

## ORIGINAL RESEARCH

# 'The Body Gets Used to Them': Patients' Interpretations of Antibiotic Resistance and the Implications for Containment Strategies

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**BACKGROUND:** Interventions promoting evidence based antibiotic prescribing and use frequently build on the concept of antibiotic resistance but patients and clinicians may not share the same assumptions about its meaning.

**OBJECTIVE:** To explore patients' interpretations of 'antibiotic resistance' and to consider the implications for strategies to contain antibiotic resistance.

**DESIGN:** Multi country qualitative interview study.

**PARTICIPANTS:** One hundred and twenty-one adult patients from primary care research networks based in nine European countries who had recently consulted a primary care clinician with symptoms of Lower Respiratory Tract Infection (LRTI).

**APPROACH:** Semi-structured interviews with patients following their consultation and subjected to a five-stage analytic framework approach (familiarization, developing a thematic framework from the interview questions and the themes emerging from the data, indexing, charting, and mapping to search for interpretations in the data), with local network facilitators commenting on preliminary reports.

**RESULTS:** The dominant theme was antibiotic resistance as a property of a 'resistant human body', where the barrier to antibiotic effectiveness was individual loss of responsiveness. Less commonly, patients correctly conceptualized antibiotic resistance as a property of bacteria. Nevertheless, the over-use of antibiotics was a strong central concept in almost all patients' explanations, whether they viewed resistance as located in either the body or in bacteria.

**CONCLUSIONS:** Most patients were aware of the link between antibiotic use and antibiotic resistance. The identification of the misinterpretation of antibiotic resistance as a property of the human body rather than bacterial cells could inform clearer clinician-patient discussions and public health interventions through emphasising the transferability of resistance, and the societal contribution individuals can make through more appropriate antibiotic prescribing and use.

**KEY WORDS:** antibiotic resistance; primary health care; qualitative research; patient beliefs.

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## INTRODUCTION

Antibiotic resistance is a major public-health problem and is reaching alarming levels for some organisms.<sup>1,2</sup> Both qualitative and survey research show that there are generally low levels of awareness of antibiotic resistance amongst the general public.<sup>3-6</sup> There have been public campaigns in many European countries promoting appropriate antibiotic prescription and use with mixed results.<sup>7</sup> Formal evaluations of some campaigns suggest that they contributed to more careful antibiotic use, especially in high antibiotic prescribing countries.<sup>3,7</sup>

The term 'antibiotic resistance' is part of everyday talk between health professionals and patients, and a common understanding of the term is generally assumed. Antibiotic resistance, interpreted in the accepted scientific sense, refers to the ability of bacteria to resist the action of a therapeutic agent, although the phrase itself makes no mention of its subject, i.e. the microbe. Studies of clinicians' use of the term confirm a scientific understanding.<sup>8-10</sup> However, two recent studies noted that patients have two different, perhaps overlapping, understandings of antibiotic resistance – that of resistance in the *body* versus the scientifically 'correct' understanding of resistance in bacteria.<sup>3,4</sup>

Research into the public perception of antibiotic resistance has been undertaken largely without an awareness of multiple interpretations of the term 'antibiotic resistance'.<sup>11,12</sup> For example, surveys examining patients' attitudes have used fixed questions with little or no opportunity for follow-up of patients' views or understanding.<sup>13-16</sup> Few studies have explored patients' understanding of antibiotic resistance as a term used in healthcare discourse. Although two recent qualitative studies have explored patient and public attitudes towards antibiotic resistance, they were limited to the United Kingdom, and the wider implications were not considered in

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depth.<sup>3,4</sup> To our knowledge, there have been no in-depth international qualitative studies that have examined patients' interpretations of the concept and given an impression of the extent to which the different understandings of resistance occur, and indeed to what extent interpretations differ by country.

Acute cough is one of the commonest reasons for seeking health care, and although studies have shown little or no benefit from antibiotic treatment in otherwise well people<sup>18-20</sup>, patients continue to expect antibiotics and clinicians continue to prescribe them for this condition.<sup>5,17,21,22</sup> Practitioners are generally aware that high rates of antibiotic prescribing are associated with increasing antibiotic resistance but continue to prescribe antibiotics for respiratory tract infections<sup>23</sup>, often due to a balancing act between what is 'clinically best' against perceived patient expectations<sup>24</sup> and a sense of social responsibility.<sup>25</sup> We therefore aimed to explore the consistency in patients' interpretation of the term 'antibiotic resistance' across a wider cross-section of European settings and to consider the implications for interventions.

