46	1.00	0.66 to 1.51		68	1.18	0.75 to 1.85	
	35–44 years	49	0.81	0.53 to 1.22		68	1.26	0.79 to 2.01	
	45–54y	53	0.79	0.53 to 1.19		73	1.59	1.01 to 2.50	
	55–64 years	47	0.99	0.67 to 1.47		77	2.27	1.43 to 3.59	
	65+ years	36	1.15	0.79 to 1.68		62	1.29	0.86 to 1.94	
Gender	Male	46	1.00		0.3	67	1.00		0.22
	Female	44	1.11	0.89 to 1.39		68	1.16	0.91 to 1.48	
Social grade β	AB	53	1.00		0.004	72	1.00		0.7
	C1	53	0.86	0.65 to 1.14		69	1.19	0.87 to 1.63	
	C2	34	1.57	1.11 to 2.23		65	1.02	0.70 to 1.48	
	DE	37	0.96	0.66 to 1.39		63	1.09	0.73 to 1.61	
Level of education reached / qualification	University	57	1.00		0.001	78	1.00		0.01
	To 18 years	47	–			65	–		
	To 16 years	39	2.11	1.54 to 2.89		62	1.53	0.37 to 0.75	
	No formal qualification	23	3.44	2.13 to 5.54		59	0.68	0.42 to 1.11	
	Still studying	–	0.96	0.51 to 1.81		–	0.75	0.35 to 1.62	
	Other	–	1.96	1.17 to 3.30		–	0.44	0.26 to 0.75	
Ethnic grouping	White	48	1.00		<0.001	68	1.00		0.3
	BAME	31	2.68	2.04 to 3.51		69	1.18	0.87 to 1.60	

β: Social grade of the household is determined by the occupation of the chief income earner. Social grade AB comprises high or intermediate managerial, administrative or professional workers; C1 Supervisory, clerical and junior managerial, administrative or professional workers; C2 skilled manual workers; D semi and unskilled manual workers; E State pensioners, casual or lowest grade workers, unemployed with state benefits only.

N=1691.

Bold font indicates statistical significance.

BAME, black, Asian and minority ethnic.

information about antibiotics and/or their infection at that time. Trust in health professional about the need for antibiotics has remained high, with only one-fifth of participants stating they would challenge a GP decision to not prescribe them; this was significantly greater in BAME and lower income participants.

Comparison with other literature

The misperception that antibiotics work for ear infections in this survey was double that reported in a 2013 Swedish survey, but not dissimilar to a French survey.^{18 19} Australian patients indicated that GPs did not provide enough information on why different medications worked to help different types of infections, specifically highlighting ear infections.²⁰ A recent exploration of public-facing

information around otitis media showed that the average website is difficult to read and use²¹; great care will be needed to quality assure website content going forward if website use is expected to increase.²²

As in our study, studies globally show that the general public agree that antibiotic overuse contributes to antibiotic resistance,^{18 23 24} but far fewer understand about the spread of AMR,^{18 23 24} or think they can influence antibiotic use or AMR.^{25 26} There is higher misunderstanding about AMR, and the benefit of antibiotics in surveys in Africa and Asia,^{25 27–31} than in this UK study. A qualitative study with ‘diverse ethnic communities’ in Australia echoed many of the findings in our BAME participants, that is, lack of knowledge of and use of antibiotics, and

