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# BMJ Open

## Exploring patients' understanding of antibiotic resistance and its influence on attitudes towards antibiotic use for acute respiratory infections: a qualitative study.

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3 **1 Title**

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5 2 Exploring patients' understanding of antibiotic resistance and its influence on attitudes  
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7 3 towards antibiotic use for acute respiratory infections: a qualitative study.  
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12 **5 Authors**

13  
14 Mina Bakhit<sup>1</sup> MD [mbakhit@bond.edu.au](mailto:mbakhit@bond.edu.au)

15  
16 Chris Del Mar<sup>1</sup> MD [cdelmar@bond.edu.au](mailto:cdelmar@bond.edu.au)

17  
18 Elizabeth Gibson<sup>1</sup> PhD [egibson@bond.edu.au](mailto:egibson@bond.edu.au)

19  
20 \*Tammy Hoffmann<sup>1</sup> PhD [thoffman@bond.edu.au](mailto:thoffman@bond.edu.au)

21  
22 <sup>1</sup>Centre for Research in Evidence-Based Practice (CREBP), Bond University, Australia 4229

23 6

24  
25 **7 \*Corresponding author**

26  
27 **8 Name:** Professor Tammy Hoffmann

28  
29 **9 Email:** thoffman@bond.edu.au

30  
31 **10 Telephone number:** +61 7 559 55522

32  
33 **11 Address:** Faculty of Health Sciences and Medicine, Bond University QLD 4229, Australia

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**15 Resistance Decay**

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3 16 **ABSTRACT**  
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5  
6 17 **Objectives:** To explore patients' understanding of antibiotic resistance and aspects of  
7  
8 18 resistance such as resistance reversibility and its spread among those in close proximity,  
9  
10 19 along with how these influenced attitudes towards antibiotic use for acute respiratory  
11  
12 20 infections (ARIs).  
13

14  
15 21 **Design:** Qualitative semi-structured interview study using convenience sampling and  
16  
17 22 thematic analysis by two researchers independently.  
18  
19

20  
21 23 **Setting:** General practices in Gold Coast, Australia.  
22

23  
24 24 **Participants:** 32 patients or parents of child patients presenting to general practice with an  
25  
26 25 ARI.  
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28  
29 26 **Results:** Five themes emerged: 1) antibiotic use is seen as the main cause of antibiotic  
30  
31 27 resistance, but what it is that becomes resistant is poorly understood; 2) resistance is  
32  
33 28 perceived as a future 'big problem' for the community, with little appreciation of the  
34  
35 29 individual impact of, or contribution to it; 3) poor awareness that resistance can spread  
36  
37 30 between family members but concern that it can; 4) low awareness that resistance can  
38  
39 31 decay with time and variable impact of this knowledge on attitudes towards future  
40  
41 32 antibiotic use; and 5) antibiotics are perceived as sometimes necessary, with some  
42  
43 33 awareness and consideration of their harms.  
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46  
47  
48 34 **Conclusions:** Patients' understanding of antibiotic resistance and aspects of it was poor.  
49  
50 35 Targeting misunderstandings about resistance in public health messages and clinical  
51  
52 36 consultations should be considered as part of a strategy to improve knowledge about it,  
53  
54 37 which may encourage more consideration about antibiotic use for illnesses such as ARIs.  
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38 **Article Summary**

39 Strengths and limitations of this study

- 40 - Thematic analysis was performed by two researchers independently.
- 41 - To our knowledge, this is the first study to explore patients' knowledge of the spread
- 42 of antibiotic resistance between those in close proximity and its decay with time.
- 43 - Sample unlikely to be representative of the wider Australian population or illnesses.

For peer review only

## 45 INTRODUCTION

46 Antibiotics, which have been critically important for treating infections since their discovery  
47 in the 1940s, are accelerating towards weakened effectiveness due to increase in antibiotic  
48 resistance.<sup>1</sup> The development of resistance is largely driven by antibiotic use.<sup>2-4</sup> Antibiotics  
49 are prescribed more in primary care than other health sectors, and often for acute  
50 respiratory infections (ARIs), which comprise approximately 10% of primary care  
51 consultations.<sup>5</sup> Because of high prescribing rates, particularly for common conditions where  
52 antibiotics provide little benefit such as sore throat,<sup>6</sup> acute otitis media,<sup>7</sup> and bronchitis,<sup>8</sup>  
53 primary care is targeted for reducing antibiotic prescribing.

54 Understanding patients' beliefs about antibiotics and reasons for using and not using them  
55 can help inform interventions and public campaigns that aim to encourage appropriate  
56 antibiotic use.<sup>9</sup> Research has revealed that patients overestimate the benefits of antibiotics  
57 for ARIs,<sup>10</sup> and their expectations can influence antibiotic prescribing.<sup>11</sup>

58 Research that has explored the public's understanding of antibiotic resistance,  
59 consequences of it, and whether patients consider the threat of resistance when deciding  
60 whether to use antibiotics is scarce. There are also aspects of antibiotic resistance that  
61 might affect perceptions about antibiotic use, but patients' understanding of and views  
62 about these have not been investigated. This include that antibiotic use increases resistance  
63 in the period following use, but this resistance decays with time,<sup>4</sup> and that resistance can be  
64 transmitted between people in close proximity such as family and household members.<sup>12</sup>  
65 How knowledge of this might influence patients' beliefs about antibiotic use for minor  
66 illnesses such as ARIs is unknown. Such information is needed to ensure that clinical

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3 67 consultations and public health campaigns about antibiotic use cover all the appropriate and  
4  
5 68 relevant key messages.  
6  
7

8 69 This study aimed to explore, in a sample of people presenting to a general practitioner,  
9  
10 70 their: 1) understanding of antibiotic resistance directly after the decision-making point in a  
11  
12 71 clinical encounter for ARI; and 2) understanding of aspects of antibiotic resistance (such as  
13  
14 72 resistance decay and spread among people in close proximity) and how these influenced  
15  
16 73 attitudes towards antibiotic use.  
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## 20 74 **METHODS**

### 21 22 23 75 **Design**

24  
25  
26 76 This was a qualitative study which used semi-structured interviews to explore participants'  
27  
28 77 understanding of antibiotic resistance and implications for antibiotic use.  
29  
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### 31 78 **Participants and setting**

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33  
34 79 Recruitment and the interviews occurred in general practices in southeast Queensland,  
35  
36 80 Australia that had been recruited as part of an ongoing cluster randomised trial.<sup>13</sup> The trial  
37  
38 81 intervention that was provided to the GPs was three patient decision aids (for acute otitis  
39  
40 82 media [AOM], acute sore throat, and acute bronchitis) and a 15-minute video that  
41  
42 83 demonstrated shared decision making.<sup>14</sup> Practices randomised to the control group did not  
43  
44 84 receive any active intervention.  
45  
46  
47

48 85 Recruitment of participants for this study occurred between September 2016 and June 2017  
49  
50 86 from both the intervention and control practices. Patients were eligible to participate if they  
51  
52 87 met the following criteria: 1) adult (or parent of a sick child) 18 years or older consulting a  
53  
54 88 consenting GP with one of three ARIs (AOM, acute sore throat, acute bronchitis) for the first  
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3 89 time for that illness episode; 2) able to understand and read English; and 3) provided  
4  
5 90 written informed consent.  
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## 8 91 **Procedure**

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10  
11 92 The interviews were conducted by one author (MB), using an interview topic guide  
12  
13 93 (provided in Box). The topic guide was developed based on a systematic review of relevant  
14  
15 94 literature,<sup>15</sup> and findings from a cross-sectional study of Australian parents' experiences of  
16  
17 95 ARI management and antibiotic use in primary care.<sup>10</sup> The questions were piloted with two  
18  
19 96 eligible participants who were not recruited into the study, and minor rephrasing of some  
20  
21 97 questions occurred after piloting.  
22  
23  
24

25 98 Some practices organised a room for the interviews, whereas at other practices, the  
26  
27 99 interviews occurred in a private area of the waiting room. The recruitment process differed  
28  
29 100 according to each practice's preference. At some practices, the interviewer approached only  
30  
31 101 patients who were waiting to see the GPs who were participating. At other practices, the  
32  
33 102 interviewer approached all waiting patients and asked if they were waiting to see one of the  
34  
35 103 participating GPs. After explaining the study, confirming eligibility and obtaining written  
36  
37 104 consent, each patient was interviewed for an average of approximately 15 minutes directly  
38  
39 105 after leaving the consultation room. Interviews were audio recorded, with participants'  
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41 106 consent, and transcribed verbatim afterwards.  
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**Box.** Summary of topic guide for interviews

- 'Usual' behaviours about management of ARIs, including beliefs about necessity of antibiotics, their benefits and harms, and other influences on decision-making about antibiotic use
- Understanding of meaning of 'antibiotic resistance', its cause/s, and implications of it. *[If the participant did not know what resistance was, the interviewer provided a brief explanation before proceeding to next questions]*
- Awareness that antibiotic resistance can spread between those in close proximity (such as family and household members) and if unaware, reactions to being told that it can
- Awareness that antibiotic resistance can decay over time and if unaware, reactions to being told that it can

109 **Data analysis**

110 After 26 participants had been interviewed, a preliminary thematic analysis was undertaken.

111 It was decided that data saturation had not occurred and recruitment of participants  
112 continued until data saturation was obtained; defined as when no new ideas or constructs  
113 emerged from two consecutive interviews.<sup>16</sup> Two authors (MB and EG) then independently  
114 used the process for thematic analysis outlined by Braun and Clark.<sup>17</sup> After familiarising  
115 themselves with the interview transcripts, they generated overarching themes and  
116 subthemes. This was a data-driven process that was inductive in nature. The authors  
117 compared and discussed their themes and analyses and with the input of an additional  
118 researcher (TH), came to consensus. The themes and illustrative quotes were then agreed to  
119 by all authors.

120 **RESULTS**121 **Participant characteristics**

122 We approached 208 patients in 5 general practices: 41 met the inclusion criterion of having  
123 an ARI, and of these, 32 (18 adult patients and 14 parents of sick children) consented to

1  
2  
3 124 participate. The main reason given for declining to participate was insufficient time to be  
4  
5 125 interviewed. Participants' mean age was 38 years (range 18-74), the majority were female  
6  
7 126 (n= 25, 78%), and half (n= 16, 50%) were consulting for an episode of acute bronchitis (Table  
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10 127 1).

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13 128 **Table 1.** Participant characteristics  
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Participant ID	Participant age (years)	Gender	Presenting condition	If child, age (years)
P01	18	Female	Sore throat	
P02	73	Male	Acute Bronchitis	
P03	34	Female	Middle ear infection	1
P04	47	Female	Sore throat	
P05	37	Female	Sore throat	1.3
P06	34	Female	Unspecified ARI	11
P07	38	Female	Acute Bronchitis	
P08	28	Female	Acute Bronchitis	
P09	32	Female	Acute Bronchitis	2
P10	22	Male	Acute Bronchitis	
P11	27	Female	Sore throat	
P12	64	Male	Acute Bronchitis	
P13	52	Male	Acute Bronchitis	3
P14	39	Male	Acute Bronchitis	2
P15	36	Female	Middle ear infection	6
P16	43	Female	Acute Bronchitis	3
P17	18	Female	Sore throat	
P18	43	Female	Sore throat	
P19	70	Female	Acute Bronchitis	
P20	45	Female	Sore throat	
P21	34	Male	Acute Bronchitis	
P22	30	Female	Middle ear infection	4
P23	74	Female	Acute Bronchitis	
P24	25	Female	Acute Bronchitis	1.3
P25	24	Female	Sore throat	
P26	18	Female	Acute Bronchitis	
P27	36	Female	Unspecified ARI	3
P28	21	Male	Unspecified ARI	
P29	50	Female	Unspecified ARI	
P30	34	Female	Acute Bronchitis	2
P31	38	Female	Acute Bronchitis	4.5
P32	35	Female	Middle ear infection	1.8

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2  
3 130 **Themes**

4  
5 131 Five themes emerged, and these are presented below and supported by illustrative quotes.

6  
7 132 Theme 1. Antibiotic use is seen as the main cause of antibiotic resistance, but *what* it is that  
8  
9  
10 133 becomes resistant is poorly understood.

11  
12  
13 134 Many participants thought that antibiotic overuse or misuse in people drives antibiotic  
14  
15 135 resistance - *"Sometimes people think they need antibiotics. That's where they can lead to*  
16  
17 136 *resistance because they have them too much"* (P03); with a few mentioning other reasons  
18  
19  
20 137 such as antibiotic use in animals; *"Through our food, that sort of thing, it does seem to be a*  
21  
22 138 *concern now. Like, animals getting fed antibiotics"* (P12); or not using the full antibiotic  
23  
24 139 course *"But if you use them ... you don't take the full dose, obviously like in that you've got*  
25  
26 140 *your certain bugs coming out."* (P25).