## METHODS

### Setting

We chose to conduct semi-structured face-to-face interviews as this is the primary method of exploring people's experiences and beliefs.<sup>26</sup> We interviewed 121 patients in nine established primary care research networks across Europe based in the cities of: Antwerp (10), Balatonfüred (20), Barcelona (19), Cardiff (10), Łódź (20), Milan (13), Southampton (9), Tromsø (10), and Utrecht (10). These nine networks had a track record of conducting research and were selected to achieve a geographical spread from 14 participating in the larger GRACE (Genomics to combat Resistance against Antibiotics in Community-acquired LRTI in Europe, [www.grace-lrti.org](http://www.grace-lrti.org)) study on the presentation, management and outcome of acute cough in Europe.<sup>27</sup> The large sample size was determined by our requirement to ensure we collected data from contrasting European settings. Patients aged 18 years or over were invited to participate in an interview if they had consulted with an acute or worsening cough or with a clinical presentation suggestive of a Lower Respiratory Tract Infection (LRTI) with a duration of up to and including 28 days, were consulting for the first time within this illness episode, seen within normal consulting hours, had provided written informed consent, were considered immunocompetent, and had not previously participated in the larger GRACE registration study.

### Recruitment and Sampling

A national network facilitator (NNF) was appointed by the GRACE study and located within each network to take responsibility for the recruitment and data management in their own network. NNFs approached clinicians who were already participating in the larger GRACE study to ask if they would recruit patients for this qualitative study. Recruiting

clinicians were selected by NNFs to achieve a balance in terms of practice size and location, aiming to recruit 10-20 patients per network. Clinicians were asked to approach consecutive patients who presented with LRTI. Recruitment took place between March 2007 and February 2008. Informed written consent was taken at the point of recruitment.

## Data Collection

We developed the interview topic guide collaboratively based on previous literature and together with experts and trained interviewers. The topic guide was revised after pilot interviews.<sup>28</sup> Study documents and material for ethics committees were translated and back-translated to ensure comparability.<sup>29</sup> Interviewers were given a two day face-to-face training course in research procedures and interviewing, and carried out practice interviews with peer and expert feedback. Interviews were conducted in the patients' homes in their preferred language.<sup>30</sup> The interview guide covered four broad topics broken down into sub-sections (see Table 1). The guide was fairly detailed because

Table 1. Examples of Interview Questions

1. Recent illness experience <i>Behaviour before consultation:</i> How long did you have the symptoms before you decided to go and see the doctor? Did you take anything for your symptoms before you saw the doctor? Did you have an idea of what was wrong with you before you saw the doctor? <i>During consultation:</i> Did the doctor give you a name for what was wrong with you? What information did the doctor give you on what was wrong with you? <i>About treatment:</i> What did he/she suggest you do to make you better/improve your symptoms? Did he/she prescribe antibiotics? Did the doctor ask you if you wanted antibiotics? How might they help? Did you follow the doctor's treatment advice or come up with your own treatment ideas too?
2. Beliefs about LRTIs and infection more generally What do you believe is happening to your body when you have an infection? What can you do to prevent yourself getting coughs/chest infections? Have you had, or do you know anyone who's had, an infection that's been resistant to antibiotics?
3. Antibiotics <i>General knowledge:</i> How do you think antibiotics work? When do you think antibiotics are needed for the type of symptoms we've talked about? How do you get access to antibiotics? Are there any possible harmful effects of taking antibiotics that you know of? <i>Communication and management decision:</i> Can doctors always make the best decision for treatment or do you know what's better for you sometimes because you know how you're feeling? If the doctor says you don't need antibiotics, and you think you do, is there anything you can do about it? <i>Antibiotic resistance:</i> Some people think taking antibiotics too often can make it harder to treat infections. What do you think about this? How would you describe antibiotic resistance? Where did you hear about it?
4. Future management <i>Raising awareness of antibiotics:</i> What can we do to stop people wanting antibiotics who don't really need them? What is the best way to let people know when antibiotics should be taken? How would you like to hear about important health issues like antibiotic resistance? Whose responsibility is it to tackle the problem? <i>Near patient tests:</i> How do you think doctors decide whether or not you need antibiotics? A test is being developed/sometimes used ((choose as applicable) which involves the doctor pricking your finger and testing the blood to find out how well you are fighting the chest infection or cough. This would help the doctor decide if you needed antibiotics or not. Would you want to have the test? Why/why not?
5. Any other questions

of the broad topic area and also to provide assistance for interviewers with varying levels of experience, and to ensure the same topics were covered across all networks. However, we designed the guide to be used flexibly. During training, interviewers were shown how to alter the wording and order of questions to take into account individuals' responses, and to pursue emerging issues. Open questions were used when possible and prompts were offered when patients gave a limited response. Interviews were audio-recorded and transcribed by the interviewer or a research administrator. They were subsequently translated into English, by the interviewer where possible, or a professional translation service.