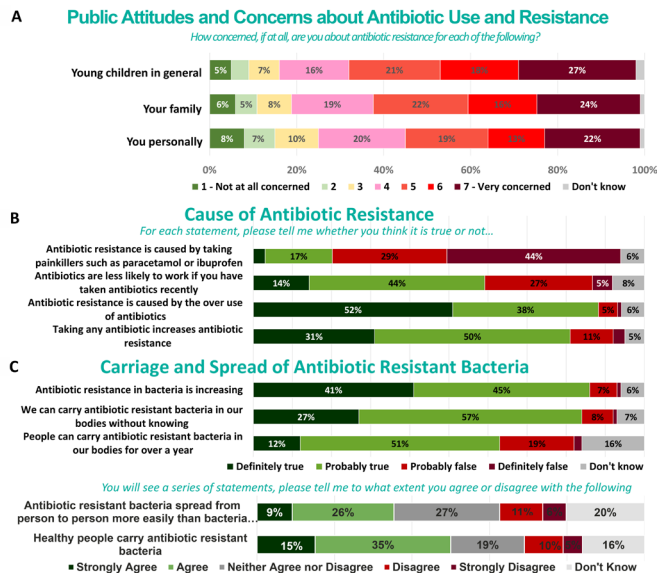


Figure 3 Antibiotic resistance. (A) Concern about antibiotic resistance in 2020 using seven point Likert scale (considered concerned if response 5–7); (B, C) Responses to statements about the causes, carriage and spread of antibiotic resistance (correct responses in green). 2022 respondents.

mistrust in doctors who do not prescribe antibiotics³²; the diverse ethnic communities additionally reported that poor antibiotic prescribing and overuse was normal in their home countries³²; we did not ask participants about antibiotic practices in their native country. However, as in our study and others,³³ the general public get much advice from relatives and friends, regular contact/visits with family/friends from countries with poor antibiotic use may influence attitudes.

Other public surveys have also shown that every level of education from secondary school upward is positively associated with greater knowledge about antibiotics.^{19 24 34 35} In our study, those who reported taking antibiotics in the last year were more likely to overestimate the value of antibiotics and state antibiotics do not affect your gut bacteria. However, other studies have conflicting results for whether more knowledge about antibiotics is associated with more appropriate use.^{18 34 36 37} In the UK, there is greater antibiotic use in areas of deprivation,³⁸ and certainly knowledge in our study was significantly lower in participants in social grade DE, and those with lower income were more likely to challenge the need for antibiotic use. A systematic review indicated that antibiotic use was higher in Australia where educating prescribers and the public has been the main antimicrobial stewardship focus compared with England and Sweden where audit, feedback and incentives have been added.³⁹ This indicates a need for a multifaceted antimicrobial strategy which in addition to education of the general public and prescribers, motivates prescribers and includes structural or policy changes that encourage appropriate antibiotic prescribing.

Patients report more beneficial health behaviours, less symptoms and to be more satisfied with treatment when they have higher trust in their healthcare professional.⁴⁰ The high trust in GPs in this survey will partly explain why patient antibiotic education in the GP setting is effective.⁴¹ Public trust in pharmacists was high in this and other studies.^{11 12 42} Most pharmacists understand the importance of AMR but historically pharmacists have not been involved in public facing AMR campaigns,^{43 44} which may reflect why few of our participants reported seeking advice from a pharmacist with their most recent infection. A recent UK pilot study, however, indicates that pharmacists can have a strong influence on patients' antibiotic knowledge and use.¹³

Japanese and Italian studies have shown higher rates of internet use by the public to obtain antibiotic advice, which is also positively associated with AMR knowledge.^{31 45} Social media platforms have emerged as powerful tools for public health promotion, having a similar influence on the public's attitudes as medical websites and expert opinions (which were often too complex for the general public readership).⁴⁶

Strengths and limitations

The large survey size, random sampling and increased sampling of BAME participants and 15–24 years old gives confidence in the findings, especially in those demographics that make up a smaller proportion of the population. However, an even bigger sample would give greater confidence in some of the questions only asked of a subset of participants. The face-to-face survey facilitated completion and ensured only one household member responded. Using the same questions over several years allowed comparison with previous surveys. The survey may have been subject to recall bias as we asked participants about their antibiotic prescriptions and use in the last 12 months. To prevent favoured recollection of their most severe infection, which may fail to capture a broad spectrum of infections, participants were asked specifically to recall their most recent infection, opposed to any infection in the past 12 months. When asked what information about antibiotics and infections participants received, it may be that information provision does not necessarily mean that the information is received and/or recalled. Although half of participants reported a cold or runny nose in the previous year, we did not ask further about these infections as our previous surveys showed most do not seek further help with these conditions.¹¹ It is difficult to design simple clear statements that cannot be misinterpreted around antibiotics and antibiotic resistance, and there were more true statements than false which could have influenced results. The data around participants perceived value of antibiotics for ear infections needs to be confirmed in another UK public survey as participants may have misinterpreted some of the question wording. For example, 68% agreed that 'antibiotics work for the majority of ear infections' which the National Institute of Clinical Excellence (NICE) use to describe acute otitis