27  
28  
29 141 Nearly all participants thought that antibiotic resistance is when the body becomes resistant  
30  
31 142 to antibiotics:

32  
33  
34  
35 143 *"Antibiotic resistance, your body is resistant to it and maybe you've used too much of it...*  
36  
37 144 *antibiotics"* (P16)

38  
39  
40 145 *"antibiotic resistance is possibly your body, rejecting the benefits of the antibiotics ... it's*  
41  
42 146 *almost like the body gets used to the antibiotic"* (P10)

43  
44  
45 147 *"if you take antibiotics too regularly, your body stops, reacting to them, or they stop*  
46  
47 148 *having an impact"* (P04)

48  
49  
50 149 Some participants still had misperceptions after the interviewer provided a simple  
51  
52 150 explanation of what antibiotic resistance is:

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3 151 *"Oh, yeah, see I've never had that sort of problem. I've never heard it. Whenever I've*  
4  
5 152 *taken it, maybe I wasn't sick enough to sort of resist it. It's always worked. And for the*  
6  
7 153 *time that I had to take more than once, a repeat, you know."* (P23)  
8  
9

10 154 Theme 2. Resistance is perceived as a future 'big problem' for the community, with little  
11  
12 appreciation of the individual impact of, or contribution to it  
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14  
15 156 Most participants perceived antibiotic resistance as a community problem caused by others  
16  
17  
18 157 who misuse antibiotics:

19  
20  
21 158 *"... if people are over using it. Yeah, especially with their children when they're so young.*  
22  
23 159 *If they're regularly on antibiotics, yeah... I think down the track definitely."* (P06)  
24

25  
26 160 *"I imagine there would be some pockets of the community that it might be an issue for."*  
27  
28 161 (P04)

29  
30  
31 162 *"I think it's a big problem. People like to get antibiotics and just solve things instantly. Like*  
32  
33 163 *people don't like to wait and see what happens, they like to get something – even if they*  
34  
35 164 *think it's going to work or not they just – something to make it better."* (P15)  
36  
37

38  
39 165 Most participants described resistance as a problem that will not impact them individually -

40  
41 166 *"I don't think it's a big issue for me"* (P09); *"I think I'll get through my life without it*  
42  
43 167 *impacting on it"* (P21). A few participants described their worry about antibiotic resistance,  
44  
45 168 although by many it was viewed as a future or a hypothetical concern:

46  
47  
48 169 *"Oh, huge, I don't want that to happen... Um, well, if she got sick and constantly needed*  
49  
50 170 *antibiotics... you know, then obviously in - as she gets older they'd stop working as much*  
51  
52 171 *as you wouldn't be able to treat infections as much and I don't want that to happen"*  
53  
54 172 (P03)  
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3 173 *"... it could become a big problem if the so-called superbugs, um, come out and about*  
4  
5 174 *later on, yeah."* (P09)  
6  
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8 175 *"It still concerns me, um, because someone as young as my two-year-old son – I guess in*  
9  
10 176 *an older person, it's perhaps not as concerning because over the course of a life time...*  
11  
12 177 *but I think the message is out there that maybe you need to think twice before (using*  
13  
14  
15 178 *antibiotics)"* (P09)  
16  
17

18 179 Theme 3. Poor awareness that resistance can spread between family members but concern  
19  
20 180 that it can  
21  
22

23 181 Most participants did not know that antibiotic resistance can spread between people who  
24  
25 182 are in close proximity, such as family members - *"No, I didn't even know it could spread"*  
26  
27 183 (P24). Some thought it would be possible:  
28  
29

30 184 *"Um, I've never really thought about it before. My initial answer would be no but I guess*  
31  
32 185 *like if – yeah I guess if one of the children had a bug that was tougher and they gave that*  
33  
34 186 *to the other child, then, yeah, I guess, yeah, I guess it would be"* (P32).  
35  
36  
37

38 187 When participants were told by the interviewer that it can, the most common reaction was  
39  
40 188 concern *"concerned. Yeah, it's not a good thing"* (P14) and shock *"Oh, shocked. No, I never*  
41  
42 189 *knew that."* (P01), with some insight into the significance of the problem *"So by one person*  
43  
44 190 *using antibiotics can create problems for the whole family... Yeah. Well, that's, um, not real*  
45  
46 191 *good, is it?"* (P19)  
47  
48  
49

50 192 Some participants suggested strategies to minimise the spread of resistance such as  
51  
52 193 decreasing antibiotic use *"... so not using them too much"* (P03) or with hand hygiene  
53  
54 194 *("hand sanitiser" (P21), "wash hands" (P07)).*  
55  
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3 195 Theme 4. Low awareness that resistance can decay with time and variable impact of this  
4  
5 196 knowledge on attitudes towards future antibiotic use  
6  
7

8 197 Most participants did not know that antibiotic resistance could decay over time:  
9

10  
11 198 *“Oh, I’ve got no idea, I thought it just – that it stayed for a lifetime if you were resistant to*  
12  
13 199 *it.” (P24)*  
14

15  
16 200 *“Oh, a long time. You’d have to - it’d take a lot of different ways to treat it” (P03)*  
17

18  
19 201 *“I imagine not, because once it’s in your system, it remains there” (P09)*  
20

21  
22 202 There was wide variation on estimation of the time to decay, ranging from days to decades:  
23

24  
25 203 *“It wouldn’t be; you wouldn’t think within a couple of days... But I’m not saying 12 months*  
26  
27 204 *or anything like that” (P19)*  
28

29  
30 205 *“Oh, probably ten years or something, crazy” (P15)*  
31

32  
33 206 After explanation from the interviewer that antibiotic resistance does decay, some  
34  
35 207 participants were more hopeful about the problem of antibiotic resistance:  
36

37  
38 208 *“... “It’s promising to know that there is a chance” (P21)*  
39

40  
41 209 *“Yeah, well that’s good that it could be then reversible” (P32)*  
42

43  
44 210 *“It makes me think that you could possibly go back to using those antibiotics if you had*  
45  
46 211 *the similar problem maybe 18 months down the track” (P10)*  
47

48  
49 212 It was assumed by some that science will come up with solutions to manage antibiotic  
50  
51 213 resistance in the future:  
52

1  
2  
3 214 *"I don't think it will go away, but I think maybe people are coming up with different*  
4  
5 215 *solutions to fight it rather than antibiotics or different ways of switching off you know our*  
6  
7 216 *body's responses and things like that."* (P15)  
8  
9

10 217 *"it will be interesting over the next 10-15 years. I think that probably there'll be some*  
11  
12 218 *really good break throughs in - - in the engineering and the science behind antibiotics..."*  
13  
14  
15 219 (P21)  
16

17  
18 220 The impact of knowing about resistance decay on attitude towards antibiotic use was  
19  
20 221 variable. Some participants indicated no change (*"It just, again, reminds me that it's very*  
21  
22 222 *important you have a genuine condition that requires antibiotics, yeah."* (P04)), whereas  
23  
24 223 others expressed that knowing this made them more cautious:  
25

26  
27 224 *"That makes me really think about it – taking antibiotics only if you really need to"* (P08)  
28

29  
30 225 *"Especially for the children it would a lot scarier that they wouldn't be able to be treated*  
31  
32 226 *... if they were sick and something. It's quite frightening."* (P22)  
33  
34

35  
36 227 Theme 5. Antibiotics are perceived as sometimes necessary, with some awareness and  
37  
38 228 consideration of their harms  
39

40  
41 229 Antibiotics were seen as beneficial by many participants (*"only thing that helps"* (P20)). The  
42  
43 230 most commonly reported perceived benefits were decreased duration of illness (*"taking*  
44  
45 231 *antibiotics would make me better quicker"* (P11)) and decreased severity or progression of  
46  
47 232 the infection (*"to make sure it doesn't go to any further stages of infection."* (P06)).  
48  
49

50  
51 233 Some participants believed in the need for antibiotics, despite being told by their GP that  
52  
53 234 antibiotics would not help with viruses or provide better outcomes for them:  
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3 235 *"...the doctor said oh it's a virus, I said well I'm going to be looking after my*  
4  
5 236 *grandchildren, it's school holidays, and I needed something to help me get over this. ...and*  
6  
7 237 *she said but they are not going to help you. I said well it's my decision at the time to have*  
8  
9 238 *them because I didn't want my children to have what I had, you know. It was just a very*  
10  
11 239 *bad virus I had, you know. But anyway, the antibiotics did work."* (P23)

14  
15 240 Some participants were reluctant to take antibiotics for minor illnesses, such as ARIs, and  
16  
17 241 preferred to reserve antibiotic use for severe infections - *"I would be hesitant. So, yes,*  
18  
19 242 *maybe each time my doctor gives me antibiotics, I would ask is that necessary?"* (P07), with  
20  
21 243 some concerned about not wanting to overuse antibiotics - *"should be more carefully*  
22  
23 244 *applied and perhaps conservatively used."* (P18). Others' attitudes about antibiotic use were  
24  
25 245 not influenced by illness severity - *"...doesn't really change my opinion of it... certain*  
26  
27 246 *antibiotics really work"* (P25). Some participants' reasons for not using antibiotics were to  
28  
29 247 *"give the body the best fighting chance"* (P15) and by *"trying natural healing and staying*  
30  
31 248 *healthy in the first place"* (P13)

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35  
36 249 The few participants who had personal experience of antibiotic resistance were particularly  
37  
38 250 cautious about antibiotic use:

39  
40  
41 251 *"...because of my bronchitis... I have taken other medications that haven't worked. The –*  
42  
43 252 *the doctors then had to change it... to a different medication. Yeah. Because I become*  
44  
45 253 *resistant to others so I'm very fussy about taking them."* (P20)

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48  
49 254 There was great variability in participants' awareness of the potential harms of antibiotics.  
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51 255 Many participants named potential side-effects with commonly listed ones including  
52  
53 256 *"vomiting", "nausea", "thrush", and "diarrhoea"*. Some mentioned *"possible resistance"* as  
54  
55 257 one of their concerns, but responses conveyed misunderstanding of what antibiotic

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3 258 resistance actually is. Some participants were not aware that antibiotics had potential harms  
4  
5 259 - *"None that I'm aware of"* (P21).  
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8 260 The patient-clinician relationship was viewed as very important when decisions about the  
9  
10 261 management of infections were being made. Trust in the clinicians' recommendation for  
11  
12 262 antibiotic use was mentioned by some - *"as long as I can talk to my doctor and trust that the*  
13  
14  
15 263 *doctor is making the right decision"* (P05)  
16  
17

18 264 Some participants described a lack of information and discussion with their clinician *"I don't*  
19  
20 265 *have enough information to probably correctly make that call."* (P18) and were unaware of  
21  
22 266 the option to not treat with antibiotics (that is, that the illness would get better without  
23  
24 267 them) *"Um, well I guess when it's infected there's not really much other choice for that*  
25  
26 268 *particular problem"* (P32).  
27  
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30 269 Some expressed a desire for more information about antibiotic resistance:

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32  
33 270 *"Um, yeah, it would be good to know more about, um, how often you have to be taking*  
34  
35 271 *them for resistance to build, whether individual, patient to patient"* (P18).  
36  
37

38 272 *"... interested in knowing more information about (antibiotic resistance)"* (P15)  
39  
40

## 41 273 **DISCUSSION**

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44 274 This study has identified five major themes that related to people's understanding of  
45  
46 275 antibiotic resistance and aspects of resistance such as resistance reversibility and spread  
47  
48 276 among those in close proximity such as family or household members. While many  
49  
50 277 participants articulated the link between antibiotic use and resistance, there was confusion  
51  
52 278 about the nature of antibiotic resistance, which was often attributed to a trait of the body  
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54  
55 279 rather than bacteria in the microbiome. Many saw antibiotic resistance as a potential  
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3 280 problem, rather than one that exists already, and that it was a consequence of and problem  
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5 281 for the others in the community rather than them as an individual. Few appreciated the  
6  
7 282 potential for antibiotic resistant organisms to spread between those in close proximity, or  
8  
9 283 that antibiotic resistance can decay.

11  
12 284 Most participants reported the main benefit of antibiotic use was a decreased duration of  
13  
14 285 illness. Some were aware of the potential for harm from antibiotics, including resistance.  
15  
16 286 Some expressed reluctance to use antibiotics for minor infections because of concern about  
17  
18 287 overuse or misuse, whereas for others, it was not because of the potential harms but  
19  
20 288 because of a preference for allowing their body to fight the infection naturally.