## Analysis

Interviews were analyzed in Cardiff by LB-H, LC and FW using a framework approach. The framework approach was designed specifically for applied qualitative research and is a systematic process of data analysis following a number of well-defined stages.<sup>31</sup> Conducting analysis along these analytic stages gives visibility to the analysis process and allows for rigorous and transparent data management.<sup>32</sup> This approach starts deductively from pre-set research objectives but also allows new themes to emerge from the data. It is designed so that it can be easily replicated and followed by people other than the primary analyst.<sup>33</sup> It is particularly suitable for managing large amounts of qualitative data, such as that collected for this study. The first three stages, 'familiarization', 'identifying a thematic framework' and 'indexing' are common to other forms of qualitative data analysis. The fourth stage, 'charting', involves retrieving the coded data and producing summaries of the talk produced on each theme, for each individual participant, and visually arranging it in a table to build an overall picture of the whole data set. This allowed easier comparisons across networks to identify variation and similarities in the final stage of interpretation of data. The fifth stage, 'mapping', involves the research team using the charts to map and interpret the data set as a whole and connect with the original research objectives. Analysis firstly consisted of a horizontal reading of different interpretations between patients, within networks. Once network-specific analysis was complete, the interpretation at the network level were contrasted to produce an analysis of similarity and variation across the European settings. LB-H and LC developed an initial thematic framework based on research objectives and emerging themes, which was revised after discussion with the Study Steering Group and again after being applied to transcripts. Transcripts were double-coded until consensus was reached (at the point when 12 (10%) of transcripts had been double-coded). This involved two researchers independently coding the same pieces of data and checking that they had both applied the codes in the same way. Any discrepancies were discussed and the framework revised if necessary until there was a shared understanding of theme definitions. The thematic framework was applied to all of the data with the assistance of the coding software package NVivo8.<sup>34</sup>

All instances of patients' talk about antibiotic resistance were retrieved and a more detailed secondary analysis

performed. GE and LBH familiarized themselves with the data extracts and noted initial recurring themes. They then developed a second more refined thematic framework generated by the interview data, specific to patients' understanding of resistance and revised it through ongoing discussion with the research team. It was then applied to further data extracts (see Table 2), in an ongoing iterative way. LB-H applied this refined framework to the data and GE double-coded all data. Data were charted to provide summaries on each theme to build an overall picture of the data set. Interpretations were discussed between LBH, GE and CB.

## Ethical Considerations

Ethical review committees in each country approved the study. Transcripts were anonymised and identifiable details removed.

**Table 2. Thematic Framework of Patients' Understanding of Antibiotic Resistance**

Theme	Sub-theme	Explanation
1. Resistance located in the person	1.1 Body incompatible with drug	Resistance interpreted as 'I have a reaction against' the drug or antibiotic, a compatibility issue
	1.2 Body getting used to the drug	Resistance interpreted as 'getting used to' the drug or 'becoming immune'
	1.3 Immune system	Resistance interpreted as if you take a lot of antibiotics, or take them when they are not needed, it damages the immune system
	1.4 Hereditary	Resistance interpreted as hereditary
2. Resistance located in the bacterium	2.1 Bacterial resistance	The scientifically correct interpretation of the term 'resistance' – bacterial development of a drug resistance
	2.2 Infection resistance	Scientifically correct concept of the term resistance using lay language so without use or awareness of term bacterial
	2.3 MRSA/Hospital acquired	Resistance related to hospital-acquired resistant infection (e.g. MRSA)
3. Resistance located in the antibiotic	3.1 Strength of antibiotic	Resistance related to the concept of a weak or strong antibiotic. May also include explanations of the wrong antibiotic being used, or too short a course
	3.2 Lost potency	The concept of the antibiotic not being effective if used too often, unnecessarily, or course not completed
4. Features of illness	4.1 A different infection	Antibiotics not effective if illness is 'new' or different to that for which it was prescribed
	4.2 Illness too strong	Illness has become too strong for antibiotics to manage
5. Psychosomatic		Psychosomatic belief that antibiotics will not work

## RESULTS

Over half the patients interviewed were women, and respondents were typical of adult attendee profiles in primary care (Table 3). Interviews ranged between 7 to 90 minutes duration, with an average of 31 minutes.