media but could also be used by the public to describe otitis externa and infections of the ear pinna. Due to financial and logistical implications, the questions were all asked in English and translation was not provided, therefore the data from BAME is only representative of the English-speaking portion of the population; further work is needed in populations in whom English is not their first language. Acquiescence bias may have occurred for

some participants because of a desire to please the person administering the survey, however, this was minimised as more sensitive questions about antibiotic use which were more subject to acquiescence bias, were answered by the participant without interviewer input.

Table 2 Suggested actions (A) and messaging content (C) needed to increase understanding of and appropriate antibiotic use

Incorrect public knowledge or behaviour identified in this survey to be addressed	Responses	Suggested (A) Government or prescriber actions And (C) content of campaign/educational messaging
Antibiotic use		
1. Antibiotics work for the majority of ear infections.	68% agree	(A) Increase campaign messaging and patient information for ear infections (A) Educate prescribers about NICE guidance (C) Most ear infections get better on their own without antibiotics (C) Use pain relief and rest not antibiotics for most ear infections
2. Readiness to challenge GPs on lack of need for antibiotic	All—21% Income < £9500 30%	(A) BAME and low-income groups need more explanation. (A) increase use of community pharmacists in areas of deprivation
3. Antibiotics always speed up my recovery, no matter what the infection is	38% agree	(A) Pharmacists and prescribers should emphasise that antibiotics do not make a difference for most common infections
4. Antibiotics treat colds and influenza viruses	55% BAME 44%, 15–24 years agree	(A) Target BAME and younger groups with messaging
Antibiotic resistance		
5. There's nothing I can personally do to prevent antibiotics from becoming less effective	31% agree	(A) Emphasise the public's personal role in preventing ARB (C) YOU and your family can help to keep antibiotics working.
6. Antibiotics are less likely to work if you have taken antibiotics recently	40% disagree	(C) Taking any antibiotic can make future infections more difficult to treat (C) Taking ANY antibiotics make MANY microbes in your body resistant
7. How concerned, if at all, are you about antibiotic resistance	46% not concerned	(A) Emphasise the role of antibiotics in treatment of illnesses that the public know about such as chest, urine and post-operative infections (C) We should all be worried about antibiotics not working in the future (C) keep antibiotics working to keep operations safe
Our gut microbes		
8. Antibiotics kill bacteria living in our gut	32% disagree	(A) Use public interest in yoghurt to emphasise down-side of antibiotics (C) Yoghurt and vegetables help your gut microbes – but antibiotics kill them (C) Taking antibiotics also kills our useful gut and skin bacteria (C) Gut microbes mutate whenever we take antibiotics.

ARB, antibiotic resistant bacteria; BAME, black, Asian and minority ethnic; GP, general practitioner; NICE, National Institute of Clinical Excellence.



Implications

The key implications are shown in [table 2](#). The key messages of future antibiotic campaigns and patient information need to emphasise the lack of benefit of antibiotics for ear infections. In line with NICE guidance, patients with ear infections should be advised to use pain relief first before seeking healthcare advice. Further qualitative and quantitative work is needed to explore the public's understanding of ear infections and to inform any interventions.

HCPs need to explain the rationale for withholding antibiotics, especially to lower educational attainment and BAME patients who were more likely to challenge the need for antibiotics. Other factors outside the HCP's control influencing opinions and antibiotic use in these groups, (eg, healthcare access, language, culture, fear of loss of earnings or eligibility for sick pay) need to be examined carefully when addressing health equalities, AMR and measuring the effectiveness of interventions. These communities need to be involved in development of behavioural change interventions.