21  
22 289 The poor understanding of the nature of antibiotic resistance has been found in previous  
23  
24 290 studies in a general practice setting,<sup>18</sup> and in non-healthcare settings.<sup>19-21</sup> A recent survey of  
25  
26 291 the UK general adult population showed that lack of antibiotic resistance awareness was  
27  
28 292 strongly associated with self-reported likelihood of requesting antibiotics for an influenza-  
29  
30 293 like infection.<sup>22</sup> It appeared that patients who had personal experience of antibiotic  
31  
32 294 resistance were the most reluctant to use them again, preferring to reserve their use for  
33  
34 295 serious illness. A survey of the general population in Germany found that people who knew  
35  
36 296 of someone suffering from multidrug-resistant organisms, received more information by  
37  
38 297 their clinician on antibiotic resistance and took less antibiotics for an infection (of any  
39  
40 298 cause), compared with people who did not have any personal involvement.<sup>20</sup>

41  
42 299 Our finding that the lack of individual 'ownership' of contribution to, or risk of, antibiotic  
43  
44 300 resistance has previously been identified in a systematic review,<sup>15</sup> which showed that the  
45  
46 301 public do not believe they contribute to the development of antibiotic resistance. This is  
47  
48 302 complemented by the finding that some participants believe that science will find a way to

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3 303 solve the resistance problem, which contradicts with messages about individuals needing to  
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5 304 change their behaviour to minimise the problem.  
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8 305 Many public health campaigns convey the message of antibiotic resistance and how it is  
9  
10 306 promoted by inappropriate antibiotic use and misuse. The effect of some campaigns has  
11  
12 307 been analysed and a decrease in antibiotic prescribing.<sup>23 24</sup> Some of our findings might be  
13  
14 308 useful in guiding and refining the content of messages in public health campaigns and  
15  
16 309 clinical consultations about antibiotic resistance. For example, the information that  
17  
18 310 developing antibiotic resistance in one's microbiome might also lead to resistance in people  
19  
20 311 who are physically close to them, such as family members, could be an additional message  
21  
22 312 that patients and the public are educated about as part of a strategy to encourage  
23  
24 313 appropriate antibiotic use. Most participants were quite concerned upon learning about  
25  
26 314 resistance spread and it prompted some to provide suggestions for how to minimise  
27  
28 315 resistance development and its spread – suggesting that perhaps this is the information that  
29  
30 316 could contribute to altering people's attitudes and behaviour about antibiotic use for minor  
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32 317 illnesses.  
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38 318 Future research into the optimal information about antibiotic use and resistance to include  
39  
40 319 in public messages and clinical consultations is recommended. This includes the potential  
41  
42 320 utility of information about resistance decay and its impact on antibiotic use. Knowing that  
43  
44 321 resistance decays over time if antibiotics are not used promoted hope in some people that  
45  
46 322 the problem of resistance was not irreversible and that efforts to conserve antibiotic  
47  
48 323 effectiveness by not using when not essential were worthwhile. However, for others,  
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50 324 knowing that resistance decay occurs over time, may thwart attempts to encourage  
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52 325 responsible antibiotic use.  
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3 326 At a clinical consultation level, better engagement with patients when antibiotics are being  
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5 327 considered by providing a balanced discussion of antibiotic benefits and harms is  
6  
7 328 encouraged. This conversation should include discussion that resistance is a potential harm  
8  
9 329 of antibiotic use, and explanation of the possible consequences of it for the individual.  
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11  
12 330 A limitation of our study is that the sample is not representative of the wider Australian  
13  
14 331 population as participants were recruited from one city in Australia and only those  
15  
16 332 presenting with an ARI were invited. For a small number of participants (9), there is the risk  
17  
18 333 that their knowledge about what antibiotic resistance was influenced by their GPs' use of a  
19  
20 334 patient decision aid - which included a very brief explanation of what resistance is, but not  
21  
22 335 about the spread or decay of resistance. Although GPs who did not receive or use the aids  
23  
24 336 may have mentioned resistance as part of the consultation regardless. Another limitation is  
25  
26 337 that participants did not have the opportunity to provide feedback on the themes derived  
27  
28 338 from the interviews. Strengths of the study include the use of two researchers  
29  
30 339 independently performing the thematic analysis. and its contribution of new findings to this  
31  
32 340 field. We are not aware of other studies which have explored people's knowledge about the  
33  
34 341 potential for antibiotic resistant organisms to spread between those who are in close  
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36 342 proximity or that antibiotic resistance decays over time.  
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### 43 **CONCLUSION**

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46 344 This study found that patients' understanding of many aspects of antibiotic resistance was  
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48 345 poor including: what it is, individual contribution to its development, individual implications,  
49  
50 346 its spread and decay. Incorporating messages that target misunderstandings into public  
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52 347 health messages and clinical consultations may be an important strategy to encourage more  
53  
54 348 appropriate use of antibiotics for illnesses such as ARIs.  
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4  
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6  
7

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9  
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11  
12 353 authors revised and approved the final manuscript.  
13  
14

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20  
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22  
23 358 interpretation, or writing of the report.  
24  
25  
26

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29

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31  
32 361 Bond University (#0000015433) and consent provided by each participant interviewed and  
33  
34 362 by GP practices to allow recruitment of their patients.  
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38 363 **Provenance and peer review:** Not commissioned; externally peer reviewed.  
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41 364 **Data sharing statement:** No additional data are available.  
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### Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:

Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

No. Item	Guide questions/description	Reported on Page #
<b>Domain 1: Research team and reflexivity</b>		
<i>Personal Characteristics</i>		
1. Inter viewer/facilitator	Which author/s conducted the interview or focus group?	Mina Bakhit
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	Mina Bakhit, MA, M.B., B.Ch. Chris Del Mar, MD Elizabeth Gibson, PhD Tammy Hoffmann, PhD
3. Occupation	What was their occupation at the time of the study?	Medical doctor, PhD candidate, Research assistant
4. Gender	Was the researcher male or female?	Male
5. Experience and training	What experience or training did the researcher have?	The researcher performed a pre- and post-qualitative skype interviews at Friedrich Alexander University, Germany in 2013
<i>Relationship with participants</i>		
6. Relationship established	Was a relationship established prior to study commencement?	No
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Participants were provided with an information sheet and consent form which outlined the aim of the study
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Participants knew the researcher was a Medical doctor

		and PhD student with an interest in reducing inappropriate antibiotic prescribing
<b>Domain 2: study design</b>		
<i>Theoretical framework</i>		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Methods
<i>Participant selection</i>		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Methods
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Methods
12. Sample size	How many participants were in the study?	Results
13. Non-participation	How many people refused to participate or dropped out? Reasons?	Results
<i>Setting</i>		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Methods
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	No
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Results
<i>Data collection</i>		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Methods
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	No
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Methods
20. Field notes	Were field notes made during and/or after the interview or focus group?	No
21. Duration	What was the duration of the inter views or focus group?	Methods
22. Data saturation	Was data saturation discussed?	Methods
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
<b>Domain 3: analysis and findings</b>		
<i>Data analysis</i>		
24. Number of data coders	How many data coders coded the data?	Methods
25. Description of the coding tree	Did authors provide a description of the coding tree?	No

26. Derivation of themes	Were themes identified in advance or derived from the data?	Methods
27. Software	What software, if applicable, was used to manage the data?	N/A
28. Participant checking	Did participants provide feedback on the findings?	No, strengths and limitations
<i>Reporting</i>		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Results
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Discussion
31. Clarity of major themes	Were major themes clearly presented in the findings?	Results
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Discussion

# BMJ Open

**Exploring patients' understanding of antibiotic resistance, and how this may influence attitudes towards antibiotic use for acute respiratory infections: a qualitative study.**

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-026735.R1
Article Type:	Research
Date Submitted by the Author:	21-Dec-2018
Complete List of Authors:	Bakhit, Mina; Centre for research in Evidence-Based Practice, Del Mar, Chris; Centre for research in Evidence-Based Practice Gibson, Elizabeth; Centre for research in Evidence-Based Practice Hoffmann, Tammy; Centre for research in Evidence-Based Practice
<b>Primary Subject Heading</b>:	Public health
Secondary Subject Heading:	General practice / Family practice, Infectious diseases
Keywords:	Antibiotics, Antibiotic Resistance, PRIMARY CARE, Respiratory Tract Infections, Antibiotic Resistance Decay

SCHOLARONE™  
Manuscripts

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3 1 **Title**  
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6 2 Exploring patients' understanding of antibiotic resistance, and how this may influence  
7 3 attitudes towards antibiotic use for acute respiratory infections: a qualitative study.  
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13 5 **Authors**  
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15 Mina Bakhit<sup>1</sup> MD [mbakhit@bond.edu.au](mailto:mbakhit@bond.edu.au)

16 Chris Del Mar<sup>1</sup> MD [cdelmar@bond.edu.au](mailto:cdelmar@bond.edu.au)

17 Elizabeth Gibson<sup>1</sup> PhD [egibson@bond.edu.au](mailto:egibson@bond.edu.au)

18 \*Tammy Hoffmann<sup>1</sup> PhD [thoffman@bond.edu.au](mailto:thoffman@bond.edu.au)  
19  
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22 <sup>1</sup>Centre for Research in Evidence-Based Practice (CREBP), Bond University, Australia 4229  
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26 7 **\*Corresponding author**  
27

28 8 **Name:** Professor Tammy Hoffmann

29 9 **Email:** thoffman@bond.edu.au

30 10 **Telephone number:** +61 7 559 55522  
31  
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33 11 **Address:** Faculty of Health Sciences and Medicine, Bond University QLD 4229, Australia  
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37 13 **Word count:** 3,435  
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39 14 **Keywords:** Antibiotics, Antibiotic Resistance, Primary Care, Respiratory Tract Infections,  
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3 16 **ABSTRACT**  
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6 17 **Objectives:** To explore patients' or parents of child patients' understanding of antibiotic  
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8 18 resistance and aspects of resistance such as resistance reversibility and its spread among  
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10 19 those in close proximity, along with how this may influence attitudes towards antibiotic use  
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12 20 for acute respiratory infections (ARIs).  
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16 21 **Design:** Qualitative semi-structured interview study using convenience sampling and  
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18 22 thematic analysis by two researchers independently.  
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21 23 **Setting:** General practices in Gold Coast, Australia.  
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25 24 **Participants:** 32 patients or parents of child patients presenting to general practice with an  
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27 25 ARI.  
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30 30 **Results:** Five themes emerged: 1) antibiotic use is seen as the main cause of antibiotic  
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32 31 resistance, but what it is that becomes resistant is poorly understood; 2) resistance is  
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34 32 perceived as a future 'big problem' for the community, with little appreciation of the  
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36 33 individual impact of, or contribution to it; 3) poor awareness that resistance can spread  
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38 34 between family members but concern that it can; 4) low awareness that resistance can  
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40 35 decay with time and variable impact of this knowledge on attitudes towards future  
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42 36 antibiotic use; and 5) antibiotics are perceived as sometimes necessary, with some  
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44 37 awareness and consideration of their harms.  
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50 39 **Conclusions:** Patients' or parents of child patients' understanding of antibiotic resistance  
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52 40 and aspects of it was poor. Targeting misunderstandings about resistance in public health  
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54 41 messages and clinical consultations should be considered as part of a strategy to improve  
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3 37 knowledge about it, which may encourage more consideration about antibiotic use for  
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6 38 illnesses such as ARIs.  
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9 **39 Article Summary**

10 40 Strengths and limitations of this study

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13 41 - Thematic analysis was performed by two researchers independently.  
14 42 - To our knowledge, this is the first study to explore patients' knowledge of the spread  
15 43 of antibiotic resistance between those in close proximity and its decay with time.  
16 44 - Sample unlikely to be representative of the wider Australian population or illnesses.  
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## 46 INTRODUCTION

47 Antibiotics, which have been critically important for treating infections since their discovery  
48 in the 1940s, are accelerating towards weakened effectiveness due to increase in antibiotic  
49 resistance.<sup>1</sup> Antibiotic resistance, which occurs when bacteria change in response to the use  
50 of antibiotics and resist the effects of antibiotics, is largely driven by community antibiotic  
51 use.<sup>2-4</sup> Antibiotics are prescribed more in primary care than other health sectors, and often  
52 for acute respiratory infections (ARIs), which comprise approximately 10% of primary care  
53 consultations.<sup>5</sup> Because of high prescribing rates, particularly for common conditions where  
54 antibiotics provide little benefit such as sore throat,<sup>6</sup> acute otitis media (AOM),<sup>7</sup> and  
55 bronchitis,<sup>8</sup> primary care is targeted for reducing antibiotic prescribing.

56 Understanding patients' beliefs about antibiotics and reasons for using and not using them  
57 can help inform interventions and public campaigns that aim to encourage appropriate  
58 antibiotic use.<sup>9</sup> Research has revealed that patients overestimate the benefits of antibiotics  
59 for ARIs,<sup>10</sup> and their expectations can influence antibiotic prescribing.<sup>11</sup>

60 Research that has explored the public's understanding of antibiotic resistance,  
61 consequences of it, and whether patients consider the threat of resistance when deciding,  
62 ideally in conjunction with their clinician, whether to use antibiotics is scarce.<sup>9 12</sup> There are  
63 also aspects of antibiotic resistance that might affect perceptions about antibiotic use, but  
64 patients' understanding of and views about these have not been investigated. This includes  
65 that antibiotic use increases resistance in the period following use, but this resistance  
66 decays with time,<sup>4</sup> and that resistance can be transmitted between people in close  
67 proximity such as family and household members.<sup>13</sup> How knowledge of this might influence  
68 patients' beliefs about antibiotic use for minor self-limiting illnesses such as ARIs is



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3 69 unknown. Such information is needed to ensure that clinical consultations and public health  
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5 70 campaigns about antibiotic use cover all the appropriate and relevant key messages.  
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9 71 This study aimed to explore, in a sample of patients, or parents of child patients, presenting  
10  
11 72 to a general practitioner (GP) directly after the decision-making point in a clinical encounter  
12  
13 73 for ARI, their understanding of: 1) antibiotic resistance in general; and 2) aspects of  
14  
15 74 antibiotic resistance, including resistance decay and spread among people in close  
16  
17 75 proximity, and how attitudes towards antibiotic use may be influenced by this  
18  
19 76 understanding.  
20  
21  
22

## 23 24 77 **METHODS**

### 25 26 27 78 **Design**

28  
29  
30 79 This was a qualitative study which used semi-structured interviews to explore participants'  
31  
32 80 understanding of antibiotic resistance and implications for decisions about antibiotic use.  
33  
34

### 35 36 81 **Participants and setting**

37  
38  
39 82 Recruitment and the interviews occurred in general practices in southeast Queensland,  
40  
41 83 Australia that had been recruited as part of an ongoing cluster randomised trial.<sup>14</sup> The trial  
42  
43 84 intervention that was provided to the general practices was three patient decision aids (for  
44  
45 85 acute otitis media [AOM], acute sore throat, and acute bronchitis) and a 15-minute video  
46  
47 86 that demonstrated shared decision making. Practices randomised to the control group did  
48  
49 87 not receive any active intervention.  
50  
51  
52