There were some differences in dominant themes between networks. However, we report these with caution due to the small numbers of respondents from each network and do not suggest that these results are generalizable to the network or country as a whole.

Almost all patients made the connection between antibiotic use and resistance but their interpretation did not generally conform to an accepted scientific view that antibiotic resistance is a property of bacteria. Patients less commonly talked about the concept of a 'resistant bacterium' and more commonly spoke about antibiotic resistance as a concept which we labeled the 'resistant body'. The 'resistant body' was the most frequent explanation given in five of the nine networks (Barcelona, Lodz, Milan, Southampton, and Cardiff). The Balatonfüred and Antwerp networks had low levels of patients volunteering the body explanation (10% and 0% respectively) but high levels of patients unable to provide any explanation at all (65% and 70%, respectively). There was also some confusion and interweaving of the two explanations by many patients.

We expand on these themes and provide representative quotes to illustrate each theme. Italics in the quote indicate our emphasis, and each quote is followed with a code that refers to the network and patient's unique study number.

### The Resistant Bacterium

A minority of patients understood that resistance was a property of the infecting agent rather than of their own body. Only 28 of the 121 patients offered this explanation, for example, "It happens when an antibiotic does not destroy some *bacteria and they evolve* and produce such features that make *their structure and existence immune* to some given antibiotics" (Lodz 428). Some also provided the scientifically accepted explanation that antibiotic resistance involves bacteria acquiring resistance and the selection of resistant microbial populations: These patients generally displayed a high level of general awareness and used medical terms (bacteria, virus, etc.) to describe how antibiotics work throughout the interview, without being prompted.

Nine patients indicated a scientifically accepted understanding but did not use exact scientific terms. Some used the word 'bug': "I guess it's just sort of mutation of the bug, if you like, because the antibiotics been used so much, or it's

been used, so that people, you know, if they don't finish their course. If they take a few tablets, feel better, the bugs have a little and it's thought oh yeah I can fight that, I guess it's the same way we fight the bug, *the bug's going to fight the antibiotic and actually work out how to mutate so that it's not going to be affected by it*" (Southampton 239).

Others grouped the concept of bacteria and virus together and considered antibiotic resistance as applying to both: "the bacteria of a viral infection will become immune to them" (Antwerp 399).

These patients also had scientifically accepted explanatory models, such as resistance being due to unnecessary or to over-use of antibiotics, and not finishing a course, which might partially treat the infection allowing remaining bacteria to 'evolve'. Others felt that being prescribed an inappropriate antibiotic could also lead to resistance: "it may happen *because an administered antibiotic is not the right one so a given bacteria doesn't react to it, it is not sensitive to it*" (Lodz 204).

Others conceptualized resistance as bacteria becoming 'used to' antibiotics where antibiotics were losing their potency: "the products are in fact *no longer strong enough* to root out the bacteria" (Antwerp 497).

### The Resistant Body

By far the most common interpretation of antibiotic resistance overall involved attributing the location of resistance in individuals' bodies, rather than as a property of bacteria. Forty-three of the 121 patients offered this explanation.

Patients largely interpreted resistance as one's body 'getting used to' antibiotics with increasing exposure, and the antibiotics therefore ceasing to work: "If you take them too much then you get to the point where it doesn't work anymore, because *the body gets used to it*. Then they don't have the desired effect" (Barcelona 185). Building up this immunity was often linked with the over-use of antibiotics as well as unnecessary use and not finishing a course. This form of immunity often led to the view that different antibiotics might be needed: "it's like everything, if you take too much of it then your body is going to start building up a resistance against those antibiotics, it's thinking 'oh not more of the same things yes I'm going to fight these'...*and your body'll build up resistance until you're put on something a different drug* where your body thinks 'oh this is different [...] I haven't had this one before'" (Cardiff 266).