The high trust in pharmacists seen in this study presents an opportunity to encourage patients to ask for advice at the community pharmacy before their GP as the general public usually live closer to a pharmacy than a general practice.^{47 48} Greater public education and behavioural change interventions could be encouraged when patients buy pharmacy infection-related products or collect antibiotics.⁴⁹ The UK 5-year AMR action plan indicates an enhanced role for pharmacists in primary care to review the dose and duration of antimicrobial prescriptions and work with prescribers to review those that are inappropriate through evidence-based, system-wide interventions.⁴ A Pharmacy antimicrobial stewardship intervention could be used more widely to facilitate this.⁴⁸

Campaign messages and health professionals advising patients with infections should stress the patient's personal role in protecting themselves and others from AMR, that taking any antibiotics increases antibiotic resistance, and that carriage of resistant microbes can continue for many months without symptoms making the treatment of future infections more difficult.^{25 26} We need more behavioural-based campaigns as many do not feel they can personally influence antibiotic use. The Antibiotic Guardian campaign that promotes pledges around antibiotic use increased participants reported personal responsibility towards tackling AMR and doubled actions in line with their pledge.⁶ Another approach is to introduce appropriate antibiotic use into the school national curriculum at an age when all students may benefit.

The concept of asymptomatic carriage of infection, mutation of microbes and asymptomatic spread has been highlighted during the COVID-19 pandemic⁵⁰—so going forward prescribers should highlight that antibiotic resistance can develop and spread easily even in healthy, asymptomatic individuals. There are numerous adverts covering the benefits of microbes in yoghurt and

other food supplements; campaigns and patient information could use these messages pictorially as prompts to indicate that antibiotics rapidly reverse their benefits by killing these microbes or causing them to mutate.

During the COVID-19 pandemic telephone and web-based consultations have increased, so it will be important to repeat this survey to determine the effect of these changes, and COVID-19, on the public's knowledge, attitudes and behaviours around antibiotic use and resistance. There is an opportunity to improve content of and access to health-related websites and social media to help improve the public's AMR awareness and facilitate antibiotic use changes.

Going forward we should not only measure the public's attitudes around antibiotic use and AMR, but also consider and monitor structural drivers of antibiotic use³⁹ including access to healthcare, language and barriers to obtaining antibiotics.

Twitter Brieze Read @brieze26 and Donna M Lecky @donnalecky

Contributors CM conceived the study, drafted and finalised the questions for the survey, organised and monitored data collection, agreed the statistical analysis plan, reviewed the data, proposed important results, drafted and revised the paper, and approved the final version of the manuscript. She is guarantor. AQ advised on the questions for the survey, supervised univariate analysis by Ipsos Mori, reviewed results and approved the final version of the manuscript. DML contributed to the design of the questionnaire survey, reviewed results and paper drafts and approved the final version of the manuscript. NQV performed multivariable data analysis, discussed results, reviewed paper drafts, and approved the final version of the manuscript. BR contributed to multivariate analysis plan, reviewed results, helped with paper drafts, finalised all figures, and approved the final version of the manuscript. We would like to thank Daniel Marshall at Ipsos MORI for his advice with question format, and prompt communications. We would like to thank staff at Ipsos MORI for performing data collection and univariate data analysis, and the public who answered the questionnaire. All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: Until December 2020 CM led the development of evidence-based antibiotic guidance for primary care and the RCGP TARGET antibiotic toolkit development including patient information leaflets encouraging delayed/back-up prescribing; DML now leads and manages the development and maintenance of products within RCGP TARGET antibiotic toolkit including a patient leaflet encouraging delayed/back-up prescribing; All other authors declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

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ORCID iDs

Clodna McNulty <http://orcid.org/0000-0003-4969-5360>

Brieze Read <http://orcid.org/0000-0002-6547-6136>

Donna M Lecky <http://orcid.org/0000-0002-1223-9356>

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