53  
54 88 Recruitment of participants for this study occurred between September 2016 and June 2017  
55  
56 89 from both the intervention and control practices. Practice managers' approvals were  
57  
58 90 obtained through email communication and recruitment days were organised according to  
59  
60

1  
2  
3 91 each practice's preference. Patients were eligible to participate if they met the following  
4  
5 92 criteria: 1) adult (or parent of a sick child) 18 years or older consulting a consenting GP with  
6  
7  
8 93 one of three ARIs (AOM, acute sore throat, acute bronchitis) for the first time for that illness  
9  
10 94 episode; 2) able to understand and read English; and 3) provided written informed consent.  
11  
12

### 13 95 **Patient and public involvement**

14  
15  
16 96 Patients were involved in this study as participants. The results of this study were  
17  
18 97 disseminated to interested study participants by email.  
19  
20  
21

### 22 98 **Procedure**

23  
24  
25 99 The interviews were conducted by one author (MB), using an interview topic guide  
26  
27 100 (summarised in Box). The topic guide was developed based on a systematic review of  
28  
29 101 relevant literature,<sup>12</sup> and findings from a cross-sectional study of Australian parents'  
30  
31 102 experiences of ARI management and antibiotic use in primary care.<sup>10</sup> The questions were  
32  
33 103 piloted with two eligible participants who were not recruited into the study, and minor  
34  
35 104 rephrasing of some questions occurred after piloting.  
36  
37  
38  
39

40 105 Some practices organised a room for the interviews, whereas at other practices, the  
41  
42 106 interviews occurred in a private area of the waiting room. The recruitment process differed  
43  
44 107 according to each practice's preference. At some practices, the interviewer (assisted by  
45  
46 108 practice staff) approached only patients who were waiting to see the GPs who were  
47  
48 109 participating. At other practices, the interviewer approached all waiting patients and asked  
49  
50 110 if they were waiting to see one of the participating GPs (GP names were listed and shown to  
51  
52 111 patients). If so, recruitment proceeded. Patient eligibility was determined by asking the  
53  
54 112 patients if they were suffering from one of the following symptoms (sore throat, cough, ear  
55  
56  
57  
58  
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60

1  
2  
3 113 pain), with the diagnosis confirmed afterwards by the treating GP. The interview recording  
4  
5 114 was deleted if a patient was diagnosed as having an illness other than an ARI. Potential  
6  
7  
8 115 participants were provided with a verbal explanation of the study and a written study  
9  
10 116 information sheet. After confirming eligibility and obtaining written consent, each  
11  
12  
13 117 participant was interviewed for an average of approximately 15 minutes directly after  
14  
15 118 leaving the consultation room. Interviews were audio-recorded, with participants' consent,  
16  
17  
18 119 and transcribed verbatim afterwards.  
19

20  
21 120 **Box.** Summary of topic guide for interviews  
22

- 23  
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39
- 'Usual' approaches to managing ARIs, including beliefs about necessity of antibiotics, their benefits and harms, and other influences on decision-making about antibiotic use
  - Understanding of the meaning of 'antibiotic resistance', its cause/s, and implications of it. *[If the participant did not know what resistance was, the interviewer provided a brief explanation before proceeding to next questions]*
  - Awareness that antibiotic resistance can spread between those in close proximity (such as family and household members) and if unaware, reactions to being told that it can
  - Awareness that antibiotic resistance can decay over time and if unaware, reactions to being told that it can

40 121 **Data analysis**  
41

42  
43 122 After 26 participants had been interviewed, a preliminary thematic analysis was undertaken.  
44  
45 123 It was decided that data saturation had not occurred, and recruitment of participants  
46  
47  
48 124 continued until data saturation was obtained at 32 participants. This was defined as when  
49  
50 125 no new ideas or constructs emerged from two consecutive interviews.<sup>15</sup> Two authors (MB  
51  
52 126 and EG) then independently used the process for thematic analysis outlined by Braun and  
53  
54  
55 127 Clark.<sup>16</sup> After familiarising themselves with the interview transcripts, they generated  
56  
57  
58 128 overarching themes and subthemes. This was a data-driven process that was inductive in  
59  
60 129 nature. The authors compared and discussed their themes and analyses and with the input

1  
2  
3 130 of an additional researcher (TH), came to consensus. The themes and illustrative quotes  
4  
5  
6 131 were then agreed to by all authors.  
7

## 8 132 **RESULTS**

### 9 133 **Participant characteristics**

10  
11  
12 134 We approached 208 patients in five general practices: 41 met the inclusion criterion of  
13  
14  
15 135 having an ARI, and of these, 32 (18 adult patients and 14 parents of sick children) consented  
16  
17  
18 136 to participate. The most common reason given for declining participation was insufficient  
19  
20  
21 137 time to be interviewed. Participants' mean age was 38 years (range 18-74), the majority  
22  
23  
24 138 were female (n= 25, 78%), and half (n= 16, 50%) were consulting for an episode of acute  
25  
26  
27 139 bronchitis (Table 1).  
28  
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140 **Table 1.** Participant characteristics

Participant ID	Participant age (years)	Gender	Presenting condition	If child patient, age (years)
P01	18	Female	Sore throat	
P02	73	Male	Acute Bronchitis	
P03	34	Female	AOM	1
P04	47	Female	Sore throat	
P05	37	Female	Sore throat	1.3
P06	34	Female	Unspecified ARI	11
P07	38	Female	Acute Bronchitis	
P08	28	Female	Acute Bronchitis	
P09	32	Female	Acute Bronchitis	2
P10	22	Male	Acute Bronchitis	
P11	27	Female	Sore throat	
P12	64	Male	Acute Bronchitis	
P13	52	Male	Acute Bronchitis	3
P14	39	Male	Acute Bronchitis	2
P15	36	Female	AOM	6
P16	43	Female	Acute Bronchitis	3
P17	18	Female	Sore throat	
P18	43	Female	Sore throat	
P19	70	Female	Acute Bronchitis	
P20	45	Female	Sore throat	
P21	34	Male	Acute Bronchitis	
P22	30	Female	AOM	4
P23	74	Female	Acute Bronchitis	
P24	25	Female	Acute Bronchitis	1.3
P25	24	Female	Sore throat	
P26	18	Female	Acute Bronchitis	
P27	36	Female	Unspecified ARI	3
P28	21	Male	Unspecified ARI	
P29	50	Female	Unspecified ARI	
P30	34	Female	Acute Bronchitis	2
P31	38	Female	Acute Bronchitis	4.5
P32	35	Female	AOM	1.8

1  
2  
3 142 **Themes**  
4

5 143 Five themes emerged, and these are presented below and supported by illustrative quotes.  
6  
7

8 144 Theme 1. Antibiotic use is seen as the main cause of antibiotic resistance, but *what* it is that  
9 becomes resistant is poorly understood.  
10

11 145  
12  
13 146 Many participants thought that antibiotic overuse or misuse in people drives antibiotic  
14  
15  
16 147 resistance - *“Sometimes people think they need antibiotics. That’s where they can lead to*  
17  
18 148 *resistance because they have them too much”* (P03); with a few mentioning other reasons  
19  
20 149 such as antibiotic use in animals; *“Through our food, that sort of thing, it does seem to be a*  
21  
22 150 *concern now. Like, animals getting fed antibiotics”* (P12); or not using the full antibiotic  
23  
24 151 course *“But if you use them ... you don’t take the full dose, obviously like in that you’ve got*  
25  
26 152 *your certain bugs coming out.”* (P25).  
27  
28  
29

30  
31 153 Nearly all participants thought that antibiotic resistance is when the body becomes resistant  
32  
33 154 to antibiotics:  
34  
35

36  
37 155 *“Antibiotic resistance, your body is resistant to it and maybe you’ve used too much of it...*  
38  
39 156 *antibiotics”* (P16)  
40  
41

42 157 *“antibiotic resistance is possibly your body, rejecting the benefits of the antibiotics ... it’s*  
43  
44 158 *almost like the body gets used to the antibiotic”* (P10)  
45  
46  
47

48 159 *“if you take antibiotics too regularly, your body stops, reacting to them, or they stop having*  
49  
50 160 *an impact”* (P04)  
51  
52

53 161 Some participants still had misperceptions after the interviewer provided a simple  
54  
55 162 explanation of what antibiotic resistance is (*“Antibiotic resistance happens when bacteria*  
56  
57  
58  
59  
60

1  
2  
3 163 *change to protect themselves from an antibiotic. They are then no longer killed by that*  
4  
5  
6 164 *antibiotic”):*

7  
8  
9 165 *“Oh, yeah, see I’ve never had that sort of problem. I’ve never heard it. Whenever I’ve taken*  
10  
11 166 *it, maybe I wasn’t sick enough to sort of resist it. It’s always worked. And for the time that*  
12  
13  
14 167 *I had to take more than once, a repeat, you know.” (P23)*

15  
16  
17 168 Theme 2. Resistance is perceived as a future ‘big problem’ for the community, with little  
18  
19 169 appreciation of the individual impact of, or contribution to it

20  
21  
22 170 Most participants perceived antibiotic resistance as a community problem caused by others  
23  
24  
25 171 who misuse antibiotics:

26  
27  
28 172 *“... if people are over using it. Yeah, especially with their children when they’re so young.*  
29  
30 173 *If they’re regularly on antibiotics, yeah....” (P06)*

31  
32  
33 174 *“I imagine there would be some pockets of the community that it [antibiotic resistance]*  
34  
35  
36 175 *might be an issue for.” (P04)*

37  
38  
39 176 *“I think it’s a big problem. People like to get antibiotics and just solve things instantly. Like*  
40  
41 177 *people don’t like to wait and see what happens, they like to get something – even if they*  
42  
43  
44 178 *think it’s going to work or not, they just – something to make it better.” (P15)*

45  
46  
47 179 Most participants described resistance as a problem that will not impact them individually -  
48  
49 180 *“I don’t think it’s a big issue for me” (P09); “I think I’ll get through my life without it*  
50  
51  
52 181 *impacting on it” (P21).* A few participants described their worry about antibiotic resistance,  
53  
54 182 although by many it was viewed as a future or a hypothetical concern:  
55  
56  
57  
58  
59  
60

1  
2  
3 183 *“Oh, huge, I don’t want that to happen... Um, well, if she got sick and constantly needed*  
4  
5  
6 184 *antibiotics... you know, then obviously in - as she gets older, they’d stop working as much*  
7  
8 185 *as you wouldn’t be able to treat infections as much and I don’t want that to happen”* (P03)

9  
10  
11 186 *“... it could become a big problem if the so-called superbugs, um, come out and about*  
12  
13  
14 187 *later on, yeah.”* (P09)

15  
16  
17 188 *“It still concerns me, um, because someone as young as my two-year-old son – I guess in*  
18  
19 189 *an older person, it’s perhaps not as concerning because over the course of a life time... but*  
20  
21 190 *I think the message is out there that maybe you need to think twice before (using*  
22  
23  
24 191 *antibiotics)”* (P09)

25  
26  
27 192 Theme 3. Poor awareness that resistance can spread between family members but concern  
28  
29 193 that it can

30  
31  
32  
33 194 Most participants did not know that antibiotic resistance can spread between people who  
34  
35 195 are in close proximity, such as family members - *“No, I didn’t even know it could spread”*  
36  
37 196 (P24). Some thought it would be possible:

38  
39  
40  
41 197 *“Um, I’ve never really thought about it before. My initial answer would be no, but I guess*  
42  
43 198 *like if – yeah I guess if one of the children had a bug that was tougher, and they gave that*  
44  
45 199 *to the other child, then, yeah, I guess, yeah, I guess it would be”* (P32).