Respondents spoke about a cut-off point where antibiotics taken for previous illness episodes might only have "a given time" until the body becomes immune to them. Some patients felt that the point at which antibiotics no longer worked may well be when they are most needed: "when you use too many

Table 3. Study Patient Details

Sex	Approximate age (mean)	Education %	%	Current occupation	%
57% Female	48 years (n = 100)	University completed	24	Retired	30
		Other post-school education	15	Administrative	16
34% Male		High school completed	28	Executive/professional	11
		Didn't complete High school	23	Skilled manual	8
				Sales/technical	7
9% Missing		Missing	10	Unskilled	2
				Other (not employed or student)	16
				Missing	11

antibiotics ... when at a given time you really need them, *your body has become so immune to them*, that they will not really have an effect, but that you should keep them for when they are really needed" (Antwerp 539).

A small number took the concept of immunity further, comparing antibiotic resistance to a drug addiction requiring increasing amounts of a substance: "if you take antibiotics too much and when you don't really need them, then the body gets used to them and then later when you do actually need them they don't work or they're less effective, kind of *like what happens with a heroine addict. They need more and more of the drug each time to get the same effect*. So, in a different way though of course, the same happens with antibiotics" (Barcelona 269).

Some patients felt that resistance might be due to the body being incompatible with the antibiotic: this was explained as the body rejecting the treatment: "I do understand quite often when the GP will say there's no point in taking antibiotics it's not going to do any good, it's not going to work or *your body may not accept them*" (Southampton 449). These patients felt that for some individuals the issue of antibiotics 'not working' was a fixed characteristic of their body rather than a factor related to the infection source. They talked of the body 'not accepting' the antibiotic, of antibiotics 'not suiting' them, or the body 'fighting' the antibiotic. Other patients confused the concept of antibiotic resistance with antibiotics creating an adverse reaction in the body, similar to an allergy: "all I know is that he is generally immune to antibiotics and *they don't work in his case. [...] For example I am allergic to detreomicine and I can't use it*" (Lodz 316).

Patients occasionally felt that antibiotic resistance was seen as an active force that weakened the body, reducing its ability to repair itself: "I see that those who take antibiotics say 'my goodness, *I am wrecked by these antibiotics. I am exhausted*'. They weaken" (Milan 471). This was in contrast to the perception that antibiotic resistance was the body acting in a passive sense, its existence only becoming known due to a lack of treatment efficacy.

## Mixed Explanations

There was some confusion, or interweaving of interpretations by many patients. For example, 4 of the 28 patients who gave a scientific explanation (or lay account of a scientific explanation) also gave a 'resistant body' explanation at other times in the same interview. Some patients who believed antibiotic resistance was linked to the infection rather than the body confused the use of the terms 'bacteria' and 'virus', and some patients compounded many different explanations in one single utterance, for example: "I think a resistance is that... when you take it, that it can't do its work anymore. That the product has lost its strength or that the illness has become too strong. That the illness, well the bacteria or the viruses, have resisted" (Antwerp 497).

## DISCUSSION

### Principal Findings

Most respondents in this multi-centre European qualitative study were aware of the problem of antibiotic resistance, yet

detailed analysis revealed a distance between lay and scientific understanding of the concept: patients most often viewed resistance as a property of the human body rather than of infecting organisms. We found that patients understood 'resistance' to mean that treatment is 'not working' and that the explanation lay in 'the body becoming used to' or 'immune' to antibiotics, that the person, or sometimes the 'illness' had developed a tolerance for the antibiotic requiring either a different 'stronger' antibiotic, or a higher dose. The scientifically accepted interpretation of 'resistance', that bacteria develop an ability to counter the effectiveness of an antibiotic, was found in the minority of patient accounts. It was striking that the lay interpretation of resistance being located in characteristics of the individual's body rather than being a characteristic of an adapted bacterium was volunteered by patients from all the networks, with the exception of Antwerp. In Antwerp, however, patients still misunderstood a scientifically correct explanation provided by the interviewer and generally responded to this with a 'body' explanation. The data clearly reveal that the public understanding of the term antibiotic resistance is generally not the same as the meaning used by clinicians and scientists. However, most patients made the connection between antibiotic use and resistance.