46  
47  
48  
49 200 When participants were told by the interviewer that it can, the most common reaction was  
50  
51 201 concern *“concerned. Yeah, it’s not a good thing”* (P14) and shock *“Oh, shocked. No, I never*  
52  
53 202 *knew that.”* (P01), with some insight into the significance of the problem *“So by one person*  
54  
55 203 *using antibiotics can create problems for the whole family... Yeah. Well, that’s, um, not real*  
56  
57 204 *good, is it?”* (P19)



1  
2  
3 205 Some participants suggested strategies to minimise the spread of resistance such as  
4  
5  
6 206 decreasing antibiotic use “... so not using them too much” (P03) or with hand hygiene  
7  
8 207 (“hand sanitiser” (P21), “wash hands” (P07)).  
9

10  
11 208 Theme 4. Low awareness that resistance can decay with time and variable impact of this  
12  
13  
14 209 knowledge on attitudes towards future antibiotic use  
15

16  
17 210 Most participants did not know that antibiotic resistance could decay over time:  
18

19  
20 211 “Oh, I’ve got no idea, I thought it just – that it stayed for a lifetime if you were resistant to  
21  
22 212 it.” (P24)  
23

24  
25 213 “Oh, a long time. You’d have to - it’d take a lot of different ways to treat it” (P03)  
26

27  
28 214 “I imagine not, because once it’s in your system, it remains there” (P09)  
29

30  
31 215 There was wide variation on estimation of the time to decay, ranging from days to decades:  
32

33  
34 216 “It wouldn’t be; you wouldn’t think within a couple of days... But I’m not saying 12 months  
35  
36 217 or anything like that” (P19)  
37

38  
39  
40 218 “Oh, probably ten years or something, crazy” (P15)  
41

42  
43 219 After explanation from the interviewer that antibiotic resistance does decay, some  
44  
45 220 participants were more hopeful about the problem of antibiotic resistance:  
46

47  
48  
49 221 “...It’s promising to know that there is a chance ... given enough time, then they  
50  
51 222 [Antibiotics] could work again” (P21)  
52

53  
54 223 “Yeah, well that’s good that it could be then reversible” (P32)  
55

56  
57 224 “It makes me think that you could possibly go back to using those antibiotics if you had  
58  
59 225 the similar problem maybe 18 months down the track” (P10)  
60

1  
2  
3 226 It was assumed by some that science will come up with solutions to manage antibiotic  
4  
5  
6 227 resistance in the future:

7  
8  
9 228 *"I don't think it will go away, but I think maybe people are coming up with different*  
10  
11 229 *solutions to fight it rather than antibiotics or different ways of switching off you know our*  
12  
13  
14 230 *body's responses and things like that."* (P15)

15  
16  
17 231 *"it will be interesting over the next 10-15 years. I think that probably there'll be some really*  
18  
19 232 *good break throughs in - - in the engineering and the science behind antibiotics..."* (P21)

20  
21  
22 233 The impact of knowing about resistance decay on attitude towards antibiotic use was  
23  
24 234 variable. Some participants indicated no change (*"No different than I said before. If it means*  
25  
26  
27 235 *it's [antibiotics] going to save my life and help me in my health, it wouldn't make any*  
28  
29 236 *difference at all.* (P23)), whereas others expressed that knowing this made them more  
30  
31  
32 237 cautious:

33  
34  
35 238 *"That makes me really think about it – taking antibiotics only if you really need to"* (P08)

36  
37  
38 239 *"Especially for the children it would a lot scarier that they wouldn't be able to be treated*  
39  
40  
41 240 *... if they were sick and something. It's quite frightening."* (P22)

42  
43  
44 241 Theme 5. Antibiotics are perceived as sometimes necessary, with some awareness and  
45  
46 242 consideration of their harms

47  
48  
49 243 Antibiotics were seen as beneficial by many participants (*"only thing that helps"* (P20)). The  
50  
51  
52 244 most commonly reported perceived benefits were decreased duration of illness (*"taking*  
53  
54 245 *antibiotics would make me better quicker"* (P11)) and decreased severity or progression of  
55  
56  
57 246 the infection (*"to make sure it doesn't go to any further stages of infection."* (P06)).  
58  
59  
60

1  
2  
3 247 Some participants believed in the need for antibiotics, despite being told by their GP that  
4  
5  
6 248 antibiotics would not help with viruses or provide better outcomes for them:

7  
8  
9 249 *“...the doctor said oh it’s a virus, I said well I’m going to be looking after my*  
10  
11 250 *grandchildren, it’s school holidays, and I needed something to help me get over this. ...and*  
12  
13 251 *she said but they are not going to help you. I said well it’s my decision at the time to have*  
14  
15  
16 252 *them because I didn’t want my children to have what I had, you know. It was just a very*  
17  
18 253 *bad virus I had, you know. But anyway, the antibiotics did work.” (P23)*

20  
21 254 Some participants were reluctant to take antibiotics for minor self-limiting illnesses, such as  
22  
23  
24 255 ARIs, and preferred to reserve antibiotic use for severe infections - *“I would be hesitant. So,*  
25  
26 256 *yes, maybe each time my doctor gives me antibiotics, I would ask is that necessary?” (P07),*  
27  
28  
29 257 *with some concerned about not wanting to overuse antibiotics - “should be more carefully*  
30  
31 258 *applied and perhaps conservatively used.” (P18). Others’ attitudes about antibiotic use were*  
32  
33  
34 259 *not influenced by illness severity - “...doesn’t really change my opinion of it... certain*  
35  
36 260 *antibiotics really work” (P25). Some participants’ reasons for not using antibiotics were to*  
37  
38 261 *“give the body the best fighting chance” (P15) and by “trying natural healing and staying*  
39  
40  
41 262 *healthy in the first place” (P13)*

42  
43  
44 263 The few participants who had personal experience of antibiotic resistance were particularly  
45  
46  
47 264 cautious about antibiotic use:

48  
49  
50 265 *“...because of my bronchitis... I have taken other medications that haven’t worked. The –*  
51  
52 266 *the doctors then had to change it... to a different medication. Yeah. Because I become*  
53  
54  
55 267 *resistant to others so I’m very fussy about taking them.” (P20)*

1  
2  
3 268 There was great variability in participants' awareness of the potential harms of antibiotics.  
4  
5  
6 269 Many participants named potential side-effects with commonly listed ones including  
7  
8 270 "vomiting", "nausea", "thrush", and "diarrhoea". Some mentioned "possible resistance" as  
9  
10 271 one of their concerns, but responses conveyed misunderstanding of what antibiotic  
11  
12 272 resistance actually is. Some participants were not aware that antibiotics had potential harms  
13  
14  
15 273 - "None that I'm aware of" (P21).

16  
17  
18 274 The patient-clinician relationship was viewed as very important when decisions about the  
19  
20 275 management of infections were being made. Trust in the clinicians' recommendation for  
21  
22 276 antibiotic use was mentioned by some - "as long as I can talk to my doctor and trust that the  
23  
24 277 doctor is making the right decision" (P05)

25  
26  
27  
28  
29 278 Some participants described a lack of information and discussion with their clinician "I don't  
30  
31 279 have enough information to probably correctly make that call." (P18) and were unaware of  
32  
33 280 the option to not treat with antibiotics (that is, that the illness would get better without  
34  
35 281 them) "Um, well I guess when it's infected there's not really much other choice for that  
36  
37 282 particular problem" (P32).

38  
39  
40  
41  
42 283 Some expressed a desire for more information about antibiotic resistance:

43  
44  
45 284 "Um, yeah, it would be good to know more about, um, how often you have to be taking  
46  
47 285 them for resistance to build, whether individual, patient to patient" (P18).

48  
49  
50 286 "... interested in knowing more information about (antibiotic resistance)" (P15)

## 51 52 53 287 **DISCUSSION**

54  
55  
56 288 This study has identified five major themes that related to people's understanding of  
57  
58 289 antibiotic resistance and aspects of resistance such as resistance reversibility and spread  
59  
60

1  
2  
3 290 among those in close proximity such as family or household members. While many  
4  
5  
6 291 participants articulated the link between antibiotic use and resistance, there was confusion  
7  
8 292 about the nature of antibiotic resistance, which was often attributed to a trait of the body  
9  
10 293 rather than bacteria in the microbiome. Many saw antibiotic resistance as a potential  
11  
12  
13 294 problem, rather than one that exists already, and that it was a consequence of and problem  
14  
15 295 for the others in the community rather than them as an individual. Few appreciated the  
16  
17  
18 296 potential for antibiotic resistant organisms to spread between those in close proximity, or  
19  
20 297 that antibiotic resistance can decay.

23 298 Most participants reported the main benefit of antibiotic use was a decreased duration of  
24  
25  
26 299 illness. Some were aware of the potential for harm from antibiotics, including resistance.

28 300 Some expressed reluctance to use antibiotics for minor self-limiting infections because of  
29  
30  
31 301 concern about overuse or misuse, whereas for others, it was not because of the potential  
32  
33 302 harms but because of a preference for allowing their body to fight the infection naturally.

36 303 The poor understanding of the nature of antibiotic resistance has been found in previous  
37  
38  
39 304 studies in a general practice setting,<sup>17</sup> and in non-healthcare settings.<sup>18-20</sup> A recent survey of  
40  
41 305 the UK general adult population showed that lack of antibiotic resistance awareness was  
42  
43  
44 306 strongly associated with self-reported likelihood of requesting antibiotics for an influenza-  
45  
46 307 like infection.<sup>21</sup> It appeared that patients who had personal experience of antibiotic  
47  
48  
49 308 resistance were the most reluctant to use them again, preferring to reserve their use for  
50  
51 309 serious illness. A survey of the general population in Germany found that people who knew  
52  
53  
54 310 of someone suffering from multidrug-resistant organisms, received more information by  
55  
56 311 their clinician on antibiotic resistance and took less antibiotics for an infection (of any  
57  
58 312 cause), compared with people who did not have any personal involvement.<sup>19</sup>  
59  
60

1  
2  
3 313 Our finding that the lack of individual ‘ownership’ of contribution to, or risk of, antibiotic  
4  
5 314 resistance has previously been identified in a systematic review,<sup>12</sup> which showed that the  
6  
7  
8 315 public do not believe they contribute to the development of antibiotic resistance. This is  
9  
10 316 complemented by the finding that some participants believe that science will find a way to  
11  
12  
13 317 solve the resistance problem, which contradicts with messages about individuals needing to  
14  
15 318 change their behaviour to minimise the problem.

17  
18 319 Many public health campaigns convey the message of antibiotic resistance and how it is  
19  
20 320 promoted by inappropriate antibiotic use and misuse. The effect of some campaigns has  
21  
22  
23 321 been analysed and a decrease in antibiotic use was found.<sup>22 23</sup> Some of our findings might be  
24  
25 322 useful in guiding and refining the content of messages in public health campaigns and  
26  
27  
28 323 clinical consultations about antibiotic resistance. For example, the information that  
29  
30 324 developing antibiotic resistance in one’s microbiome might also lead to resistance in people  
31  
32 325 who are physically close to them, such as family members, could be an additional message  
33  
34 326 in patient and public educational strategies to encourage appropriate antibiotic use. Most  
35  
36 327 participants were quite concerned upon learning about resistance spread and it prompted  
37  
38 328 some to provide suggestions for how to minimise resistance development and its spread –  
39  
40 329 suggesting that perhaps this is the information that could contribute to altering people’s  
41  
42 330 attitudes and behaviour about antibiotic use for minor self-limiting illnesses.

43  
44 331 Future research into the optimal information about antibiotic use and resistance to include  
45  
46 332 in public messages and clinical consultations is recommended. This includes the potential  
47  
48 333 utility of information about resistance decay and its impact on antibiotic use. Knowing that  
49  
50 334 resistance decays over time if antibiotics are not used promoted hope in some people that  
51  
52 335 the problem of resistance was not irreversible and that efforts to conserve antibiotic  
53  
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55  
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1  
2  
3 336 effectiveness by not using unless essential are worthwhile. However, for others, knowing  
4  
5  
6 337 that resistance decay occurs over time, may thwart attempts to encourage responsible  
7  
8 338 antibiotic use.  
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10  
11 339 At a clinical consultation level, better engagement with patients when antibiotics are being  
12  
13 340 considered by providing a balanced discussion of antibiotic benefits and harms is  
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16 341 encouraged. This conversation should include discussion that resistance is a potential harm  
17  
18 342 of antibiotic use, and explanation of the possible consequences of it for the individual and  
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20  
21 343 the broader community.  
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23  
24 344 A limitation of our study is that the sample is not representative of the wider Australian  
25  
26 345 population as participants were recruited from one city in Australia, only those presenting  
27  
28 346 with an ARI were invited, and the majority of participants were female. For a small number  
29  
30  
31 347 of participants (9), there is the risk that their knowledge about antibiotic resistance was  
32  
33 348 influenced by their GPs' use of a patient decision aid - which included a very brief  
34  
35 349 explanation of what resistance is, but not about the spread or decay of resistance. Although  
36  
37  
38 350 GPs who did not receive or use the aids may have mentioned resistance as part of the  
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41 351 consultation regardless. Other limitations are that participants did not have the opportunity  
42  
43 352 to provide feedback on the themes derived from the interviews and the short duration of  
44  
45  
46 353 the interviews—which could have affected the depth of the gathered information. Strengths  
47  
48 354 of the study include the use of two researchers independently performing the thematic  
49  
50  
51 355 analysis and its contribution of new findings to this field. We are not aware of other studies  
52  
53 356 which have explored people's knowledge about the potential for antibiotic resistant  
54  
55  
56 357 organisms to spread between those who are in close proximity or that antibiotic resistance  
57  
58 358 decays over time.  
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3 359 **CONCLUSION**  
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5

6 360 This study found that patients' understanding of many aspects of antibiotic resistance was  
7  
8 361 poor including: what it is, individual contribution to its development, individual implications,  
9  
10 362 its spread and decay. Incorporating messages that target misunderstandings into public  
11  
12 363 health messages and clinical consultations may be an important strategy to encourage more  
13  
14 364 appropriate use of antibiotics for illnesses such as ARIs.  
15  
16  
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18

19 365 **Acknowledgement:** The authors would like to acknowledge and thank all patients and GPs  
20  
21 366 who participated in this study.  
22  
23  
24

25 367 **Author Contributions:** MB, TH and CDM designed the study. MB recruited and interviewed  
26  
27 368 participants. MB, EG, TH and CDM analysed the data. MB drafted the original manuscript  
28  
29 369 and EG, TH and CDM contributed to writing and revising the manuscript. All authors read  
30  
31 370 and approved the final manuscript.  
32  
33  
34

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40  
41 374 (#1044904), which had no role in study design, data collection, data analysis, data  
42  
43 375 interpretation, or writing of the report.  
44  
45  
46  
47

48 376 **Competing interests:** None declared  
49  
50

51 377 **Ethics approval:** Ethical approval was provided by the Human Research Ethics Committee at  
52  
53 378 Bond University (#0000015433) and consent provided by each participant interviewed and  
54  
55 379 by GP practices to allow recruitment of their patients.  
56  
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59 380 **Provenance and peer review:** Not commissioned; externally peer reviewed.  
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381 **Data sharing statement:** No additional data are available.

For peer review only

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## Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:

Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

No. Item	Guide questions/description	Reported on Page #
<b>Domain 1: Research team and reflexivity</b>		
<i>Personal Characteristics</i>		
1. Inter viewer/facilitator	Which author/s conducted the interview or focus group?	Mina Bakhit
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	Mina Bakhit, MA, M.B., B.Ch. Chris Del Mar, MD Elizabeth Gibson, PhD Tammy Hoffmann, PhD
3. Occupation	What was their occupation at the time of the study?	Medical doctor, PhD candidate, Research Assistant
4. Gender	Was the researcher male or female?	Male
5. Experience and training	What experience or training did the researcher have?	The researcher performed a pre- and post-qualitative skype interviews at Friedrich Alexander University, Germany in 2013
<i>Relationship with participants</i>		
6. Relationship established	Was a relationship established prior to study commencement?	No
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Participants were provided with an information sheet and consent form which outlined the aim of the study
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Participants knew the researcher was a

		Medical doctor and PhD student with an interest in reducing inappropriate antibiotic prescribing
<b>Domain 2: study design</b>		
<i>Theoretical framework</i>		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Methods; page 7
<i>Participant selection</i>		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Methods; page 5
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Methods; page 6
12. Sample size	How many participants were in the study?	Results; page 8
13. Non-participation	How many people refused to participate or dropped out? Reasons?	Results; page 8
<i>Setting</i>		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Methods; page 6
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	No
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Results (Table 1)
<i>Data collection</i>		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Methods; page 6 and Box
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	No
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Methods; page 7
20. Field notes	Were field notes made during and/or after the interview or focus group?	No
21. Duration	What was the duration of the inter views or focus group?	Methods; page 7
22. Data saturation	Was data saturation discussed?	Methods; page 7
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
<b>Domain 3: analysis and findings</b>		
<i>Data analysis</i>		
24. Number of data coders	How many data coders coded the data?	Methods; page 7

25. Description of the coding tree	Did authors provide a description of the coding tree?	No
26. Derivation of themes	Were themes identified in advance or derived from the data?	Methods; page 7
27. Software	What software, if applicable, was used to manage the data?	N/A
28. Participant checking	Did participants provide feedback on the findings?	No, reported as a study limitation; page 19
<i>Reporting</i>		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Results; page 10-16
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Discussion; page 16-18
31. Clarity of major themes	Were major themes clearly presented in the findings?	Results; page 10-16
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Results Discussion; page 16-17

# BMJ Open

**Exploring patients' understanding of antibiotic resistance, and how this may influence attitudes towards antibiotic use for acute respiratory infections: a qualitative study in Australian general practice.**

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-026735.R2
Article Type:	Research
Date Submitted by the Author:	04-Feb-2019
Complete List of Authors:	Bakhit, Mina; Centre for research in Evidence-Based Practice, Del Mar, Chris; Centre for research in Evidence-Based Practice Gibson, Elizabeth; Centre for research in Evidence-Based Practice Hoffmann, Tammy; Centre for research in Evidence-Based Practice
<b>Primary Subject Heading</b>:	Public health
Secondary Subject Heading:	General practice / Family practice, Infectious diseases
Keywords:	Antibiotics, Antibiotic Resistance, PRIMARY CARE, Respiratory Tract Infections, Antibiotic Resistance Decay

SCHOLARONE™  
Manuscripts

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3 1 **Title**  
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6 2 Exploring patients' understanding of antibiotic resistance, and how this may influence  
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8 3 attitudes towards antibiotic use for acute respiratory infections: a qualitative study in  
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10 4 Australian general practice.  
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15 6 **Authors**

16 Mina Bakhit<sup>1</sup> MD [mbakhit@bond.edu.au](mailto:mbakhit@bond.edu.au)

17 Chris Del Mar<sup>1</sup> MD [cdelmar@bond.edu.au](mailto:cdelmar@bond.edu.au)

18 Elizabeth Gibson<sup>1</sup> PhD [egibson@bond.edu.au](mailto:egibson@bond.edu.au)

19 \*Tammy Hoffmann<sup>1</sup> PhD [thoffman@bond.edu.au](mailto:thoffman@bond.edu.au)

20  
21  
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24  
25 <sup>1</sup>Centre for Research in Evidence-Based Practice (CREBP), Bond University, Australia 4229

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27  
28 8 **\*Corresponding author**

29  
30 9 **Name:** Professor Tammy Hoffmann

31  
32 10 **Email:** [thoffman@bond.edu.au](mailto:thoffman@bond.edu.au)

33  
34 11 **Telephone number:** +61 7 559 55522

35  
36 12 **Address:** Faculty of Health Sciences and Medicine, Bond University QLD 4229, Australia

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39 14 **Word count:** 3,435

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41 15 **Keywords:** Antibiotics, Antibiotic Resistance, Primary Care, Respiratory Tract Infections,  
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43 16 Resistance Decay  
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2  
3 17 **ABSTRACT**  
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6 18 **Objectives:** To explore patients' or parents of child patients' understanding of antibiotic  
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9 19 resistance and aspects of resistance such as resistance reversibility and its spread among  
10  
11 20 those in close proximity, along with how this may influence attitudes towards antibiotic use  
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13  
14 21 for acute respiratory infections (ARIs).

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16  
17 22 **Design:** Qualitative semi-structured interview study using convenience sampling and  
18  
19 23 thematic analysis by two researchers independently.  
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22 24 **Setting:** General practices in Gold Coast, Australia.  
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25 25 **Participants:** 32 patients or parents of child patients presenting to general practice with an  
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27 26 ARI.  
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30  
31 27 **Results:** Five themes emerged: 1) antibiotic use is seen as the main cause of antibiotic  
32  
33 28 resistance, but what it is that becomes resistant is poorly understood; 2) resistance is  
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35  
36 29 perceived as a future 'big problem' for the community, with little appreciation of the  
37  
38 30 individual impact of, or contribution to it; 3) poor awareness that resistance can spread  
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40  
41 31 between family members but concern that it can; 4) low awareness that resistance can  
42  
43 32 decay with time and variable impact of this knowledge on attitudes towards future  
44  
45 33 antibiotic use; and 5) antibiotics are perceived as sometimes necessary, with some  
46  
47  
48 34 awareness and consideration of their harms.  
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50  
51 35 **Conclusions:** Patients' or parents of child patients' understanding of antibiotic resistance  
52  
53 36 and aspects of it was poor. Targeting misunderstandings about resistance in public health  
54  
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56 37 messages and clinical consultations should be considered as part of a strategy to improve  
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3 38 knowledge about it, which may encourage more consideration about antibiotic use for  
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6 39 illnesses such as ARIs.  
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8  
9 40 **Article Summary**

10 41 Strengths and limitations of this study

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12  
13 42 - Thematic analysis was performed by two researchers independently.  
14 43 - To our knowledge, this is the first study to explore patients' knowledge of the spread  
15 44 of antibiotic resistance between those in close proximity and its decay with time.  
16 45 - Sample unlikely to be representative of the wider Australian population or illnesses.  
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## 47 INTRODUCTION

48 Antibiotics, which have been critically important for treating infections since their discovery  
49 in the 1940s, are accelerating towards weakened effectiveness due to increase in antibiotic  
50 resistance.<sup>1</sup> Antibiotic resistance, which occurs when bacteria change in response to the use  
51 of antibiotics and resist the effects of antibiotics, is largely driven by community antibiotic  
52 use.<sup>2-4</sup> Antibiotics are prescribed more in primary care than other health sectors, and often  
53 for acute respiratory infections (ARIs), which comprise approximately 10% of primary care  
54 consultations.<sup>5</sup> Because of high prescribing rates, particularly for common conditions where  
55 antibiotics provide little benefit such as sore throat,<sup>6</sup> acute otitis media (AOM),<sup>7</sup> and  
56 bronchitis,<sup>8</sup> primary care is targeted for reducing antibiotic prescribing.

57 Understanding patients' beliefs about antibiotics and reasons for using and not using them  
58 can help inform interventions and public campaigns that aim to encourage appropriate  
59 antibiotic use.<sup>9</sup> Research has revealed that patients overestimate the benefits of antibiotics  
60 for ARIs,<sup>10</sup> and their expectations can influence antibiotic prescribing.<sup>11</sup>

61 Research that has explored the public's understanding of antibiotic resistance,  
62 consequences of it, and whether patients consider the threat of resistance when deciding,  
63 ideally in conjunction with their clinician, whether to use antibiotics is scarce.<sup>9 12</sup> There are  
64 also aspects of antibiotic resistance that might affect perceptions about antibiotic use, but  
65 patients' understanding of and views about these have not been investigated. This includes  
66 that antibiotic use increases resistance in the period following use, but this resistance  
67 decays with time,<sup>4</sup> and that resistance can be transmitted between people in close  
68 proximity such as family and household members.<sup>13</sup> How knowledge of this might influence  
69 patients' beliefs about antibiotic use for minor self-limiting illnesses such as ARIs is

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3 70 unknown. Such information is needed to ensure that clinical consultations and public health  
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5 71 campaigns about antibiotic use cover all the appropriate and relevant key messages.  
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9 72 This study aimed to explore, in a sample of patients, or parents of child patients, presenting  
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11 73 to a general practitioner (GP) directly after the decision-making point in a clinical encounter  
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13 74 for ARI, their understanding of: 1) antibiotic resistance in general; and 2) aspects of  
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15 75 antibiotic resistance, including resistance decay and spread among people in close  
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17 76 proximity, and how attitudes towards antibiotic use may be influenced by this  
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19 77 understanding.  
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## 23 24 78 **METHODS**

### 25 26 27 79 **Design**

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30 80 This was a qualitative study which used semi-structured interviews to explore participants'  
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32 81 understanding of antibiotic resistance and implications for decisions about antibiotic use.  
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### 35 36 82 **Participants and setting**

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39 83 Recruitment and the interviews occurred in general practices in southeast Queensland,  
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41 84 Australia that had been recruited as part of an ongoing cluster randomised trial.<sup>14</sup> The trial  
42  
43 85 intervention that was provided to the general practices was three patient decision aids (for  
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45 86 acute otitis media [AOM], acute sore throat, and acute bronchitis) and a 15-minute video  
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47 87 that demonstrated shared decision making. Practices randomised to the control group did  
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49 88 not receive any active intervention.  
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54 89 Recruitment of participants for this study occurred between September 2016 and June 2017  
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56 90 from both the intervention and control practices. Practice managers' approvals were  
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58 91 obtained through email communication and recruitment days were organised according to  
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3 92 each practice's preference. Patients were eligible to participate if they met these criteria.  
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6 93 The first was that they were an adult (or parent of a sick child) 18 years or older consulting a  
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8 94 consenting GP with one of three ARIs (AOM, acute sore throat, acute bronchitis) for the first  
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10 95 time for that illness episode. We recruited adults and children as both experience ARIs and  
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13 96 with a few exceptions, the benefits and harms of antibiotics for ARIs, along with the risk and  
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15 97 consequences of antibiotic resistance, are similar for both groups. Other criteria were that  
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18 98 participants could understand and read English and provide written informed consent.  
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### 20 21 99 **Patient and public involvement**

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24 100 No patients or members of the public were involved in the design of this study. However,  
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26 101 they were involved in the development of the decision aids used by GPs in some of the  
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29 102 recruited general practices. Patients were involved in this study as participants. The results  
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31 103 of this study were disseminated to interested study participants by email.  
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### 33 34 104 **Procedure**

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37 105 The interviews were conducted by one author (MB), using an interview topic guide  
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39 106 (summarised in Box). The topic guide was developed based on a systematic review of  
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42 107 relevant literature,<sup>12</sup> and findings from a cross-sectional study of Australian parents'  
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45 108 experiences of ARI management and antibiotic use in primary care.<sup>10</sup> The questions were  
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47 109 piloted with two eligible participants who were not recruited into the study, and minor  
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50 110 rephrasing of some questions occurred after piloting.