## Results in Context

Street and Haidet found that clinicians are poor judges of their patients' health beliefs and can misinterpret how their patients understand relatively common medical issues.<sup>35</sup> Our study builds on Brooks and colleagues and Hawkins and colleagues findings to confirm that patient interpretations of the term antibiotic resistance are often at odds with scientific understanding, and this is commonplace across Europe.<sup>3,4</sup>

Previous research in this area is limited. Gould and colleagues examined patients' and public knowledge, sources of information and perceptions about healthcare-associated infection but did not address the issue of patients understanding of antibiotic resistance.<sup>36</sup> However, patients understanding of Methicillin-resistant *Staphylococcus aureus* (MRSA) has been better studied. Lindberg and colleagues found that the 13 patients they interviewed related resistance to the bacterium, which is not so surprising given that the term itself declares the *Staphylococcus* resistant, and that this organism is also commonly known as a 'super-bug'.<sup>37</sup> Nevertheless, most surveys about the public perception of antibiotic resistance have been naïve to the possibility of multiple interpretations of the term antibiotic resistance,<sup>11-15</sup> and did not give respondents the opportunity to elaborate on the issue.<sup>13-15</sup> Respondents to those surveys may not have interpreted antibiotic resistance as intended by the researchers.

## Strengths and Weaknesses of the Study

Although small exploratory studies on patients' understandings of antibiotic resistance have been conducted in the UK, this is the first study to use semi-structured, qualitative face-to-face interviews to capture patients' explanations about antibiotic resistance across a range of contrasting European countries. This is important because culture and health care

setting can be associated with beliefs about treatment and disease mechanisms, which could have implications for tailoring public health campaigns and individually focused to setting. Clinicians recruited patients who had recently experienced symptoms of LRTI, so these were 'real' patients reflecting 'real' settings.

Exploring patients' views on antibiotic resistance was one of a number of study objectives. The data were collected as part of a wider study exploring determinants of antibiotic use in primary care across Europe. It's possible that responses about antibiotic resistance were not probed in as much depth as if this issue had been the sole aim, but this does have the advantage that the interviewer was not primed to seek specific patient interpretations. Using multiple interviewers within a study raises the possibility of differential quality of interviews between settings, but we minimized this by providing all interviewers with a detailed interview schedule and detailed training followed by repeated interviewer contact with feedback on transcriptions of early interviews (via email, telephone and face-to-face).

This study included European patients. The implications therefore may be less applicable to intervention development in developing countries where health care system vary widely with differing common etiology of infections, associated morbidity and mortality, availability of health care, over-the-counter availability of antibiotics, use of narrow repertoire of antimicrobials, use of poor quality antimicrobials, inadequate infection control in health-care institutions, and shortfalls in hygiene.<sup>7,39</sup> Legislation changes, improved health care delivery, and public health interventions such as provision of clean water and promoting hygiene measures might be greater priorities for these settings.<sup>7,39</sup>

## Implications

The public can contribute to controlling resistance by lowering expectations for antibiotics (using them only when there is a proven chance of meaningful benefit) and helping reduce the spread of resistant organisms.<sup>3</sup> In line with UK based research, interviewees in our European study already connected antibiotic resistance with antibiotic overuse.<sup>3,4</sup> The concept of the resistance as a property of organisms selected out by antibiotics and transferred between organisms and people was far less commonly understood. This is unsurprising given that Huttner and colleagues' review of 22 large-scale public campaigns in high-income countries indicate that only nine dealt with transferability by advocating hand-washing to prevent the spread of organisms but still did not explicitly link this with the transfer of resistant organisms and antibiotic resistance.<sup>7</sup> However, all 22 campaigns bore the key message that misuse of antibiotics promotes resistance. Continuing to focus solely on this message may reinforce the idea that antibiotic resistance is an individual, rather than community, problem.<sup>3,4</sup> It is possible that changing the way practitioners talk about resistance so that the location of the resistance is clearer, such as the use of a term like 'superbugs', may lead to better understanding.

We speculate that interventions may be more effective if they were to more clearly make a connection between individuals reducing their own use of antibiotics with potential social benefit. This would move beyond the personal/individual threat

(the risk of 'you' being effected by antibiotic resistance), to include the community threat (how antibiotic resistance is spread from person to person throughout the community) and also incorporates a positive message (what you can do to help prevent the spread of resistant infection to help yourself, those close to you and your community). Positive messages are most effective but the value of negative fear-evoking messages may also need to be considered.<sup>7,38</sup> Such an approach would require careful development, implementation and evaluation.

Our findings therefore have implications beyond semantics. The common understanding of antibiotic resistance situates the problem within the individual and contributes to a wider misunderstanding. Addressing this misunderstanding is important to developing better ways of communicating messages about appropriate antibiotic use and antibiotic resistance, whether in clinical interactions between doctors and patients or in public health campaigns.

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