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53 111 Some practices organised a room for the interviews, whereas at other practices, the  
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55 112 interviews occurred in a private area of the waiting room. The recruitment process differed  
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58 113 according to each practice's preference. At some practices, the interviewer (assisted by  
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3 114 practice staff) approached only patients who were waiting to see the GPs who were  
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5 115 participating. At other practices, the interviewer approached all waiting patients and asked  
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8 116 if they were waiting to see one of the participating GPs (GP names were listed and shown to  
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10 117 patients). If so, recruitment proceeded. Patient eligibility was determined by asking the  
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13 118 patients if they were suffering from one of the following symptoms (sore throat, cough, ear  
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15 119 pain), with the diagnosis confirmed afterwards by the treating GP. Potential participants  
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18 120 were provided with a verbal explanation of the study and a written study information sheet.  
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20 121 After confirming eligibility and obtaining written consent, each participant was interviewed  
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23 122 for an average of approximately 15 minutes directly after leaving the consultation room.  
24  
25 123 Patients were interviewed directly after the consultation because this is: i) for most, the  
26  
27 124 time of decision making about whether to take antibiotics, ii) important for reducing recall  
28  
29  
30 125 bias, and iii) enabled face-to-face interviews to occur. Interviews were audio-recorded, with  
31  
32 126 participants' consent, and transcribed verbatim afterwards. The interview recording was  
33  
34  
35 127 deleted if a patient was diagnosed by their GP as having an illness other than an ARI. This  
36  
37 128 occurred for one recording as the patient had a cough from a chronic illness.  
38  
39

40  
41 129 **Box.** Summary of topic guide for interviews  
42

- 43  
44  
45 - 'Usual' approaches of expecting and/or using antibiotics for managing ARIs, including beliefs about necessity of antibiotics, their benefits and harms, and other influences on decision-making about antibiotic use
- 46  
47 - Understanding of the meaning of 'antibiotic resistance', its cause/s, and implications of it. *[If the participant did not know what resistance was, the interviewer provided a brief explanation before proceeding to next questions]*
- 48  
49 - Awareness that antibiotic resistance can spread between those in close proximity (such as family and household members) and if unaware, reactions to being told that it can
- 50  
51 - Awareness that antibiotic resistance can decay over time and if unaware, reactions to being told that it can
- 52  
53  
54  
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58

59 130 **Data analysis**  
60

1  
2  
3 131 After 26 participants had been interviewed, a preliminary thematic analysis was undertaken.  
4  
5  
6 132 It was decided that data saturation had not occurred, and recruitment of participants  
7  
8 133 continued until data saturation was obtained at 32 participants. This was defined as when  
9  
10 134 no new ideas or constructs emerged from two consecutive interviews.<sup>15</sup> Two authors (MB  
11  
12  
13 135 and EG) then independently used the process for thematic analysis outlined by Braun and  
14  
15 136 Clark.<sup>16</sup> After familiarising themselves with the interview transcripts, they generated  
16  
17 137 overarching themes and subthemes. This was a data-driven process that was partially  
18  
19 138 inductive in nature. The authors compared and discussed their themes and analyses and  
20  
21 139 with the input of an additional researcher (TH), came to consensus. The themes and  
22  
23 140 illustrative quotes were then agreed to by all authors.  
24  
25  
26  
27

## 28 141 **RESULTS**

### 29 142 **Participant characteristics**

30  
31  
32  
33  
34 143 We approached 208 patients in five general practices: 41 met the inclusion criterion of  
35  
36 144 having an ARI, and of these, 32 (18 adult patients and 14 parents of sick children) consented  
37  
38 145 to participate. The most common reason given for declining participation was insufficient  
39  
40 146 time to be interviewed. Participants' mean age was 38 years (range 18-74), the majority  
41  
42 147 were female (n= 25, 78%), and half (n= 16, 50%) were consulting for an episode of acute  
43  
44 148 bronchitis (Table 1).  
45  
46  
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48  
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50 149  
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59  
60

150 **Table 1.** Participant characteristics

Participant ID	Participant age (years)	Gender	Presenting condition	If child patient, age (years)
P01	18	Female	Sore throat	
P02	73	Male	Acute Bronchitis	
P03	34	Female	AOM	1
P04	47	Female	Sore throat	
P05	37	Female	Sore throat	1.3
P06	34	Female	Unspecified ARI	11
P07	38	Female	Acute Bronchitis	
P08	28	Female	Acute Bronchitis	
P09	32	Female	Acute Bronchitis	2
P10	22	Male	Acute Bronchitis	
P11	27	Female	Sore throat	
P12	64	Male	Acute Bronchitis	
P13	52	Male	Acute Bronchitis	3
P14	39	Male	Acute Bronchitis	2
P15	36	Female	AOM	6
P16	43	Female	Acute Bronchitis	3
P17	18	Female	Sore throat	
P18	43	Female	Sore throat	
P19	70	Female	Acute Bronchitis	
P20	45	Female	Sore throat	
P21	34	Male	Acute Bronchitis	
P22	30	Female	AOM	4
P23	74	Female	Acute Bronchitis	
P24	25	Female	Acute Bronchitis	1.3
P25	24	Female	Sore throat	
P26	18	Female	Acute Bronchitis	
P27	36	Female	Unspecified ARI	3
P28	21	Male	Unspecified ARI	
P29	50	Female	Unspecified ARI	
P30	34	Female	Acute Bronchitis	2
P31	38	Female	Acute Bronchitis	4.5
P32	35	Female	AOM	1.8

151



1  
2  
3 153 **Themes**  
4

5 154 Five themes emerged, and these are presented below and supported by illustrative quotes.  
6  
7

8 155 Theme 1. Antibiotic use is seen as the main cause of antibiotic resistance, but *what* it is that  
9  
10  
11 156 becomes resistant is poorly understood.  
12

13  
14 157 Many participants thought that antibiotic overuse or misuse in people drives antibiotic  
15  
16 158 resistance - *“Sometimes people think they need antibiotics. That’s where they can lead to*  
17  
18 159 *resistance because they have them too much”* (P03); with a few mentioning other reasons  
19  
20  
21 160 such as antibiotic use in animals; *“Through our food, that sort of thing, it does seem to be a*  
22  
23 161 *concern now. Like, animals getting fed antibiotics”* (P12); or not using the full antibiotic  
24  
25 162 course *“But if you use them ... you don’t take the full dose, obviously like in that you’ve got*  
26  
27 163 *your certain bugs coming out.”* (P25).  
28  
29  
30

31 164 Nearly all participants thought that antibiotic resistance is when the body becomes resistant  
32  
33  
34 165 to antibiotics:  
35

36  
37 166 *“Antibiotic resistance, your body is resistant to it and maybe you’ve used too much of it...*  
38  
39 167 *antibiotics”* (P16)  
40

41  
42 168 *“antibiotic resistance is possibly your body, rejecting the benefits of the antibiotics ... it’s*  
43  
44 169 *almost like the body gets used to the antibiotic”* (P10)  
45  
46  
47

48 170 *“if you take antibiotics too regularly, your body stops, reacting to them, or they stop having*  
49  
50 171 *an impact”* (P04)  
51

52  
53  
54 172 Some participants still had misperceptions after the interviewer provided a simple  
55  
56 173 explanation of what antibiotic resistance is (*“Antibiotic resistance happens when bacteria*  
57  
58  
59  
60

1  
2  
3 174 *change to protect themselves from an antibiotic. They are then no longer killed by that*  
4  
5  
6 175 *antibiotic”):*

7  
8  
9 176 *“Oh, yeah, see I’ve never had that sort of problem. I’ve never heard it. Whenever I’ve taken*  
10  
11 177 *it, maybe I wasn’t sick enough to sort of resist it. It’s always worked. And for the time that*  
12  
13  
14 178 *I had to take more than once, a repeat, you know.” (P23)*

15  
16  
17 179 Theme 2. Resistance is perceived as a future ‘big problem’ for the community, with little  
18  
19 180 appreciation of the individual impact of, or contribution to it

20  
21  
22 181 Most participants perceived antibiotic resistance as a community problem caused by others  
23  
24  
25 182 who misuse antibiotics:

26  
27  
28 183 *“... if people are over using it. Yeah, especially with their children when they’re so young.*  
29  
30 184 *If they’re regularly on antibiotics, yeah....” (P06)*

31  
32  
33 185 *“I imagine there would be some pockets of the community that it [antibiotic resistance]*  
34  
35  
36 186 *might be an issue for.” (P04)*

37  
38  
39 187 *“I think it’s a big problem. People like to get antibiotics and just solve things instantly. Like*  
40  
41 188 *people don’t like to wait and see what happens, they like to get something – even if they*  
42  
43  
44 189 *think it’s going to work or not, they just – something to make it better.” (P15)*

45  
46  
47 190 Most participants described resistance as a problem that will not impact them individually -  
48  
49 191 *“I don’t think it’s a big issue for me” (P09); “I think I’ll get through my life without it*  
50  
51  
52 192 *impacting on it” (P21). A few participants described their worry about antibiotic resistance,*  
53  
54  
55 193 *although by many it was viewed as a future or a hypothetical concern:*

1  
2  
3 194 *"Oh, huge, I don't want that to happen... Um, well, if she got sick and constantly needed*  
4  
5  
6 195 *antibiotics... you know, then obviously in - as she gets older, they'd stop working as much*  
7  
8 196 *as you wouldn't be able to treat infections as much and I don't want that to happen"* (P03)

9  
10  
11 197 *"... it could become a big problem if the so-called superbugs, um, come out and about*  
12  
13  
14 198 *later on, yeah."* (P09)

15  
16  
17 199 *"It still concerns me, um, because someone as young as my two-year-old son – I guess in*  
18  
19 200 *an older person, it's perhaps not as concerning because over the course of a life time... but*  
20  
21 201 *I think the message is out there that maybe you need to think twice before (using*  
22  
23  
24 202 *antibiotics)"* (P09)

25  
26  
27 203 Theme 3. Poor awareness that resistance can spread between family members but concern  
28  
29  
30 204 that it can

31  
32  
33 205 Most participants did not know that antibiotic resistance can spread between people who  
34  
35 206 are in close proximity, such as family members - *"No, I didn't even know it could spread"*  
36  
37 207 (P24). Some thought it would be possible:

38  
39  
40 208 *"Um, I've never really thought about it before. My initial answer would be no, but I guess*  
41  
42  
43 209 *like if – yeah I guess if one of the children had a bug that was tougher, and they gave that*  
44  
45 210 *to the other child, then, yeah, I guess, yeah, I guess it would be"* (P32).

46  
47  
48  
49 211 When participants were told by the interviewer that it can, the most common reaction was  
50  
51 212 concern *"concerned. Yeah, it's not a good thing"* (P14) and shock *"Oh, shocked. No, I never*  
52  
53 213 *knew that."* (P01), with some insight into the significance of the problem *"So by one person*  
54  
55 214 *using antibiotics can create problems for the whole family... Yeah. Well, that's, um, not real*  
56  
57 215 *good, is it?"* (P19)

1  
2  
3 216 Some participants suggested strategies to minimise the spread of resistance such as  
4  
5  
6 217 decreasing antibiotic use “... so not using them too much” (P03) or with hand hygiene  
7  
8 218 (“hand sanitiser” (P21), “wash hands” (P07)).  
9

10  
11 219 Theme 4. Low awareness that resistance can decay with time and variable impact of this  
12  
13  
14 220 knowledge on attitudes towards future antibiotic use  
15

16  
17 221 Most participants did not know that antibiotic resistance could decay over time:  
18

19  
20 222 “Oh, I’ve got no idea, I thought it just – that it stayed for a lifetime if you were resistant to  
21  
22 223 it.” (P24)

23  
24  
25 224 “Oh, a long time. You’d have to - it’d take a lot of different ways to treat it” (P03)

26  
27  
28 225 “I imagine not, because once it’s in your system, it remains there” (P09)

29  
30  
31 226 There was wide variation on estimation of the time to decay, ranging from days to decades:  
32

33  
34  
35 227 “It wouldn’t be; you wouldn’t think within a couple of days... But I’m not saying 12 months  
36  
37 228 or anything like that” (P19)

38  
39  
40 229 “Oh, probably ten years or something, crazy” (P15)

41  
42  
43 230 After explanation from the interviewer that antibiotic resistance does decay, some  
44  
45 231 participants were more hopeful about the problem of antibiotic resistance:

46  
47  
48  
49 232 “...It’s promising to know that there is a chance ... given enough time, then they  
50  
51 233 [Antibiotics] could work again” (P21)

52  
53  
54 234 “Yeah, well that’s good that it could be then reversible” (P32)

55  
56  
57 235 “It makes me think that you could possibly go back to using those antibiotics if you had  
58  
59 236 the similar problem maybe 18 months down the track” (P10)

1  
2  
3 237 It was assumed by some that science will come up with solutions to manage antibiotic  
4  
5  
6 238 resistance in the future:

7  
8  
9 239 *"I don't think it will go away, but I think maybe people are coming up with different*  
10  
11 240 *solutions to fight it rather than antibiotics or different ways of switching off you know our*  
12  
13 241 *body's responses and things like that."* (P15)

14  
15  
16  
17 242 *"it will be interesting over the next 10-15 years. I think that probably there'll be some really*  
18  
19 243 *good break throughs in - - in the engineering and the science behind antibiotics..."* (P21)

20  
21  
22 244 The impact of knowing about resistance decay on attitude towards antibiotic use was  
23  
24 245 variable. Some participants indicated no change (*"No different than I said before. If it means*  
25  
26 246 *it's [antibiotics] going to save my life and help me in my health, it wouldn't make any*  
27  
28 247 *difference at all.* (P23)), whereas others expressed that knowing this made them more  
29  
30 248 cautious:

31  
32  
33  
34  
35 249 *"That makes me really think about it – taking antibiotics only if you really need to"* (P08)

36  
37  
38 250 *"Especially for the children it would a lot scarier that they wouldn't be able to be treated*  
39  
40 251 *... if they were sick and something. It's quite frightening."* (P22)

41  
42  
43  
44 252 Theme 5. Antibiotics are perceived as sometimes necessary, with some awareness and  
45  
46 253 consideration of their harms

47  
48  
49 254 Antibiotics were seen as beneficial by many participants (*"only thing that helps"* (P20)). The  
50  
51 255 most commonly reported perceived benefits were decreased duration of illness (*"taking*  
52  
53 256 *antibiotics would make me better quicker"* (P11)) and decreased severity or progression of  
54  
55 257 the infection (*"to make sure it doesn't go to any further stages of infection."* (P06)).  
56  
57  
58  
59  
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1  
2  
3 258 Some participants believed in the need for antibiotics, despite being told by their GP that  
4  
5  
6 259 antibiotics would not help with viruses or provide better outcomes for them:  
7

8  
9 260 *"...the doctor said oh it's a virus, I said well I'm going to be looking after my*  
10  
11 261 *grandchildren, it's school holidays, and I needed something to help me get over this. ...and*  
12  
13 262 *she said but they are not going to help you. I said well it's my decision at the time to have*  
14  
15 263 *them because I didn't want my children to have what I had, you know. It was just a very*  
16  
17 264 *bad virus I had, you know. But anyway, the antibiotics did work."* (P23)  
18  
19  
20

21 265 Some participants were reluctant to take antibiotics for minor self-limiting illnesses, such as  
22  
23 266 ARIs, and preferred to reserve antibiotic use for severe infections - *"I would be hesitant. So,*  
24  
25 267 *yes, maybe each time my doctor gives me antibiotics, I would ask is that necessary?"* (P07),  
26  
27 268 with some concerned about not wanting to overuse antibiotics - *"should be more carefully*  
28  
29 269 *applied and perhaps conservatively used."* (P18). Others' attitudes about antibiotic use were  
30  
31 270 not influenced by illness severity - *"...doesn't really change my opinion of it... certain*  
32  
33 271 *antibiotics really work"* (P25). Some participants' reasons for not using antibiotics were to  
34  
35 272 *"give the body the best fighting chance"* (P15) and by *"trying natural healing and staying*  
36  
37 273 *healthy in the first place"* (P13)  
38  
39  
40  
41  
42  
43

44 274 The few participants who had personal experience of antibiotic resistance were particularly  
45  
46 275 cautious about antibiotic use:  
47

48  
49 276 *"...because of my bronchitis... I have taken other medications that haven't worked. The –*  
50  
51 277 *the doctors then had to change it... to a different medication. Yeah. Because I become*  
52  
53 278 *resistant to others so I'm very fussy about taking them."* (P20)  
54  
55  
56  
57  
58  
59  
60

1  
2  
3 279 There was great variability in participants' awareness of the potential harms of antibiotics.  
4  
5  
6 280 Many participants named potential side-effects with commonly listed ones including  
7  
8 281 "vomiting", "nausea", "thrush", and "diarrhoea". Some mentioned "possible resistance" as  
9  
10 282 one of their concerns, but responses conveyed misunderstanding of what antibiotic  
11  
12  
13 283 resistance actually is. Some participants were not aware that antibiotics had potential harms  
14  
15 284 - "None that I'm aware of" (P21).

16  
17  
18 285 The patient-clinician relationship was viewed as very important when decisions about the  
19  
20  
21 286 management of infections were being made. Trust in the clinicians' recommendation for  
22  
23  
24 287 antibiotic use was mentioned by some - "as long as I can talk to my doctor and trust that the  
25  
26 288 doctor is making the right decision" (P05)

27  
28  
29 289 Some participants described a lack of information and discussion with their clinician "I don't  
30  
31  
32 290 have enough information to probably correctly make that call." (P18) and were unaware of  
33  
34 291 the option to not treat with antibiotics (that is, that the illness would get better without  
35  
36 292 them) "Um, well I guess when it's infected there's not really much other choice for that  
37  
38  
39 293 particular problem" (P32).

40  
41  
42 294 Some expressed a desire for more information about antibiotic resistance:

43  
44  
45 295 "Um, yeah, it would be good to know more about, um, how often you have to be taking  
46  
47 296 them for resistance to build, whether individual, patient to patient" (P18).

48  
49  
50 297 "... interested in knowing more information about (antibiotic resistance)" (P15)

## 51 52 53 298 **DISCUSSION**

54  
55  
56  
57 299 This study has identified five major themes that related to people's understanding of  
58  
59 300 antibiotic resistance and aspects of resistance such as resistance reversibility and spread  
60

1  
2  
3 301 among those in close proximity such as family or household members. While many  
4  
5 302 participants articulated the link between antibiotic use and resistance, there was confusion  
6  
7  
8 303 about the nature of antibiotic resistance, which was often attributed to a trait of the body  
9  
10 304 rather than bacteria in the microbiome. Many saw antibiotic resistance as a potential  
11  
12  
13 305 problem, rather than one that exists already, and that it was a consequence of and problem  
14  
15 306 for the others in the community rather than them as an individual. Few appreciated the  
16  
17  
18 307 potential for antibiotic resistant organisms to spread between those in close proximity, or  
19  
20 308 that antibiotic resistance can decay.

23 309 Most participants reported the main benefit of antibiotic use was a decreased duration of  
24  
25 310 illness. Some were aware of the potential for harm from antibiotics, including resistance.  
26  
27  
28 311 Some expressed reluctance to use antibiotics for minor self-limiting infections because of  
29  
30 312 concern about overuse or misuse, whereas for others, it was not because of the potential  
31  
32  
33 313 harms but because of a preference for allowing their body to fight the infection naturally.  
34  
35  
36 314 The poor understanding of the nature of antibiotic resistance has been found in previous  
37  
38 315 studies in a general practice setting,<sup>17</sup> and in non-healthcare settings.<sup>18-20</sup> A recent survey of  
39  
40 316 the UK general adult population showed that lack of antibiotic resistance awareness was  
41  
42  
43 317 strongly associated with self-reported likelihood of requesting antibiotics for an influenza-  
44  
45  
46 318 like infection.<sup>21</sup> It appeared that patients who had personal experience of antibiotic  
47  
48 319 resistance were the most reluctant to use them again, preferring to reserve their use for  
49  
50 320 serious illness. A survey of the general population in Germany found that people who knew  
51  
52  
53 321 of someone suffering from multidrug-resistant organisms, received more information by  
54  
55  
56 322 their clinician on antibiotic resistance and took less antibiotics for an infection (of any  
57  
58 323 cause), compared with people who did not have any personal involvement.<sup>19</sup>  
59  
60



1  
2  
3 324 Our finding that the lack of individual ‘ownership’ of contribution to, or risk of, antibiotic  
4  
5 325 resistance has previously been identified in a systematic review,<sup>12</sup> which showed that the  
6  
7  
8 326 public do not believe they contribute to the development of antibiotic resistance. This is  
9  
10 327 complemented by the finding that some participants believe that science will find a way to  
11  
12  
13 328 solve the resistance problem, which contradicts with messages about individuals needing to  
14  
15 329 change their behaviour to minimise the problem.

16  
17  
18 330 Many public health campaigns convey the message of antibiotic resistance and how it is  
19  
20 331 promoted by inappropriate antibiotic use and misuse. The effect of some campaigns has  
21  
22  
23 332 been analysed and a decrease in antibiotic use was found.<sup>22 23</sup> Some of our findings might be  
24  
25 333 useful in guiding and refining the content of messages in public health campaigns and  
26  
27  
28 334 clinical consultations about antibiotic resistance. For example, the information that  
29  
30 335 developing antibiotic resistance in one’s microbiome might also lead to resistance in people  
31  
32 336 who are physically close to them, such as family members, could be an additional message  
33  
34  
35 337 in patient and public educational strategies to encourage appropriate antibiotic use. Most  
36  
37  
38 338 participants were quite concerned upon learning about resistance spread and it prompted  
39  
40 339 some to provide suggestions for how to minimise resistance development and its spread –  
41  
42  
43 340 suggesting that perhaps this is the information that could contribute to altering people’s  
44  
45 341 attitudes and behaviour about antibiotic use for minor self-limiting illnesses.

46  
47  
48 342 Future research into the optimal information about antibiotic use and resistance to include  
49  
50 343 in public messages and clinical consultations is recommended. This includes the potential  
51  
52  
53 344 utility of information about resistance decay and its impact on antibiotic use. Knowing that  
54  
55 345 resistance decays over time if antibiotics are not used promoted hope in some people that  
56  
57  
58 346 the problem of resistance was not irreversible and that efforts to conserve antibiotic  
59  
60

1  
2  
3 347 effectiveness by not using unless essential are worthwhile. However, for others, knowing  
4  
5 348 that resistance decay occurs over time, may thwart attempts to encourage responsible  
6  
7  
8 349 antibiotic use.  
9

10  
11 350 At a clinical consultation level, better engagement with patients when antibiotics are being  
12  
13 351 considered by providing a balanced discussion of antibiotic benefits and harms is  
14  
15  
16 352 encouraged. This conversation should include discussion that resistance is a potential harm  
17  
18 353 of antibiotic use, and explanation of the possible consequences of it for the individual and  
19  
20  
21 354 the broader community.  
22

23  
24 355 A limitation of our study is that the sample is not representative of the wider Australian  
25  
26 356 population as participants were recruited from one city in Australia, only those presenting  
27  
28  
29 357 with an ARI were invited, and the majority of participants were female. For a small number  
30  
31 358 of participants (9), there is the risk that their knowledge about antibiotic resistance was  
32  
33  
34 359 influenced by their GPs' use of a patient decision aid - which included a very brief  
35  
36 360 explanation of what resistance is, but not about the spread or decay of resistance. Although  
37  
38  
39 361 GPs who did not receive or use the aids may have mentioned resistance as part of the  
40  
41 362 consultation regardless. Other limitations are that participants did not have the opportunity  
42  
43  
44 363 to provide feedback on the themes derived from the interviews and the short duration of  
45  
46 364 the interviews—which could have affected the depth of the gathered information. Strengths  
47  
48  
49 365 of the study include the use of two researchers independently performing the thematic  
50  
51 366 analysis and its contribution of new findings to this field. We are not aware of other studies  
52  
53 367 which have explored people's knowledge about the potential for antibiotic resistant  
54  
55  
56 368 organisms to spread between those who are in close proximity or that antibiotic resistance  
57  
58 369 decays over time.  
59  
60

1  
2  
3 370 **CONCLUSION**  
4  
5

6 371 This study found that patients' understanding of many aspects of antibiotic resistance was  
7  
8 372 poor including: what it is, individual contribution to its development, individual implications,  
9  
10 373 its spread and decay. Incorporating messages that target misunderstandings into public  
11  
12 374 health messages and clinical consultations may be an important strategy to encourage more  
13  
14 375 appropriate use of antibiotics for illnesses such as ARIs.  
15  
16  
17  
18

19 376 **Acknowledgement:** The authors would like to acknowledge and thank all patients and GPs  
20  
21 377 who participated in this study.  
22  
23  
24

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26  
27 379 participants. MB, EG, TH and CDM analysed the data. MB drafted the original manuscript  
28  
29 380 and EG, TH and CDM contributed to writing and revising the manuscript. All authors read  
30  
31 381 and approved the final manuscript.  
32  
33  
34

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38  
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40  
41 385 (#1044904), which had no role in study design, data collection, data analysis, data  
42  
43 386 interpretation, or writing of the report.  
44  
45  
46  
47

48 387 **Competing interests:** None declared  
49  
50

51 388 **Ethics approval:** Ethical approval was provided by the Human Research Ethics Committee at  
52  
53 389 Bond University (#0000015433) and consent provided by each participant interviewed and  
54  
55 390 by GP practices to allow recruitment of their patients.  
56  
57  
58

59 391 **Provenance and peer review:** Not commissioned; externally peer reviewed.  
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392 **Data sharing statement:** No additional data are available.

For peer review only

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## Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist

Developed from:

Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

No. Item	Guide questions/description	Reported on Page #
<b>Domain 1: Research team and reflexivity</b>		
<i>Personal Characteristics</i>		
1. Interviewer/facilitator	Which author/s conducted the interview or focus group?	Mina Bakhit
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	Mina Bakhit, MA, M.B., B.Ch. Chris Del Mar, MD Elizabeth Gibson, PhD Tammy Hoffmann, PhD
3. Occupation	What was their occupation at the time of the study?	Medical doctor, PhD candidate, Research Assistant
4. Gender	Was the researcher male or female?	Male
5. Experience and training	What experience or training did the researcher have?	The researcher performed a pre- and post-qualitative skype interviews at Friedrich Alexander University, Germany in 2013
<i>Relationship with participants</i>		
6. Relationship established	Was a relationship established prior to study commencement?	No
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Participants were provided with an information sheet and consent form which outlined the aim of the study
8. Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Participants knew the researcher was a

		Medical doctor and PhD student with an interest in reducing inappropriate antibiotic prescribing
<b>Domain 2: study design</b>		
<i>Theoretical framework</i>		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Methods; page 7
<i>Participant selection</i>		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Methods; page 5
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Methods; page 6
12. Sample size	How many participants were in the study?	Results; page 8
13. Non-participation	How many people refused to participate or dropped out? Reasons?	Results; page 8
<i>Setting</i>		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Methods; page 6
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	No
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Results (Table 1)
<i>Data collection</i>		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Methods; page 6 and Box
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	No
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Methods; page 7
20. Field notes	Were field notes made during and/or after the interview or focus group?	No
21. Duration	What was the duration of the inter views or focus group?	Methods; page 7
22. Data saturation	Was data saturation discussed?	Methods; page 7
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
<b>Domain 3: analysis and findings</b>		
<i>Data analysis</i>		
24. Number of data coders	How many data coders coded the data?	Methods; page 7



25. Description of the coding tree	Did authors provide a description of the coding tree?	No
26. Derivation of themes	Were themes identified in advance or derived from the data?	Methods; page 7
27. Software	What software, if applicable, was used to manage the data?	N/A
28. Participant checking	Did participants provide feedback on the findings?	No, reported as a study limitation; page 19
<i>Reporting</i>		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Results; page 10-16
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Discussion; page 16-18
31. Clarity of major themes	Were major themes clearly presented in the findings?	Results; page 10-16
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Results Discussion; page 16-17